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INTERNATIONAL CONFERENCE ON ECONOMICS, BUSINESS & MANAGEMENT (ICEBM)

*Strategic Responses to Global Uncertainty:
Rethinking Markets, Governance and Innovation*

Conference proceedings

25th – 26th September 2025



INTERNATIONAL CONFERENCE ON ECONOMICS, BUSINESS & MANAGEMENT (ICEBM)

Strategic Responses to Global Uncertainty: Rethinking Markets, Governance and Innovation

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**Edited by:
Prof. Bistra Vassileva, PhD
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PLENARY PAPER

Knowledge Management in the Age of Artificial Intelligence: New Paradigms for Entrepreneurship, Business, and Economics

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Abstract

Artificial intelligence is being addressed as a general-purpose technology that transforms opportunity recognition in entrepreneurship, business strategy, and macro-level dynamics of productivity and competitiveness. However, the economic value of artificial intelligence does not emerge automatically and cannot be explained solely by technical capacity; value creation is shaped by how organizations govern data, how they transform information into actionable organizational knowledge, and how they institutionalize mechanisms of learning, governance, and trust. This study integrates knowledge management theories with contemporary findings from the literature on generative artificial intelligence, human-artificial intelligence collaboration, and trustworthy artificial intelligence, and discusses how the role of artificial intelligence is being redefined across the processes of knowledge creation, storage and retrieval, sharing, and application. In addition, it demonstrates how generative artificial intelligence expands entrepreneurial capacity for exploration and experimentation by mainstreaming prompt-based knowledge work, and how it accelerates transformation through process automation, operational efficiency, and decision-support applications across functions. The study analyses how economic outcomes, such as productivity gains, the diffusion of innovation, and risks of inequality, are shaped through knowledge infrastructures and governance arrangements, and it proposes a knowledge management-driven strategic framework centered on knowledge audits, socio-technical workflow design, transparency and explainability, and continuous organizational learning. It ultimately argues that sustainable competitive advantage depends less on adopting artificial intelligence tools than on building artificial intelligence-ready knowledge ecosystems that coherently integrate technology, people, and institutions.

Key words:

knowledge management, generative artificial intelligence, AI governance, entrepreneurial innovation, decision support systems, business model innovation, trustworthy AI

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1. Introduction

The modern economic environment is being transformed by the rapid development and extensive dissemination of artificial intelligence as a general-purpose technology, capable of fundamentally altering how organisations identify opportunities, formulate strategies, and compete on a large scale. Unlike previous rounds of automation that mainly mechanised physical labour and routine manufacturing processes, contemporary developments are progressively focussing on cognitive and knowledge-driven tasks, such as writing, sensemaking, classification, forecasting, and decision support. This transition is taking place amidst conditions of volatility, uncertainty, complexity, and ambiguity, wherein organisations must respond promptly to evolving signals while concurrently managing increased operational, reputational, and regulatory risks. In this context, the primary managerial challenge is not whether artificial intelligence can produce outputs, but rather whether organisations can transform those outputs into dependable, contextualised, and actionable knowledge that enhances decision-making and supports ongoing value creation (Nguyen et al., 2025).

The economic significance of artificial intelligence is thus neither inherently automatic nor solely technical. It is facilitated by the manner in which organisations oversee data quality and access, organise and verify knowledge flows, and institutionalise learning among individuals, processes, and digital infrastructures. Knowledge management scholarship has historically highlighted that organisational advantage relies on the ability to generate, retain, transfer, and utilise knowledge, with information technologies influencing these processes through facilitation of codification, retrieval, collaboration, and distributed work (Alavi & Leidner, 2001; Noy & Zhang, 2023). What is notable in the present moment is that generative systems are capable of engaging directly in knowledge work by generating manuscripts, summaries, alternatives, classifications, and conversational guidance at minimal marginal cost. However, these capabilities also exacerbate well-known knowledge risks (such as loss of context, over-codification, misinterpretation, and organisational forgetting) while introducing new challenges including hallucinated content, opacity of model behaviour, and the swift dissemination of unverified claims within organisational channels. Systematic reviews of artificial intelligence in knowledge management consistently converge on a central conclusion: performance improvements are most probable when artificial intelligence is integrated into socio-technical frameworks that delineate accountability, validation, and iterative learning processes, rather than being implemented as a standalone tool (Nguyen et al., 2025).

Recent evidence further demonstrates that the organisational effects of generative systems are diverse and heavily influenced by knowledge infrastructures. Experimental and field studies demonstrate significant productivity enhancements in tasks that are writing- and service-intensive, along with redistribution effects whereby less experienced or lower-performing workers can gain disproportionately, as best practices become more accessible and simpler to implement. Simultaneously, these studies also indicate that the advantages are contingent upon context specificity, seamless workflow integration, and access to comprehensive organisational knowledge that underpins outputs and facilitates verification (Noy & Zhang, 2023; Brynjolfsson et al., 2025; Leoni et al., 2024). In organisational contexts, empirical studies on artificial intelligence-enabled knowledge management for decision-making emphasise that value is generated when artificial intelligence facilitates the entire process (from knowledge acquisition and organisation to interpretation and application) and when organisations establish governance frameworks that align artificial intelligence outputs with decision-making authority, documentation standards, and performance evaluation (Leoni et al., 2024). Additionally, systematic reviews of generative artificial intelligence and large language models in knowledge management emphasise the increasing significance of prompt-based knowledge tasks, human–system collaboration, and measures to ensure trust, ethics, and transparency as adoption transitions from experimental phases to routine implementation (Nguyen et al., 2025).

These developments are especially significant for entrepreneurship and the process of business transformation. Artificial intelligence has the potential to enhance entrepreneurial opportunity recognition by reducing the costs associated with exploration, prototyping, market analysis, and the integration of dispersed information into actionable hypotheses. Nevertheless, the sustainability of these advantages relies on an organization's ability to institutionalise learning, safeguard against the dissemination of unreliable information, and defend strategic assets such as proprietary knowledge, customer trust, and compliance posture. Research on sustainable entrepreneurship similarly suggests that capabilities enhanced by artificial intelligence are reinforced when knowledge management is regarded as an enabling dynamic capability that orchestrates sensing, seizing, and reconfiguring around high-quality knowledge flows and organisational learning (Alshammakhi & Sheikh, 2025). Therefore, artificial intelligence should be regarded not as a replacement for knowledge management, but as a catalyst that enhances the benefits of effective knowledge management while simultaneously elevating the costs associated with inadequate governance.

This study enhances a knowledge management perspective on AI-enabled entrepreneurship and business transformation by combining traditional, process-oriented approaches to organisational knowledge with recent research on generative systems, human-AI collaboration, and trustworthy governance. It articulates a clear strategic position: maintaining a competitive edge in the AI era relies less on simply implementing tools and more on developing “*AI-ready knowledge ecosystems*” that integrate technology, personnel, and institutions through

verifiable knowledge assets, explicitly defined socio-technical workflows, and ongoing learning. Establishing such ecosystems involves: (i) conducting knowledge audits to identify relevant knowledge, its locations, validation processes, and the decisions it informs; (ii) designing workflows that delineate when AI should generate, retrieve, or recommend information, and when human judgement is necessary to verify, contextualise, and authorise outputs; (iii) institutionalising transparency and explainability practices that document provenance, underlying assumptions, and limitations to ensure knowledge remains trustworthy, auditable, and amenable to continuous enhancement; and (iv) implementing learning mechanisms that position AI deployment as an evolving organisational capability rather than a one-time initiative.

The governance dimension is essential. As regulatory frameworks and standards continue to develop, organisations are progressively required to oversee risks associated with safety, accountability, transparency, and the societal implications of artificial intelligence systems. The European Union Artificial Intelligence Act implements a risk-based framework for the governance of artificial intelligence, while the National Institute of Standards and Technology's Artificial Intelligence Risk Management Framework and the Organisation for Economic Co-operation and Development (OECD) recommendations delineate principles and practices for the development of trustworthy systems throughout their lifecycle (Regulation - EU - 2024/1689 - EN - EUR-LEX, 2024; National Institute of Standards and Technology, 2023; OECD, 2019). From a knowledge management standpoint, these frameworks suggest that trust is not merely a rhetorical quality, but an organisational result generated through documented procedures for data governance, model supervision, assessment, incident handling, and post-deployment review. When these conditions are lacking, artificial intelligence may transform into a rapid and opaque “*black box*” that expedites decision-making without enhancing comprehension; conversely, when these conditions are in place, artificial intelligence can serve as a scalable framework for disciplined sensemaking and organisational learning (National Institute of Standards and Technology, 2023; Leoni et al., 2024).

Against this backdrop, this study advances a knowledge management contribution by reframing artificial intelligence adoption as a knowledge governance problem rather than a technology acquisition problem. It proposes an integrated, knowledge management-driven strategic framework that connects micro-level human-artificial intelligence work practices with firm-level learning and decision rights, and links these mechanisms to macro-level outcomes such as productivity diffusion and inequality risks. By specifying auditable knowledge assets, socio-technical workflow controls, and lifecycle governance arrangements for transparency and accountability, the study provides a structured basis for building artificial intelligence-ready knowledge ecosystems that sustain performance while maintaining trust.

Building on this contribution, the remainder of the study proceeds as follows. The next section positions artificial intelligence within knowledge management processes and clarifies how generative systems reshape knowledge creation, storage and retrieval, sharing, and application. The following sections examine entrepreneurial implications and business-function impacts, before synthesising macro-level consequences for productivity, diffusion, and inequality as mediated by organisational knowledge infrastructures. The study concludes by proposing a knowledge management-driven strategic framework for designing artificial intelligence-based strategies that are operationally effective, institutionally governable, and economically sustainable.

2. The Strategic Role of Knowledge and Data Management in AI-Based Business Models

The increasing incorporation of artificial intelligence into organisational operations necessitates a strategic re-evaluation of knowledge and data, viewing them not just as operational inputs, but as foundational elements essential for value generation. Conventional managerial thought has frequently posited that data may be converted into information, synthesised into knowledge, and finally refined into actionable insights through predominantly linear organisational processes. Contemporary artificial intelligence systems, especially advanced analytics and generative models, condense these layers and progressively create iterative, feedback-driven cycles of knowledge production and utilisation. In this evolving paradigm, competitive advantage relies less on the availability of

artificial intelligence tools and more on organisations' ability to structure data and knowledge frameworks that facilitate dependable learning, prompt action, and responsible decision-making.

From Static Repositories to Dynamic Knowledge Flows

Historically, knowledge management systems were mostly developed as repositories for capturing and storing explicit knowledge - such as documents, manuals, and technical reports - for subsequent retrieval. Nevertheless, as the literature highlights, numerous organisations continue to depend on these storage-and-retrieval mechanisms despite facing increasing data volume and velocity, so limiting the capacity of knowledge management to address real-time organisational requirements. Gelashvili-Luik, Vihma & Pappel (2025) emphasise that legacy knowledge management systems were primarily designed for the storage of explicit knowledge, rather than for managing rapid, diverse data streams or facilitating artificial intelligence-driven analysis; thus, modernising these systems requires architectural choices that significantly impact daily reliability and usability.

This subject is commonly characterised as a “*knowledge management*” issue, however the fundamental limitation is generally a deficiency in data governance. In AI-enabled environments, organisations must guarantee that data are consistently accurate, complete, timely, and interpretable, underpinned by comprehensive metadata operations (definitions, context, and documentation), lineage/provenance mechanisms (traceability across transformations), and enforceable access controls and privacy protections. Master and reference data practices enhance the stability of essential entities (e.g., customers, products, suppliers), ensuring that analytical and generative outputs are consistently aligned with a unified organisational “*source of truth*”. These practices are increasingly implemented through “*data product*” thinking, wherein curated datasets are regarded as managed products with designated owners, service levels, and reuse regulations, thus establishing a dependable foundation for knowledge flows and the generation, validation, and reuse of AI outputs (DAMA International, 2017).

This constraint becomes increasingly significant in the generative era, as organisational knowledge no longer functions as a fixed “*asset*” that can be codified once and utilised indefinitely. Instead, information increasingly manifests as a perpetually updated stream, influenced by new data and the results of previous applications. Gelashvili-Luik, Vihma & Pappel (2025) elucidate that, within the realm of big data analytics, knowledge management transitions from a linear progression to a dynamic feedback loop, whereby knowledge is regarded as provisional and perpetually refined through monitoring and learning methods. This transition is not solely technical; it redefines the concept of “*managing*” knowledge, as the primary administrative responsibility shifts to ensuring that swiftly produced knowledge is reliable, comprehensible, and verifiable.

A significant implication arises: if information is generated through feedback loops instead of static storage, then knowledge governance must function in real time. This aligns with empirical evidence indicating that artificial intelligence, knowledge management procedures, and decision-making form mutually reinforcing cycles. Leoni et al. (2024) explicitly demonstrate that organisations undergo a retroactive relationship: the adoption of artificial intelligence influences decision outcomes, which subsequently affect future decisions about artificial intelligence adoption and the reconfiguration of knowledge management procedures. The strategic function of data and knowledge management is to establish infrastructures that moderate flows, maintain context, and record feedback as a resource for organisational learning, rather than allowing it to dissipate as noise.

A pragmatic approach to elucidate the strategic function of “*data*” in conjunction with “*knowledge*” is to conceptualise governance as a hierarchical sequence: data governance → knowledge management governance → artificial intelligence governance. Data governance establishes the evidentiary criteria for AI through the assurance of dataset quality, documentation, lawful access, and traceability; knowledge management governance stabilises meaning and authorised usage by delineating validation protocols, ownership, versioning, and conflict resolution for knowledge artefacts and flows; subsequently, AI governance regulates the AI lifecycle (design, deployment, monitoring) by enforcing accountability, risk management, and performance constraints. Effective AI governance is seldom attainable without governed data and knowledge upstream, as the behaviour, outputs, and decision impacts of models are challenging to audit, recreate, or justify. This layered view also aligns with contemporary

frameworks (European Union AI Act Article 10; NIST AI RMF 1.0; ISO/IEC 42001) that explicitly foreground data governance and lifecycle risk management for trustworthy AI.

This framework facilitates the transition from repositories to flows, operationalised via knowledge-flow architectures that incorporate (i) the ongoing capture of work outputs, (ii) validation, lineage/provenance, and access/privacy controls, and (iii) feedback mechanisms linking decisions to learning loops. With the implementation of flow-oriented architectures, organisations can advance from mere incremental process enhancements to comprehensive business model redesign, as the autonomy of business models is fundamentally limited by the quality, transparency, and governability of the underlying knowledge flows.

The AI-Driven Business Model Framework: From Assistance to Representation

The strategic implications of these knowledge transformations are particularly evident in the realm of business model innovation. Weill et al. (2025) contend that the proliferation of artificial intelligence technology drives business models to become progressively outcome-oriented and facilitated by autonomous artificial intelligence. The vertical dimension of value creation shifts from “*understanding the customer*” to “*advocating for the customer*”, including a spectrum from aiding consumers to representing them in attaining objectives within clearly established parameters. This articulation is significant as it positions business model transformation not solely in automation, but in the broadening of organisational accountability for results - thereby amplifying the necessity for knowledge governance, oversight, and responsibility.

Supporting this viewpoint, studies on artificial intelligence-driven business model innovation in digital platform firms emphasise incremental capability growth and the associated progression of resource actions. Zhang et al. (2025) assert that competitive advantage is inadequately elucidated by straightforward data network effects; rather, it arises from dynamic, iterative processes wherein organisations mobilise and reconfigure resources to cultivate new knowledge and enhance skills. In practice, initial phases often entail entry-focused “*resource patchwork*”, wherein enterprises aggregate internal and external resources through swift trial-and-error to establish foundational artificial intelligence-assisted capabilities. As companies evolve, the focus transitions to coordination-centric resource orchestration, encompassing partnerships, modular platforms, and ecosystem governance, bolstered by more sophisticated artificial intelligence capabilities.

This structured perspective elucidates why the function of knowledge management is dynamic in the context of artificial intelligence integration. In the initial phases of business models, knowledge management is predominantly curatorial, ensuring the relevance, accuracy, and contextual appropriateness of data and knowledge inputs. During intermediate phases, knowledge management progressively facilitates co-creation by assimilating input and integrating it into iterative human-artificial intelligence workflows. In advanced stages, where organisations operate independently for consumers, knowledge management must transform into governance infrastructure, overseeing performance limits, recording justifications, and maintaining confidence.

The autonomy of business models afforded by artificial intelligence is inherently limited by an organization’s capacity for knowledge governance. In other words, companies do not transition from aiding consumers to advocating for them unless they can exhibit verifiable knowledge assets, integrated workflow controls, and lifecycle governance that render autonomous actions institutionally feasible. This reasoning corresponds with a dynamic capabilities perspective: the evolution of business models relies on organisations’ ability to identify, seize, and transform opportunities via knowledge flows that are both scalable and manageable.

Dynamic Capabilities and the Knowledge Value Chain in the AI Era

The consequences of artificial intelligence on business models are more analytically manageable when viewed through the lens of dynamic capabilities. Organisations in volatile environments must detect changes, capitalise on opportunities through resource mobilisation, and modify structures and procedures to maintain competitive advantage. Artificial intelligence can enhance these three capabilities, but only when facilitated by strong knowledge management systems that transform data into verified and actionable information (Alshammakhi & Sheikh, 2025).

Initially, in sensing, artificial intelligence enhances environmental scanning and pattern recognition; however,

organisations necessitate knowledge management systems to filter relevance, preserve contextual significance, and provide insights to decision-makers prior to the deterioration of signal value. Secondly, in the context of seizing, generative and analytical capabilities enhance prototyping, scenario production, and option assessment; yet, these benefits are tenuous unless knowledge is documented, assessed against previous performance, and incorporated into decision-making authority. Third, artificial intelligence can automate workflow reconfiguration throughout transformation; nevertheless, strategic coherence is achieved only when knowledge management ensures institutional memory by recording the rationale behind decisions, the progression of outcomes, and the elements that must be preserved or modified.

Evidence from sustainable entrepreneurship reinforces the same mediation principle. Alshammakhi & Sheikh (2025) demonstrate that the capabilities of artificial intelligence present opportunities for sustainable entrepreneurship, contingent upon the mediation of knowledge management that transforms processing capacity into implementable eco-innovations and strategic adjustments. In the absence of such mediation, investments in artificial intelligence often remain fragmented, producing outputs that lack institutionalisation as learning and competence.

In this perspective, the “*knowledge value chain*” in the era of artificial intelligence is regarded as a manageable capability system. The primary unit of analysis is not the model, algorithm, or tool, but rather the organisational knowledge infrastructure that integrates data ingestion, validation, contextualisation, decision authorisation, and feedback learning. This framework sets a basis for the discourse by demonstrating that artificial intelligence-driven business models attain economic significance only when organisations can create knowledge ecosystems that maintain trust while facilitating scalable performance.

3. Entrepreneurial Innovation and the Emergence of AI-Driven Business Ideas

The impact of artificial intelligence on entrepreneurship is increasingly dual: it serves as a general-purpose tool that enhances the entrepreneur’s problem-solving abilities and as an innovation platform that transforms the conception, validation, and scaling of new ventures. As an innovation platform, AI not only reduces experimentation costs but also reshapes how ventures codify, govern, and compound learning over time. The modern “*knowledge economy*” is progressively transforming into a “*algorithmic economy*”, where competitive advantage is determined not solely by traditional intellectual property, but by the capacity to leverage proprietary data, models, and AI-driven processes that enhance reasoning, experimentation, and decision-making on a large scale (Ide & Talamàs, 2025). The same trend that reduces entry barriers for early-stage innovation can elevate the requirements for sustainable competitive advantage, since imitation becomes more feasible with the widespread availability of generic tools, while differentiation relies on unique knowledge assets, governance, and organisational learning.

Building on the preceding argument that AI-driven value generation depends on the quality of knowledge infrastructures and governance, this section argues that AI-driven entrepreneurship gains strategic significance when AI is integrated into knowledge management systems that transform rapid, cost-effective outputs into validated, contextually aware, and decision-relevant knowledge. In practice, this indicates that entrepreneurial innovation is influenced not solely by the accessibility of AI capabilities, but also by the manner in which ventures structure knowledge processes for (i) opportunity identification, (ii) swift experimentation and iteration, and (iii) synchronised execution among individuals, tools, and organisational boundaries (Alshammakhi & Sheikh, 2025; Nguyen et al., 2025).

Enhancing Entrepreneurial Orientation through AI

Entrepreneurial orientation is typically conceptualised as a strategic stance characterised by proactiveness, innovativeness, and risk-taking, which collectively influence how enterprises recognise and pursue opportunities (Covin & Slevin, 1989; Lumpkin & Dess, 1996). AI enhances this stance by condensing cycles of information acquisition, ideation, and experimentation; nevertheless, its effectiveness varies based on the ability of ventures to manage AI outputs as dependable knowledge rather than perceiving them as effortless solutions.

From proactiveness to predictive proactiveness

Proactiveness conventionally depends on market analysis, interpreting subtle indicators, and reallocating focus prior to competition. AI-driven analytics and search can enhance an entrepreneur's perceptual abilities by analysing extensive external data - market trends, consumer feedback, rival indicators - and transforming them into organised hypotheses for action. Nonetheless, “*earlier*” does not inherently equate to “*better*”: proactive measures gain significance when enterprises can substantiate them with verifiable evidence and comprehensive analytical processes. In summary, AI enhances the velocity of perception, whereas knowledge management (KM) governs the calibre of sensemaking, encompassing the validation, documentation, and association of claims with decision thresholds (Nguyen et al., 2025).

From innovativeness to democratized experimentation

Generative AI techniques can diminish the time and expense associated with prototyping business concepts - crafting product narratives, generating alternative designs, making preliminary marketing assets, or even assisting in basic code development. This can enhance involvement in innovation by allowing founders with constrained technological resources to swiftly test ideas. This “*democratisation*” alters the definition of innovativeness. Novelty is now less limited by basic production capabilities and more constrained by strategic acumen - the capacity to identify valuable problems, articulate unique value propositions, and develop proprietary knowledge advantages that are difficult to replicate through generic prompts. This is exactly where knowledge management transforms into entrepreneurial infrastructure: enterprises require systems for assimilating insights from experiments, avoiding redundant errors, and converting prototypes into cumulative knowledge assets (He & Yang, 2025; Nguyen et al., 2025).

From blind risk-taking to calculated risk-taking

A persistent limitation in entrepreneurship is the expense of failure. AI-driven simulation and decision assistance can reduce costs by enabling ventures to evaluate assumptions and conduct scenario planning prior to allocating limited capital. Empirical evidence from micro, small, and medium enterprises suggests that AI-driven decision support systems can enhance growth and sustainability through improved forecasting, operational planning, and evidence-based decision-making, while also presenting governance challenges including reliance on data quality, interpretability issues, and skills deficiencies (Sakova et al., 2024). Consequently, the essential transformation is not merely “*increased risk-taking*”, but rather more effectively managed risk-taking - where AI is employed to quantify uncertainty and clarify trade-offs, and where knowledge management guarantees that the foundational assumptions and data provenance are subject to audit and review throughout time.

An especially significant expansion pertains to sustainable enterprise. Empirical research demonstrates that AI capabilities can facilitate sustained entrepreneurial results when mediated by effective knowledge management systems that transform AI's processing power into actionable eco-innovation and strategic adjustments (Alshammakhi & Sheikh, 2025). This discovery corresponds with a comprehensive dynamic-capabilities perspective: AI may enhance sensing, seizing, and transforming, but only if enterprises establish robust learning loops and knowledge governance to avert fragmentation and superficial automation (Teece, 2007).

If entrepreneurial orientation elucidates the strategic behaviour of founders, the subsequent inquiry pertains to who derives the most advantage from AI-enabled entrepreneurship and the implications for the foundational structure of labour and knowledge. This results in a developing labour division that differentiates between routine execution and advanced problem-solving in AI-dominated settings.

The Solvers and the Workers: A New Labor Division

In the macroeconomic environment, AI is transforming the nature of work by redefining the distinction between routine, codifiable tasks and those requiring tacit judgement, domain expertise, and exception management. Contemporary thinking conceptualises the knowledge economy as an ecosystem comprising “*workers*” who do organised tasks and “*solvers*” who navigate ambiguity, rectify exceptions, and generate new knowledge amidst uncertainty (Ide & Talamàs, 2025). AI introduces a novel dynamic into this hierarchy by enhancing specific

cognitive capacities; however, the resulting distributional effects are contingent upon the manner of AI deployment.

A crucial distinction exists between non-autonomous AI (co-pilot systems that assist people) and autonomous AI (systems that achieve objectives within specified parameters). Non-autonomous AI enhances the productivity of less experienced employees by offering direction, templates, and real-time feedback, thereby elevating the quality of everyday activities and alleviating training demands. For entrepreneurial teams, this facilitates more efficient scaling, as junior talent may operate at elevated levels when augmented by systematic AI help.

In contrast, autonomous AI tends to enhance the influence of highly qualified individuals - those who can establish objectives, design routines, and manage exceptions. If autonomous systems diminish coordination and oversight expenses, expert “*solvers*” can extend their judgement across a wider domain, thereby exacerbating performance disparities between enterprises with expert orchestration capabilities and those that depend on ad hoc tool adoption (Ide & Talamàs, 2025). This implies not only productivity gains but also potential inequality in entrepreneurial ecosystems, depending on who can govern and orchestrate autonomous workflows. The implication for entrepreneurship extends beyond basic efficiency; it necessitates a strategic transformation in the competencies founders must acquire: transitioning from managing personnel and processes to architecting human - AI work systems and overseeing algorithmic workflows.

Nevertheless, this is exactly where a knowledge management-centered perspective becomes crucial. In the absence of clear knowledge governance, AI-driven labour division may generate concealed vulnerabilities: excessive dependence on model outputs, deterioration of contextual judgement, and fragile decision-making processes that falter in unprecedented situations. Consequently, the entrepreneurial challenge is in transforming AI-driven job redesign into institutionalised learning - documenting the rationale behind decisions, preserving traceable justifications, and averting organisational amnesia as enterprises expand.

As enterprises expand, the division of labour becomes inextricably linked to coordination. Despite advancements in AI enhancing individual productivity, scaling efforts will still falter if knowledge is confined behind silos. The subsequent subsection analyses how generative AI might establish an organisational “*knowledge layer*” that connects silos, while simultaneously presenting governance concerns that impact entrepreneurial resilience.

Bridging Organizational Silos with Generative AI: Toward an Entrepreneurial “Knowledge Layer”

A continual challenge in expanding entrepreneurial enterprises is the establishment of silos - functional units that withhold information, resulting in disjointed decision-making and erratic execution. As enterprises evolve from initial experimenting to scaling, coordination expenses increase, and the informal “*garage*” approach to information dissemination yields to bureaucratic obstacles. Generative AI and massive language model-based systems offer a technology solution to address this difficulty by facilitating a cohesive “*knowledge layer*” across diverse, unstructured organisational content.

This knowledge layer can index and retrieve information from documents, internal communication channels, project repositories, and technical artefacts, enabling employees to query organisational memory in natural language and obtain synthesised responses that transcend departmental boundaries. From a knowledge management perspective, this signifies a transition from static repositories to dynamic knowledge flows: instead of relying on users to locate stored knowledge, AI-enabled systems may proactively deliver pertinent information at the point of demand, hence enhancing organisational agility (Nguyen et al., 2025). Consistent with this logic, in manufacturing environments, a phased framework for generative AI-driven knowledge management underscores iterative enhancement: documenting knowledge artefacts from routine operations, organising and improving them, and reintegrating them into innovation cycles and decision-making processes (He & Yang, 2025).

The entrepreneurial value of a knowledge layer is contingent. AI does not eradicate traditional knowledge management issues; rather, it has the potential to reverse them. Conventional knowledge systems faced challenges related to capture bottlenecks and inconsistencies in metadata. Artificial intelligence can automate aspects of data collecting and summarisation; nevertheless, it also presents hazards such as the generation of fabricated information,

loss of provenance, and the swift dissemination of unsubstantiated assertions (Nguyen et al., 2025). Research on knowledge capture and transfer indicates that AI-enhanced systems can facilitate organisational learning by expediting codification and dissemination, while also presenting challenges related to reliability, interpretability, and socio-technical dependence that require management throughout the lifecycle (Sira, 2024).

Three governance concerns are particularly prominent in entrepreneurial ventures:

- *Redundancy and overlap in knowledge:* In the presence of overlapping content produced by several sources and teams, AI systems may exacerbate duplication instead of enhancing clarity, unless deduplication guidelines, source hierarchies, and validation methods are established.
- *Obsolete and contradictory information:* A knowledge layer can enhance access to institutional memory; but, it may also perpetuate outdated guidance unless time-stamping, version control, and review cycles are integrated into workflows.
- *Responsibility and authority in decision-making:* When synthesised outputs traverse departmental boundaries, organisations must delineate who possesses the authority to accept, override, or implement AI-generated recommendations, as well as how justifications are recorded for auditing and educational purposes.

Accordingly, these dangers highlight a more comprehensive issue: integrating silos is not merely a technological retrieval challenge but also a matter of knowledge governance. The scalability of a business utilising generative AI hinges on its capacity to establish guidelines for organisational knowledge, encompassing provenance, validation, update duties, and escalation procedures when AI outputs contradict human expertise. The knowledge layer transforms into an entrepreneurial capability, enhancing collective intelligence and synchronising execution, provided it is managed as a dynamic knowledge system rather than a mere convenience interface.

Collectively, these arguments illustrate that AI-driven entrepreneurship is optimally perceived as the design and governance of accelerated learning loops: AI enhances ideation and execution capabilities, whereas knowledge management dictates whether such capabilities result in enduring advantages, responsible scaling, and sustainable value generation. This sets the stage for the subsequent section, which analyses the manifestation of these mechanisms in certain business functions and the diffusion of performance enhancements - and their associated risks - through organisational processes.

4. Enhancements in Operational Efficiency and Decision Support Systems

Discussions on artificial intelligence (AI) in corporate operations often highlight enhancements in efficiency - accelerated execution, diminished expenses, and decreased error rates. Although these achievements are significant, they merely reflect the superficial consequences of a more profound organisational shift. A significant transformation transpires in the quality, timing, and framework of decision-making, as AI-integrated systems progressively incorporate analytical reasoning directly into operational processes. Operational efficiency and decision assistance should be regarded as interrelated results of AI-driven knowledge infrastructures rather than as distinct benefits.

Mechanisms of AI-Enhanced Decision Support Systems

AI-powered decision support systems (AI-DSS) combine machine learning, advanced analytics, and decision modelling to support complex decisions under uncertainty. Beyond producing recommendations, AI-DSS function as socio-technical arrangements in which data are transformed into model-based outputs, outputs are interpreted against organisational context, and decisions are finalised through human approval and exception handling. Importantly, these systems continuously learn from historical outcomes and real-time data streams, enabling organisations to move from reactive responses to probabilistic, anticipatory decision-making.

Efficiency improvements at an operational level arise from three interrelated mechanisms: real-time data processing, pattern identification, and scenario modelling. Initially, real-time processing lowers delay between

operational occurrences and managerial reactions, enabling organisations to respond to emergent signals instead of relying on retrospective reports. Secondly, pattern recognition allows AI systems to identify non-linear relationships among extensive, diverse datasets that surpass human cognitive capacities. Third, scenario modelling - typically executed via simulation techniques - facilitates the assessment of various strategies under diverse risk scenarios. These systems convert raw data into actionable knowledge, thereby connecting operational efficiency with analytical precision. The efficacy of AI-DSS is not only contingent upon algorithmic sophistication. Knowledge management research underscores that decision support systems yield sustainable value solely when integrated into organisational learning processes that evaluate, contextualise, and enhance AI outputs over time (Leoni et al., 2024). This discovery establishes a conceptual connection between efficiency improvements and the case-based evidence presented thereafter.

Predictive Maintenance and Decision Support in Healthcare Operations

The healthcare sector demonstrates how AI-DSS can enhance both operational efficiency and decision-making quality in high-risk settings. Failures of medical equipment - spanning imaging systems to life-support devices - constitute substantial risks to patient safety and service continuity. Conventional maintenance strategies are generally either preventive, adhering to predetermined schedules, or corrective, initiated post-failure. Both methodologies are ineffective in scenarios where the risks of failure fluctuate dynamically.

AI-driven predictive maintenance systems tackle this issue by amalgamating sensor data with machine learning models to foresee equipment problems prior to their occurrence. Evidence synthesised by Alkhatib et al. (2025) and related empirical studies suggests that economic benefits can be substantial, with diagnostic and repair cost savings that can reach up to ~25% in specific implementations. Reported predictive performance is likewise context-dependent, ranging from around 96% accuracy in general workflows (e.g., SVM: 96.1%) to up to 99.6% in device-specific studies; more broadly, results vary by asset type, data quality, and operating setting. These systems function not just as dashboards but as knowledge loops: feedback from technicians and physicians is collected and reintegrated into model training, facilitating ongoing enhancement of predictions.

This human-in-the-loop concept is especially important for decision support. By methodically integrating implicit expert judgement into algorithmic learning, AI-DSS in healthcare transform experiential knowledge into organisational assets. Consequently, operational efficiency is attained not solely through automation, but through the institutionalisation of learning that harmonises technical forecasts with clinical realities.

Contract Intelligence and Decision Automation in Financial Services

Healthcare emphasises the significance of AI-DSS in asset-intensive settings, whilst financial services illustrate its influence on knowledge-intensive tasks. The examination of intricate legal and financial documents has historically necessitated considerable human labour, rendering it an ideal target for AI-assisted decision automation. JPMorgan Chase & Co.'s Contract Intelligence (COiN) platform illustrates this transition by utilising natural language processing and machine learning to evaluate commercial credit agreements. According to the firm's 2016 annual report, in an initial implementation COiN can extract 150 relevant attributes from 12,000 annual commercial credit agreements in seconds, compared with as many as 360,000 hours per year under manual review - enabling legal teams to shift attention toward exception handling, negotiation, and oversight rather than routine extraction (JPMorgan Chase & Co., 2016; 5D Vision, 2023). The importance of this approach, from a knowledge management standpoint, resides in its codification of expert legal reasoning. Senior lawyers' interpretive criteria for identifying contractual hazards are converted into machine-readable formats, therefore translating implicit knowledge into scalable decision-making procedures.

This transition exemplifies a wider organisational impact: when AI-DSS assimilate standardised cognitive tasks, human knowledge is redirected onto higher-value endeavours such as negotiation, advisory services, and oversight. As a result, efficiency improvements entail a qualitative restructuring of decision-making roles rather than mere labour replacement.

Digital Twins and Asset-Focused Decision Support in Industry

The incorporation of AI-DSS with digital twin technologies in industrial processes broadens decision support from individual assets to entire fleets. Digital twins - virtual duplicates that are perpetually updated with sensor data - allow organisations to observe, simulate, and enhance asset performance in actual operating settings. Studies on power generation and grid infrastructure indicate that digital twins facilitate predictive diagnostics, risk-oriented maintenance planning, and lifetime optimisation (Zorchenko et al., 2024).

From a knowledge management perspective, digital twins serve as collective memory systems. Upon the detection of a failure mode in one asset, the relevant knowledge is disseminated across the digital representations of analogous assets, facilitating the coordination of preventive measures on a large scale. Evidence synthesised in the digital twin and predictive maintenance literature indicates that digital twin-enabled decision support can strengthen fleet-level maintenance prioritisation by combining real-time condition monitoring with simulation and optimisation, thereby supporting risk-informed planning, reducing unplanned downtime, and improving lifecycle performance; however, realised outcomes remain contingent on data quality, model validity, and organisational integration (Zhong et al., 2023; Werbińska-Wojciechowska et al., 2024; Abd Wahab et al., 2024).

This collective learning ability signifies a major transformation in decision support reasoning. The quality of decisions enhances not due to individual managers possessing more information, but because organisational knowledge is perpetually updated, disseminated, and implemented via interconnected digital artefacts.

Workforce Knowledge Ecosystems and Operational Agility

Operational efficiency and decision support are limited by the effectiveness with which organisations leverage human expertise. Siemens exemplifies how AI-driven knowledge ecosystems improve both aspects by rendering skills and learning pathways visible on a large scale. Siemens utilises advanced analytics and AI-driven learning platforms to align operational requirements with specific upskilling pathways, viewing employee expertise as a dynamic resource rather than a fixed characteristic (Freise et al., 2025).

This method facilitates expedited and better-informed judgements concerning task distribution, project personnel assignment, and skill enhancement. Integrating learning analytics into daily operations minimises coordination delays and enhances the pace of problem resolution. These systems incorporate governance controls that prioritise transparency and employee confidence, hence enhancing the validity of AI-assisted choices.

The cases analysed in this part illustrate that AI-driven efficiency improvements are most sustainable when integrated with strong decision support systems. AI-DSS create value across several domains, including healthcare maintenance, financial document analysis, industrial asset management, and workforce development, by converting data into actionable insights that are perpetually validated and enhanced. Operational efficiency should be perceived not solely as expedited execution, but as the organization's ability to make timely, educated, and accountable decisions in uncertainty.

5. Economic Sustainability and KM in Digital Transformation

Economic sustainability in digital transformation entails more than merely implementing artificial intelligence (AI) to reduce expenses or expedite decision-making; it involves guaranteeing that digital capabilities yield lasting value while avoiding concealed environmental, organisational, or distributional liabilities. In this context, knowledge management (KM) serves as the stabilising framework that renders AI “*economically governable*”: it transforms data and model outputs into collective comprehension, replicable processes, and verifiable decisions that endure leadership transitions, market disruptions, and regulatory examination.

This section advances the argument on two interconnected levels. At the organisational level, AI can enhance eco-efficiency and “*green innovation*”, provided that knowledge management connects metrics, practices, and incentives across functions - particularly through Green Human Resource Management (GHRM) and competence development. Secondly, at the macro level, AI transforms the knowledge economy by altering the distribution of cognitive labour, the allocation of benefits, and the progression of inequality. In this context, knowledge management emerges as a societal competency that may either exacerbate disparities - when knowledge and

artificial intelligence are concentrated - or facilitate labour restoration through upskilling, task reconfiguration, and the dissemination of problem-solving abilities.

Green Human Resource Management (GHRM) and Sustainability

As organisations shift towards sustainability goals, AI is increasingly regarded as a catalyst for environmentally friendly operations - facilitating enhanced analytics, automation, and monitoring that can uncover inefficiencies and foster innovation. However, technology by itself seldom achieves enduring revolution. The durability of eco-efficiency is contingent upon an organization's ability to assimilate AI-generated insights, implement them in practice, and institutionalise them via policies, routines, and competencies. The translation is essentially a knowledge management task.

A systematic review of AI and GHRM indicates that the literature progressively positions AI as a facilitator of essential green HR functions - such as green recruitment, training, and performance management - while concurrently highlighting the necessity for ethical safeguards and organisational preparedness for implementation (Alherimi et al., 2025). The review's focus is crucial for economic sustainability as numerous sustainability achievements are operationally "*fragile*": they rely on regular behaviour (e.g., environmentally friendly activities), dependable measurement, and enduring incentives. GHRM offers frameworks for integrating sustainability into job design, skill development, and performance metrics; KM facilitates the dissemination of sustainability knowledge (both tacit and explicit) across departments instead of confining it to a sustainability office or analytics team.

- The intersection of AI with "*green KM*" involves AI generating detailed sustainability signals - patterns in energy use, process inefficiencies, or performance metrics - while KM facilitates the transformation of these signals into organisational learning. In practical terms, KM provides the "*coordination layer*" that transforms isolated analytics into cross-functional eco-innovation: shared taxonomies (definitions of waste or carbon hotspots), communities of practice (methods for teams to exchange solutions) and decision logs (rationale for accepted sustainability trade-offs). Empirically, this synergy aligns with studies indicating that the combination of AI and KM, when integrated with innovation capabilities, correlates with enhancements in sustainability-related performance inside organisations (Alherimi et al., 2025).
- *Algorithmic bias and sustainability deviation.* A prevalent danger in AI-driven sustainability initiatives is "*objective drift*": models prioritise easily quantifiable metrics (such as speed, throughput, and cost) while neglecting or externalising environmental impacts. The systematic study identifies algorithmic bias and the potential for discriminatory results in AI-driven HR systems as significant issues, emphasising that inadequate governance and controls might lead to unforeseen consequences from AI integration (Alherimi et al., 2025). From an economic sustainability standpoint, bias constitutes not merely an ethical issue; it may evolve into a cost center over time due to employee attrition, reputational harm, litigation, and the misallocation of talent - particularly in areas vital to sustainability where competence and engagement are paramount.

Here, KM governance becomes into a practical design necessity rather than a mere managerial catchphrase. To effectively address sustainability constraints, they must be integrated into the processes of AI-supported decision-making and evaluation: this includes documenting model objectives and assumptions, providing verifiable justifications for sustainability trade-offs, and establishing systems for ongoing feedback and correction. Companies require a knowledge management-supported "*control loop*" that consistently aligns optimisation with sustainability objectives, especially when artificial intelligence technologies are employed to inform human resources choices, operational planning, or supply chain coordination.

- *Knowledge Management as the intermediary of sustainable results:* Data from SMEs substantiates this mediation rationale. A study on sustainable entrepreneurship indicates that AI capabilities impact sustainability mainly when companies have strong knowledge management systems that can convert digital insights into practical applications (Alshammakhi & Sheikh, 2025). The study indicates that entrepreneurial orientation (characterised by innovative and proactive behaviour) and governmental policy support can

enhance the transformation of knowledge into sustainable results, while cautioning that excessive dependence on incentives may promote compliance behaviour instead of meaningful change.

Collectively, these data suggest a definitive managerial conclusion: AI can assist in identifying sustainability opportunities, but knowledge management dictates the organization's ability to execute on such opportunities consistently, equitably, and at scale. In the absence of knowledge management, sustainability is merely a dashboard; with knowledge management, it transforms into an organisational competence.

Macroeconomic Transformations: The Knowledge Economy

While firm-level sustainability improvements are significant, economic sustainability also hinges on whether AI-driven transformations promote macroeconomic stability, particularly concerning labour markets and inequality dynamics. The “*knowledge economy*” refers not merely to an economy abundant in information, but to one in which production and wages are contingent upon the organization, communication, and governance of knowledge. AI imposes a structural disruption on the organization.

A formal model of AI within the knowledge economy posits that the critical distinction lies not alone in “*automation versus augmentation*”, but rather in whether AI operates as autonomous or nonautonomous. In the model, nonautonomous AI augments worker productivity, whereas autonomous AI can partially supplant high-skill problem-solving, increasing output but modifying the distribution of benefits (Ide & Talamàs, 2025). This framework elucidates why enhancements in aggregate productivity do not inherently result in widespread prosperity: identical technological capabilities can yield disparate macroeconomic outcomes contingent upon the entities that govern them, the manner of their application, and whether they replace or augment human expertise.

- *The trade-off between productivity and inequality:* The model underscores a significant tension: autonomous AI predominantly advantages individuals with superior knowledge assets (“*solvers*”), and although productivity may increase, inequality may also escalate (Alherimi et al., 2025). This is not simply a distributional consideration; it is a matter of economic sustainability, since enduring inequality can diminish social cohesiveness, curtail human-capital investment, and destabilise labour markets - ultimately jeopardising demand, legitimacy, and institutional confidence.
- *The significance of knowledge management at the macro level:* If the economic risk is that autonomous AI consolidates rewards among model owners and individuals with rare expertise, then knowledge management serves as a counterbalancing capability: it can expand access to codified knowledge, reduce learning curves, and augment the workforce capable of engaging in higher-value problem-solving. Conversely, KM can serve as a diffusion mechanism that inhibits AI from being solely an exclusive “*solver technology*”. When organisations regard knowledge management as an internal public good - via training knowledge bases, mentoring systems, structured decision documentation, and transparent competency frameworks - they enhance the likelihood that AI functions as nonautonomous, augmenting labour rather than supplanting it (Ide & Talamàs, 2025). This comprehensive perspective is further substantiated by evidence that AI is increasingly regarded not merely as a tool but also as an economic disruptor and a potential independent entity within finance and the wider economy (Mo & Ouyang, 2025). Governance extends beyond mere technical model performance; it must encompass the integration of AI into institutions and the transformation of its outputs into decisions - specifically, the area where knowledge management design choices are significant.
- *Reintegration of labour via human-centered activities:* Economic sustainability necessitates not only the alleviation of displacement but also the development and expansion of roles that prioritise human judgement. From an organisational perspective, knowledge management facilitates this “*reinstatement*” by systematically identifying areas where uniquely human competencies - contextual reasoning, ethical judgement, negotiation, and accountability for outcomes - are essential, and subsequently developing training pathways and role structures accordingly. This is not a sentimental assertion of human exceptionalism; rather, it is an institutional argument positing that sustained digital transformation relies on

complementarity: AI manages pattern recognition and scalability, whilst humans maintain accountable judgement among uncertainty. The organization's capacity to sustain that complementarity over time constitutes a knowledge management challenge (Ide & Talamàs, 2025; Mo & Ouyang, 2025).

In conclusion, economic sustainability in digital transformation depends on the integration of AI into manageable knowledge systems. At the organisational level, AI may enhance eco-efficiency and green innovation, provided that knowledge management transforms analytics into collective learning and ethically sound practices. At the macro level, AI has the potential to enhance productivity while exacerbating inequality - unless knowledge management facilitates the dissemination of problem-solving abilities and fosters a reimagining of work centred on accountable, human-centric decision-making.

6. The Ethical Imperative: Trust, Transparency, and Governance

As AI systems increasingly mediate organisational knowledge and decision-making, trust becomes an operational asset rather than a purely reputational concern. In knowledge-intensive settings, adoption is constrained not by the ability of models to generate outputs but by whether organisations can render those outputs institutionally usable - contextualised, contestable, auditable, and aligned with decision authority. This shifts the governance question from "*Can the model produce an answer?*" to "*Can the organisation justify, monitor, and correct AI-enabled knowledge claims over time?*" The National Institute of Standards and Technology's AI Risk Management Framework (AI RMF 1.0) formalises this orientation by treating trustworthiness as a set of measurable characteristics and by organising risk management activities into four lifecycle functions – "*Govern*", "*Map*", "*Measure*", and "*Manage*" (National Institute of Standards and Technology, 2023).

In this study, Algorithmic Trust Infrastructure (ATI) is used as a knowledge governance construct: an integrated set of organisational controls that makes AI-enabled knowledge work reliable and accountable in practice. ATI is anchored in (i) lifecycle risk governance (National Institute of Standards and Technology, 2023), (ii) legal obligations for high-risk AI systems - especially risk management, data governance, technical documentation, record-keeping/logging, transparency, human oversight, and robustness (European Union, 2024), (iii) principle-based stewardship of trustworthy AI (Organisation for Economic Co-operation and Development [OECD], 2019), and (iv) an AI management system logic for continual improvement consistent with ISO/IEC 42001:2023 (International Organization for Standardization, 2023).

The Dilemma of the "Black Box"

Conventional knowledge management systems facilitated verification through the examination of authorship, provenance, timestamps, and corroboration. Numerous modern AI systems, particularly deep neural networks, function as "*black boxes*", rendering their decision-making processes challenging to elucidate, debate, or analyse. This opacity induces two symmetrical lapses in judgement. Users may experience algorithm aversion, disregarding algorithmic recommendations following mistakes. Conversely, users may demonstrate automation bias by naively accepting outcomes, so institutionalising erroneous recommendations (Han & Ko, 2025). Both dynamics compromise KM's fundamental promise: transforming information into dependable, actionable knowledge instead of merely generating rapid responses.

Opacity transfers the ethical responsibility from achieving the correct outcome to maintaining a justifiable knowledge assertion. An AI-enabled system in knowledge management must offer more than a conclusion; it must facilitate a reasoning or evidence trail - an operational provenance that elucidates the evidence that influenced the output, the assumptions employed, and the areas of uncertainty that persist. Explainable AI (XAI) is significant not merely as a stylistic enhancement, but as a governance prerequisite that facilitates the conversion of model outputs into responsible organisational knowledge (Balarabe et al., 2025). In the absence of explainability, responsibility becomes unclear; when responsibility is unclear, trust becomes tenuous.

Components of an Algorithmic Trust Framework

ATI cannot be reduced to a single technical feature (e.g., explainability) because trustworthy AI in organisational knowledge work is an end-to-end property of governance, data, documentation, oversight, and learning. A robust ATI can be specified as four mutually reinforcing control families, each grounded in primary governance frameworks and management-system requirements (European Union, 2024; International Organization

for Standardization, 2023; National Institute of Standards and Technology, 2023; OECD, 2019).

- *Governance*, accountability, and decision rights (Govern): ATI begins with explicit assignment of responsibilities and decision authority: who defines acceptable risk, who approves deployment, who can override AI recommendations, and how accountability is recorded. The AI RMF positions “Govern” as a cross-cutting function that shapes all other risk activities, while risk-based regulation reinforces that accountability and oversight must be operational rather than symbolic (European Union, 2024; National Institute of Standards and Technology, 2023).
- Data governance, provenance, and quality controls (Map): AI-enabled knowledge work inherits the strengths and weaknesses of its data and organisational content. ATI therefore requires defensible data governance: documented sources, traceable transformations, appropriate access controls, and quality criteria aligned to the use context. This aligns with the AI Act’s emphasis on data governance and with the AI RMF’s emphasis on mapping context, stakeholders, and known risks before measurement and management (European Union, 2024; National Institute of Standards and Technology, 2023).
- Transparency, documentation, and contestability (Measure): Trustworthy outputs must remain contestable. Organisations need technical documentation and records that support evaluation, auditing, and learning, including information that enables users and reviewers to interpret outputs and their limitations. This corresponds to transparency and documentation expectations in the AI Act and to the AI RMF’s trustworthiness characteristics related to accountability, transparency, and interpretability (European Union, 2024; National Institute of Standards and Technology, 2023).
- *Continuous monitoring, incident response, and corrective learning (Manage)*: ATI must persist after deployment: performance drift, emergent risks, security vulnerabilities, and unintended harms require ongoing monitoring, escalation procedures, and corrective updates. This aligns with the AI RMF’s “Manage” function and with an AI management system approach that embeds continual improvement across organisational AI practices (International Organization for Standardization & International Electrotechnical Commission, 2023; National Institute of Standards and Technology, 2023).

The Temporal Dynamics of Trust

Trust in AI is fluid rather than fixed. Research in human-AI financial advisory settings suggests that trust typically develops through distinct stages: initial establishment influenced by perceived accuracy, a significant “single-error shock”, and subsequent repair that relies on the system’s explanation and response to the failure (Han & Ko, 2025). Significantly, confidence may diminish abruptly following an error, and restoration is neither instinctive nor assured.

Post-error explanations can facilitate correction, however they are not universally advantageous. Poorly timed or mismatched explanations can increase cognitive strain, divert attention from pertinent cues, or unintentionally enhance confidence (Han & Ko, 2025). Restoring trust involves more than merely providing explanations. It necessitates regulated transparency: articulating the reasons for failure, the contributing boundary conditions, and the corrective measures implemented - enabling users to adjust their reliance accordingly, rather than fluctuating between rejection and over dependence.

This is where ATI becomes fundamentally pivotal. Restoring trust is not solely a communicative endeavour; it constitutes an organisational learning cycle. Errors should prompt documentation, corrective measures, and revised monitoring techniques instead of discreet alterations that raise suspicion. When the governance reaction is transparent and verifiable, trust may be restored without naivety.

Implementing Ethical Principles in AI-Driven Knowledge Work

Ethical governance becomes actionable only when translated into repeatable organisational routines that determine what data and knowledge may be used, how outputs are validated, who may act on recommendations, and how impacts are monitored and corrected. At the level of societal principles, the OECD AI Recommendation provides a widely adopted baseline for trustworthy AI - emphasising responsible stewardship, transparency, robustness, and accountability (OECD, 2019). At the level of organisational implementation, the AI RMF provides lifecycle risk-management functions and measurable trustworthiness characteristics, while the EU AI Act operationalises obligations for higher-risk contexts through requirements related to risk management, data governance, documentation and record-keeping, transparency, human oversight, and robustness (European Union,

2024; National Institute of Standards and Technology, 2023). ISO/IEC 42001:2023 complements these frameworks by specifying requirements for an Artificial Intelligence Management System that embeds governance, monitoring, and continual improvement across an organisation's AI portfolio (International Organization for Standardization, 2023).

A practical way to operationalise these requirements in knowledge management is to implement an ATI-aligned control checklist, cross-walked to the frameworks above:

- *Security and resilience*: protect models, pipelines, and knowledge assets through access control, secure development, and resilience testing (National Institute of Standards and Technology, 2023).
- *Privacy and lawful use*: ensure lawful, proportional handling of personal and sensitive data and enforce purpose limitation in AI-enabled retrieval and generation (OECD, 2019).
- *Transparency, documentation, and record-keeping*: document data sources, system limitations, and decision rationale; retain logs and artefacts needed for audit and learning (European Union, 2024).
- *Human oversight and decision rights*: define escalation paths, override authority, and exception-handling routines so that speed does not outrun accountability (European Union, 2024; National Institute of Standards and Technology, 2023).
- *Ongoing monitoring and corrective learning*: monitor drift and emergent risks, capture incidents, and feed corrective actions back into policies, data governance, and workflow design (International Organization for Standardization, 2023; National Institute of Standards and Technology, 2023).

This reframing preserves the conceptual utility of ATI while grounding it in primary governance frameworks and management-system requirements, thereby strengthening the academic and policy legitimacy of the argument. The ethical imperative is inherently structural: reliable AI-driven knowledge management does not arise solely from improved models. It arises when organisations establish infrastructures that render knowledge claims visible, decisions accountable, performance auditable, and failures rectifiable over time.

7. Proposed Comprehensive Strategy: The Integrative Intelligence Framework

A robust artificial intelligence (AI) strategy is not established merely through model selection and tool implementation; it necessitates an organisational framework that ensures intelligent actions are reproducible, manageable, and subject to continual enhancement. The Integrative Intelligence Framework addresses this need by merging (i) the Antecedent-Consequence-Intervention (ACI) logic utilised in research on AI-enabled knowledge management systems (AIKMS) and (ii) a pragmatic methodology that considers AI alignment as a multi-dimensional “fit” across strategy, culture, operations, and governance. The ACI methodology enables the conceptualisation of AI not solely as a technical enhancement, but through the simultaneous examination of adoption conditions (antecedents), practical implementation methods (interventions), and the resultant performance and risk outcomes (consequences) (Panda & Puri, 2025). This integrated logic represents the framework's primary contribution: technical capabilities may evolve into a sustainable and verifiable institutional capability only if these three dimensions are developed concurrently.

Framework Structural Design

The framework is structured to guide organisations from initial strategic vision to sustainable implementation, supported by three interdependent pillars.

Pillar 1: Strategic Alignment (Precedents)

Business objectives and the value proposition delineate the strategic rationale that governs AI decisions. While efficiency improvements are significant, AI initiatives should be associated with long-term value generation and competence development, as the strategic importance of knowledge management is evident in its capacity to enhance decision quality and organisational learning over time (Panda & Puri, 2025).

Cultural preparedness and entrepreneurial mindset influence whether AI serves as a “*learning accelerator*” or a vulnerable layer of automation. Even when an organization has data and resources, it is challenging to create effect in situations where experimentation is discouraged or model flaws cannot be disclosed securely. Consequently, the cultural layer converts AI transformation from a technological initiative into an operational framework for managing

uncertainty, risk, and learning.

Resource mobilisation denotes a transition from “*stockpiling and ownership*” of limited assets to their strategic orchestration across various units and processes. Research indicates that AI catalyses business model innovation in digital platform firms through “*resource actions*” - including patching, organising, and orchestrating resources - by reconfiguring organisational capabilities (Zhang et al., 2025). The practical implication of this foundational pillar is to enhance the visibility of data assets, delineate access and sharing protocols, and furnish suitable computational infrastructure. In the absence of this basis, the expansion of advanced AI applications frequently exacerbates organisational fragmentation; hence, the subsequent focus shifts from “*AI selection*” to the design of human - AI work systems.

Pillar 2: Operational Integration (Interventions)

Operational integration converts strategy purpose into operations that address the enquiries of “*who-when-under what controls*”. Two mechanisms are critical.

- *The establishment of an Algorithmic Trust Infrastructure (ATI)*. Trust must be cultivated prior to expansion. An assessment of organisational “*as-is*” conditions for AI-driven digital transformation highlights the necessity of integrating governance and audit requirements into the design, in addition to mapping business processes and the data landscape (Aldoseri et al., 2024). Accordingly, ATI brings traceable data processing, documented decision authority, explainability and ethical criteria, and escalation pathways - triggered when outputs conflict with policy or domain expertise - into a unified trust architecture. As a result, AI outputs become usable in high-impact scenarios. Concretely, ATI is operationalised by aligning organisational controls with the AI RMF’s lifecycle functions, the EU AI Act’s high-risk requirements (notably data governance, technical documentation, record-keeping/logging, transparency and user information, human oversight, and robustness/cybersecurity), the OECD principles for trustworthy AI, and an AI management system approach consistent with ISO/IEC 42001:2023 (European Union, 2024; International Organization for Standardization, 2023; National Institute of Standards and Technology, 2023; OECD, 2019).
- *Hybrid intelligence workflows*. In situations where AI is regarded as a “*problem-solving partner*” rather than merely a tool, it is essential to clearly delineate hand-off points for the partnership to operate effectively. The knowledge economy perspective elucidates this design necessity: while AI automates routine tasks in certain contexts, it also engages in exception handling and problem-solving in others, establishing a new division of labour between “*workers*” and “*solvers*”; as autonomy escalates, output may increase, yet the distribution of benefits and regulatory decisions also become more intricate (Ide & Talamàs, 2025). Consequently, if oversight, speed, and responsibility are not integrated, hybrid-intelligence productivity may become an institutional danger.

Capability development constitutes the operational investment that stabilises hybrid workflows: instead of just substituting humans, the objective is to enhance their competencies for new roles and abilities that facilitate collaboration with AI (verification, supervision, exception management, interaction design, etc.). Systematic study about AI applications in green human resource management indicates that effectiveness is limited by skills, training design, ethical considerations, and organisational preparedness (Alherimi et al., 2025). As interventions become institutionalised, the emphasis of assessment transitions: effectiveness is assessed not solely through output metrics, but also through the extent to which knowledge is transformed into sustainable organisational competence.

Pillar 3: Sustainable Outcomes

The outcomes pillar is founded on three criteria that render results “*sustainable*”: measurability, learnability, and social responsibility.

Return on Knowledge (ROK) inquiries - together with return on investment (ROI) - assess how proficiently an organization transforms knowledge into insight, decisions, and innovation. In an environment where AI alters the production and application of knowledge, this viewpoint necessitates an emphasis on not merely cost reduction, but also on time-to-insight, the reuse rate of verified solutions, and decision dependability.

Continuous learning loops embed the integration of operational achievements and failures into the knowledge management system, thereby changing data, policies, workflows, and, when required, models. Research indicates that AI capabilities influence sustainable entrepreneurship by enhancing sustainability outcomes through robust knowledge management systems, with digital insights actionable solely via knowledge management (Alshammakhi

& Sheikh, 2025). In the absence of such loops, scale exacerbates not learning, but rather errors and inconsistencies.

Social and environmental responsibility encompasses assessment beyond organisational limits. Failure to monitor the potential injustices, externalities, or unintentional harms generated by AI systems leads to the erosion of trust and legitimacy, all of which are essential for long-term competitiveness (Alshammakhi & Sheikh, 2025). The framework integrates performance and accountability into a unified outcomes architecture.

Implementation Roadmap

The staged roadmap aims to move from readiness to scale, and from scale to learning-based sustainability.

- *Stage 1 - Knowledge audit and data hygiene*: The starting point is a structured assessment of processes, existing systems, the data landscape, and AI capability. Mapping the organizational “as-is” condition makes the quality of data sources, gaps, and risk areas visible (Aldoseri et al., 2024). This stage surfaces “dark data” (unprocessed/dispersed knowledge) and establishes cleaning, access, and ownership arrangements for critical datasets.
- *Stage 2 - Co-pilot pilot (AI-assisted)*: AI-assisted applications are deployed in low-risk but high-frequency areas (e.g., help-desk classification, routine text drafting). Evidence that AI capabilities in digital platform enterprises evolve in stages indicates that transformation should progress iteratively through a “review and adjustment” capacity (Zhang et al., 2025). This approach expands trust and familiarity while limiting potential harm.
- *Stage 3 - Building ATI*: Based on pilot evidence, governance is formalized: decision authorities, audit routines, explainability, and ethical requirements are clarified (Aldoseri et al., 2024). Thus, the “rules of the road” become explicit, and scaling advances together with institutional control capacity.
- *Stage 4- Integrated autonomy in core operations (AI-integrated)*: AI expands from assistance into core processes (e.g., pricing decisions, predictive maintenance); the accompanying design principle is that humans remain in the loop for exception management. As AI autonomy increases “solver” functions, oversight and approval mechanisms must be strengthened so that speed does not outrun accountability (Ide & Talamàs, 2025).
- *Stage 5 - Learning loop (the learning organization)*: Feedback mechanisms are institutionalized: errors and successes are translated into knowledge assets and decision protocols; data/policy/flows are updated when needed. The long-term differentiator is not AI itself, but the organization’s capacity to convert operational experience into reusable knowledge assets and better decision controls. The ACI perspective explicitly supports that sustainable performance depends on being able to build these linkages (Panda & Puri, 2025).

This roadmap’s original contribution is that it defines AI transformation as a capability sequence - from making knowledge visible, to using it safely, to governing it at scale, and finally to learning from it continuously. Instead of jumping from pilots to full autonomy, it ties every increase in AI use to a matching increase in data quality, decision clarity, and oversight strength. The result is a practical path where speed never outruns accountability, and where sustainable performance comes from turning day-to-day operations into reusable knowledge and better decision routines.

8. Conclusion

Artificial intelligence is frequently depicted as a universal catalyst for productivity and innovation. This research demonstrates that such acceleration is not, in isolation, an economic strategy. The critical inquiry is not if AI can produce outputs, but if organisations can transform those outputs into dependable organisational knowledge - knowledge that is contextualised, contestable, reusable, and sanctioned for action. In the absence of that conversion, AI enhances speed at the expense of comprehension: it generates numerous drafts, recommendations, and analyses, but it equally risks proliferating inconsistency, misinterpretation, and erroneous confidence. In essence, the competitive edge in the AI era lies not in access to models, but in the ability to manage knowledge to ensure that intelligent actions are explainable, reproducible, and amendable.

In entrepreneurship, commercial operations, and macroeconomic results, the same idea applies: AI generates value solely when integrated into knowledge infrastructures that maintain significance over time. As businesses transition from static repositories to dynamic knowledge flows, knowledge is no longer a stable asset that can be

“captured once” and reused indefinitely. It evolves into a dynamic system - constantly updated, perpetually implemented, and consistently susceptible to deviation. This transition elevates the benchmark for managerial proficiency. Successful companies will be those that can sustain coherent information amidst rapidity: they can avert duplication and contradiction, reveal assumptions, uphold version control, and guarantee that decisions are anchored in evidence rather than convenience.

The conclusion for entrepreneurship is as straightforward. Generative AI reduces the expenses associated with research and experimentation, hence enhancing opportunity identification and shortening the gap between concept, prototype, and market evaluation. However, the same simplicity of creation facilitates imitation and renders superficial novelty more prevalent. The sustainable entrepreneurial advantage transitions from merely increasing outputs to enhancing learning: ventures must institutionalise their discoveries, convert experiments into lasting knowledge assets, and establish workflows where verification, exception handling, and judgement are integral routines rather than mere afterthoughts. Enterprises that expand sustainably will regard AI as a methodical learning collaborator - one that enhances iteration while preserving the integrity of decision-making.

Operationally, efficiency benefits should be regarded as a by-product of enhanced decision-making systems rather than the primary objective. When AI transforms processes, the profound alteration involves not merely accelerated execution, but a reallocation of cognitive labour: routine interpretation can be standardised, while human focus shifts to exception management, risk trade-offs, negotiation, and accountability. Nonetheless, this reallocation is effective only if companies establish explicit transitions between human and machine roles, delineate authority for actions and approvals, and preserve an institutional memory regarding the rationale behind decisions made. Otherwise, organisations may grow more rapid yet increasingly fragile - exhibiting high performance under normal settings while remaining susceptible when circumstances diverge from established patterns.

The study’s strategic conclusion is fundamentally structural: AI transformation should be regarded as a series of capabilities rather than merely a deployment of tools. The initial step is to render knowledge discernible - via audits that ascertain its significance, location, validation methods, and the actions it underpins. The subsequent phase is rendering knowledge actionable - via processes that delineate when AI is permitted to generate or obtain information, when human verification and contextualisation are required, and the methods for resolving conflicts. The ultimate objective is to ensure the sustainability of knowledge via governance and learning loops that track deviations, document occurrences, revise regulations, and perpetually enhance the system. When these components are amalgamated, AI transforms into a mechanism of structured sensemaking and expandable proficiency. In their absence, AI transforms into a catalyst for swift production accompanied by a decline in trust.

The primary assertion of this work is clear and challenging: the economic potential of AI is actualised not through the mere adoption of intelligence, but by establishing institutions capable of coexisting with intelligence - institutions that maintain the veracity of knowledge amidst rapidity, ensure accountability in decision-making amid complexity, and foster continuous learning in the face of change.

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Declaration of AI Use

This study used generative AI-based writing and language-support tools (ChatGPT and QuillBot) in an auxiliary manner to support academic writing. These tools were not used to generate original data, conduct analyses, derive findings, or fabricate citations or references. All references and in-text citations were verified by the author against primary sources, and AI outputs were treated solely as editorial suggestions subject to human review. No personal data, confidential institutional information, or copyrighted materials were entered into these tools. The author bears full responsibility for the final manuscript.

1. ECONOMICS, FINANCE, AND ACCOUNTING

A Micro-Study on the Parameters of the Recent Activity of the Romanian SAI

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JEL: H83, M42, H61, H72

Abstract

Background and aim: This paper analyzes the recent activities of the Romanian Supreme Audit Institution (SAI), namely the Court of Accounts, in the context of Romania's ongoing budgetary challenges and governance reforms. The study aims to evaluate both the quantitative dimensions—volume and typology of audit missions, damages, and additional revenues—and qualitative aspects such as the implementation of recommendations, performance auditing, and the impact on public policies. *Scope:* The research is limited to secondary data from official reports and legislation, which reflect the institutional perspective, without primary empirical investigations. *Methods:* The approach combines documentary and statistical analysis with qualitative assessments, complemented by international standards (INTOSAI/ISSAI) and comparative references. *Results:* The findings highlight significant progress in expanding audit missions and strengthening follow-up actions, but also reveal persistent deficiencies, including low recovery rates of identified damages, partial implementation of recommendations, and underutilization of performance auditing. *Conclusions:* The study concludes that the RCA remains a vital actor in safeguarding public resources, yet its effectiveness is constrained by structural deficiencies and slow digitalization. *Originality:* The paper contributes by offering a critical institutional analysis that links audit outcomes with governance quality, emphasizing the preventive and reform-oriented role of external audit. *Practical implications:* The results suggest that policy-makers should prioritize digitalization, strengthen follow-up mechanisms, and expand performance auditing to ensure that audit findings effectively support fiscal discipline, administrative modernization, and public trust.

Key words:

SAI / Romanian Court of Accounts (RCA), public financial resources, damages and additional revenues, internal managerial control system, digitalization and administrative modernization.

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1. Introduction

Supreme Audit Institutions (SAI) represent, within the institutional architecture of any consolidated democratic state, fundamental pillars in ensuring legality, efficiency, and transparency in the use of public resources (Aniței, 2011; Costaș & Tofan, 2023; Costea, 2024). It should be noted that, through their activity, these institutions are not limited merely to control and sanctioning functions; they also fulfill a constructive mission, oriented toward providing recommendations aimed at improving administrative performance and strengthening citizens' trust in the state's capacity to responsibly manage public funds (Ștefănescu & Trincu-Drăgușin, 2020).

In Romania, this highly important role belongs to the RCA, an institution established under Law no. 94/1992 on its organization and functioning. In fact, 1992 marked the resumption of its activity, since the institution was originally created in 1864 but experienced several interruptions depending on the political regimes of the past (Bostan, 2023; Băjan et al., 1994). At present, under the provisions of the above-mentioned law (PR, 1992), the RCA verifies the formation, administration, and use of the financial resources of the state and of territorial-administrative units. Since 1992, the RCA has consolidated its position as an independent authority, capable of exercising complex control adapted to macroeconomic challenges, thus confirming its

role as guarantor of financial discipline and good governance (Bostan, 2010; Tataru, 2008).

It must be emphasized that the relevance of the RCA's activity is even greater in the current context of economic and social pressures, characterized by persistent budget deficits, low levels of tax revenue collection, and the imperative need for efficient use of European funds. Thus, the institution under analysis is not only an instrument of retrospective control, but also a strategic partner in the process of reform and modernization of public administration, contributing through its reports and recommendations to the shaping of public policies and the creation of a climate of institutional responsibility.

Against this background, our study seeks to analyze the parameters of the RCA's recent activities, from both quantitative and qualitative perspectives, with emphasis on recorded progress, persistent challenges, and the implications these generate for financial discipline, governance quality, and public trust.

Our approach followed the following structure: (1) Introduction; (2) Material and methods; (3) Normative and methodological framework; (4) Macroeconomic context of 2023; (5) Investigation of quantitative parameters of RCA activity; (6) Results of external public audit carried out at the state administration level; (7) Follow-up activity and evaluation of the internal managerial control system; (8) Critical institutional analysis; and (9) Conclusions.

The final part of the paper also includes references to the research limitations and the future directions of study on which we intend to focus.

2. Material and methods

The research is based on a qualitative–quantitative approach, with the main sources being the normative framework applicable to the RCA and the institution's recent official reports concerning the results of external public audit activities. The analysis was complemented by the legislative framework (Law no. 94/1992), the macroeconomic reports of the Romanian Government (GR, 2024), INTOSAI/ISSAI standards, and the specialized literature. The research design is illustrated in Figure 1.

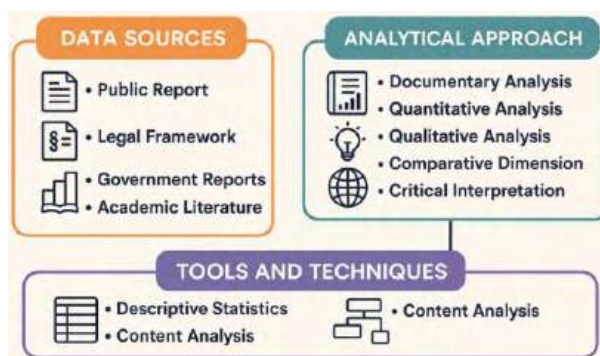


Fig. 1. Research design

Source: Authors' elaboration

The methodology included: documentary and statistical analysis of official data (number and type of audit missions, damages, additional revenues); qualitative analysis of the degree of implementation of recommendations and the impact on public policies; and comparative interpretation by reference to international audit standards. The data were synthesized in tables and figures elaborated by the authors.

3. Normative and methodological framework

In the context of the particular importance attached to financial control in the national economy (Bostan, 2010a), the activity of the RCA is grounded in the provisions of Law no. 94/1992, which regulates in detail the responsibilities of this institution, as well as in the international standards developed by INTOSAI and

ISSAI. By applying these standards (Bostan, 2010b), the RCA ensures that the methodologies employed are aligned with globally recognized best practices, thereby guaranteeing a higher degree of comparability and relevance of its results. At the same time, the autonomy it enjoys in establishing the Annual Audit Program allows the institution to select topics according to macroeconomic priorities and the risks identified in the management of public resources.

The recent modernization of the normative framework has emphasized strengthening performance auditing and integrating digital tools, reflecting the institution's orientation towards a comprehensive rather than merely formal evaluation of the use of public funds (Bostan, 2023).

As illustrated in Figure 2, the activity of the RCA is founded on a solid normative and methodological framework that combines the provisions of Law no. 94/1992 with INTOSAI/ISSAI international standards, complemented by modern practices such as digitalization and continuous professional training.



Fig. 2. Normative and methodological framework of the RCA

Source: Authors' elaboration

In its activities, the institution places strong emphasis on standardization and consolidated methodologies, directs evaluations toward performance and results, and develops a permanent dialogue with the audited entities and civil society. Equally important, it should be noted that in recent years the RCA has invested significantly in the continuous professional training of auditors and in the integration of digital technologies into the audit process.

4. Macroeconomic context of 2023

The financial year 2023 unfolded in an economic environment marked by a series of significant challenges, generated by high inflation, the continuation of the excessive deficit procedure, and increasing budgetary constraints (RG, 2024). Romania recorded a real economic growth of 2.4%, exceeding the European Union average; however, this result was offset by an inflation rate of 7% in December 2023 and a budget deficit of 6.5% of GDP. Moreover, the level of budget revenues—only 33.7% of GDP—remained well below the EU average of 45.5%, indicating a low fiscal collection capacity and a structural vulnerability of public finances. Public expenditures, although higher in nominal terms (688.4 billion lei), represented only 42.9% of GDP, compared to the EU average of 49%.

These indicators outline a macroeconomic framework that requires strict oversight by control institutions, underlining the role of the RCA in monitoring fiscal discipline and preventing budgetary slippages.

5. Investigation of the quantitative parameters of the RCA's activity

Focusing on the quantitative parameters of the recent activity carried out by the RCA, we observe a

significant volume of audit missions, reflecting both the complexity and the breadth of the institution's responsibilities (Aniței, 2011; Bostan, 2010b). Thus, in 2023 (RCA, 2024), a total of 535 financial audit missions, 1,060 compliance audit missions, five performance audit topics, and 23 documentation actions were conducted, covering 1,361 entities. In addition, 2,473 follow-up actions were undertaken to assess the degree of implementation of previously issued measures.

The quantitative results included 519 audit opinions and 1,008 conclusions, the identification of financial-accounting irregularities amounting to 82.7 billion lei, additional revenues of 779 million lei, and damages of 758 million lei. Furthermore, 52 criminal notifications were filed for failure to implement measures and 27 notifications for indications of criminal acts.

These data demonstrate both the scale of the Court's activity and its relevance in safeguarding the public interest. The main quantitative parameters of the RCA's activity for 2023 are summarized in Figure 3, which illustrates the volume of audit missions, the number of entities verified, as well as the magnitude of irregularities and additional revenues identified.

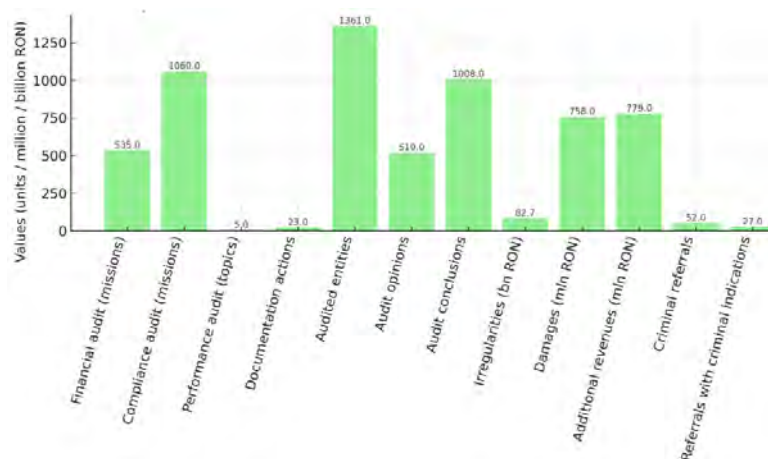


Fig. 3. Quantitative parameters of the RCA's activity in 2023

Source: Prepared by the authors based on data extracted from RCA, 2024

The figure summarizes the main quantitative dimensions of the RCA's activity, including the number of audit missions (financial, compliance, performance), the entities audited, the opinions and conclusions formulated, as well as the related financial indicators—irregularities, damages, and additional revenues. These data reflect both the scale of the activities carried out and the relevance of the institution in safeguarding the public interest and monitoring the management of state funds.

In order to better understand the structure and magnitude of the identified irregularities, it is useful to examine in detail the main non-compliances found at the National Agency for Fiscal Administration (ANAF), structured by audit objectives and areas of activity (Table 1).

Table 1

Non-compliances identified by the RCA at ANAF (2023)

Audit objective	Number of non-compliances	Additional revenues (thousand lei)	Financial-accounting errors (thousand lei)
Analysis of revenues and arrears (VAT, corporate income tax)	24	87,694	214,667
Analytical accounting records by taxpayers	134	10,168	975,395
Administration of general consolidated budget revenues	104	79,568	338,180

Risk analysis and tax inspections	271	365,300	875,503
Tax optimization (transfer pricing)	45	1,943	0.0
VAT reimbursement	53	27,485	1,662
Collection of budgetary receivables (VAT, corporate income tax)	102	299	357,411
Total	733	572,458	2,762,819

Source: Prepared by the authors based on data extracted from RCA, 2024

6. Results of the external public audit carried out at the level of state administration

6.1. Central public administration

Within the central public administration, the audit missions covered a wide spectrum of fundamental areas: public finance, health, education, research, culture, labor and social protection, agriculture, environment, energy, transport, development and investment, as well as the fields related to defense, public order, and justice.

The conclusions highlighted persistent deficiencies in tax revenue collection, difficulties in managing public debt, major inefficiencies in the health sector—such as the lack of correlation between investments made and results achieved—underfunding and inadequate use of resources in education and research, systematic delays in implementing infrastructure projects, and shortcomings in digitalization programs. All these findings reveal a deficit of managerial performance and institutional capacity at the level of central administration.

The analysis of audit missions in the central administration further emphasized a series of structural deficiencies, reflected particularly in the implementation of government programs and the management of public assets. The 2023 Public Report identified significant irregularities across several ministries and agencies, which generated delays, distorted reporting, and inefficient use of allocated funds. To better understand the typology of these deficiencies, Table 2 presents a selection of representative examples from the audit findings.

Table 2

Issues identified in the central public administration (selected, 2023)

Institution / Program	Type of deficiency	Concrete example
MDLPA	Inefficiency in implementing government programs	Anghel Saligny Program – contracting rate of 56%, payments under 5% of allocation
MDLPA	Overlapping programs	Parallel funding for road and water/sewage infrastructure
Ministry of Economy, Entrepreneurship and Tourism	Distorted reporting	Assets overvalued by 4.1 billion lei
MCID	Unclear accounting records	Receivables overvalued in relation to the EC by 2 million lei
Authority for the Digitalization of Romania	Unlawful salary payments	Bonuses granted cumulatively, not recorded as receivables
CN Romanian Lottery SA	Inadequate use of resources	Funds directed to commercial promotion instead of social objectives

Source: Prepared by the authors based on data extracted from RCA, 2024

The synthesized data show that the problems are not isolated but concern both investment sectors and current management areas, affecting the performance and credibility of the central administration. This confirms the persistence of institutional vulnerabilities that require not only punctual corrections but also

fundamental reforms in the field of public financial management.

6.2. Local public administration

At the level of local public administration, the analysis highlighted recurring problems related to the inefficient use of funds intended for community development, poor management of public and private assets, the incomplete collection of own revenues, and the absence of coherent investment strategies. During the period 2020–2023, local government expenditures increased by 42.8%, yet this budgetary expansion was not reflected in a proportional improvement in the quality of public services provided. This gap between resources and results underscores the importance of continuously monitoring the allocation and use of public funds.

A recurring theme of the audit at the local government level concerns the dynamics of public debt, which reflects the pressure on the budgetary resources of local administrative units (UATs). The 2023 Report reveals significant increases in local public debt, both direct and guaranteed, as illustrated in Table 3.

Table 3

Evolution of local public debt service (2022–2023)

Indicator	2022 (million lei)	2023 (million lei)	Variation (%)
Total local public debt	4,021.7	4,822.6	+19.9
Direct local public debt	3,881.3	4,571.0	+17.8
Guaranteed local public debt	140.4	251.6	+79.2

Source: Prepared by the authors based on data extracted from <https://mfinante.gov.ro/raportare-statistica-privind-datoria-publica-public-sector-debt-statistics>

The recorded developments confirm a trend of accelerated indebtedness, particularly through the increase of guaranteed debts, which indicates an accentuated financial vulnerability at the local level.

Another important dimension of the analysis is the structure of local public expenditures, which reveals the financing priorities assumed by local administrations. The distribution by sectors, presented in Table 4, highlights the significant share of expenditures for education, social assistance, and public development.

Table 4

Local public administration expenditures (2023, by main sectors)

Sector	Expenditures (million lei)	Share of total (%)
Public authorities	15,644	10.9
Education	47,245	32.9
Health	11,832	8.2
Culture, recreation and religion	5,611	3.9
Social assistance	27,518	19.2
Housing, services and public development	16,872	11.7
Environmental protection	7,125	5.0
Transport	12,680	8.8

Source: Prepared by the authors based on data extracted from RCA, 2024

A disproportionate allocation can be observed between important sectors, with clear underfunding of health and culture, which raises concerns regarding the sustainability of local policies. These data confirm that, although local administrations manage considerable resources, the efficiency of their use remains a major issue.

7. Follow-up activity and evaluation of the internal managerial control system

Our analysis found that the follow-up activity carried out in 2024 had a remarkable scope, targeting the verification of 12,198 measures previously imposed. The results showed that 79% of the measures were fully or partially implemented, although the degree of compliance varied significantly across sectors: 83% in public finance, 81% in defense and public order, 75% in agriculture, 63% in education, and 64% in environment.

The degree of implementation of the measures ordered by the RCA following previous missions is presented in Figure 4.

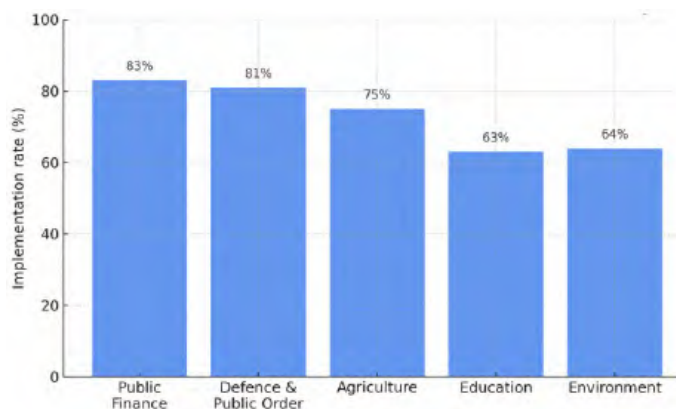


Fig. 4. Degree of implementation of the measures ordered by the RCA (Follow-up 2024)

The figure shows the level of compliance of audited entities with the measures established by the RCA, following the verifications carried out in 2024. It highlights the differences in implementation across sectors—with higher percentages in finance and defense, but lower levels in education and environment—revealing areas resistant to reform and the need to strengthen monitoring and enforcement mechanisms. A synthetic overview of the share and degree of implementation by sector is presented in Table 5, which complements the graphical data illustrated above.

Table 5

Implementation of measures and recommendations by sector (Follow-up 2024)

Sector	Share of total measures & recommendations (%)	Implementation rate (%)
Public finance and banking	20	83
Health	18	n/a
Agriculture and food safety	11	n/a
Labor and social protection	10	n/a
Culture and recreation	7	n/a
Education and research	6	63
Central public administration	5	n/a
Economy, digitalization, and business environment	5	n/a
Transport and infrastructure	5	n/a
Defense, public order, foreign affairs, and justice	5	n/a
Energy	3	n/a
Environment	3	64
Development and investment	2	n/a

Source: Prepared by the authors based on data extracted from RCA, 2024

Focusing only on the follow-up activity carried out in the field of public finance, we noted the implementation of important measures regarding the improvement of budget revenue collection, the stimulation of taxpayers' voluntary compliance, the consolidation of the regulatory framework on public debt, and the correction of deficiencies in recording government guarantees. At the same time, progress was recorded in recovering amounts unduly collected from the state budget and in strengthening preventive financial control. Through these actions, budgetary discipline was enhanced and transparency in the management of public funds increased.

Referring also to the evaluation of the Internal Managerial Control System (IMCS), we found that it revealed structural deficiencies such as excessive formalism in the drafting of internal procedures, the absence of effective monitoring of operational risks, the partial or formal application of internal audit standards, and the lack of a direct correlation between strategic objectives and resource allocation. Table 6 systematically presents the deficiencies identified in each of the major IMCS components, providing an overview of the causes of dysfunctions.

Table 6
Structural vulnerabilities of the IMCS (2023)

IMCS Component	Main deficiencies identified
Control environment	Lack of codes of conduct, formal ethics only, under-resourced audit/IT structures
Objectives and risk management	Objectives not defined as SMART, absence of performance indicators, superficial risk assessment
Control activities	Outdated procedures, formal controls without real impact
Information and communication	Insufficient information flow, lack of transparency
Internal audit and evaluation	Formal or absent internal audit, lack of audit committees, weak oversight

Source: Prepared by the authors based on data extracted from RCA, 2024

We must note that the RCA issued clear recommendations regarding the need to strengthen managerial responsibility, consolidate risk assessment capacity, and implement more effective reporting mechanisms, in order to reduce vulnerabilities within the administrative system.

8. Critical institutional analysis

Beyond the strictly quantitative dimension of its activity, which is important to reflect the workload and the scope of the missions carried out by the RCA, the authors undertake a critical analysis of the institution's results. This is intended to allow for fundamental observations regarding the efficiency, relevance, and real impact of its interventions on public financial management.

What we observe, first and foremost, is that the effectiveness of corrective measures remains relatively limited. Although damages and additional revenues are rigorously identified and quantified in financial terms, the degree of effective recovery and correction of deficiencies is partial and uneven across different sectors. This discrepancy suggests that, in the absence of coherent and firm follow-up and enforcement mechanisms, the preventive and corrective role of the RCA is not fully realized, with many of the identified irregularities persisting from one fiscal year to another.

Secondly, the persistence of structural deficiencies in sectors such as health, education, or the environment indicates that the recommendations issued by the Court are not sufficiently integrated into decision-making processes and sectoral strategies. It is readily observable that in these areas—characterized by high complexity and strong exposure to social and political pressures—there is greater resistance to change, which causes the deficiencies highlighted in successive reports to become practically constant. In our opinion, this phenomenon can undermine the credibility of the external public audit mechanism and diminish the positive impact it could have on improving governance.

Thirdly, the limited number of performance audit topics significantly restricts the institution's ability to strategically influence the administrative reform process. While financial and compliance audits provide a snapshot of the legality and regularity of operations, performance auditing has the merit of evaluating the efficiency, effectiveness, and economy of resource use, making it an important tool for formulating better public policies. The fact that only a limited number of such topics were addressed in 2023 indicates a predominant focus on compliance verification, to the detriment of a proactive and results-oriented approach.

Finally, the authors emphasize that the lack of accelerated digitalization visibly reduces the efficiency of audit processes and their capacity to provide decision-makers with relevant, real-time data. In a context where public administrations manage massive volumes of financial and operational data, the absence of advanced digital tools (big data, artificial intelligence, integrated reporting systems) makes the audit process time-consuming and, at times, reactive rather than preventive and anticipatory. In our opinion, this technological lag not only limits the speed and accuracy of verifications but also creates a gap compared to international standards, where the digitalization of public audit has become a strategic priority.

Therefore, the authors argue that a critical analysis of the parameters of the RCA's recent activity outlines the image of an institution that is procedurally robust but—it must be stressed—faced with major challenges regarding its real impact on good governance. We believe we are justified in stating that overcoming this impasse requires not only strengthening the normative and institutional framework but also making better use of recommendations, expanding performance auditing, and accelerating the digitalization process. Only in this way, in our view, can the Court's role evolve beyond identifying deficiencies, toward preventing them and fostering administrative reform.

9. Conclusions

The study we conducted shows that, through its recent activity on which we focused, the RCA confirms its status as an indispensable actor in the institutional architecture of the state, playing a central role in safeguarding public resources and consolidating financial discipline. The audit missions carried out during the period under review demonstrate that the institution has significant control capacity, a solid normative framework, and accumulated experience that allow it to cover a wide range of areas—from finance and health to education, agriculture, and environmental protection. This diversity reflects not only the complexity of its activity but also the strategic relevance of the Court in the process of democratic governance and the protection of the public interest.

However, the authors note that the analysis of the 2023 activity parameters reveals a dual reality. On the one hand, there are undeniable advances in expanding and diversifying audit missions, in consolidating the follow-up function, and in identifying with greater accuracy irregularities, damages, and additional revenues. These achievements confirm the institutional maturity of the RCA and its capacity to remain relevant in a complex financial and economic context marked by budgetary constraints, excessive deficits, and the need for improved absorption of European funds.

On the other hand, we observe that structural challenges persist, highlighting the limits of the real effectiveness of the external public audit mechanism. Among these are the insufficient degree of recovery of identified damages, the only partial implementation of measures and recommendations, and the lack of a stronger focus on performance auditing, which remains underexploited compared to international standards. We also note that the slow pace of digitalization in audit processes reduces the institution's capacity to respond swiftly to new challenges, including managing the growing volume of data and meeting the need for greater transparency in communicating results.

Therefore, in our opinion, in the coming years the priority directions for consolidation should include accelerating the digitalization process and integrating modern analytical tools (big data, artificial intelligence, integrated information systems), strengthening institutional cooperation with central and local administrations, and ensuring a more consistent integration of the Court's findings into the formulation and adjustment of public policies.

At the same time, the authors consider it necessary to emphasize the preventive dimension of audit and to adopt a stronger orientation toward evaluating performance and the impact of public policies, so that the

Court's activity becomes not only a retrospective verification but also a determining factor in modernizing administration and improving governance quality. Through these development directions, the RCA can strengthen its status not only as a guardian of public funds but also as a strategic partner of state institutions in the process of reform and modernization. Moreover, through a results-oriented activity that is transparent and aligned with international standards, we are convinced that the institution can decisively contribute to regaining and consolidating citizens' trust in the state's capacity to responsibly manage collective resources.

Thus, with certainty, the RCA will not remain merely a technical control instrument but will become a proactive actor, capable of supporting the consolidation of democracy and the rule of law in Romania.

Research limitations

The study relies exclusively on secondary data and official documents, which means that the results mainly reflect the institutional perspective. Moreover, the analysis is predominantly descriptive and does not include international comparisons.

Future research directions

Looking ahead, our research will extend the analysis over multiple years and in a comparative international framework, using advanced statistical methods to assess the impact of audits. We also intend to deepen the study of performance auditing and investigate the role of digitalization and artificial intelligence in modernizing external public audit.

Author Statement on AI Use

The authors declare that AI-based tools (ChatGPT-5) were employed solely for assistance in language editing, style improvement, translation verification, text refinement, and illustration enhancement, under the full supervision of the authors. The entire content has been thoroughly reviewed and finally approved by all authors of the paper.

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Empirical Validation of the Taste–Value–Risk (TVR) Model and Sectoral Extension of the Crisis Liquidity Ratio (CLR): A Dual Approach to Risk and Liquidity Assessment under Information Asymmetry

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JEL: G32, M41, D81, D83

Abstract

This paper develops an integrated framework for assessing risk and liquidity when information between firms and creditors is uneven. We bring together a conservative accounting indicator – the Crisis Liquidity Ratio (CLR) – and a cognitive model, Taste–Value–Risk (TVR). Quantitatively, we analyse 12 leading companies from the primary automotive market in Bulgaria (72 annual financial statements for 2018–2023) and compare CLR with the traditional Current Ratio (CR) and Quick Ratio (QR). The evidence shows that CLR behaves more steadily in crisis periods, because it removes receivables that are only liquid on paper and focuses on assets that can be converted into cash. Qualitatively, we report a psycholinguistic experiment with 312 respondents (Bulgarian- and English-speaking), which tests how people organise their perceptions of value and risk along a “sweet–bitter” axis. “Financial security” is consistently placed in the “sweet” and low-risk area, while “high interest rate” is perceived as “bitter” and highly risky; “short-term loans” and “credit cards” fall in between. Reading CLR and TVR together creates a dual filter – accounting and cognitive – that reduces both distortions in reported information and misunderstandings in communication, and offers a grounded toolkit for credit analysis, corporate governance and risk management.

Key words:

liquidity, Crisis Liquidity Ratio (CLR), Taste–Value–Risk (TVR), information asymmetry, cognitive economics, credit analysis, corporate governance

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1. Introduction

The economic dynamics of the past decade clearly show that firms operate under persistent uncertainty, marked by pandemic shocks, inflationary pressures, and structural imbalances in global supply chains. In this context, the problem of information asymmetry becomes particularly critical: creditors and investors often struggle to distinguish between reported and actual liquidity, which risks misguided decisions and an inefficient allocation of capital.

The classical indicators – Current Ratio (CR) and Quick Ratio (QR) – retain their analytical value under normal conditions, but in crises, they often produce misleading signals. The receivables included in the numerator retain their book value but lose their economic collectability. This systematically overstates liquidity coverage and creates preconditions for misjudgement precisely when the need for a reliable indicator is greatest.

In response to this deficit, Petrov (2012) formulated the Crisis Liquidity Ratio (CLR) – an indicator that eliminates receivables and thus focuses on assets with a higher degree of convertibility. Its initial empirical validation was conducted across the entire primary automotive market in Bulgaria over the period 2007–2017, during which it was established that, under crisis conditions, inventories serve as a more reliable source of

liquidity than receivables. Since its introduction, CLR has gradually gained academic and practical recognition: it has been incorporated into doctoral dissertations (Petrov, 2019), sectoral analyses (Ivanova, 2021), university literature (Kostova, 2019; 2023), and official corporate disclosures of regulated entities. This evolution consolidates CLR as a corrective to traditional indicators and as an instrument for reducing information asymmetries.

Analogous to Akerlof's (1970) logic of the “market for lemons”, where information asymmetry drives high-quality assets out of the market, the Quick Ratio often behaves as a “sweet lemon” – appealing in the financial statements but misleading in times of crisis because of the illusory liquidity of receivables. CLR corrects this illusion by redirecting the analysis towards genuinely convertible assets. In parallel, Petrova and Petrov (2025) develop the Taste–Value–Risk (TVR) model, which shows how cognitive associations (“sweet”/“bitter”) structure perceptions of value and risk. The combination of CLR and TVR creates a dual filter – an accounting and a cognitive one – for a more reliable assessment of risk under information asymmetry.

The present study aims to test this integrated framework empirically. On the quantitative side, the primary automotive market in Bulgaria is analysed (12 enterprises; 72 financial statements for the period 2018–2023) to trace the behaviour of CLR relative to CR and QR. On the qualitative side, a psycholinguistic experiment (N = 312) is conducted to validate the TVR model's associative links.

The following research hypotheses are formulated:

H1: The Crisis Liquidity Ratio (CLR) is a more stable indicator of liquidity during crisis conditions than traditional measures (CR and QR).

H2: The perceptual axes “taste–value–risk”, conceptualised through the TVR model, exhibit a statistically significant relationship with the willingness to undertake financial commitments and with risk assessment.

By testing these hypotheses, the study seeks to provide an integrated validation of both the financial-accounting and the cognitive-behavioural components, and to propose a more reliable methodology for assessing risk and liquidity under conditions of information asymmetry.

2. Theoretical Background

2.1. Conceptual Framework for Liquidity and the Crisis Liquidity Ratio (CLR)

Liquidity assessment is a fundamental dimension of financial analysis for non-financial enterprises. It is traditionally carried out using ratios such as the Current Ratio (CR) and the Quick Ratio (QR), which measure the ability of current assets to cover current liabilities. Although widely used, these indicators have inherent limitations. CR includes fewer liquid components, while QR, despite excluding inventories, retains receivables in the numerator. Under normal conditions, this is considered acceptable, but in times of crisis, receivables often become less collectable. As a result, QR may systematically overstate adequate liquidity and send misleading signals about solvency (Petrov, 2012).

In response to this analytical deficit, Petrov (2012) formulated the Crisis Liquidity Ratio (CLR), defined as follows:

$$CLR = \frac{CA - R}{CL} \quad (1)$$

Where:

CA – *Current Assets*,

R – *Receivables*,

CL – *Current Liabilities*.

The key innovation of CLR is the exclusion of receivables from the numerator, which redirects attention

to assets with a higher degree of convertibility under crisis conditions – inventories and cash. In this way, CLR functions as a corrective to the QR, reducing the discrepancies between reported and actual liquidity.

Since its introduction, CLR has received both academic and practical recognition. It has been incorporated into doctoral dissertations (Petrov, 2019), sectoral studies (Ivanova, 2021), university textbooks (Kostova, 2019; 2023), and has been presented at national conferences on financial diagnostics (Kasarova & Yordanov, 2013). Moreover, it has found application in official corporate disclosures – for example, in the annual reports of DeltaStock AD (2016; 2021), where CLR appears as part of the prudential framework aligned with EU legislation. This trajectory has consolidated CLR as an early-warning indicator of liquidity stress (Kostova, 2023).

Consequently, CLR may be viewed as an instrument of informational transparency that brings accounting indicators closer to economic reality. By eliminating receivables, it overcomes one of the key distortions embedded in classical ratios and provides a more reliable basis for analysis, particularly in economic crises and heightened uncertainty.

2.2. The TVR Concept – Taste, Value, Risk

Petrova and Petrov (2025) developed the Taste–Value–Risk (TVR) model, an interdisciplinary effort to combine cognitive linguistics and economic theory to understand better how people perceive risk and value when they are unsure what will happen. The primary hypothesis posits that economic decisions are not exclusively predicated on rational calculations but are instead mediated by associative cognitive frameworks of a corporeal, sensory character.

At the heart of the model lies the metaphorical “sweet–bitter” axis, which, in cognitive linguistics, is consistently associated with positive and negative experiences. “Sweet” symbolises security, attractiveness and low risk, whereas “bitter” signals uncertainty, loss or a high price. In this way, taste perceptions serve as a cognitive tool for associating economic concepts (e.g., loan, credit card, high interest rate, financial stability) with corresponding emotional and evaluative nuances.

The theoretical basis of TVR connects Akerlof’s idea of information imbalance with work in cognitive and cultural linguistics. Important reference points include the metaphorical structures of Lakoff and Johnson (1980), the ethnolinguistic frameworks of Bartmiński (2009) and Maslova (2001), the semiotics of food-related discourse (Zemskova, 2008), and studies on sensory integration (Engelen, 2003). The application of the taste–emotion–evaluation link relies on Kostyaev’s (2007) classification, which helps map the shift from “sweet/bitter” to emotional response, perceived value, and perceived risk. The model offers a systematic measurement framework comprising:

1. a Perceived Value Index (Value Index);
2. a Perceived Risk Index (Risk Index);
3. an emotional axis (positive/negative experience).

The relevance of TVR goes beyond cognitive linguistics, as it provides an analytical tool for understanding financial communication and managing reputational risk. The “sweet/bitter” perception is not only a cultural code but also a predictive factor for how clients and investors react to different financial products.

The initial conceptual studies (Petrova & Petrov, 2025) outlined the potential of TVR as an analytical instrument. The present study takes the next step by empirically validating the model on a sample of 312 respondents (students and faculty members in philology) to test whether the associative “taste–value–risk” framework is statistically related to the willingness to make financial commitments.

In summary, CLR and TVR are distinct yet mutually complementary tools for reducing information asymmetry. While CLR addresses the limitations of classical ratios by focusing on the effective convertibility

of assets, TVR introduces a qualitative–cognitive perspective on risk and value perception. Together, they form an integrated framework for more precise risk diagnostics under conditions of uncertainty.

3. Methodology

3.1. Study on the Crisis Liquidity Ratio (CLR)

The object of the analysis is the primary automotive market sector in Bulgaria, represented by the companies that are members of the Association of Automobile Manufacturers and Their Authorised Representatives (AAP), as well as by Industrial Commerce Co. EAD – the authorised representative of Hyundai. The sample includes 12 companies with 2023 revenues over BGN 100 million, ensuring that the leading players in the sector are adequately represented.

The study period covers 2018–2023, allowing the behaviour of liquidity indicators to be traced under successive crises: the global pandemic (2020–2021), the inflationary shock and disrupted supply chains (2022), and the phase of partial recovery (2023). In total, 72 annual financial statements are included in the analysis.

The leading indicator is the Crisis Liquidity Ratio (CLR), defined in section 2.1, calculated for each year and for each company. Based on the individual values, sectoral aggregates (mean and median) are derived. For comparison, the Current Ratio (CR) and the Quick Ratio (QR) are also included. This makes it possible to:

1. trace the dynamics of CLR over time and identify crisis phases;
2. compare CLR, CR and QR in order to assess the stability of the indicators;
3. Derive sectoral conclusions about the liquidity of the automotive market.

The methodological approach is descriptive–analytical, applying time-series analysis, year-on-year (y-o-y) percentage changes, and comparative analysis between the median and the mean. In addition, net working capital (WC) and the Sales/WC ratio are used as auxiliary indicators of working capital management efficiency.

The sample includes the following companies: “Silver Star Motors” EAD (Mercedes-Benz, Setra, Fuso), “Keos Sofia” EAD (Renault, Dacia), “Porsche BG” EOOD (Volkswagen, Audi), “Toyota Balkans” EOOD (Toyota, Lexus), “Euratek” OOD (Škoda), “Moto-Pfohe BG” EOOD (Ford, Volvo, Jaguar, Land Rover), “Turbotraks Bulgaria” OOD (DAF), “BMW Bulgaria” EOOD (BMW, MINI), “Industrial Commerce Co” EAD (Hyundai), “KIA Bulgaria” OOD (KIA), “MVB Truck and Bus Bulgaria” AD (MAN), and “Scania Bulgaria” EOOD (Scania).

As previous empirical studies show (Petrov, 2019), the top ten companies on the Bulgarian new car market for the period 2007–2017 accounted for more than 70% of total sales (an average of 71.1%). This ensures that the liquidity indicators in this group reflect actual market trends rather than the volatility of smaller distributors.

3.2. Empirical Validation of the TVR Model

In parallel with the quantitative liquidity analysis, an associative study was conducted in order to test the applicability of the Taste–Value–Risk (TVR) model in the context of financial decision-making. A total of 312 respondents participated, divided into two subgroups: 157 native Bulgarian speakers (students and researchers in philological fields) and 155 native English speakers. The questionnaire was bilingual, with each respondent completing the version in their mother tongue.

The sampling strategy was methodologically motivated: it included highly educated individuals from disciplines distant from economics and finance to avoid the influence of professional expertise. In this way, perceptions are shaped primarily through linguistic, cultural and emotional codes, and abstract financial categories are interpreted via everyday associations in which taste and emotion function as cognitive filters for

evaluating value and risk.

The survey instrument contained four stimulus concepts reflecting key financial notions: short-term loan, credit card, financial security and high interest rate. For each concept, respondents were guided through the three dimensions of the TVR model:

1. Associative level – indicating three words related to taste or food and locating the concept on the taste axis (sweet/bitter);
2. Emotional level – identifying the dominant emotion (positive/negative);
3. Evaluative level – assessing perceived usefulness and risk on a seven-point Likert scale¹ (1 – minimal, 7 – maximal).

The bilingual configuration has important methodological implications: it enables a comparison of results across different cultural contexts and provides a basis for testing the universality of the TVR model. The survey was conducted online from 15 August to 20 September 2025 (the questionnaire is available upon request). The collected data were aggregated into composite indicators – the Value Index and Risk Index - and supplemented by the emotional axis, through which the model acquires quantitative measurability while preserving the qualitative depth of the associative material.

The combination of the two research approaches – the financial–accounting one, represented by CLR and its comparison with CR and QR, and the cognitive–behavioural one, operationalised through TVR and the associative experiment – constructs a multi-layered analytical framework. While the former reveals the objective changes in the liquidity of automotive-sector firms, the latter captures the subjective cognitive filters through which economic agents perceive risk and value. This dual perspective sets the stage for the empirical analysis presented in the next section.

4. Results

4.1. Empirical Assessment of CLR: Aggregate Results and Dynamics

The analysis of aggregate data for the 12 leading companies in the primary automotive market in Bulgaria over the period 2018–2023 allows for clear delineation of crisis phases and tracing the responses of liquidity indicators under heightened uncertainty. Their high exposure to global shocks drives the choice of period and sector – the pandemic, inflationary pressures and supply-chain disruptions – which provides a robust empirical basis for testing the hypothesis regarding the stability of CLR.

For analytical clarity, the main text presents an abridged table of key liquidity indicators and the structure of current assets (Table 1). In this way, attention is focused on the measures that are most directly related to the research hypotheses and that most accurately illustrate the manifestations of crisis liquidity.

The data show that early signs of decline are already visible in 2019. In 2020, the pandemic and supply-chain disruptions led to pronounced shocks: total assets decreased by 14.8%, while current assets decreased by 16.7%; inventories and receivables fell by 23.7% and 22.4%, respectively. This outlines a first crisis phase (2019–2020), in which receivables remain dominant over inventories and the QR reports relatively high levels (0.87–0.92). This paradox illustrates the weakness of QR: its increase in a crisis context is not driven by real liquid resources, but by the nominal reporting of receivables.

¹ The Likert scale, proposed by R. Likert in 1932, is a well-established instrument for measuring attitudes through ordered response categories. In the present study, a seven-point version (1–7) is employed, chosen to ensure greater measurement sensitivity and more favourable conditions for statistical analysis.

Table 1.

Dynamics of Liquidity Indicators and the Structure of Current Assets in the Primary Automotive Market Sector in Bulgaria (2018–2023)

Year	CR	QR	CLR	Inventories (% of current assets)	Receivables (% of current assets)
2018	1.49	0.68	0.92	54.6	38.2
2019	1.65	0.87	0.93	47.2	43.5
2020	1.61	0.92	0.96	43.3	40.6
2021	1.76	1.15	1.02	35.0	42.0
2022	1.70	1.09	1.03	35.6	39.6
2023	1.63	0.68	1.09	58.3	33.1

Source: Authors' calculations based on financial statements of the sample companies, 2018–2023.

The second phase (2021) may be defined as an adaptation phase: there is a moderate recovery of assets (+2.7%) and revenues (+8.6%), but the structure of current assets remains unbalanced – the share of inventories falls to 35%, while that of receivables reaches 42%. It is precisely here that QR peaks (1.15), yet the signal is illusory, as uncollectible receivables sustain it. At the same time, CLR stabilises around 1.02, which demonstrates its analytical robustness.

The third phase (2022–2023) is expansionary, with a sharp increase in assets (+23.3% and +39.1%) and revenues (+16.9% and +31.6%). Here, an opposite phenomenon is observed – inventories double and reach 58% of current assets, while the share of receivables declines to 33%. As a result, QR plunges to 0.68 in 2023, whereas CLR increases smoothly to 1.09. This confirms that CLR more accurately captures the actual liquidity position – regardless of whether the pressure stems from dominant receivables (Phase I) or from excess inventories (Phase III).

Table 2.

Correlation between Profit and Liquidity Indicators (2018–2023)

Indicator	PCC (r)	Interpretation
CLR	0.872	Strong positive relationship
QR	– 0.254	Weak negative relationship

Source: Authors' calculations based on financial data of the sample companies, 2018–2023.

The correlation analysis shows that CLR exhibits a strong, statistically significant positive relationship with profit ($r = 0.872$), indicating that firms with higher CLR values achieve better financial results. In contrast, QR exhibits a weak negative dependence ($r = -0.254$), indicating that, in crisis contexts, its values may be misleading due to the inclusion of uncollectible receivables.

On this basis, the first research hypothesis (H1) is confirmed: CLR functions not only as a more reliable liquidity indicator under crisis conditions, but also demonstrates economic relevance through its direct association with profit. This distinguishes it from the traditional CR and QR, whose signals are more susceptible to distortions arising from different crisis scenarios.

In summary, the dynamics and correlations show that CLR is a more reliable and conceptually grounded indicator of liquidity in a crisis environment. Its stability and positive relationship with profit confirm that reducing informational distortions caused by uncollectible receivables directly impacts financial resilience. This result not only validates hypothesis H1 but also highlights the potential of CLR as a tool for strategic risk management. In the next section, attention shifts to the cognitive–behavioural perspective through the TVR model, which complements the accounting analysis by examining the associative mechanisms underlying the perception of value and risk.

4.2. Empirical Assessment of the Taste–Value–Risk (TVR) Model

The empirical data collected through the survey cover 312 respondents – 157 native speakers of Bulgarian and 155 native speakers of English – who were presented with four stimulus concepts representing key financial notions: short-term loan, credit card, financial security and high interest rate. The responses were systematised along three analytical planes – associative, emotional, and evaluative – and subsequently aggregated into the composite indicators: the Value Index, the Risk Index, and the emotional axis, in line with the methodological principles of the TVR model.

The results allow both delineating the dominant patterns of perception for each concept under study and testing the validity of the “sweet–bitter” opposition as a cognitive mechanism for structuring economic meanings. The bilingual configuration provides a basis for cross-comparative analysis, which shows the extent to which the associative–emotional profiles may be regarded as universal or culturally conditioned.

The analysis outlines clear trends along both the taste and the emotional axis. “Financial security” is consistently associated with “sweet” associations and positive emotions, which aligns with its semantic load as a symbol of stability, predictability, and trust. In contrast, “high interest rate” is almost unanimously positioned within the “bitter” spectrum and elicits predominantly negative emotions associated with loss, uncertainty and risk.

The picture is more ambivalent in the case of “short-term loan” and “credit card”. Respondents perceive both as applicable (flexibility, accessibility) and as requiring pronounced caution, linked to concerns about future indebtedness or financial dependence. This duality is reflected in a more balanced proportion of “sweet” and “bitter” associations, indicating a more differentiated cognitive evaluation.

$$\text{Risk Index} = \frac{\text{Bitter Count}}{N} \quad (2)$$

$$\text{Value Index} = \frac{\text{Sweet Count}}{N} \quad (3)$$

Where N is the total number of valid responses, Sweet Count is the number of associations classified as “sweet”, and Bitter Count is the number of associations classified as “bitter”.

4.2.1. Results for the concept “short-term loan”.

The analysis shows a predominantly “bitter” profile: 74% of respondents associate it with a negative taste, and 81% with negative emotions. The subjective evaluation is critical: usefulness $M = 3.6/7$ (low); risk $M = 5.4/7$ (high). This configuration positions the short-term loan in a zone of heightened caution, where the Risk Index substantially exceeds the Value Index and the emotional background reinforces the sense of vulnerability.

4.2.2. Results for the concept “credit card”.

The “credit card” occupies an intermediate position. Its associative profile shows a predominance of “bitter” links (63% versus 37%), but the emotional reactions are relatively balanced: 52% negative, 44% positive and 4% neutral. Subjective assessments place it close to the centre of the scale – usefulness $M = 4.7/7$ (moderately high) and risk $M = 4.5/7$ (medium). This ambivalence outlines a “zone of hesitation”, where value and risk are relatively balanced and perception depends to a considerable extent on the individual context.

4.2.3. Results for the concept “financial security”.

“Financial security” is the most positively perceived concept in the study. Almost all respondents (96%) associate it with “sweet”, and 100% with positive emotions. Subjective evaluations confirm this unanimity:

usefulness $M = 6.6/7$ (exceptionally high) and risk $M = 2.4/7$ (low). This configuration positions financial security in the zone of trust and high value, where the Value Index reaches its maximum levels and the Risk Index is minimal – the “ideal case” of cognitive harmony between value and emotion.

4.2.4. Results for the concept “high interest rate”.

The most negative profile is observed for the concept “high interest rate”. It is classified as “bitter” by 85% of respondents, and its emotional background is overwhelmingly negative (96%), with only 4% reporting mixed reactions. Subjective evaluations are extreme: usefulness $M = 2.1/7$ (very low) and risk $M = 6.0/7$ (exceptionally high). This configuration positions the high-interest rate in the zone of distrust and high risk, where the Risk Index is at its maximum and the Value Index is at its minimum.

Summary. To systematise the results of the associative, emotional and evaluative analysis, Table 3 presents the composite values of the Value Index and the Risk Index for the four concepts under examination. This enables a comparison of cognitive profiles within a single metric and the identification of distinct “zones” of perception – trust, hesitation or risk.

Table 3.

Indices of perceived value and risk (Value Index and Risk Index) for four financial concepts

Concept	Value Index	Risk Index
Short-term loan	0.26	0.74
Credit card	0.37	0.63
Financial security	0.96	0.04
High interest rate	0.15	0.85

Source: Authors’ calculations based on TVR survey data (N = 312).

As the data indicate, “financial security” stands out with an exceptionally high Value Index (0.96) and a low Risk Index (0.04), confirming its role as a universal symbol of trust and stability. Conversely, “high interest rate” is perceived unequivocally as risky (Risk Index = 0.85) while offering minimal perceived value (Value Index = 0.15). “Short-term loan” and “credit card” occupy intermediate positions, characterised by predominantly “bitter” associations and a pronounced ambivalence between value and risk.

This configuration provides empirical confirmation of the second research hypothesis (H2), which posits that the perceptual axes “taste–value–risk” exhibit a statistically significant relationship with both the willingness to assume financial commitments and risk assessment. The results suggest that the TVR model can serve as a robust cognitive filter for analysing financial attitudes across different cultural contexts.

4.3. Recommendations and Behavioural Interpretation

To illustrate the analytical potential of the TVR model, the quantitative results are synthesised in Table 4, which integrates the associative profile, the emotional dominant, and the calculated indices. This interpretative matrix simultaneously summarises the empirical findings and offers strategic guidance for their practical application.

Table 4.

Perceptual zones according to the TVR model

Concept	Profile and emotion	Value Index / Risk Index	Interpretation within the TVR model
Short-term loan	Bitter, negative	0.26 / 0.74	Zone of heightened caution
Credit card	Mixed, ambivalent	0.37 / 0.63	Zone of hesitation

Financial security	Sweet, positive	0.96 / 0.04	Zone of trust
High interest rate	Bitter, negative	0.15 / 0.85	Zone of distrust

Source: Authors' elaboration based on TVR survey results.

Based on this matrix, several behavioural interpretations can be formulated:

(a) Financial security – zone of trust and high value.

Consolidating established trust requires an emphasis on stability, reliability, and predictability, with communication that relies on positive examples, guarantees, and the highlighting of long-term resilience, proving particularly effective.

(b) High interest rate – zone of distrust and high risk.

It is necessary to address negative associations through transparent terms and clearly formulated guarantees; compensatory mechanisms (e.g., bonuses or preferential conditions) can also be used to reduce perceived uncertainty.

(c) Short-term loan – zone of heightened caution.

Appropriate strategies emphasise their practical usefulness in specific situations (for example, emergencies), while at the same time alleviating the sense of burden through accessibility, clarity, and personalised examples.

(d) Credit card – zone of hesitation.

Here, it is imperative to adapt communication to individual attitudes and user profiles, balancing convenience with transparency about potential risks to strengthen rational evaluation.

The systematisation of the data in the interpretative matrix shows that the TVR model functions as a robust cognitive–emotional filter. The universality of the “sweet–bitter” opposition, confirmed in two linguistic contexts, establishes the model as an analytical resource with significant potential for future research on economic behaviour and for the development of communication strategies that integrate objective indicators with subjective perceptions.

5. Interpretations and Analytical Conclusions

The combination of the accounting indicator CLR and the cognitive TVR model provides a more in-depth understanding of both the liquidity crisis dynamics and how economic agents interpret risk. The empirical analysis of aggregate data from the automotive sector showed that CLR is more stable and maintains a closer relationship with profitability than QR, as it reduces distortions arising from uncollectible receivables or excess inventory. These results establish CLR as a reliable tool for the early diagnosis of financial disruptions.

In parallel, TVR adds a qualitative dimension: while CLR reveals the accounting reality, TVR shows how these data are perceived and filtered through associative categories of taste and emotion. If CLR reduces “noise” in reported information, TVR mitigates the cognitive and communicative distortions that affect the behaviour of creditors, investors and consumers. In this way, a dual filter is created for a more precise, multidimensional risk assessment.

Several potential applications emerge from the analysis:

1. Credit analysis. CLR already functions as an indicator of the real liquidity position under conditions of instability. Combining it with TVR enables the capture of clients' and counterparties' perceptions of risk.
2. Business communication. TVR enables companies to understand how linguistic and metaphorical frames shape customers' and partners' trust, and to adapt their strategies to align with existing cognitive filters.
3. Reputational risk management. The integration of CLR and TVR provides, simultaneously, financial stability and an understanding of the symbolic–cultural mechanisms that can strengthen or weaken a

company's resilience in crises.

In this sense, the combination of CLR and TVR offers a new methodological perspective – both accounting-conservative and cognitively interpretative – that can enrich academic literature and practice in corporate governance and strategic planning.

6. Conclusion

The analysis of the empirical data for the period 2018–2023 confirms the trends identified in the initial validation of CLR for the entire automotive sector in Bulgaria (2007–2017). This demonstrates its long-term analytical robustness and its ability to serve as a reliable indicator across different macroeconomic contexts – from the global financial crisis through pandemic shocks to post-crisis expansion phases. The present study not only confirms hypothesis H1 – that CLR is a more stable indicator of liquidity under crisis conditions than CR and QR – but also provides an empirical basis for H2 by showing that perceptions of value and risk are structured along associative cognitive axes. In this way, an integrated framework is proposed for assessing risk and liquidity under information asymmetry, combining an accounting-conservative and a cognitive-interpretative approach.

The study's contribution is twofold. On the one hand, it provides a sectoral verification of CLR, demonstrating its analytical robustness as a crisis indicator. On the other hand, it provides the first empirical verification of TVR, complementing accounting measures with a cultural–cognitive dimension. The combination of the two approaches forms a new methodological perspective that integrates the financial-conservative and the cognitive-interpretative levels of analysis.

The limitations of the study stem from its sectoral specificity: the analysis focuses on the automotive market and may not fully reflect the dynamics in other industries. In addition, the sample of 312 respondents included in the psycholinguistic experiment has a predominantly academic profile (students and faculty), which constrains the extent to which the findings can be generalised to broader social and professional groups.

Directions for future research include:

1. testing CLR across different industries in order to examine its universality as a crisis indicator;
2. expanding the TVR experiment through larger and more diverse samples, including representatives of business and financial institutions;
3. Integrating CLR and TVR into a unified analytical model for forecasting corporate distress and reputational risk.

In conclusion, the proposed CLR–TVR framework has the potential to enrich both academic literature and the practical toolkit of financial and credit analysis by providing a more comprehensive and reliable methodology for assessing risk and liquidity under conditions of information asymmetry.

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Engagement to Express Assurance by Registered Auditors on the Sustainability Report of Pension Funds

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Abstract

The expression of assurance by certified expert accountants, registered auditors on the Sustainability Report of pension funds increases the trustworthiness and reliability of sustainability reporting and disclosure by performing an independent financial audit of both financial and non-financial information related to the three components of sustainability. Transparent communication improves stakeholders' understanding and trust in the presented sustainability information. Registered auditors must draft a conclusion on whether the information disclosed in the Sustainability Report of pension funds contains any material misstatements and whether the information disclosed in their statements is sufficient and relevant. Auditing the sustainability reports poses different challenges for registered auditors compared to those in the course of the audit of pension funds' financial statements, as auditors primarily review "verbal" information rather than financial information – concrete data and values. Auditors must question and critically assess the reliability and accuracy of sustainability information.

Key words:

sustainability, certified expert accountants, registered auditors, pension funds, expression of assurance

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Introduction

Sustainable development, presented through its three aspects – environmental responsibility, social justice, and economic viability – is becoming increasingly important for achieving economic growth in the activities of every enterprise in the modern economy. The simultaneous and interconnected application of all three sustainability factors is crucial for the global economy. Only in this way can effective interaction between the environment, society, and the economy be achieved to improve living conditions on the planet and enhance the well-being of future generations. Environmentally sound, socially justified, and economically viable corporate activities that seek a balance between the three aspects of sustainable development contribute to achieving significant benefits for individual enterprises and substantial progress in the development of their specific operations. The activity of pension funds is of particular importance to society, as they provide their insured persons with an additional pension under the supplementary mandatory or voluntary pension insurance upon the occurrence of insured events specified by law, in the pension fund's regulations, or in the insurance contract. As financial enterprises, pension funds are also required to disclose in their financial statements and in their dedicated non-financial sustainability report essential, relevant, and reliable information regarding the activities they undertake to implement the three components of sustainability. The disclosure of their environmental, social, and governance (corporate) sustainability development policies is intended to meet the needs and expectations of stakeholders in the society, enabling them to make informed, well-founded, and effective managerial decisions regarding the insurance activities carried out by pension funds. Reporting of non-financial information in the Sustainability Report is not sufficient for society. Pension funds must also disclose financial information in their financial statements related to the expenses they have incurred and the investments they have made in assets associated with the implementation of their environmental-social-corporate governance model of sustainability. The disclosure

of the accounting information they generate for reporting the three aspects of sustainability is linked to improving transparency; enabling timely identification and management of various types of financial and non-financial sustainability-related risks; and increasing stakeholder trust in the activities of pension funds. For this reason, society and stakeholders need to obtain a certain level of assurance – specifically expressed degree of confidence, that pension funds report on all three aspects of their sustainability in accordance with the reporting standards, as well as with the reporting requirements set out in the 2020 Taxonomy Regulation (Regulation (EU), 2020), which provides a classification system of environmentally sustainable economic activities that have material impact on their operations, financial position, financial performance, cash flows, and elements of their equity.

The subject of the study is the engagement undertaken by statutory auditors to provide assurance on the Sustainability Report of pension funds.

The object of the study is the creation of financial information on the three components of sustainability by pension funds through the application of specific accounting models for their reporting.

The purpose of the study is to examine the possibilities for statutory auditors to provide specific degree of assurance regarding the disclosed non-financial information on the three sustainability components in the Sustainability Report, as well as the financial information presented in the financial statements of pension funds.

The main tasks of the present study are:

1. To present the specific disclosures of the three components of sustainability in the Sustainability Report of pension funds;
2. To propose specific accounting models for reporting the three components of sustainability by pension funds;
3. To propose specific audit procedures that statutory auditors should perform in order to provide assurance and confirm the non-financial information in the Sustainability Report of pension funds;
4. To present the engagement to express assurance by registered auditors on the Sustainability Report of pension funds

1. Specific disclosures of the three components of sustainability in the Sustainability Report of pension funds

The Sustainability Report is essential for pension funds, which must align their activities with the environmental, social, and governance standards established globally. The main criteria for sustainability reporting are set out in several regulatory acts:

The EU Sustainable Finance Disclosure Regulation (SFDR) 2019/2088, adopted in 2019, concerns the disclosure of information related to sustainability in the financial services sector and its aim is to ensure transparency for investors regarding the environmental, social, and governance policies of pension funds and other financial enterprises.

The EU Taxonomy Regulation 2020/852, adopted in 2020, establishes criteria for determining the sustainability of economic activities. This Regulation requires the application of measures and policies aimed at sustainable financing for financial market participants, including pension funds. It obliges enterprises, including pension funds, to classify their sustainability-related activities and to achieve at least one of the six environmental objectives (SC criteria): climate change mitigation; climate change adaptation; sustainable use and protection of water and marine resources; transition to a circular economy; pollution prevention and control; protection and restoration of biodiversity and ecosystems.

The EU Corporate Sustainability Reporting Directive (CSRD) 2022/2464, adopted in 2022 and transposed into the Accounting Act and the Independent Financial Audit and Assurance of Sustainability

Reporting Act of the Republic of Bulgaria, requires pension funds to report on material risks related to their sustainability, on the adverse impacts of these risks on their sustainability, and on the options for mitigating such adverse impacts. It introduces a mandatory assessment of compliance with the principle of “Double Materiality”, which obliges enterprises, including pension funds, to report both the impact of their activities on society and the environment, and the influence of sustainability-related issues and risks on their business. Reporting under the double materiality principle ensures that sustainability efforts focus on the most significant and material aspects of the pension funds’ activities for the benefit of their stakeholders.

The European Sustainability Reporting Standards (ESRS), adopted in 2023, build upon the CSRD requirements and require enterprises, including pension funds, to report non-financial information on their environmental, social, and governance sustainability-related activities, including matters such as climate change, pollution, water and marine resources, biodiversity and ecosystems, resource use, and circular economy.

Sustainability disclosure standards under the International Financial Reporting Standards /IFRS/ – IFRS S1 and IFRS S2, adopted in 2023, require enterprises, including pension funds, to disclose the sustainability of financial markets. IFRS S1 defines the general requirements for disclosure of sustainability-related financial information, while IFRS S2 sets out the requirements for disclosing climate-related information.

Standards for limited assurance on sustainability matters are currently under development and are expected to be adopted by the European Commission by October 2026. These standards relate to the provision of assurance on sustainability by independent service providers (e.g., statutory sustainability auditors, independent evaluators, environmental specialists, etc.) concerning the non-financial information disclosed in the Sustainability Report.

The Sustainability Report is a document that provides non-financial information about the social, environmental, and economic impacts of enterprises, including pension funds, as well as the ways in which these ESG factors affect their sustainable development, financial performance, and financial position. The Sustainability Report includes non-financial information that is material for understanding the sustainable development of enterprises, including of pension funds, and their impacts on the environment, society, and the economy. It describes both the current measures undertaken and the results (progress) achieved in the sustainability-related activities of pension funds, as well as the long-term strategies and goals they have developed to achieve sustainable development in accordance with the European Sustainability Reporting Standards and the Paris Agreement. The report must be prepared in compliance with the requirements of the Accounting Act, the Independent Financial Audit and Assurance of Sustainability Reporting Act, the applicable Regulations and Directives, and the Thematic Sustainability Reporting Standards and the Double Materiality Assessment Standards: ESRS E1: Climate Change; ESRS E2: Pollution; ESRS E3: Water and Marine Resources; ESRS E4: Biodiversity and Ecosystems; ESRS E5: Resource Use and Circular Economy; ESRS S1: Own Workforce; ESRS S2: Workers in the Value Chain; ESRS S3: Affected Communities; ESRS S4: Consumers and End-Users; ESRS G1: Business Conduct.

The environmental, social, and governance factors and the risks associated with them must be adequately structured and disclosed in the Sustainability Report of pension funds. Their strategic goals should be grouped into five main pillars: Client Orientation; Innovation and Digitalization; Growth and Profitability; Stability and Sustainability; Environmental, Social, and Governance Factors. The commitment of pension funds to environmental protection and climate change mitigation, as well as their social and corporate responsibility, must be reflected in their Sustainability Report. They must ensure timely, comprehensive, lawful, and accurate sustainability reporting.

The Sustainability Report of pension funds includes the disclosure of the following non-financial information (Accounting Act, 2025, article 48):

- 1) Description of the business model and strategy for carrying out sustainability-related activities. This

includes description of the adaptations of the business model in response to sustainable development-related risks; disclosure of the opportunities available to pension funds for taking measures to mitigate the adverse impacts of financial risks on sustainability, and an outline of the development of plans for achieving sustainable objectives related to their financial and investment commitments.

2) Time-bound commitments and targets – one of the key components of the Sustainability Report is the clearly defined timelines set for achieving ESG objectives, for example, environmental targets to 2030 and 2050. The report must also include a description of the progress made and evidence demonstrating the scientific basis of the targets related to environmental factors. Such disclosure ensures that the Report objectively reflects the reality of climate-related challenges and aligns with the scientific standards for sustainable development.

3) The role of the managing and supervisory bodies, their knowledge and competencies in managing sustainability, and any incentive schemes for the executive team linked to sustainability objectives. This information provides clarity in the Sustainability Report regarding the extent to which the management of the pension insurance company administering the pension funds is committed to their sustainable development and the mechanism used to encourage performance in this direction.

4) Sustainability-related due diligence processes performed by pension funds to identify, monitor, control, prevent, mitigate, or remedy actual or potential adverse impacts of sustainability-related risks on their activities, on the value chain, the supply chain, their business relationships, and the pension insurance services they provide. The report must also include a description of the actions taken by pension funds to prevent or mitigate such impacts, as well as an assessment of the effectiveness of these measures.

5) The main sustainability-related risks – the dependencies and methods used to manage these risks are described. The Sustainability Report also includes indicators that reflect information on the impacts of pension funds on sustainability, in accordance with the European Sustainability Reporting Standards.

6) The key indicators required for disclosing financial and non-financial sustainability-related information.

7) The sustainability-related policies of pension funds and their short-term, medium-term, and long-term time horizons for achievement and implementation.

The economic effects of the application of the European regulations requiring mandatory disclosure of non-financial information for sustainability reporting by pension funds are associated with generating added value, achieving economic growth, and expanding their pension insurance activities. The implementation of possible scenarios, initiatives, mechanisms, models, and tools for reporting the ESG factors supports the sustainable development of pension funds and their achievement of the strategic objectives of the European economy. The benefits and advantages arising from the implementation of environmental, social, and governance policies are reflected in the improved development prospects of pension funds with respect to: positioning, market share, and competitiveness; corporate image, reputation, and value of pension funds; enhanced opportunities for generating added value; increased interest from insured individuals; transparency, public visibility societal trust and certification with a sustainability label.

Timely forecasting, monitoring, and identification of these effects may contribute to accelerating some positive trends in the activities of pension funds, such as: implementing more transparent business models and building an effective governance structure; opportunities for generating added value in the short-, medium-, and long-term; sustainable financing of ESG activities, projects, and initiatives; improved risk management; realization of sustainable investments, etc. However, these effects must be substantiated through the expression of assurance on sustainability by independent certified accountants, statutory auditors who are certified to provide opinion on sustainability matters. By expressing assurance on sustainability, they provide stakeholders with confidence regarding the benefits obtained by pension funds from the

implementation of their environmental, social, and corporate policies. In this way, insured individuals are able to make informed decisions and make favorable consumer choice – to insure themselves in pension funds that are socially engaged, environmentally responsible, and corporately accountable and funds that have achieved their sustainable development goals.

2. Specific accounting models for reporting of the three components of sustainability by pension funds

The expenses incurred and investments made for the implementation of the three components of sustainability must be accounted for in accordance with accounting legislation and included in the Statement of Profit or Loss and Other Comprehensive Income and, respectively, in the Statement of Financial Position, and must be duly disclosed in the Sustainability Report for the current reporting period of the pension funds..

To prepare a Sustainability Report that discloses non-financial information on the implementation of environmental, social, and governance policies, the financial information related to the expenses incurred and investments made for the implementation of these policies related to the environment protection and enforcement of pension funds' social and corporate responsibility must first be recorded using appropriate accounting models. This requires adequate informational and digital support of reporting processes and definition of specific accounting models ensuring faithful and accurate accounting. According to D. Feschiyan, "True and fair presentation is ensured by reliable disclosure of the effects of transactions, other events, and conditions in accordance with definitions and criteria for recognition of assets, liabilities, income, and expenses set out in applicable accounting standards." (Feschiyan, D., 2023).

„The accounting models for reporting of sustainability-related information of pension funds are specific. The accounting models proposed by the author are universal and can also be used by other enterprises in relation to the reporting expenses for the implementation of the three components of sustainability, namely:

✓ *Proposal for an Accounting model for reporting of the governance component*

Dr account Anti-corruption, counter terrorism financing, anti-bribery and anti-money laundering expenses

Cr account Cash

and

Dr account Cybersecurity expenses

Cr account Cash

✓ *Proposal for an Accounting model for reporting of the environmental component*

Dr account Energy, water, waste and emission expenses

Cr account Cash

✓ *Proposal for an Accounting model for reporting of the social component*

Dr account Social expenses

Cr account Cash” (Natchkova, M., 2025,a)

„By including expenses for the three components of sustainability in the total amount of operating expenses of pension funds, they practically apply the principle of “Double Materiality” because it establishes the materiality framework. On one hand, the accounting models for these expenses demonstrate how the development strategy and the pension insurance operations of pension funds align with the environmental, social, and governance components of sustainability. On the other hand, the accounting models show the impact of these expenses on the achieved yield and the final efficiency of the pension insurance operations

conducted by the pension funds to achieve sustainable development.“ (Natchkova, M., 2025,b)

3. Specific audit procedures for providing assurance and verifying the non-financial information in the Sustainability Report of pension funds

The specific audit procedures that must be performed by certified public accountants, statutory auditors certified to provide assurance on sustainability, are as follows:

- understanding the specific pension insurance activities of pension funds and conducting a risk assessment;

- an audit strategy and audit plan for performing the engagement; a letter for undertaking engagement to provide assurance on sustainability; significant risks and key audit matters; the scope and timing of the audit; allocation of tasks among the members of the audit team; a written memorandum on the distribution of audit procedures; the audit methodology used; the quantitative materiality threshold applied during the statutory audit performed for the purposes of the financial statements; the existence or absence of significant deficiencies in the system of internal financial control and in the accounting system of the pension fund; conclusions regarding the accounting valuation methods used, the reporting models, and the going concern principle; findings identified during the audit and additional recommendations; the draft key audit question; the independence of the certified public accountants, statutory auditors certified to provide assurance on sustainability and of the members of the audit team;

- tests of controls – general IT controls and controls over the expenses incurred and investments made for the implementation of the three components of sustainability;

- tests of controls for identifying, assessing, and measuring all sustainability-related risks arising from internal and external sources of risk. All risks that have a direct material impact on sustainability and that pension funds face, and which may adversely affect the achievement of sustainability objectives, are subject to continuous assessment. Risks arise from the operational environment, personnel, information and communication systems and technologies, the growth rate, technological developments, and the services offered by pension funds, from mergers and acquisitions in the sector, from changes in the legal regulations; or they may change as a result of shifts in ESG sustainability factors. The audit tests relate to the adequate identification, measurement, monitoring, and management of risk, as well as the models used to assess the impact of risks on the activities of pension funds; monitoring and periodic assessment of compliance of internal risk management rules with the market conditions and the good pension insurance practices; policies and procedures for risk assessment, establishing and observing risk limits, and allowing exceptions in extraordinary situations; scope, structure, and frequency of risk reporting; and risk culture;

- assessment of pension funds' adopted risk strategy:

- ✓ Acceptance strategy (for low and normal risk) – no actions are undertaken, with some risks being tolerated and others monitored;

- ✓ Reduction/ management strategy (for elevated risk) – includes internal controls, limits, and additional corrective actions;

- ✓ Transfer/ sharing strategy (for high risk) – active management involving insurances, entering into partnerships, outsourcing, hedging, and contractual arrangements (e.g. foreign-exchange clauses, price indices). Verification of whether the risk assessment is updated on an annual basis;

- verification of the measures undertaken by pension funds for the prevention of corruption, money laundering, and terrorism financing. Auditors must review internal policies, rules, and procedures focusing on improving awareness and effectiveness in complying with AML/CFT requirements. They must examine whether deficiencies exist identified during internal audit reviews of pension funds. Audit procedures include assessing the risk of corruption, money laundering, and terrorism financing in three stages: identification, analysis and assessment of risks, management and review of controls, as well as the methods through which

these risks have been mitigated;

- verification of disclosures in the financial statements and in the Sustainability Report concerning the expenses and investments made to implement the three components of sustainability;

- a communication plan through which significant sustainability matters to be mandatorily communicated to management and those charged with governance, as well as to the Audit Committee of the pension fund, are identified, such as: conclusions on the qualitative aspects of the pension funds' accounting and financial reporting practices; significant risks and issues arising during the audit; major weaknesses in internal control identified during the audit; identification or suspicion of fraud involving management, leading to material inaccuracies, deviations, or inconsistencies between the financial statements and the Sustainability Report; expected auditor's report, including possible modifications of the audit opinion; corrected and uncorrected misstatements;

- addition of paying attention or other matter paragraph in the auditor's report;

- addition of a key audit matters paragraph: significant issues related to the application of environmental, social, and governance policies; significant issues related to the application of the double materiality principle, etc.;

- analytical procedures at the completion of the audit engagement;

- auditor's report

The audit process of the three sustainability aspects, and the phases it undergoes, involves auditing the environmental, social, and governance policies of pension funds.

The specific activities of pension funds are not related to carrying out environmentally harmful activities triggered by environmental risks. Nevertheless, pension funds must develop their own environmental policies, which should include preventive measures to mitigate adverse impacts of environmental risks related to the protection of the environment, natural resources, water, and biodiversity; environmental restoration policies; adaptation to climate change; transition to renewable alternative energy sources; implementation of circular economy opportunities, etc. They need to embed in their environmental policies and risk management systems the specific actions they undertake to counteract and mitigate the impacts of these risks. They must accurately account for and disclose expenses incurred for environmental protection, pollution prevention, and restoration of ecological balance of the planet, which are, in turn, subject to audit verification through tests and analytical procedures performed by statutory auditors providing assurance on sustainability.

The specific activities of pension funds are also not related to carrying out social activities triggered by social risks, because they do not have their own personnel. Their operations are managed by the pension management company, which has appointed staff responsible for the management of the assets and liabilities of the pension funds. For this reason, social risks related to inequality and discrimination based on gender, age, marital status, sexual orientation, religious or political beliefs, union membership, race, ethnicity, nationality, social origin and status, physical and mental disabilities of workers and employees in the enterprises do not directly affect the activities of pension funds; nor do violations of the economic, social, and cultural rights of workers and employees, people with disabilities, or migrants. In the course of their activities, pension funds do not employ child or forced labor, and it is not necessary to provide training or personal development for staff, nor to implement measures to improve fair compensation, benefits, health, and well-being. In this context, auditors can verify through tests and analytical procedures how remunerations are managed; what the different categories of remuneration are; what is the process for identification and reporting of the risk of concealment, falsification, or misstatement of important information in the current accounting for remunerations accrued and paid by the pension funds and related social contributions and taxes due for members of the Board of Trustees /for Universal and Professional Pension Funds/ and members of the Advisory Board /for Voluntary Pension Funds/, as well as for insurance

and investment intermediaries, investment consultant, and actuary who are natural persons. Auditors must check whether any payments or benefits, either monetary or non-monetary, have been provided directly to these natural persons in exchange for the professional services they provide. They should assess whether these are in compliance with national and international rules, principles, and standards, including the remuneration policy for ensuring fair forms of fixed and variable compensation; whether such policy has been designed and implemented in a way that prevents the creation of incentives for excessive risk-taking, conflicts of interest, or another behavior leading to adverse consequences for the pension funds' operations; and whether the principle of neutrality (equal treatment) under the gender-related policy has been effectively applied in terms of the Boards of Trustees and the Advisory Boards of the different pension funds, etc.

Auditors can also verify, through tests and analytical procedures, the risk of human errors and unauthorized actions in documenting the social and governance-related expenses incurred by pension funds, with the aim of concealing any cases of gained financial benefits, corruption, money laundering, or terrorism financing by the management of the pension management company; the risk of cyberattacks and external and internal threats to data loss related to the activities of the pension funds, for which they are required to provide assurance on the sustainability. The scope of the audit includes the following procedures:

- review of the existing anti-money laundering and counter-terrorism financing processes and the control mechanisms in place within the pension funds;
- assessment of the effectiveness and efficiency of the main anti-money laundering and counter-terrorisms financing organizational measures, including: risk assessment; review of the AML systems in use for prevention; implementation of due diligence procedures; assessment of risk from individual relationships with the insured persons and determination of risk profiles; control over identification, registration, and monitoring of relationships with the insured persons; internal rules; safeguarding and disclosure of information by the pension funds;
- evaluation of the adequacy of the existing rules and procedures regulating the operations of the pension funds; organizational structure and division of responsibilities, delegation of authority; effectiveness of control mechanisms and their implementation.
- evaluation of the adequacy and effectiveness of financial management and control systems regarding the identification, assessment, and management of ESG-related risks;
- evaluation of the reliability, accuracy, and comprehensiveness of financial and non-financial information;
- evaluation of the protection of assets and information relevant to the sustainability of the pension funds;
- evaluation of the adequacy, quality, and effectiveness of audits and reports made by the pension funds' internal audit regarding the security, risk management, and legal compliance;
- evaluation of the execution of tasks and the achievement of sustainability goals.

Auditors must examine the operational logs for the organization of document flow; documents related to the closing of the financial year and their preparation in accordance with the regulatory requirements and internal regulations, as well as review the availability, accuracy, and archiving of documents in the audited pension funds on random basis. They must assess the effectiveness of the audited sustainability-related activities in relation to their inherent risks, the applied control mechanisms, and must identify the opportunities to minimize accepted risks and improve the control environment. Auditors should evaluate whether the control mechanisms are adequate, whether the internal control system is reliable and sufficiently limits the inherent risks for the audited sustainability activities, and whether the control mechanisms need to be improved.

Auditors must examine the information security management system of the audited pension funds to ensure compliance with the regulatory minimum requirements for network and information security

regarding the controls applied for the security of their clients – the insured persons; whether these controls are properly documented in the working files that describe the mandatory and recommended control mechanisms applied. Auditors should examine the resource allocation for analyzing the risk indicators and the causal relationships between them; assess whether the internal control framework of the pension funds is effective and efficient, including evaluating the appropriateness of the fund management framework; whether the existing policies and procedures remain adequate and comply with legal and regulatory requirements, as well as with the risk appetite and strategy of the audited pension funds; whether the procedures comply with applicable laws, subordinate regulations, and the decisions of the governing body; whether the procedures are applied correctly and effectively (whether the transactions are in compliance with the requirements, the actual level of risk taken, etc.); and the adequacy, quality, and effectiveness of reviews and reports performed by business units responsible for security, as well as functions responsible for risk management and legal compliance.

Auditors verify whether the Risk Management and Control Policy of the pension funds, which defines the framework and structure for risk management and control, including the identification of sustainability-related risks, is aligned with the applicable regulatory and legal requirements and whether it supports their financial stability, sustainable development, and economic growth, and whether it facilitates the proper safeguarding of the assets in the individual accounts of the insured persons within the pension funds. They also review the Risk Management Strategy of the pension funds to determine whether the main objectives and principles for risk management are correctly defined, how the framework and structure for risk management and control are established, whether it maintains the fund's financial stability, and whether it ensures the protection of the assets of the insured persons in the fund.

4. Providing assurance and verifying non-financial information in the Sustainability Report of pension funds

The expression of assurance by certified expert accountants, registered auditors on the Sustainability Report of pension funds increases the trustworthiness and reliability of sustainability reporting and disclosure by performing an independent financial audit of both financial and non-financial information related to the three components of sustainability. “There is a need for unified established practices and principles regarding the transparency of the information disclosed in financial statements.” (Andasarova, R., 2016) Transparent communication improves stakeholders' understanding and trust in the presented sustainability information. Registered auditors must draft a conclusion on whether the information disclosed in the Sustainability Report of pension funds contains any material misstatements and whether the information disclosed in their statements is sufficient and relevant. Their audit reports should comply with various frameworks applied by pension funds, including those issued by the International Sustainability Standards Board (ISSB), such as IFRS S1 and IFRS S2, the standards of the Global Reporting Initiative, and the regulatory requirements of the national supervisory authority. Auditing the sustainability reports poses different challenges for registered auditors compared to those in the course of the audit of pension funds' financial statements, as auditors primarily review “verbal” information rather than financial information – concrete data and values. The CSRD Directive requires auditors to verify the information disclosed in the Sustainability Report of pension funds and to give an audit opinion to express assurance on it. Registered auditors must be sustainability-licensed, meaning they have undergone specialized sustainability training, acquired new skills within the audit profession, and obtained certification as sustainability auditors. The expression of assurance by registered auditors is made according to the Independent Financial Audit Act amended on 17.09.2024, which is now the Independent Financial Audit and Sustainability-Related Expression of Assurance Act (IFASREAA, 2024, article 51a, paragraph 3), and the International Standard on Assurance Engagements (ISAE) 3000, “Assurance Engagements Other than Audits or Reviews of Historic Financial Information”, published in February 2019. However, this standard does not prescribe a specific form or content for auditor

reports on expressing assurance on the information disclosed in the sustainability reports. To address this global need for consistent assurance standards regarding sustainability information, the International Auditing and Assurance Standards Board (IAASB) developed the International Standard on Sustainability Assurance 5000 (ISSA 5000), General Requirements for Sustainability Assurance Engagements. This new standard aims to establish a global basis for expressing assurance on sustainability information by enhancing its quality and reliability and to encourage greater accountability and transparency. ISSA 5000 defines a global reference point for those who provide assurance expression services in terms of sustainability information. The standard introduces key elements that strengthen the assurance process and promote reliable reporting in terms of sustainability. It emphasizes the necessity for professionals in the field of expression of assurance to have the requisite expertise and competencies in sustainability issues. It highlights the importance of professional skepticism and requires registered sustainability auditors to provide stakeholders with a comprehensive assurance report on the non-financial information in the sustainability report. This audit report must explain the scope of the engagement, the procedures performed, and any modifications due to identified material misstatements or inability to obtain sufficient appropriate evidence, and finally provide an overall conclusion. Auditors must question and critically assess the reliability and accuracy of sustainability information. They must perform audit procedures to exercise independent external control over the expenses incurred by pension funds in the implementation of the three components of sustainability.

The standard encourages a risk-based approach to the expression of assurance, requiring registered auditors to assess risks of material misstatements in sustainability information and tailor their audit procedures accordingly. It strengthens the requirement for the registered auditors to express professional skepticism, while expressing assurance, to verify and confirm the non-financial information in the sustainability report. The standard also enhances the transparency in the assurance engagements undertaken by the auditors by requiring clear reporting on the scope, methodology, and limitations of the independent financial audit performed for expression of assurance on the non-financial information in the sustainability report.

Independent financial audit applies a risk-based approach, which allows for the identification of objects and precise determination of risk factors. The application of a risk-based approach in the planning of each specific audit engagement for providing assurance enables auditors to focus their efforts on examining activities of high significance for pension funds and to concentrate on risk-related activities associated with their sustainability. The organization of the audit process should support the management of the pension management company in making decisions to mitigate sustainability-related risks affecting the specific operations of the pension funds. In performing their duties, auditors should not face restrictions while performing their tasks, obtaining audit results from conducted tests and analytical audit procedures, or accessing the accounting records and information systems of the audited pension funds.

In performing their duties, statutory auditors follow and apply International Standards on Auditing, the International Code of Ethics for Professional Accountants, including the International Independence Standards of the International Ethics Standards Board for Accountants (IESBA Code), together with the ethical requirements under the Independent Financial Audit and Assurance of Sustainability Act. They must not have any assigned powers and responsibilities over the activities and objects they audit. They must state in their reports that the scope, effectiveness, and quality of the independent financial audit have not been affected by any limitations imposed by the audited pension funds. Their tasks include analyzing the operation of the internal control system to identify areas where control systems are insufficient; evaluating internal control procedures and their compliance with the policies of the pension funds, the guidelines of the regulatory and supervisory authorities, and the applicable legislation; periodically reviewing the actions and measures taken by regulatory and supervisory authorities; and monitoring whether the corresponding corrective measures have been implemented within the audited pension funds.

Conclusion

The significance of environmental, social, and governance factors of sustainability is increasing every year, naturally leading to their integration into the business model of pension funds. ESG – environmental, social and governance indicators are a set of parameters through which pension funds, their investors (the insured persons), regulatory authorities, and other stakeholders measure the impact of operational and strategic decisions on the value and reputation of the pension funds, their access to financing sources, and their potential for economic development, while focusing on the achievement of sustainable growth. Identifying and mitigating adverse sustainability-related impacts reflect the pension funds' approach to the environment, their social responsibility, and their adherence to corporate governance standards.

In the context of ESG reporting, pension funds are required to apply the “Double Materiality” principle. ESG reporting requires the inclusion of non-financial factors in the process of making financial decisions. Pension funds design strategies, policies, and systems for assessment and management of the relevant risks so that these risks are properly managed within their operations, thereby contributing to the protection of the environment and the achievement of climate neutrality. To effectively manage environmental, social, and governance risks, pension funds need to continuously improve their practices and further develop the controls implemented as part of the relevant processes, which cover risk identification, assessment, monitoring, and reporting. Adapting the internal regulatory framework so that it becomes a tool for mitigating the impacts of ESG risks, ensuring a regulated volume of information and data in accordance with legal requirements, is crucial for expressing assurance on sustainability by statutory auditors certified for sustainability. Integrating environmental, social, and governance factors into the management business model and recognizing them as part of the corporate governance of pension funds links the business strategy with ESG objectives and implements the funds' Sustainable Development Strategy with commitments made to their insured persons. This strategy ensures strategic alignment of corporate social responsibility and sustainability initiatives with the values and business objectives of the pension funds and supports effective planning, execution, and monitoring of social responsibility efforts, as well as reporting on their progress and effectiveness.

Public non-financial reporting – the Sustainability Report, which is part of the Annual Management Report of the pension funds for each reporting year, provides information on their activities in the context of social responsibility and sustainable development, demonstrating the results achieved in reaching the ESG goals of society.

Statutory auditors provide assurance (degree of confidence) that the audited pension funds have conducted their activities in an effective and efficient manner across the three aspects of sustainability during the reporting year.

By carrying out an independent assurance audit, society receives valuable feedback on the reliability of the information reported by pension funds regarding their sustainability reporting. Providing assurance on the non-financial information in their sustainability reports acts as a stimulus for improving their sustainable development policies. This facilitates a continuous improvement cycle, where pension funds refine their strategies and policies for a more sustainable future, supporting the accurate, precise, and transparent reporting of the three components of sustainability. Assurance provided by statutory auditors of sustainability enables decision-making by stakeholders – the persons insured in the pension funds, investors, state authorities, supervisory bodies, etc. Only in this way can pension funds enhance their progress, efficiency, and capabilities in terms of sustainability reporting, and will be able to report more reliable, credible, and consistent sustainability information.

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Municipal Waste Management in the Post-Pandemic Period: Deficiencies and Risks Revealed by Public External Audit – A Focus on Constanța County (Romania)

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Abstract

Background and aim: The article investigates the systemic deficiencies and risks in Romania's municipal waste management system during the post-pandemic period, focusing on the role of external public audit missions conducted by the Romanian Court of Accounts. The main objective is to assess the risk of infringement procedures against Romania due to persistent non-compliance with EU environmental directives. *Scope and limitations:* The research concentrates on the period 2015–2021, with particular emphasis on the case of Constanța County, and is limited to the analysis of official audit reports and regulatory frameworks. *Methods:* The study employs a qualitative methodology based on document analysis, comparative evaluation of legal frameworks, and synthesis of audit findings, with emphasis on compliance, infrastructure, and institutional performance. *Results:* Findings highlight significant shortcomings: delayed closure of non-compliant landfills, insufficient implementation of selective collection and recycling, lack of a functional electronic traceability system, and weak monitoring by central and local authorities. Constanța County illustrates critical infrastructural and contractual deficiencies that compromise EU compliance targets. *Conclusions:* Romania remains at high risk of EU sanctions due to poor waste management performance, limited strategic coordination, and underuse of European funding. *Originality:* The article provides an integrated perspective by linking external audit findings to broader systemic vulnerabilities in the post-pandemic context. *Practical implications:* The study offers actionable recommendations for improving compliance, strengthening administrative capacity, and ensuring alignment with EU circular economy goals, thus supporting policymakers and practitioners in sustainable waste governance.

Key words:

municipal waste management,
external public audit, Constanța
county (Romania),
environmental compliance, EU
infringement risk.

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1. Introduction

The concept of environmental audit is relatively new, referring to the process of determining and examining—through analyses, tests, and confirmations—the extent to which an enterprise as a whole, or certain of its components, complies with legal environmental protection requirements (Artene, 2011; Macoveanu & Ciubotă-Roșie, 2008; Panaite et al., 2007). In countries with a well-developed environmental protection activity, environmental auditing across all categories of enterprises has become a core component of corporate environmental management, thereby complementing the overall management system. The characteristics of this type of audit are presented in Table 1.

Table 1

Characteristics of environmental audit

Objective	Description
Characteristic	Assessment of the compliance of activities, processes, and infrastructure with environmental legislation, applicable sustainability standards, and policies (ISO, 2015).
Typology	• Compliance audit (verifies compliance with legislation and standards) • Performance audit (evaluates the efficiency and effectiveness of environmental policies and programs) • System audit (examines environmental management and the implementation of ISO 14001) (ISO, 2018; OECD, 2005).
Audit criteria	Legal norms (EU directives and regulations, national legislation), international standards (ISO, EMAS), public policies, and strategic environmental objectives (EP, 2009).
Scope of application	Industrial processes, public infrastructure, utility services (waste, water, air, soil), projects funded by public or European resources (ECA, 2021).
Methodology	Documentary analysis, interviews, field observations, sampling, technical testing and verification, use of performance indicators (ISO, 2018).
Frequency	Periodic (planned annually or multi-annually) or thematic (depending on risks, complaints, or priorities) (OECD, 2005).
Actors involved	Central and local public authorities, independent audit bodies, Courts of Accounts, international organizations, economic operators (Bostan, 2010ab).
Results	Audit report containing: findings, deficiencies, recommendations, action plans, and, where appropriate, sanctions (Gray & Bebbington, 2001).
Impact	Increases compliance with environmental legislation, prevents international sanctions (infringement), improves organizational performance, and enhances environmental protection (ECA, 2021).

The environmental management system of an enterprise must ensure that decision-makers are confident that all provisions of environmental protection regulations are observed throughout its activities, and that internal operations, organizational structures, and procedures regarding environmental protection are clearly defined. The same decision-makers must also be assured that the enterprise's environmental risks are known, monitored, and controlled, supported by the existence of financial resources allocated to environmental services. In essence, there must be constant certainty that environmental requirements are applied and kept under control (Rojanschi & Rădulescu, 2015).

From the perspective of the supreme audit institution, which holds the legal mandate to exercise external public audit (PR, 1992; Bostan, 2010ab), based on the national regulatory framework and international agreements to which Romania is a party, the Romanian Court of Accounts also has competences in the field of environmental audit. This orientation aligns with the concerns of the International Organization of Supreme Audit Institutions (INTOSAI) to ensure independent auditing of activities with environmental impact. The Law on the organization and functioning of the Romanian SAI stipulates in Article 22 that “Within the competences provided for in Article 21, the Court of Accounts exercises its specific responsibilities in the following fields: (...) g) the establishment, use, and management of financial resources regarding environmental protection, the improvement of living and working conditions.” (PR, 1992).

In fact, the issue of municipal waste management has recently become one of the most pressing challenges for public authorities in Romania, with major implications for public health, the environment, and sustainable economic development (Bold & Maracineanu, 2003; Pălărie & Chirigiu, 2016). In the post-pandemic years, the structural deficiencies of the waste management system have worsened, with the health and economic context driving both an increase in household waste volumes and difficulties in its collection and treatment.

By analyzing the external public audit activity focused on this objective, and seeking to estimate the risk of infringement proceedings against Romania concerning municipal waste disposal, several serious deficiencies and systemic risks were brought to light.

The importance of this study emerges in relation to the European Union's strategic objectives on the circular economy, where Romania faces significant delays. According to Eurostat, the recycling rate of municipal waste in Romania was below 15% in 2020, compared to the European average of over 45%, highlighting substantial performance gaps. Thus, analyzing structural deficiencies through the lens of external public audit is important for understanding the post-pandemic context and identifying actionable directions.

In this regard, our approach follows the following structure: (1) Introduction; (2) Material and methods; (3) National regulatory framework and European context in waste management; (4) Design of the external public audit mission addressing the issue of landfills in large cities (2022); (5) Findings and deficiencies identified by the Court of Accounts; (6) Risks identified following the external public audit; (7) Compliance challenges in the management of waste infrastructure in Constanța county; and (8) Conclusions and recommendations.

Finally, the paper includes references to the research Limitations and the Future directions of study on which we intend to focus.

2. Material and methods

The research was grounded in a qualitative approach, based on a documentary analysis of official audit reports issued by the Romanian Court of Accounts (RCA), the national and European legislative framework in the field of waste management, as well as the specialized literature dedicated to environmental auditing and auditing in general. The analysis covered the period 2015–2021, which corresponds to the timeframe considered by external public audit missions that addressed the issue of municipal waste disposal in Romania's large cities.

The research design is illustrated in Figure 1.

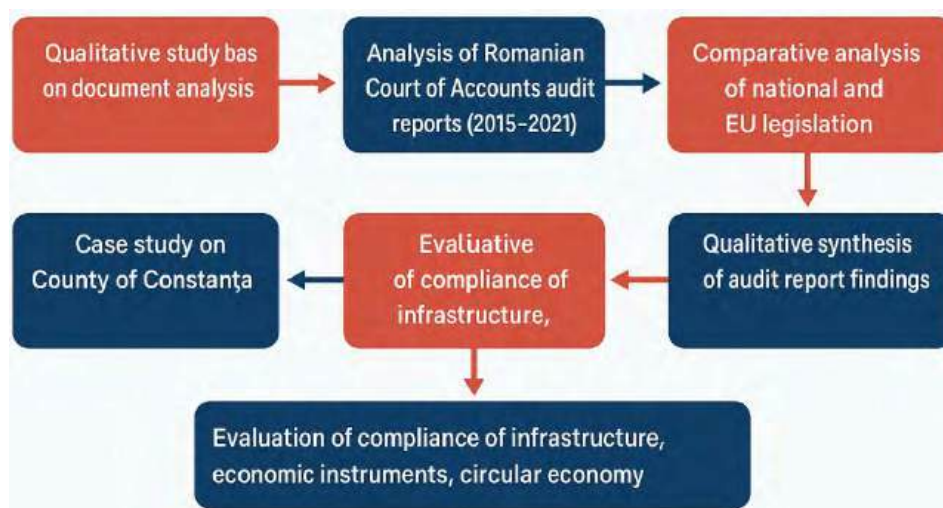


Fig. 1. Research design

Source: Authors' elaboration

The research methodology consisted of: (i) a comparative analysis of relevant national and European legislation, such as Directive 1999/31/EC and Directive 2008/98/EC, Law No. 211/2011, Government Emergency Ordinance (GEO) No. 92/2021, and Government Ordinance (GO) No. 2/2021 (CEU, 1999; EP, 2008; PR, 2011; GR, 2021a); (ii) qualitative synthesis of findings from external public audit reports, with

emphasis on structural and institutional deficiencies (Romanian Court of Accounts, 2022; <https://www.curteadeconturi.ro>); (iii) evaluation of compliance criteria regarding infrastructure, the application of economic instruments, and the degree of implementation of circular economy principles; and (iv) a case study applied to Constanța County, selected due to the relevance and persistence of deficiencies identified in the integrated waste management infrastructure (SMID) (RCA, 2022).

For the validation of interpretations, the research also relied on comparative European reports (Eurostat, European Court of Auditors), which provided a benchmark for assessing performance gaps. This approach did not involve direct quantitative measurements but was instead an exploratory and evaluative methodology, specific to public policy analysis and compliance auditing.

3. National regulatory framework and the European context in waste management

Romania, as a Member State of the European Union, is obliged to comply with the provisions of European directives in the field of environmental protection, in particular Directive 1999/31/EC on landfill of waste and Directive 2008/98/EC on waste (CEU, 1999; EP, 2008). According to these regulations, landfilling is permitted only for pre-treated waste and under conditions that do not endanger human health or the environment. Upon accession in 2007, Romania committed itself to aligning its national legislation and waste management practices with these EU standards.

At the national level, the legal framework has been further developed through Law No. 211/2011 on waste regime, Government Emergency Ordinance (GEO) No. 92/2021, and Government Ordinance (GO) No. 2/2021 (PR, 2011; GR, 2021ab). However, the enforcement of these regulations has been characterized by delays and inconsistencies. The National Waste Management Plan (PNGD), approved in 2017, set ambitious objectives: 100% coverage of sanitation services by 2018, a 10% reduction in household waste by 2025, recycling of 50% of municipal waste by 2025, and reducing the amount of biodegradable waste landfilled to 35% of the 1995 level. It must be noted that these targets were not achieved, which confirms persistent deficiencies in implementation.

In the following section, we provide references to Romania's situation in the field of environmental protection and the associated risk of infringement, as reflected in the years immediately following the outbreak of the Covid-19 pandemic. These issues are graphically illustrated in Figure 2.



Fig. 2. Romania's environmental protection context and risk of infringement

Source: Authors' elaboration

Our analysis highlights the persistence of structural and institutional vulnerabilities that amplify the risk of new infringement proceedings at the European level. Despite repeated opportunities to attract EU funds for the development of Integrated Waste Management Systems (SMID), local authorities have not succeeded in implementing such projects across all counties. Similarly, although the European Union provided resources for financing the closure of non-compliant landfills, the Environmental Fund Administration failed to access these programs, leading to reliance solely on state budget resources.

Another critical weakness concerns improper waste collection, characterized by mixing fractions, lack of sorting, and absence of pre-treatment, all of which contravene European principles and set the premises for new infringement procedures. Regarding landfill management, the existing legal framework stipulates the creation of a closure and post-closure monitoring fund, but the absence of legally established amounts and the relatively low level of sanctions create a high risk that these obligations are treated superficially by operators. Moreover, both central and local authorities have undertaken insufficient monitoring and control actions, thereby perpetuating major deficiencies in waste management.

Regulatory gaps are also evident in the application of economic instruments. The central authority has not established the framework for collecting the necessary financial resources to cover Romania's contribution to the European Union for unrecycled plastic packaging waste. In this context, Romania committed only to the EU minimum recycling target of 22.5% of plastic placed on the market, leaving 77.5% unaddressed. The direct consequence is that the Romanian state is obliged to pay an annual contribution of €0.8/kg of unrecycled plastic waste, creating additional pressure on the public budget and further demonstrating the inadequacy of national plastic waste management policies.

4. Design of the external public audit mission on the issue of municipal landfills in large cities (2022)

An audit mission of this type—focusing on compliance over a relatively long period (January 2015 to December 2021)—requires the elaboration of an audit framework based on clear criteria, such as: the existence and adequacy of waste management infrastructure, the degree of implementation of European environmental principles, the application of extended producer responsibility, the use of performance indicators in waste management, the issuance and monitoring of environmental authorizations, the effectiveness of sanctioning non-compliant operators, and the suspension of illegal activities. Naturally, the auditors involved applied specific tests, calibrated to the profile of the audited entities, in order to provide a comprehensive and objective picture of the deficiencies affecting Romania's national system of municipal waste management. The design of the external public audit mission addressing the issue of landfills in large Romanian cities (2022) is illustrated in Figure 3.



Fig. 3. Schematic representation of the external public audit mission addressing the issue of landfills in large Romanian cities

Source: Authors' elaboration

The study of official documents issued by the Romanian Court of Accounts (RCA, 2022) shows that the general objective of this audit mission was to evaluate the risk of infringement proceedings against Romania, triggered by persistent deficiencies in the management of municipal landfills in large cities, as well as to identify the main factors amplifying this risk.

The immediate context was the receipt, on 12 November 2021, of the letter of formal notice from the European Commission, a document anticipating the imminence of formal sanctioning proceedings. The specific objectives of the mission were: (i) evaluation of policies and instruments adopted in the field of waste management; (ii) regulation and authorization of landfill activities; (iii) analysis of the existence and functionality of technical and utility infrastructure for collection, transport, and treatment; (iv) evaluation of the organization and operation of municipal waste management systems at local level; and (v) monitoring and control exercised at central level over operators in the sector. As shown in Figure 3, the audit targeted both the central level of public administration and local structures involved in waste management. The main audited entities were: the Ministry of Environment, Waters and Forests, the National Environmental Protection Agency, the National Environmental Guard, the Environmental Fund Administration, county environmental protection agencies, and county and local administrative-territorial units. It should be noted that an important methodological element was the decision to approach the audit through the perspective of processes preceding final disposal (collection, transport, sorting, recycling, recovery), these being considered decisive factors influencing both the likelihood and the level of infringement risk.

5. Findings and deficiencies identified by the Romanian Court of Accounts

Romania committed to closing all non-compliant landfills by 2017; however, this objective was not achieved, leading to the initiation of infringement procedures. A major long-standing deficiency is the absence of a functional electronic waste traceability system, required by Directive 2008/98/EC. Although Government Ordinance No. 2/2021 transposed this obligation, by 2022 no steps had been taken to implement it. This situation creates a significant risk of inaccurate data reporting, with direct impact on Romania's relationship with European institutions.

5.1 At the level of central public authorities

The audit found deficiencies at the Ministry of Environment, Waters and Forests (MMAP), which failed to prepare a new waste management strategy after the expiration of the previous one in 2020 (RCA, 2022). These findings are schematically represented in Figure 4.

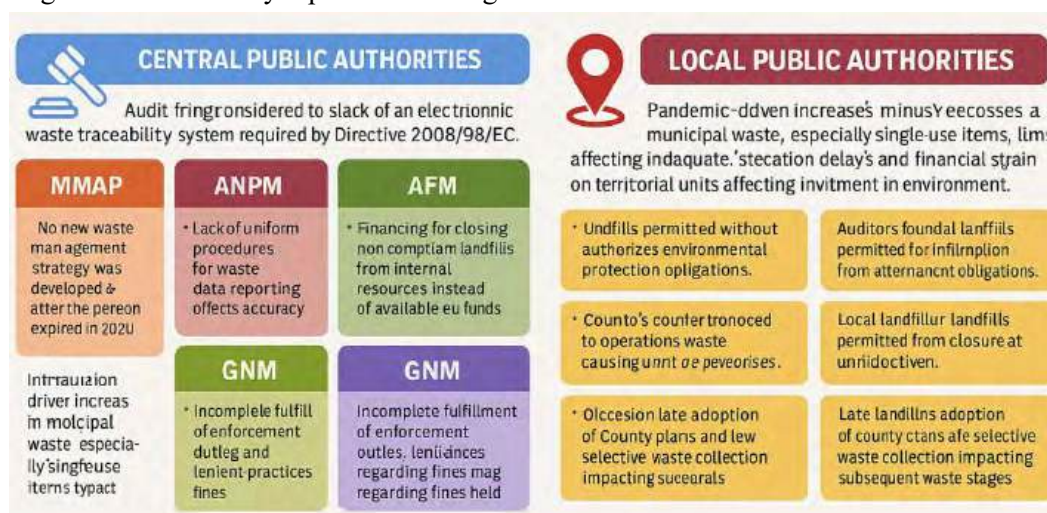


Fig. 4. Findings and deficiencies identified by the mission of the Romanian Court of Accounts

Source: Authors' elaboration

The lack of an updated strategic framework led to delays and incoherence in policy implementation. Similarly, the National Environmental Protection Agency (ANPM) did not develop uniform procedures for reporting waste data, which undermined the accuracy of figures submitted at European level. The Environmental Fund Administration (AFM) financed the closure of non-compliant landfills from internal resources, without accessing available European funds. The National Environmental Guard (GNM) did not fully exercise its control and sanctioning duties. Its practice of replacing legally prescribed penalties with warnings ran contrary to the national objective of preventing the initiation of European judicial cases against Romania.

5.2 At the level of local public authorities

As is well known, at the territorial level, the COVID-19 pandemic generated a significant increase in household waste, particularly packaging and single-use products. Sanitary restrictions led to delays in separate collection and a reduction in recycling capacities. Moreover, the financial resources of territorial administrative units were negatively affected, reducing investments in environmental infrastructure. These factors further amplified the structural deficiencies already present in the waste management system. At the same time, at the level of local public authorities, the audit revealed delays in the implementation of county waste management plans, a low degree of separate collection, and inadequate infrastructure for sorting and treatment (RCC, 2022).

In many counties, integrated waste management systems (SMID) were either not completed or only partially operational, forcing waste to be transported to other counties. In the capital city, landfill capacity is limited, and a significant share of waste is disposed of directly in landfills without prior treatment. More seriously, auditors found that there were cases in which county authorities authorized the establishment of landfills that were not required to comply with environmental protection standards. In an entirely abnormal development, the closure of landfills—due to the absence of financing from local budgets or from economic operators with administrative responsibilities—ended up being covered financially by the Environmental Fund, contrary to the purpose for which the fund was originally created.

It was also noted that county waste management plans were adopted with delays and that separate waste collection is carried out at a low rate, thereby affecting subsequent stages of the waste management chain. Furthermore, municipal waste treatment and sorting facilities remain insufficient, while significant amounts of untreated waste continue to be directed to landfills, in contravention of legal requirements.

6. Risks identified following the external public audit

In the absence of rapid corrective measures, Romania risks remaining on the periphery of European policies concerning the circular economy. The audit conducted by the Romanian Court of Accounts (RCC) serves not only as a warning signal but also as a guidance tool for policymakers. Strict implementation of the recommendations formulated is very important, not only for avoiding sanctions but also for ensuring a cleaner environment and sustainable long-term development.

The RCC highlighted the high risk of new infringement procedures being initiated against Romania due to non-compliance with obligations on recycling, reduction of biodegradable waste disposed of in landfills, and waste traceability (RCC, 2022). Moreover, financing the closure of non-compliant landfills from the Environmental Fund budget, rather than from European or local funds, generates budgetary pressures and potential state aid issues.

In other words, the central risk identified is financial, stemming from possible sanctions imposed by the Court of Justice of the European Union, which could exceed several hundred thousand euros per day of delay. At the same time, increased costs for transporting waste to other counties negatively affect local budgets and may lead to higher tariffs for the population, with significant social consequences.

7. Compliance difficulties in the case of waste management infrastructure in Constanța county

The aforementioned audit mission established that the Integrated Waste Management System (SMID) Project in Constanța County was not operational, even though the collection, transport, transfer, and sorting infrastructure was formally organized in line with legal provisions and had the potential to cover the waste management needs of the county's three zones. However, at the local level, the collection infrastructure was found to be undersized for separate collection, while the sorting infrastructure was both undersized and outdated, particularly in the city of Constanța.

The infrastructure for preparatory operations prior to recovery or disposal of waste was deemed insufficient, requiring an additional treatment capacity of 60,000 t/year and the expansion of the existing composting capacity with an additional facility of 10,000 t/year. These measures are necessary to reduce the volume of waste disposed of in landfills and to meet the targets assumed by national and EU policies.

Table 2

Compliance difficulties in waste management infrastructure in Constanța county

Analyzed Domain	Findings / Main Deficiencies
Waste landfills	• Operate according to environmental authorizations, but the closure and post-closure fund is not aligned with the approved projects. • The Tortoman ecological landfill (SMID) is not operational due to delays in awarding the sanitation service concession. • Non-compliant landfills covered by Government Decision no. 349/2005 were closed, but post-closure monitoring has been missing (2018–present), leading to degradation.
Contracts and financial management	• Local administrative units (ATUs) did not include clauses on covering closure and post-closure costs through landfill tariffs. • Lack of requirement for environmental financial guarantees from operators. • Delegation contracts did not include clear obligations regarding landfill safety and environmental protection.

SMID infrastructure	• SMID infrastructure (Tortoman, Ovidiu, Costinești) not operational, with degradations identified by the National Environmental Guard (GNM). • Investments worth 31 million lei (fixed assets acquired in 2015) remain unused, at risk of moral and physical wear. • Additional needs: +60,000 t/year TMB capacity and +10,000 t/year composting capacity.
Environmental performance	• 88% of municipal waste ends up in landfills (2019–2021). • Extremely low recycling rate (1.5%), far below EU targets. • Existing sorting capacities theoretically sufficient, but used at less than 50% of potential.
Regulation and control	• Issuing of environmental agreements complies with legislation, but monitoring of the closure fund is missing. • Operators complied with reception procedures and reported refusals to accept waste. • GNM found degradations in the absence of post-closure monitoring.
Organization of ATU services	• 12% of ATUs do not have sanitation regulations with anti-dumping measures. • 34% did not organize separate collection (paper, plastic, metal, glass). • 66% did not include clauses on sorting and treatment in sanitation contracts. • ADI Dobrogea submitted documentation for improving the delegation framework and for continuous awareness campaigns.

Source: Prepared by the authors based on data extracted from RCC, 2022

The implementation of the economic instrument “pay-as-you-throw” is in a deficient stage, as approximately 60% of the administrative-territorial units (ATUs) have not established concrete modalities for its application. Moreover, sanitation services have been delegated to authorized operators in the absence of clear regulations, without performance indicators, and without ensuring the necessary infrastructure for selective collection, which has led to the non-achievement of environmental objectives and to negative economic and social effects.

Another critical aspect is that two-thirds of the ATUs (66%) have not concluded contracts with Producer Responsibility Organizations (OIREPs) for the takeover and recovery of packaging waste, even though the SMID documentation explicitly provides for this obligation (RCC, 2022). Furthermore, the delegation of sanitation service management through SMID had not yet been finalized, while at the local level, six ATUs failed to adopt measures for sanctioning waste abandonment outside designated collection points.

With regard to operational landfills, these generally complied with the conditions set in the integrated environmental authorizations; however, the awarding of the operating service for the landfill included in the SMID infrastructure remains unfinished. Figure 5 also suggests the existence of additional weaknesses within the specific waste management infrastructure of Constanța County.

Constanța County	
Area Analyzed	Main Findings / Deficiencies
Waste deposits - Operate according environmental permits for fondul de închidere și post-closure fund not correlated with projects approved legal - Tortoman ecological deposit (SMID) not operationalized due to sanitation service concessioning - Delegates no compliant deposits listed in HG no. 249/2005 have been closed, but lack post-closure monitoring licenses (2018–present)	- Operate conform environmental permits, but closed post-closure monitoring through, storage tariffs with surcharge. - Lipsa compliant contracts lack explicit obligations explicit obligations for depopulate safety and environmental protection response
Contracts and financial management - LGs arant pre-ordered clauses proving coverage costs through storage lands - Lipsa silitarity financial environmental guarantees from operators - Delegation contracts lack explicit obligations provided depot safety and environmental protection neglect	SMID infrastructure - SMID Infrastructure (Tortoman Ovidiu-Costinesti) nonoperationalized, with degradation identified by GNM - investments of 3.1 million lei (fixed assets acquired in 2015) remain unused risking moral and physical wear
	88% of municipal waste reach landfill (2019–2021) - Extremely low recycling rate of 1.5%, far below European targets - Sorting capacities theoretically sufficient, but utilized at sub 50%
	Regulation and control - Environmental agreements respect legislation, but lacks controls to avoid abandon, assurances 34% no organization collection separate waste, plastic, metal glass) 66% not include sorting and treatment contracts in sanitation contracts - ADL Dobrogea financial documentations for improvement campaign continuous
	Environmental performance 88% of municipal waste reached landfill (2019–2021) - Extremely low recycling rate of 1.6% mult sub European targets

Fig. 5. Various weaknesses of municipal waste management (Constanța county)

Source: Authors' elaboration

In conclusion, regarding the analyzed county, it can be observed that the environmental regulatory authority has, in general, complied with the legal provisions concerning the authorization of landfills, which have operated in line with the conditions set by legislation. However, an important exception was identified: the Constanța Environmental Protection Agency failed to verify whether the value of the closure and post-closure monitoring fund corresponded to the amount established in the landfill's technical project. This shortcoming raises significant concerns regarding the long-term management and sustainability of such facilities.

Moreover, delays in awarding contracts for the delegation of sanitation service management within the SMID infrastructure threaten the achievement of strategic objectives established at the county level. In the absence of efficient and timely operation, there is a considerable risk that: (i) the collection and treatment of waste, including biodegradable waste, will not be carried out in compliance with national legislation and the County Waste Management Plan; and (ii) persistent economic, social, and environmental risks will continue to negatively affect the administrative-territorial units.

8. Conclusions and recommendations

Our analysis highlights that municipal waste management in Romania continues to be characterized by major structural and institutional deficiencies, which persist despite the commitments undertaken at the European level. The post-pandemic context has further accentuated these vulnerabilities, through the increase in household waste volumes and additional pressures on local collection and treatment infrastructure. Several findings of the Romanian Court of Accounts confirm the lack of coherence in policy planning and implementation, as well as the insufficiency of monitoring and sanctioning measures applied by central and local authorities.

A central issue identified is the generalized delay in applying the principles of the circular economy. The persistently low levels of separate collection and recycling, coupled with the continued reliance on landfilling

as the primary method of waste disposal, keep Romania in a vulnerable position with respect to European Union standards. The delayed finalization of Integrated Waste Management Systems (SMIDs) and the blockages related to the delegation of sanitation services contribute to the perpetuation of non-compliance. Moreover, the obligation of operators to establish the funds necessary for the closure and post-closure monitoring of landfills remains only partially respected, due to the absence of clear regulations on amounts and the lack of sanctions proportional to real costs, which risks making this requirement merely formal.

In our view, overcoming these difficulties requires strengthening the institutional and regulatory framework, accompanied by an acceleration of investments in waste management infrastructure. The study suggests that the completion and operationalization of SMIDs, the modernization of sorting and treatment facilities, and the expansion of composting capacities are key measures to reduce dependence on landfilling and bring Romania closer to EU objectives. Equally important is strengthening monitoring and control capacity at both central and local levels, to ensure consistent enforcement of legislation and the sanctioning of non-compliant operators.

We also argue that the implementation of economic instruments, such as the “pay-as-you-throw” principle and extended producer responsibility, can foster behavioral change at both institutional and individual levels, driving Romania toward a functional circular economy. At the same time, making full use of available European funds for the closure of non-compliant landfills and the development of modern infrastructure remains a necessary condition.

In conclusion, reducing the risk of new infringement procedures and ensuring Romania’s alignment with the objectives of the European Green Deal require an integrated approach, grounded in strategic planning, institutional accountability, and the efficient use of resources. Without such a model, a sustainable waste management system capable of responding to European standards and societal needs cannot be built.

Research limitations and future research directions

This study is subject to certain limitations. The analysis relied primarily on secondary literature, official audit reports, legislative frameworks, and qualitative synthesis, without employing quantitative measurements of waste management performance at the local level. Furthermore, the research timeframe provides a relevant yet partial perspective, as it does not fully capture the effects of recent European environmental policies or the implementation of the European Green Deal.

Future research will therefore focus on up-to-date longitudinal analyses of waste management performance, with particular emphasis on Romania’s capacity to comply with newly adopted EU requirements. Comparative studies with other EU Member States could also be valuable in identifying transferable best practices and governance models.

We believe that such research can contribute to a deeper understanding of systemic vulnerabilities and provide evidence-based recommendations for policy reform.

Author Statement on AI Use

The authors declare that AI-based tools (ChatGPT-5) were employed solely for assistance in language editing, style improvement, translation verification, text refinement, and illustration enhancement, under the full supervision of the authors. The entire content has been thoroughly reviewed and finally approved by all authors of the paper.

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Self-Discrimination among Women in the CEECs

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JEL: O14, P24, C41, E13

Abstract

Background and aim: The main purpose of the paper is to consider the phenomena of personal and group self-discrimination among women in the context of professional advancement. *Scope:* The spatial scope includes countries of Central and Eastern Europe, namely, Czechia, Hungary, Poland, Slovakia, and Slovenia. The time frame covers the years 2004-2024. *Methods:* A literature review and critique, methods of descriptive statistics are used to assess the mechanism of appearance of self-discrimination. *Conclusions:* The analysis reveals that the female participation among managers is lower than among men despite the higher education indicators in the CEECs in 2004-2024. Personal and group self-discrimination stem from invisible powers (glass phenomena) appearing in organisations. Their mechanism is based on stereotypical thinking about the roles of gender in society, which weaken women' (a glass ceiling) and concurrently strengthen men' (a glass escalator) opportunities of getting managerial positions. *Originality:* The issue of self-discrimination of women has not been described in the literature and is an innovative approach on the economics from a gender perspective. *Practical implications:* A thorough examination of the phenomena of personal and group self-discrimination against women requires a shift in survey questions towards inclusivity and non-discrimination.

Key words:

self-discrimination, women,
labour market

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1. Introduction

Economic situation in the labour markets in most highly-developed countries has been improving in the perspective of gender equality and eliminating of discrimination according to sex, although it is far from ideal. Among manifestations of sex differences in the employment sphere the smaller contribution of women than men in management has been observed. There are many reasons which have been analysed in the literature but the substantial research gap exists in explaining the phenomenon called self-discrimination of women. This topic is explored broader in the paper, especially in the context of gender discrimination among managers. The present paper is to fill the scientific gap in the literature of gender inequality referring to various reasons for resigning from being promoted due the decisions made by women themselves.

The main purpose of the paper is to consider the phenomena of personal and group self-discrimination among women in the aspect of professional advancement in the chosen countries of Central and Eastern Europe in the years 2004-2024. The spatial scope includes the group of post-communist countries with the common past of functioning in the system of centrally-planned economies, namely, Czechia, Hungary, Poland, Slovakia and Slovenia (hereafter: CEECs). The selection was dictated by both the historical, economic and social similarities, and high positions in the gender equality rankings – in terms of Gender Inequality Index, Gender Development Index, Gender Social Norms Index (UNDP, 2023), and very high human development (UNDP, 2025). The time frame covers the years 2004-2024, hence since the accession of all the abovementioned countries to the European Union (EU) in 2004, which gave the opportunity of measuring phenomena occurring in this area with usage of common and equivalent methods (Eurobarometer), pending the most recent period. In the paper such phenomena as a glass ceiling and a glass escalator are mentioned in the aspect of hindering

or boosting chances of promotion in company according to sex.

Against the background of gender inequality in the labour market, this study raised the following research questions referring to the CEECs in 2004-2024:

- What is the scope and tendency of changes in the differences between the participations of men and women among managers?
- What is the extent and trend in the discrepancies in the level of human capital between men and women with particular concentration on the tertiary level of education?
- What symptoms do women exhibit suggesting occurrence of personal self-discrimination in the professional careers?
- What type of prejudice do confirm group self-discrimination of women in the occupational advancement?

2. Literature Review and Hypotheses Development

2.1. Gender Differences, Gender Inequality, and Gender Discrimination

What is the crucial matter in defining economic discrimination in the labour market is to distinguish between gender differences, gender inequality, and gender discrimination. While gender differences and gender inequality may be considered equally and treated as normal conditions occurring in the labour market without pejorative connotations (Gornick, 1999; Kalinowska-Nawrotek, 2005), insofar gender discrimination is defined as unfair and unequal treatment of individuals not according to their personal characteristics determining their levels of productivity but based solely on their sex (Arrow, 1971). Regarding the results presented by Goldin and Rouse, it is remarkably challenging to judge the employees' productivity without bias. It is worth emphasising that employee assessment is executed by people who are not free from their beliefs, stereotypes and frequently unconscious prejudice also about the level of efficiency due to gender (Goldin & Rouse, 2000). There is a strong connection between stereotypes, prejudice and discrimination. G. Allport presented this mechanism as a chain of discrimination, in which stereotypes are the source for prejudice, which – in turn – causes discrimination (Allport, 1958). The paper was based on the influence of stereotypes on occurrence of both types of self-discrimination, inasmuch as the existence of self-discrimination in the labour market is strongly determined by societal and cultural standards. Social norms held by individuals are determined by values and beliefs, which in turn convey prejudiced ideas, which then express biased attitudes transferring into discriminatory practices, including self-exclusion (Allport, 1958; UNDP, 2020).



Fig. 1. The chain of discrimination

Source: Based on (Allport, 1958).

2.2. Personal and Group Self-Discrimination against Women

Self-discrimination of women is the form of discrimination taking place at two different ranks: the personal (self-limitation due to social expectations) and group level (inter-group processes) (Camussi & Leccardi, 2005; Bourguignon, Seron, Yzerbyt, & Herman, 2006).

Personal self-discrimination stems from self-categorisation according to culture and socialisation indicated in identity theory. The scope of self-discrimination is determined by the strength of social gender stereotypes with regard to stereotypically considered male and female roles affecting female self-selection decisions at education, and then at entry the labour market and in work. The occupational career, particularly

professional advancement, is hindered by negative self-esteem and traditional beliefs about women's abilities and priorities. The mechanism is similar to self-fulfilling prophecies and negatively affect human capital, chosen occupation and professional path of carrier (Stets & Burke, 2000; Ghirardello, 2019; Anker, Melkas, & Korten, 2003; Polachek, 1981).

In turn, group self-discrimination is an economic counterpart of the queen bee syndrome, introduced by Staines, Tavis and Jayaratne in 1974. The phenomenon was firstly observed in male-dominated organisations in which strong gender-stereotypical expectations led to underestimation of the female professional opportunities. Women emphasised their masculinity, "self-group distancing" was observed as a result. In economic and managerial perspectives women declare that they prefer male heads over female leaders what hampers the chances of advancement of other women (Faniko, Ellemers, & Derks, 2021; Bourguignon, Seron, Yzerbyt, & Herman, 2006). Furthermore, Derks et al (Derks, Van Laar, Ellemers, & De Groot, 2011) affirm that women are their own worst enemies. The rivalry among women is the next mechanism which impedes women's careers.

Personal and group self-discrimination of women are rarely indicated and explained in the literature, especially in the economic perspective despite their self-evident consequences observed in an economy. In general, self-discrimination at both levels affects the processes of self-evaluation, self-categorisation and self-confidence which step-by-step determines female professional decisions, ambitions, career commitments and paths (Stets & Burke, 2000; Mussweiler, 2003; Faniko, Ellemers, & Derks, 2021).

2.3. Glass Phenomena

With reference to barriers in the professional career among women, a complex of terms "glass phenomena" is used. It symbolises the invisible powers which hinder or accelerate getting promoted by women or men in the labour market. A glass ceiling and glass escalator are conventionally mentioned in this group. The glass ceiling is a metaphor applied to represent a hidden strength composing obstacles, including self-imposed by women for themselves and other women, that keep them from rising beyond a certain level in a hierarchy of organisation (Manzi & Heilman, 2020; Wirth, 1998). Afterwards, the glass escalator is an indiscernible accelerator of male careers observed especially in some female-dominated industries (e.g., education) (Othman, 2014; Ryan & Haslam, 2007). Both glass appearances symbolise unseeable forces which work in the opposite directions depending on gender. The glass ceiling obstructs or even blocks women's career while the glass escalator precipitates men's advancement.

2.4. Literature Overview

The number of scientific studies from the CEECs confirm that there are manifestations of personal and group self-discrimination against women simultaneously with the appearance of glass ceiling and glass escalator in the scrutinised region. Both levels of self-discrimination are not necessarily strictly named in the literature, but one can encounter the sources, symptoms, and effects of their occurrence in each of these labour markets.

Evidences of appearance of self-discrimination in the Polish labour market can be discovered in the results of public opinion surveys conducted by Public Opinion Research Centre (CBOS, 1998; CBOS, 2013). Furthermore, the perception on the glass ceiling issue is delineated in the publication by Titkow (2003). The symptoms of both levels of self-discrimination can be divided into the quantitative (CBOS) and qualitative (Titkow) nature of explanation of their genesis.

The Czech situation in the labour market in gender perspective is widely presented based on stereotypes by Lőrinczy, Stojanová, and Blašková (2016), Kroupová (2009), and in the view of qualitative opinions published by Hejlova (2021), Lituchy, Bryer, and Reavley (2003), as well as of collective opinions more of quantitative character about women managers released by Jurajda and München (2006).

The surveys about the relatively smaller acceptance of female managers in Slovakia, particularly among women (which had the matching standards to those conducted by CBOS in Poland in 1998) were published by research teams composed of Křížková and Pavlica (2004), and Dobrovič et al (2019). Furthermore, the analysis of gender inequality at the managerial positions with usage of qualitative descriptions may be found in publications by Delgradová and Gullerová (2017), Piscová (2003), Adamus and Ballová Mikušková (2024).

The condition of the Hungarian labour market does not differ from other markets in the region in terms of gender inequality in the managerial positions. Women's reluctance to use positive discrimination with usage of qualitative interviews is presented by Nagy (2003; 2005; 2014). In turn, the analysis of the differences between female and male managers is portrayed by Oborni (2021).

The Slovenian labour market differs from the other analysed states. Nevertheless, gender inequality in the promotion sphere remains. The analogical background of the situation is depicted in views by Othman (2014), Fink-Hafner (2009), Šandl (2009), Tomec, and Gričar (2024).

In general the trigger points for self-discrimination of women are analogous in all the analysed countries. Gender stereotypes affect both the hierarchy of values and the perceptions of chances for the professional carrier differentiated by sex. The first group of stereotypes pertains to the managerial skills by sex. According to social convictions, while men are perceived as born managers women must learn how to become a manager. These beliefs conduce to contrasting classification of employees by gender not by skills, activating "glass phenomena" – the glass ceiling among women and the glass escalator among men. In the second group different treatment of parents by sex consists of opinions that while women are overburdened with household responsibilities, men have to work to earn money. As being a father triggers becoming a manager, being a mother – definitely oppositely. The third category of convictions partly refers to the first one. While men are better (than women) managers, women are worse (than men) managers. In result, men and women do not want to work under the female boss as eagerly as under the male boss. To summarise all the above mentioned gender stereotypes are the source for appearance and maintenance of personal and group self-discrimination of women.

2.5. Hypotheses

In the course of analysis two hypotheses concerning the CEECs in 2004-2025 are verified. The first one is as follows: the effect of personal and group self-discrimination of women reduces their share among managers. In compliance with the second hypothesis: stereotypical thinking about the gender roles in society, which causes „glass phenomena”, and in turn weaken women' (the glass ceiling) and concurrently strengthen men' (the glass escalator) opportunities of getting managerial positions.

3. Material and Methods

In the first place, the situation in the light of the statistical data in the CEECs in 2004-2024 is presented. Two perspectives are considered to be crucial: the participation of women in the group of employees working as managers and the difference between the share of women and the share of men with higher education level (Gender Tertiary Education Gap). Both indicators determine the scale of differences between men and women in the labour market in the context of managerial positions and human capital.

The second and third parts of the study are focused on examination of public opinions expressed by men and women in the group of scrutinised countries. To ensure the comparable methodology, the results of Eurobarometer surveys, conducted in the EU countries, published in the years 2004-2025, are used. In this part of research the answers given by respondents are presented in aggregated way, namely: “agree” instead of “totally agree” and “tend to agree”, and analogically “disagree” instead of “tend to disagree” and “totally disagree”. To unify the method of data presentation the third category occurs mostly as “don't know” (which contains occasionally “it depends”). Access to the results of the surveys is limited, ergo the presentation of

opinions is made on the basis of available data within the time range. Attention is concentrated on beliefs that influence promotion decisions made in economic organisations. Importantly, some social beliefs may influence the occurrence and intensification of both categories of self-discrimination against women, but the classification has been made on the basis of a subjective assessment of more power influence on either personal or group self-discrimination. The categorisation was made in order to conduct this investigation, albeit it can be subject to further scientific discussion and reconsideration. To be precise the note is done about the chosen beliefs and their potential influence on either personal and group self-discrimination, but the results of public opinion are presented only once. Figures contain merely the label data which suggest self-discrimination but the other statistics. An important contribution to the science of further self-discrimination research is to draw attention to methodological fallacies in conducting surveys and the need to introduce a neutral way of asking questions in order to avoid systematic inaccuracies in measuring the scope of gender in/equality (de la Torre-Pérez, Oliver-Parra, Torres, & Bertran, 2022).

3.1. Statistical Framework

At first, the statistical data for the years 2004-2024 should be discussed in the form of the average contribution of women in the group of managers in given countries. The highest average percentage of women working as managers was recorded in Poland – 39.2%. Slightly lower share was observed in Hungary (38.1%) and Slovenia (36.6%). A lower contribution of female managers was noted in Slovakia (32.9%) and the lowest – in Czechia (27.9%) (Eurostat, 2025a). The conclusion referring to the fraction of female managers in the CEECs is that a parity among managers has not been achieved thus far. Furthermore, there are various lengths of a way to go to break the glass ceiling¹ – from 10.8 p.p. in Poland to 22.1 p.p. in Czechia.

The second significant factor, which characterises a potential manager, is their education level. Having a university degree is the most desirable for managerial staff due to the highest level of human capital. Considering the Gender Tertiary Education Gap (GTEG) understood as the difference between the percentage of women with university education level (ISCED 5-8) and the corresponding percentage of men, it can be noticed that there are substantial discrepancies in this area in favour of women. On average, the largest GTEG was registered in Slovenia (20.3 pp). The next in the ranking was Poland with the value of 16.4 pp. and the following were Slovakia (12.4 pp) and Hungary (10.5 pp). The smallest number of GTEG was observed in Czechia (9.5 pp). First and foremost, definitely the share of women with the university level of education was higher in all countries in comparison to men. The disparities between genders in the aspect of the university education were in the range between 9.5 and 20.3 pp. The most substantial change in the GTEG was observed in Slovakia (16.9 pp difference between the extreme years) and Czechia (14.8 pp). The following countries were Poland (9.7 pp), Slovenia (7.7 pp) and Hungary (6.0 pp). The crucial observation is that the disparities between women and men in the sphere of tertiary education were dynamically increasing in favour of women. The next reflection is that the pace of increase of the level of human capital among women is not followed by adequately fast pace of growth of their share among managers in the same region and time frame.

¹ The parity in management according to sex is obtained in a situation in which the shares of men and women among managers are equal and yield 50% for men and 50% for women.

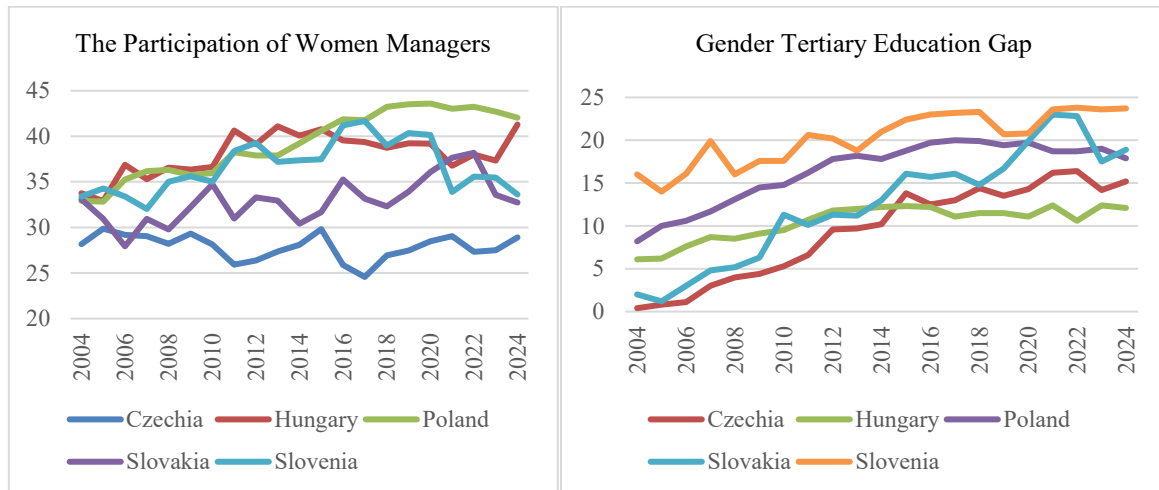


Fig. 2. The statistical data on gender inequality the CEECs in 2004-2024

Source: Own calculations based on (Eurostat, 2025a), (Eurostat, 2025b).

3.2. Personal Self-Discrimination

Social beliefs that are a source of personal self-discrimination, expressed by women from Czechia, Hungary, Poland, Slovakia and Slovenia, can be classified into the following groups: lack of interests to be a manager and family responsibilities.

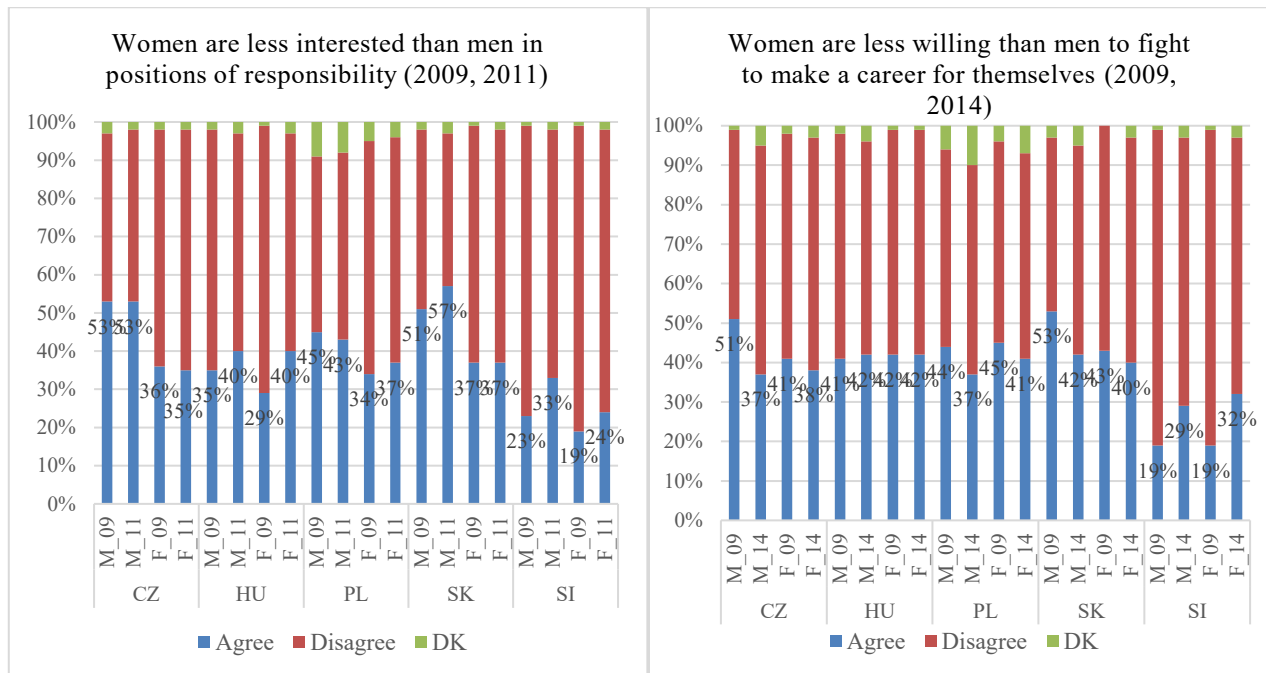


Fig. 3. Distribution of declarations on the lower interests and willingness to be a manager among women in the CEECs in 2009, 2011 and 2014

Source: Own calculations based on: (Eurobarometer, 2009; 2012; 2015).

The first group of factors fostering the appearance of personal self-discrimination of women includes beliefs that women are less than men interested in performing managerial functions. The essential reflection comes to the way of posing the question which is addressed merely to women. To obtain a full vision of gender inequality in these circumstances, the question should be raised to representatives of both sexes and then the

results should be compared (*Are you interested in positions of responsibility? Are you willing to fight to make a career for you?*). A priori assumption that women are not inherently interested in performing managerial roles and that they do not want to fight for a professional career can contribute to the emergence of both personal and group self-discrimination. In the first case, we are dealing with the self-exclusion of women from considering professional promotion as a part of their careers, in the second – with the exclusion of a group of women who may be potential candidates, but are not taken into account due to the misguided assumptions. On average, in 2009 and 2011 pointing to the reason for the lower presence of women in the professional group of managers, women (33%) were less likely than men (43%) to agree with the opinion that women are less interested in professional promotion. Among the average values which characterise the CEECs the highest percentage of agreement occurred in the Czech Republic (where we *de facto* have the lowest percentage of female managers), and the lowest in Slovenia (25%). Despite the fact that the highest percentage of female managers was observed in Poland, an average of 40% of respondents from this country agreed with the posed statement. The group of women who are convinced that the interest in the process of professional promotion is lower among women than among men can be a source of personal self-discrimination.

The smaller discrepancies between the sexes in declarations expressed in 2009 and 2014 occurred in a case of request about potential willingness to take activities in furtherance of making a professional career. On average, women (38%) were slightly less likely to agree than men (40%) with the statement that women are less willing than men to fight to make a career for themselves. Quite a high level of consent among women in this situation can speak in favour of appearing of personal self-discrimination. Women more often than men assume that it is not worth fighting for the next levels of their professional careers and thus condemn themselves to lack of promotion. When examining the answers by countries, the highest level of agreement to lower interest of women in being promoted was noted in Slovakia (45%), the lowest one and significantly lower than other states – in Slovenia (25%). The other countries were characterised with the same mean level of approval (42%).

The second group of sources of personal self-discrimination of women includes issues related to the family responsibilities. This factor was classified as affecting the level of personal self-discrimination of women. Provided that a woman agrees with the social beliefs and gender stereotypes due to the distinct socialisation by sex, the decisions, she makes over her professional lifetime, are closer to the fulfilment of social norms than to make a professional career in the managerial group. Women who stand out from outside of socially permissible patterns of behaviour classified by sex experience various dilemmas, including token status (Kander, 1977). Furthermore, many public opinion polls have been conducted on the issue of dividing the female time budget between the household chores and work. The first fundamental question that should arise is that in research it is assumed in advance that it is the woman who is responsible for "household matters". No one poses above-mentioned issues to men. If we were to turn the questions around: *Do you agree with the sentence?*, they would be as follows: *Men should give priority to their family responsibilities over their career; All in all, family life suffers when the father has a full time job; Men have less freedom because of their family responsibilities*. Be that as it may, the answers in neutral version should be posed without mentioning a gender, therefore:

- *Should you give priority to your family responsibilities over your career?*
- *Does your family life suffer when you have a full time job?*
- *Do you have less freedom because of your family responsibilities?*

The questions seem illogical, if we address them to men, thus why they are asked over and over again solely to women, who are much more likely to have a higher level of education than men?

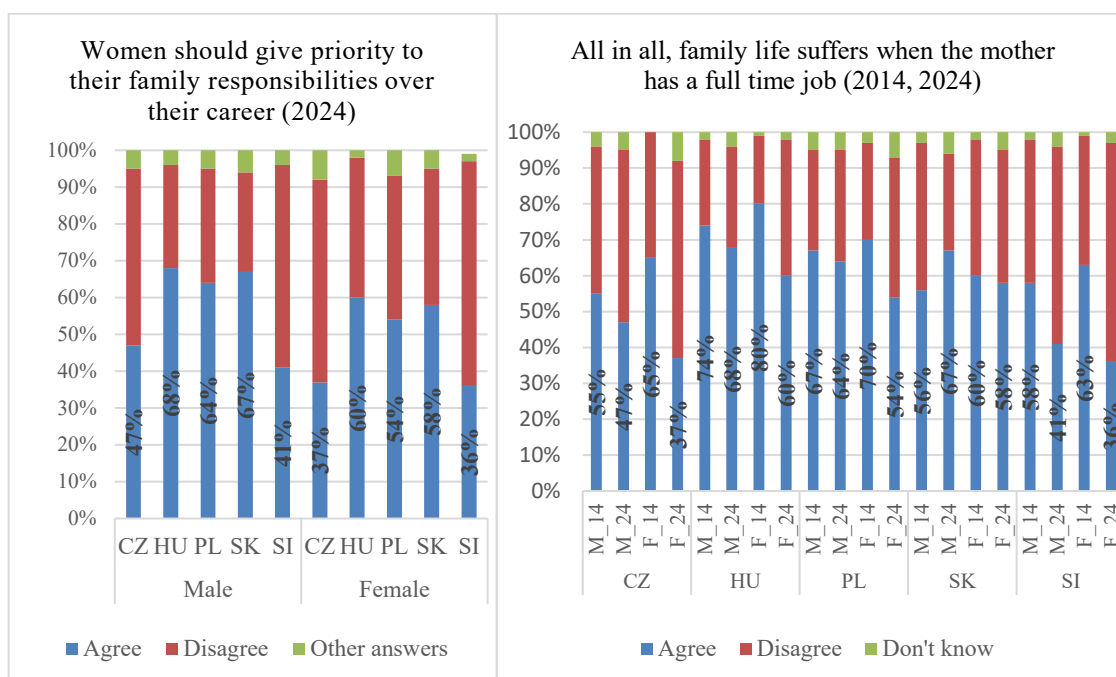


Fig. 4. Distribution of declarations pertaining to family responsibilities in the CEECs in 2014 and 2024

Source: Own calculations based on: (Eurobarometer, 2012; 2024).

Returning to the research results, the first question refers to the women's priority to their family responsibilities over their careers. On average in 2024, the level of agreement differed between women (49%) and men (57%). The highest consent with the statement was noticed in Hungary (64%), the lowest – in Slovenia (39%). The next question posted in 2014 and 2024, according to which *All in all, family suffers when the mother has a full time job*, on average raised a high level of agreement among women (58%) and men (60%). While the differences in the responses given by men and women were not strongly different, there were significant contrasts between countries. The highest level of approval was observed in Hungary (71%), the lowest level – in Slovenia (50%).

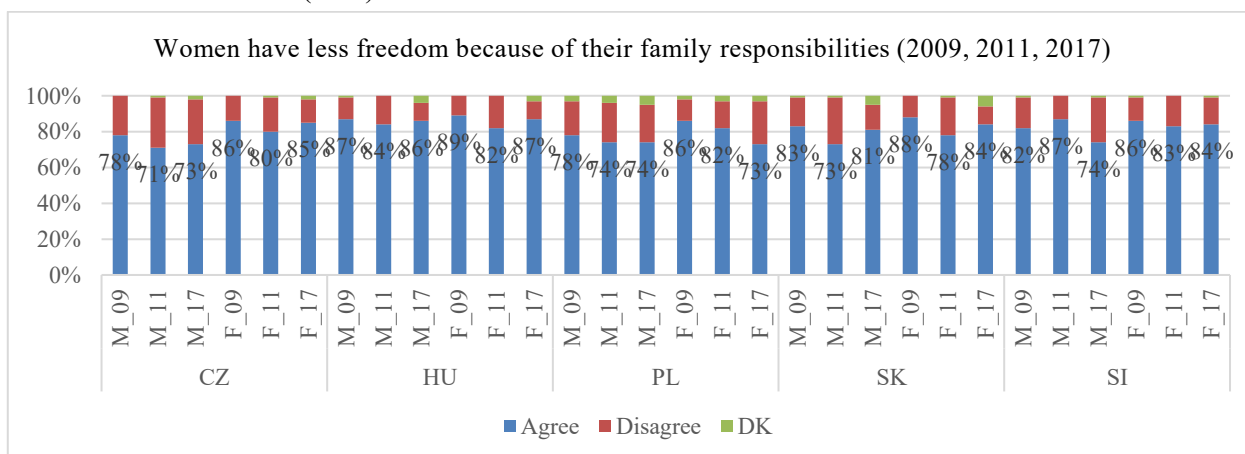


Fig. 5. Distribution of declaration that women have less freedom because of their family responsibility (by sex and country in 2009, 2011, and 2017)

Source: Own calculations based on: (Eurobarometer, 2009; 2012; 2017).

The third question contented declaration that *Women have less freedom because of their family responsibilities*. On average, 79% of women and 84% of men agreed with the declaration that belonged to the

most researched topics due to the most numerous availability of data in this area (2009, 2011, and 2017). Regarding the answers given by respondents of scrutinised countries, the highest level of mean agreement was noted in Hungary (86%), the lowest – in Czechia (79%).

3.3. Group Self-Discrimination

Social values inherent in the CEE societies and which can be a source of group self-discrimination of women have been classified into the following clusters: social acceptance to gender equality in management, lack of skills in women to be a manager, and assessment of female managers.

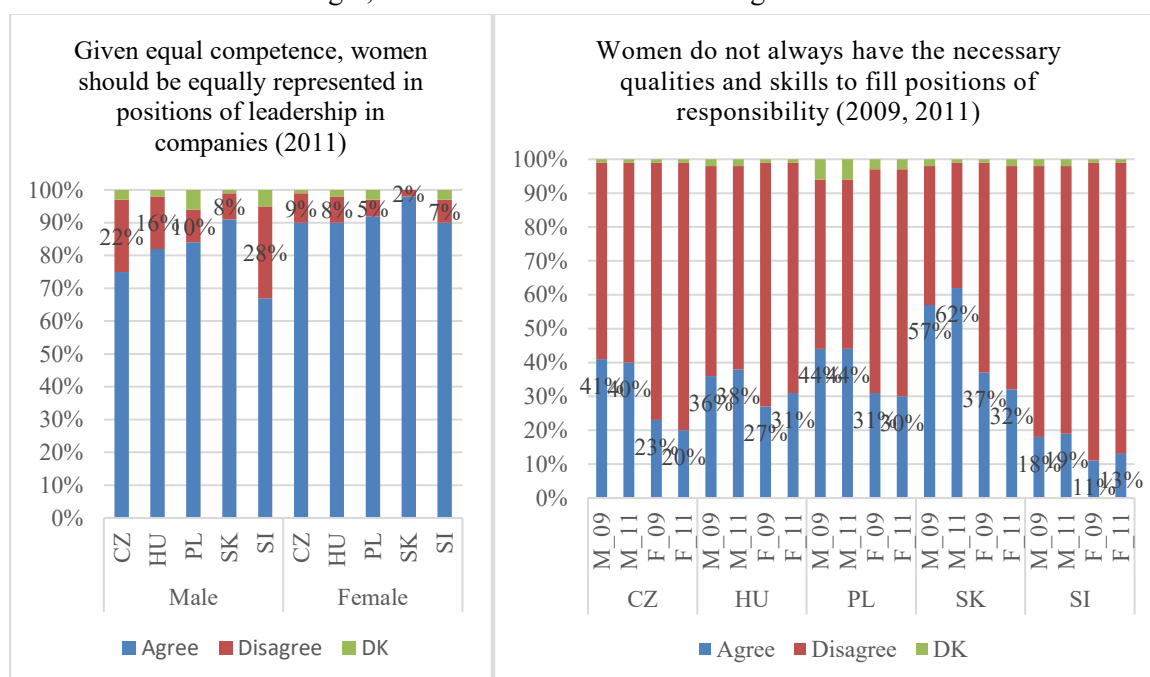


Fig. 6. Distribution of declarations on the statements pertaining to gender equality and female managerial qualities in the CEECs in 2009 and 2011

Source: Own calculations based on: (Eurobarometer, 2009; 2012).

Public acceptance of gender equality in economic organisations manifests in support for equal opportunities, among others in the equal representation of men and women in managerial positions. The lack of societal approval for women's professional advancement can be a significant barrier to undertaking initiatives conducive to becoming a manager. It is simultaneously the source of group self-discrimination of women which is the result of the diverse socialisation undergone by representatives of both sexes in childhood. While in the socialisation of boys a support of active behaviour dominates, in the socialisation of girls fostering of passivity and subordination is more prevalent. The mechanisms learned in early socialisation of children in society, immersed in social values, norms, stereotypes and prejudices, result in education segregation and then job segregation according to sex (Kalantari, 2012; Getik & Meie, 2021). Cultural standards differentiated according to gender have impact on gender-based sorting across occupations and positions in hierarchy of organisations (Morales & Marcén, 2024). Furthermore, Allport's chain of discrimination, including self-discrimination, begins with stereotypes and the convictions about gender roles in society. Most interviewees were convinced that given equal competence, women should be equally represented in positions of leadership in companies, yet there are ever-present groups of respondents who did not agree with this opinion in the CEECs in 2011. The average level of discriminatory answers was higher among men (17%) than women (6%). Slovenians were the nation in which the percentage of disagreement with gender equality in the issue of women's management was the lowest (5%), while Slovaks were at the opposite pole (18%). The extent of female self-discriminatory responses was

significantly of lower coverage: from 2% in Slovenia to 9% in Czechia. Notwithstanding the low share of disapproval to female representation in leadership positions, the above mentioned conviction observable among women strongly suggests occurrence of group self-discrimination in the CEECs.

On the other hand, the ratings for having the necessary qualities and skills to fill positions of responsibility were strongly divided in 2009 and 2011. On average, Slovaks most often expressed opinions about the lack of female preparation for a managerial role (47%), while Slovenians – the least frequently (15%). Significant differences were also visible between the sexes. On average, 33% of CEECs' residents were negative about women's ability to be managers, with as many as 40% of men and 26% of women sharing this opinion. Therefore, among women we encounter group self-discrimination, manifested by the belief that women are not prepared to be a manager, albeit the statistical data indicate a higher level of human capital acquired during their studies at the university level than among men. The self-esteem of human capital among women is lower than in reality what impedes their decisions about their (personal self-discrimination) and other women' (group self-discrimination) professional advancement. What matters, analogical questions are not directed to men (a version of a question addressed to men: Men do not always have the necessary qualities and skills to fill positions of responsibility), although they were on average with a lower level of education. Ultimately, the question should be posed neutrally: Do you have the necessary qualities and skills to fill positions of responsibility? and then the responses should be compared according to sex.

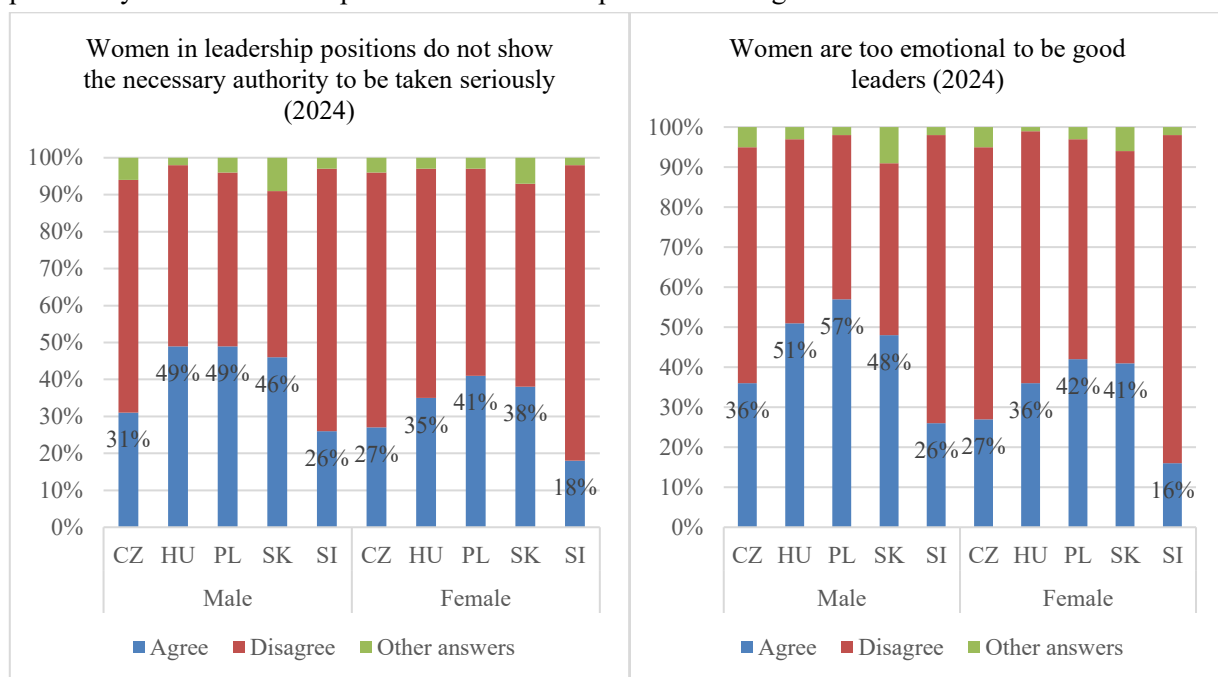


Fig. 7. Distribution of opinions about women in the leadership positions in the CEECs in 2024

Source: Own calculations based on: (Eurobarometer, 2024).

The next group of factors conducive to the formation of group self-discrimination of women is the way of assessment of female managers. The first notice is connected with the observation that there are no analogical questions addressed to men and women. The questionnaires are created based on the gender stereotypes what influences the results. The available surveys with the enquiries containing the following suggestions to agree or disagree with statements: Men in leadership positions do not show the necessary authority to be taken seriously or Men are too emotional to be good leaders do not exist. Moving towards eliminating the stereotypical beliefs about men and women in managerial roles, the questions could be modified into sentences as follows: Men in leadership positions do not show the necessary level of empathy and Men are too aggressive to be good leaders. In the long run, the questions should be of a neutral character,

namely: Do you show the necessary authority to be taken seriously? or: Are you too emotional/aggressive (other suggestions) to be good leader?

Questions, posed in 2024 to respondents referring to women as managers, have a character that a priori discredits them strongly in these roles. Furthermore, Arrow's statistical discrimination (Arrow, 1971) is noticed in the formation of questions due to mismatch between the evaluation of an individual regardless of gender and a particular person who is a candidate to be a manager. The advance judgement is made with assumptions applying to gender stereotypes and beginning with the indication that assessed women are characterised with stereotypical qualities associated with "typical" women. Regardless of the possibility that respondents can choose from the cafeteria of answers, as mentioned above, notwithstanding the most important matter is that the question contains a gender-discriminatory suggestion and it can be described as the misleading operationalisation of research problem. On average, residents of CEECs in 38% agreed with the opinion that women are too emotional to be good leaders, yet again men more frequently (44%) than women (32%) supported this judgement. Interestingly, because most often Poles (50%) agreed with this gender stereotype, while Slovenians (21%) – the least. Once again, it would be thought-provoking if we turned the query around and addressed it to respondents in the following form: Women make better leaders than men. Here we have completely different suggestion: men are worse managers than women. Despite the fact that respondents may deny, but the gender-based prejudice question contained in it is extremely strong and can determine response supporting the negative viewpoint.

Table 1

Distribution of answers to a question *Would you personally prefer to work with a woman or man as a boss?* (on the left) and about who makes better leader (on the right) in Poland and Slovakia

Speci- fication	Men			Women		
	Poland		Slovakia	Poland		Slovakia
	2006	2013	2019	2006	2013	2019
Man	41	38	22.97	37	35	44.30
Woman	8	9	13.51	9	10	3.80
No matter	49	52	63.52	49	54	51.90
DK	2	1	-	4	1	-

Men make better leaders than women (2024)

Gender	Country	Agree (%)	Disagree (%)	Other answers (%)
Male	CZ	40%	59%	1%
	HU	64%	35%	1%
	PL	70%	29%	1%
	SK	37%	63%	0%
	SI	31%	69%	0%
Female	CZ	39%	61%	0%
	HU	46%	54%	0%
	PL	52%	48%	0%
	SK	21%	79%	0%
	SI	21%	79%	0%

Addendum: DK – Hard to say, only in Poland. There was no such a question in the survey conducted in Slovakia.

Source: (CBOS, 2013; Dobrovič, et al., 2019).

The subsequent issue refers to women's dislike for cooperation with female managers. Unfortunately, there are surveys conducted solely in Poland in 2006 and 2013 and Slovakia in 2019. According to these polls among women there is a dislike for cooperation with women managers, which is the most powerful confirmation of the occurrence of group self-discrimination against women. Analysing these statements from Poland in more depth, it turns out that among the reasons for the reluctance to cooperate with female managers is the lack of such experience and the association of female managers in the light of the stereotypical perception of women and their character traits. Public Opinion Research Centre confirms that working under managers

of both sexes reduces prejudice against both genders (CBOS, 2013).

Conclusion

Summarising the examination of the phenomenon of self-discrimination of women in the personal and group perspective in the CEECs in 2004-2024, the most significant outcomes should be presented. The findings pertain to personal and group self-discrimination, the methods of conducting surveys and the direction of further research.

All things considered, the statistical data from the CEECs in 2004-2024 irrefutably show that more women than men have a university education level which should convey to at least gender equality and parity in management in the analysed countries. Unfortunately, there is the substantial disparity between percentage of men and women in the managerial posts and definitely far from equality to the detriment of women. A qualitative analysis of the public opinion surveys conducted in the CEECs results in the numerous findings connected with personal and group self-discrimination of women in the sphere of promotion in companies in the examined states. Self-discrimination against women has many faces. On the one hand, we are dealing with personal self-discrimination, which manifests itself in creating a barrier to social advancement to women, despite their higher education level in relation to men. Socialisation differentiated according to gender causes educational segregation at first, and then occupational segregation not only horizontally, but also vertically according to Allport's chain of discrimination. Women self-exclude from the professional promotion with lower interest of being a manager and family responsibilities. On the other hand, group self-discrimination of women consists in a weaker evaluation of female managers, as well as a reluctance to cooperate with women. This may be due to the lack of experience of such cooperation, but also the social conviction that men are born managers and women should learn to manage. Various beliefs present in society self-create a glass ceiling for women and concurrently a glass escalator for men.

With regard to the methods of performing research in the field of discrimination and gender inequality, there is a strong need to alter the methodology of surveys conducted. Reading the attainable studies leads to the idea about requirements to scrutinise and modify the method of interviewing addressed to men and women on issues of managerial functions. The questions must not suggest that one of the sexes is more or less suitable for managerial functions because then they are definitely of discriminatory character. Secondly, the postulate is to introduce gender equality into research and gender equality among managers. The essential change consists in addressing analogical (the best solution: identical) questions to both genders or in the neutral form. Gender equality involves conducting mirror analyses for both sexes – if we ask whether women want to be managers, we should also ask an analogous question to men: do men want to be managers. Then there is a possibility of a real comparison of the results and determining the extent of gender differences.

The direction of further research should be presented at the end of consideration on personal and group self-discrimination. The last chapter – as it calls Claudia Goldin (2021) – may be examination of the specific scope of women' self-discrimination. Inclusion of the feminine point of view to process of governing converges companies to diversity management and more equal chances world.

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Problems and Challenges Associated with the Instruction and Assessment of Student Competencies in the Theory of Control Course in a Distance Learning Environment

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Abstract

This report seeks to examine several fundamental challenges encountered in the distance learning of students in academic disciplines related to accounting and control. It argues that recent political and social transformations in the economy and society have elevated education to a crucial role in facilitating the successful integration of young people into the labour market. The report identifies the primary users of this educational service. Appropriate attention is given to the effectiveness of distance learning and its role within the broader educational system, particularly in terms of opportunities for the education and training of the individual. While distance learning has a place in the educational system, it is argued that it is more closely associated with training than with comprehensive education. Foundational, broad-based training in a given field should be acquired through students' physical presence at the university, as it is precisely this immersion in the academic environment that fosters the intellectual growth of young people. Building on this foundation, individuals can further develop their knowledge and skills in specific subject areas by participating in short-term courses, which are more focused, targeted toward the acquisition of particular competencies, and practically oriented.

Key words:

distance learning; theory of control; education, training; assessment.

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1. Introduction

In the contemporary context, the term *distance learning* is generally understood as a set of educational services delivered to broad segments of the population, both nationally and internationally, through the use of modern information and communication technologies. Essentially, distance learning represents a form of continuing education that facilitates the implementation of the lifelong learning paradigm, thereby ensuring individuals' right to access education and information. The foundation of distance learning rests on the principle that the educational system should ensure equal access to education for all interested individuals - including pupils, students, the unemployed, and the economically inactive. This, in turn, contributes to raising the overall educational level across increasingly wider strata of society by leveraging the expertise and resources of leading universities, academies, professional development centers, and other educational institutions.

2. Literature Review

An analysis of labor market trends shows that even during the twentieth century, a significant number of people continued to aspire to attain higher levels of education. However, due to factors such as geographical remoteness from university centres, social isolation, physical disabilities that prevent regular attendance, and other limiting circumstances, the educational needs of these individuals could not be fully addressed within the framework of traditional education systems. In this regard, although distance learning is intended to serve all members of society, it is generally accepted that it should primarily target the following categories of

learners:

- Individuals who are unable to take advantage of traditional educational services due to the need to search options for balancing study with work, geographical distance from university centres, or other reasons;
- Economically inactive individuals, including the unemployed;
- Individuals who have completed their formal education but seek to pursue higher academic qualifications or retrain in response to evolving labour market demands;
- Dual-degree candidates who aspire to pursue studies in two distinct academic majors simultaneously;
- Professionals whose specific occupations or work schedules prevent them from full-time attendance at a university or other higher education institution;
- Medical patients requiring prolonged hospitalization;
- Large numbers of working adults who completed their education long time ago and wish to acquire new knowledge and skills;
- Shift workers, athletes and other professional whose schedules and occupational demands prevent adherence to conventional educational timetables and program structures;
- Individuals serving sentences in correctional facilities;
- Individuals with disabilities or physical impairments;
- Women on maternity leave.

In today's rapidly transforming economic, political, and social landscape, where these changes affect all sectors of the economy and society to varying degrees, education is increasingly recognized as a critical factor for successful integration into the labour market. This trend is driven by the continuous advancement of technology, which steadily raises the demand for higher levels of education and professional qualifications across the workforce. Structural changes in the economy further generate an acute need for highly qualified specialists across all sectors, including marketers, financial experts, accountants, and related professions. Moreover, the rapid pace of change across all areas of life renders knowledge and skills acquired in the past increasingly obsolete, highlighting the necessity for on-going upskilling and reskilling of the labour force. In this regard, the development of distance learning, underpinned by modern information technologies, emerges as a natural and necessary response to the evolving demands of the educational system and society at large.

The development of distance learning is occurring within the context of global transformations in education, which are characterized by:

- The massification of education, providing increasingly broader segments of the population with the opportunity to obtain higher educational qualifications;
- The growing recognition of the role of education in fostering both individual personal development and the advancement of the economy and society as a whole;
- The adaptation of educational processes to meet the needs and requirements of individual learners.

The correspondence course is widely regarded as the precursor to modern distance learning. It was first introduced approximately 150 years ago, in the distant 1856, when Charles Toussaint, a French language instructor at the University of Berlin, and Gustav Langenscheidt, a member of the Berlin Society for Modern Languages, established correspondence courses in foreign languages in Germany. They developed a method for delivering learning materials, assignments, and other instructional resources to students via mail. This innovation enabled individuals to enrol in and complete these courses without interrupting their professional commitments. Over time, this form of distance education gained increasing popularity and expanded both in the United States and across Central and Eastern Europe.

With regard to distance education - or, as it is commonly known in its modern form, distance learning-researchers have proposed various approaches to its study, addressing both its origins and the definition of its fundamental nature. Some authors (Peters, O., 1983) attribute the rise of distance learning to the shift towards

industrialization and the massification of education. Others (Holmberg, 1989; Moore, 1973) highlight the physical separation between educators and the learners as a defining characteristic. A third group (Garrison, 2000), reflecting on the effectiveness of this type of education, argue that the lack of direct contact between educators and learners can be compensated for through the development of appropriate electronic learning materials, among other means. As for the essence of the concept itself, researchers also advance diverse - and at times, highly contradictory perspectives. Some authors (D. Mielke, 1999) conceptualize distance learning as a method of instruction; others (Polat, E., 2004; N. Raycheva, 2011) define it as a form of education, while a third group focuses on: a) instructional guidance (from educators to students— my(author's) note Sv. St.)(J. Hill, 1997); b) physical separation between educators and learners (B. Willis & J. Dickinson, 1997); c) education that requires teaching and communication between educators and learners through electronic and other technologies (D. Keegan, 1993).

Teaching accounting disciplines - as well as those related to controlling - to students enrolled in distance learning programs follows a logic that differs substantially from the approach used in traditional (on-campus) education. For example, electronic textbooks developed for distance learning must meet a range of specific requirements, including the following:

1. Didactic Requirements:

1.1. The content of electronic textbooks should be structured into modules composed of concise and thematically coherent units;

1.2. The instructional material should guide students through the subject matter in a systematic and logically progressive manner, beginning with relatively simple concepts and gradually advancing to more complex topics;

1.3. The electronic textbook should provide opportunities for self-assessment by learners (regarding their level of mastery of the material) through completing tests incorporating various types of questions;

1.4. The electronic textbook should include methodological guidelines that direct learners through the logical sequence in which the educational material should be studied.

2. Content Requirements

2.1. Relevance. The electronic textbook must present the most current information on thematic units included in the curriculum of the academic discipline under study. This requires that the educational material in each topic be updated practically on an annual basis;

2.2. The individual thematic units within the electronic textbook should be practically oriented and incorporate case studies from real-world practice within the relevant field of study. This approach will enable students to understand how the theoretical knowledge acquired in the discipline can be applied in practical contexts;

2.3. The electronic textbook should be characterized by interactivity, meaning it should contain links to additional online resources or electronic documents;

2.4. The electronic textbook should demonstrate interdisciplinary connections, allowing learners to comprehend the relationship between the studied academic discipline and other disciplines included in the curriculum of their specialty.

3. Technical Requirements

3.1. The electronic textbook must be available in both PDF format and a web-based version, ensuring compatibility with a range of devices, including: desktop computers, laptops, tablets, mobile phones, other electronic devices.

3.2. The electronic textbook should be compatible with various learning management systems, such as Moodle, Kajabi, Vedomo.

3.3. The electronic textbook must provide efficient search capabilities for students, incorporating: hyperlinks, indexes, an intuitive navigation structure, etc.

4. Pedagogical Requirements

4.1. The electronic textbook should foster interest and intrinsic motivation among learners, encouraging them to actively engage with the educational content of the discipline;

4.2. Each electronic textbook should feature uniform headings for all topics and maintain a consistent structure across all thematic units;

4.3. In developing the electronic textbook, a consistent font type and size should be used, along with appropriate graphical elements to support the layout of each topic.

One of the most widely used methods for assessing the knowledge and skills of students in distance learning is the computer-based electronic test. This form of assessment is appropriate for evaluating students' progress at different stages of the learning process: at the beginning of the semester (entry assessment), during the semester (formative assessment), and at the end of the semester (summative assessment). While entry and formative assessments can effectively measure students' knowledge and skills through tests containing one or two types of questions, it is advisable that summative assessments include a greater variety of question types. Such an approach allows instructors to evaluate multiple dimensions of students' understanding and provides continuous feedback on their acquired knowledge and skills throughout the semester, thereby supporting a more objective and comprehensive evaluation of their overall performance.

3. Material and Methods

The empirical research was conducted during the January 2025 examination session based on the examination results of 32 students enrolled in the Theory of Control course. The participants were students from the Accounting and Audit program, studying via distance learning. The examination test was of a combined type and comprised a total of 70 questions, as follows: (a) five (5) numerical questions, (b) twenty (20) true/false questions, and (c) forty-five (45) multiple-choice questions, each containing four alternative answers, only one of which is correct. The analysis of the questions was carried out entirely using the statistical tools embedded in the Moodle platform, through which the examination test was administered. Specifically, the analysis focused on the following indicators: a) Average score of initial attempts; b) Overall average score; c) Average score of final attempts; d) Average score of highest-scoring attempts; e) Median of the scores for the highest-scoring attempt's) Standard deviation for the highest-scoring attempt; g) Skewness of the distribution for the highest-scoring attempt; h) Kurtosis of the score distribution for the highest-scoring attempt; i) Internal consistency coefficient (Cronbach's alpha, α); j) Relative error for the highest-scoring attempt; k) Standard error for the highest-scoring attempt (see Table 1)

Table 1

Values of Metrics Characterizing the Results of the *Theory of Control* Exam

No	Metric Name	Metric Value
1.	Average Score of Initial Attempts	64,05%
2.	Overall Average Score	64,05%
3.	Average Score of Final Attempts	64,05%
4.	Average Score of Highest-Scoring Attempts	64,05%
5.	Median of Scores	66,67%
6.	Standard Deviation	15,44%
7.	Skewness of the Distribution	- 0,7580
8.	Kurtosis of the Score Distribution	0,6850
9.	Internal Consistency Coefficient (Cronbach's Alpha, α)	85,88%
10.	Relative Error	37,58%
11.	Standard Error	5,80%

Based on the data from Table 1, it can be observed that:

1. The values of the indicators Average Score of Initial Attempts, Overall Average Score, Average Score of Final Attempts, and Average Score of Highest-Scoring Attempts (64.05%) are identical. This is due to the fact that students were allowed only one attempt at completing the test, which is typical for formal examinations;

2. The Median of Scores indicator (66.67%) is higher than the mean value and effectively divides the examined students into two equal groups: one half achieved scores lower than or equal to the median, while the other half achieved a score higher than or equal to it. The fact that the median exceeds the mean can be interpreted positively, suggesting that the majority of students performed well. Most students received a grade of “Good (4)” on the six-point grading scale, although, naturally, some performed above this level while others scored lower.

3. Based on the Standard Deviation indicator (15.44%), it can be concluded that most student results are distributed within the range of $64.05\% \pm 15\%$, or, in other words, between approximately 49% and 79%. This corresponds to grades between “Satisfactory (3.00)” and “Very Good (5.00)” according to the university’s adopted scale for assessing students’ knowledge, skills, and competencies. Furthermore, the magnitude of this indicator demonstrates that the students’ scores are appropriately dispersed relative to their level of knowledge and skills demonstrated during the examination. Therefore, the test provides a clear opportunity to differentiate students based on their knowledge and skills, as well as on their ability to apply the acquired theoretical knowledge to solving practical cases. It can be concluded that the group is highly heterogeneous with respect to the level of acquired knowledge and skills in the Theory of Control course. Some students demonstrated very good or excellent knowledge, while others achieved considerably lower results.

4. The Skewness of Distribution indicator (-0.758) shows a moderately left-skewed distribution. This supports the conclusions drawn from the previous indicators that the majority of students scored above the mean, while a smaller number of students achieved lower scores, forming the left tail;

5. The Kurtosis of Score Distribution indicator ($\approx 0,686$) indicates that the distribution of results approximates a normal curve. It also shows that the test has centered students’ performance around the mean, while still allowing for clearly defined extreme scores. Given the total number of 32 students, this should be interpreted more as a trend rather than a definitive conclusion;

6. The Internal Consistency Coefficient (Cronbach’s Alpha, α) indicator indicates the extent to which all questions in the test collectively assess the same knowledge and skills. When the coefficient assumes high values, it can be concluded that all test items together evaluate the same set of knowledge and skills. Conversely, low values would suggest that the questions measure different types of knowledge or that a substantial number of answers were given randomly. In this particular case, the coefficient value (0.86) is high, which allows us to consider the test as highly reliable. This means that students who answered some questions correctly were also likely to perform well on the remaining questions. Consequently, it can be concluded that the constructed combined computer-based test is a very reliable instrument for assessing students’ knowledge and skills in the discipline. The test items are appropriately selected and complement one another, producing objective results that clearly differentiate students based on their acquired knowledge and skills in the course.

7. The Relative Error indicator (37.58%) suggests that the average score (64.05%) alone is not a sufficiently reliable measure on which to base conclusions regarding the reliability of the exam results. When considered in conjunction with the Standard Error indicator (5.80%), it can be inferred that the true mean score likely lies within the interval of $64.05\% \pm 5.80\%$. Therefore, the average score should always be interpreted alongside other indicators - such as the median.

It is an undeniable fact that, with great desire and a serious approach - including motivation and discipline - toward the educational process, students can acquire substantial knowledge and skills. Furthermore, the use of modern information and communication technologies allows this form of education to approximate as closely as possible the learning that takes place in a traditional face-to-face setting. When evaluating its effectiveness, learners’ preferences regarding their physical location during the educational process should be taken into

account. Very often, students participate in training while at their workplace or engage in distance learning from the comfort of their own homes. However, it is crucial to consider that the human brain perceives different physical spaces in distinct ways. The office, for instance, is typically associated with work; the home - with relaxation and rest; and the university - with learning and intellectual engagement. Each environment elicits different psychological and emotional responses. For example, the bedroom is a place for sleep; the kitchen is where one cooks or has meals with family; and the living room is a space where people can invite guests or friends to talk, watch movies, or watch television. Naturally, since these spaces have different functional purposes, utilizing them for learning, and in particular, for distance learning, can significantly reduce the effectiveness of the learning process. This is similar to listening to a symphony concert at home instead of in a concert hall: the experience is far less immersive and inspiring -just as exercising at home is generally less effective than working out in a gym. There is another factor contributing to the reduced effectiveness of distance learning, which is that when a person studies remotely, they lose their sense of rhythm. This often occurs because learners engage in online education while simultaneously performing other tasks, whether at home or in the office. This is when the effect of multitasking manifests itself. However, the human brain is structured in such a way that when several activities are performed simultaneously, it constantly switches from one to another, which, according to experts, can lead to a decrease in overall efficiency of about 30%.

In this context, it is important to recognize that distance learning has its rightful place within the educational system; however, it aligns more closely with training than with education itself. We believe that individuals should first acquire a solid and comprehensive foundation in their chosen field of study - something that can only be achieved through education, during which the intellect is shaped. Thereafter, one can build upon this foundation by expanding their knowledge and gaining practical competencies through specialized training programs. Such programs are more narrowly focused and practice-oriented, designed to equip learners with specific knowledge and skills required for professional practice, and are typically conducted over a shorter duration.

Taking all this into account, it is only natural to question why distance learning is often the preferred option - and what drives so many young people to shift from traditional, in-person education to remote learning. The answer is not straightforward, but one of the main reasons appears to be that students are highly pragmatic and are constantly pursuing opportunities to earn more. To make that happen, that is, to generate financial returns, young people first need to acquire specific skills that, once applied in real work settings, will allow them to achieve financial independence. Yet, once they start generating income, the pursuit of broader, fundamental knowledge - the kind that shapes one's intellect - tends to recede into the background, postponed for "better times." Quite naturally, these "better times" often never come. Instead, young people periodically enrol in short-term training courses to maintain their skills at the required level, ensuring they remain employable. In doing so, their personal development is effectively put on hold.

The study of university disciplines shapes the intellect of students. In this regard, students' innate talents must be supported by their intellect. This is precisely why it is necessary for individuals to be educated. It is within the university environment that intellect is cultivated and honed. Every educator strives to teach students for whom learning is a pleasure, while also fostering an environment which students enjoy and encourage their growth. In other words, the university should provide young people with opportunities to cultivate their strengths and contribute their fullest potential to the educational process. Ultimately, students should graduate with a strong sense of self-confidence, equipped with the conviction that they can handle anything and turn their aspirations into reality.

Conclusion

Distance learning offers the opportunity to raise the educational level of ever broader segments of the population through the use of modern information and communication technologies. The latter is of paramount

importance in light of forthcoming political and social transformations in the economy and society, as education increasingly emerges as a crucial factor for enabling young people to successfully establish themselves in the labour market.

As a result of the empirical research on the knowledge and skills of students in the *Theory of Control* course, it was found that the administered exam test allows for a clear differentiation of students based on their examination results, both in terms of their acquired theoretical knowledge and their ability to apply it when solving practical cases.

Despite the undeniable advantages of distance learning, it is important to acknowledge certain factors that may reduce its effectiveness. These are mainly linked to the absence of a true university environment during study, the disruption of a consistent learning rhythm in remote education, and tendency of learners to multitask, often attempting to handle several activities at once while studying. This constant switching of attention typically results in a loss of focus and lowers the overall effectiveness of distance learning.

Therefore, we consider that distance learning has its rightful place within the educational system of the Republic of Bulgaria. However, we believe that it is better suited for shorter more narrowly focused training programs aimed at acquiring specific knowledge and skills necessary for successful integration into the labour market, rather than for comprehensive university education. The intellect of students is shaped within the university environment, providing them with the opportunity to develop their strengths. Moreover, this process reinforces their confidence and belief in their ability to achieve any goal they set out to pursue. Yet, accomplishing this remains a major challenge in distance learning.

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Politics-Driven Sustainability Reporting - How Best Ideas May Fail

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Abstract

Background and aim: The paper explores the growing politicization of sustainability reporting within the European Union, focusing on how political interventions have shaped — and in some cases, undermined — the implementation of the Corporate Sustainability Reporting Directive (CSRD). The study aims to critically assess the recent “Omnibus” legislative package and its implications for corporate transparency and the EU’s sustainability agenda. *Scope:* The analysis is limited to the CSRD regulatory framework, excluding detailed examination of ESRS and CSDDD amendments. *Methods:* A qualitative policy and document analysis was conducted using EU legislative texts, Commission communications, and professional reports to identify trends and contradictions in sustainability reporting regulation. *Results:* Findings reveal that political simplification efforts have significantly reduced the scope of obligated entities—by up to 80%—creating uncertainty, inconsistency, and weakened comparability of sustainability disclosures across the EU. *Conclusions:* Political compromise has diluted the transformative intent of the CSRD and delayed progress toward EU Green Deal objectives. *Originality:* By linking policy analysis with regulatory outcomes, the paper contributes to understanding the fragility of politically driven sustainability reforms. *Practical implications:* The findings underscore the need for long-term policy consistency and evidence-based regulation to ensure reliable sustainability reporting.

Key words:

sustainability reporting, ESG reporting, political decisions, political influence, CSRD, ESRS.

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1. Introduction

Sustainability has established itself as a central theme in contemporary research related to the future of the business environment and the models according to which corporate business will develop. In response to changing global challenges and increased demands for corporate transparency and accountability, sustainability reporting has evolved into a critical tool for strategic risk management, attracting sustainable investment and building trust among all stakeholders.

Since 2014, the topic of sustainability has also been officially included in the field of corporate information reporting and disclosure in the EU through the adoption of Directive 2014/95/EU on the disclosure of non-financial and diversity information by certain large undertakings and groups (the so-called NFRD), followed by Directive (EU) 2022/2464 (CSRD) in 2021. Despite the high regulatory ambition, the process was unexpectedly hampered at the end of 2024 with the emergence of the Omnibus legislative package, which aimed to “simplify” and review the rules. This political move, taken immediately before the actual entry into force of the CSRD for a large number of companies, effectively halted the preparation process for a significant number of entities. The relevance of this study stems precisely from the fact that sustainability reporting continues to be a highly politicised topic on the European Parliament's agenda. The changes in the regulatory framework have caused considerable uncertainty and legitimate concerns among corporate management, investors and civil society alike.

In light of the dynamic political decisions, the aim of this report is to critically analyse the development of regulatory requirements for sustainability reporting in the EU in the context of the latest changes brought

about by the Omnibus package and the subsequent political reactions, as well as to assess the effects of the proposed changes in terms of ensuring reliable, transparent and sufficient information to achieve the EU's objectives set out in sustainability legislation.

The analysis will be limited to examining the changes to the Corporate Sustainability Reporting Directive (CSRD) without going into detail on the proposed changes to the ESRS and CSDDD, which limits the scope of our study.

2. Transition from the liberal NFRD to the ambitious CSRD and problems in the area of sustainability reporting

The introduction of the NFRD as part of the EU regulatory framework was cited as a prerequisite for the introduction of clear rules on the reporting of this type of information. In this way, the EU recognised the importance and significance of the disclosure of sustainability-related information, such as social and environmental factors, by companies in order to identify sustainability risks and increase investor and consumer confidence. In practice, sustainability reporting has thus moved from a voluntary phase to a mandatory one for those companies falling within the scope of the NFRD. As we mentioned, the introduction of regulations was expected to raise the level and quality of sustainability disclosures on the one hand, but at the same time it provided a tool in the hands of the ruling majorities in the European Parliament to push through certain lobbying texts that were not always in line with the declared intentions.

With this directive (NFRD), the EU attempted to regulate the reporting of non-financial information, but at the same time left the reporting regime too liberal. In our view, the chief shortcoming of Directive 2014/95/EU is its lack of a mandatory disclosure format. Instead, it grants firms broad latitude to report information as they deem most useful. As a result, companies selectively refer to different guidelines and frameworks to present what they consider relevant. Applying different standards and frameworks for non-financial reporting has even created a new professional jargon - the so-called "Alphabet Soup", which has become a kind of description of the sea of abbreviations of used frameworks and standards (Atanasov, 2022).

These weaknesses have been reflected in a number of studies and have caused concern among some researchers and stakeholders. In this regard, Boiral et al. point out that corporate sustainability reporting faces a number of challenges that hinder its effectiveness. The main problems include the lack of effective standardisation and comparability of information, which makes comparative analysis between organisations difficult (Boiral et al., 2019). There are difficulties in integrating financial and non-financial data into a single report, which would allow for a more comprehensive understanding of corporate performance (Eccles & Krzus, 2018).

According to other authors, companies also encounter difficulties in setting materiality thresholds for non-financial indicators, as there are no generally accepted assessment criteria (Adams & Abhayawansa, 2022). An additional complication is the dynamic change in stakeholder expectations, which makes the assessment of materiality highly variable over time (Eccles et al., 2021).

According to a European Parliament study on the implementation of the NFRD, a large proportion of stakeholders found the information provided under the NFRD to be insufficiently comparable (71%), reliable (60%) and relevant (57%). As a result of the review conducted after the introduction of the Directive, in 2021 the EU initiated changes to the NFRD to address the main weaknesses identified in the post-implementation review. In April 2021, the European Commission proposed a Corporate Sustainability Reporting Directive (CSRD) to replace the NFRD entirely. After a year and a half of consultations, on 16 December 2022, the Directive was published in the Official Journal of the EU as Directive 2022/2464 (EU). The new directive was intended to support the European Green Deal, a set of policy measures designed to combat the climate crisis by transforming the EU into a modern, resource-efficient and competitive economy with net-zero greenhouse gas emissions by 2050. Furthermore, the directive can be seen as part of the larger Sustainable Finance

package, which supports the implementation of the Green Deal by helping to channel private investment towards the transition to a climate-neutral economy. The package includes: (European Commission, 2021)

- **The EU Taxonomy Climate Delegated Act** -- its purpose is to support sustainable investments (i.e. investments for sustainable development) by clarifying which economic activities contribute most to the achievement of the EU's environmental objectives;
- **Corporate Sustainability Reporting Directive (CSRD)** -- aims to improve the flow of information on corporate sustainability. The proposed directive will make corporate sustainability reporting more consistent, so that all stakeholders can benefit from comparable and reliable sustainability information.
- **Six delegated acts** aimed at ensuring that companies in the financial sector include sustainability as a factor in their procedures and investment advice to clients.

The adoption of Directive (EU) 2022/2464 (CSRD) introduced key changes both in terms of the scope of companies applying the directive and the content of the information reported, which was one of the main weaknesses of the NFRD. (Table 1)

Table 1

Changes in the CSRD compared to the NFRD

Element	Content of the changes	Key details
Extended scope	Significantly more companies subject to the regulation	From ~11,000 to ~50,000 in the EU; all "large companies" that meet ≥ 2 of 3 criteria: net revenue $\geq$ €40 million , balance sheet total $\geq$ €20 million , ≥ 250 employees ; also covers third-country companies with net turnover in the EU $>$ €150 million and at least one subsidiary/branch in the EU.
Mandatory standards (ESRS)	Single European Sustainability Standards	Application of ESRS developed by EFRAG ; objective: high quality, comparability and reliability of data.
Double materiality	Two perspectives for reporting	"Outside-in": how climate and society affect business; "Inside-out": the impact of the company on people and the environment.
Mandatory audit	Audit of non-financial information	Initially limited assurance , with the aim of moving to reasonable assurance in the future.
Integrated and digital reporting	Inclusion in the management report and machine-readable format	Sustainability information is part of the management report (not a separate report); reports in XHTML with digital markup (machine-readable).

Source: Authors' Compilation based on NFRD and CSRD

It should be noted that although the CSRD is an EU directive, it has a significant impact on sustainability reporting for companies outside the Union - including in the US and other jurisdictions - when their securities are admitted to trading on a regulated market in the EU, which determines its strategic importance for the Union.

At the same time as adopting the CSRD, the European Commission tasked EFRAG with developing the European Sustainability Reporting Standards (ESRS), which are scheduled to be implemented in phases from 2024 onwards. However, the process was delayed and on 31 July 2023, the Commission approved the delegated act for the first ESRS package, leaving companies with only five months to prepare for the new requirements - a circumstance that has become an additional challenge for businesses.

As of September 2025, the process of transposing the Corporate Sustainability Reporting Directive (CSRD) into the national laws of the countries of the European Economic Area (EEA) remains uneven. According to Accountancy Europe, as of 26 September 2025, a total of 21 countries have transposed the directive, 5 are in the process of discussion and implementation, and 3 are still at the consultation stage. These

delays are explained by the short transposition deadlines following the adoption of the CSRD at the end of 2022. In Bulgaria, the directive was transposed in the summer of 2024 through amendments to the Accounting Act (State Gazette, No. 72), and as of 26 September 2025, the country is listed among those that have transposed the directive. However, this is not entirely true, as a decision by the National Assembly on 19 February 2025 postponed the application of the CSRD by one year for all companies. According to preliminary estimates by the Ministry of Finance, this decision affects about 54 companies that have already invested significant resources in preparing for compliance with the directive. In this way, Bulgaria is in fact implementing part of the Omnibus package envisaged by the European Commission in an even more conservative form, even before its official adoption by the European Parliament. The information provided by Accountancy Europe shows fragmentation in the implementation of the CSRD in the EEA, expressed in:

1. Asymmetric transposition, reflected in different speeds and consistency, including lagging behind in some large economies (Germany, Austria, etc.).
2. The use of different transitional mechanisms - national mitigation measures (e.g. the Austrian approach to thresholds and exemptions) and de facto postponements (e.g. the Bulgarian decision) aimed at reducing the short-term administrative burden.

Legal and operational uncertainty, which is particularly pronounced for first-wave companies that have already started or completed the preparation/publication of their 2024 reports.

3. The Omnibus Package – how politics can mess everything up

At the beginning of 2025, the legislative landscape changed dramatically once again. On 26 February 2025, the European Commission proposed the Omnibus Package. Conveniently disguised behind the idea of the need to reduce the administrative burden on companies, the proposals represent a significant retreat from the European Commission's original ambitions regarding sustainability reporting. Some of the most significant changes that were proposed are (Omnibus Proposal (COM_2025_80_EN & COM_2025_81_EN):

- Reduction in scope:
 - Introduction of a new threshold for companies - It is proposed that the reporting obligation should only apply to companies with more than 1,000 employees (compared to 250 previously) and a turnover of €50 million or a balance sheet value of €25 million.
 - Number of companies affected - The number of companies subject to the reporting obligation is expected to fall by over 80% - from over 50,000 to less than 7,000.
 - Obligations for third-country companies: The turnover threshold for them is raised from €150 million to €450 million.
 - Changes for publicly traded SMEs: They are excluded from mandatory reporting and will be able to report on a voluntary basis.
 - The Omnibus proposes delaying the deadline for CSRD reporting by two years - to 2027 for wave two companies, and 2028 for wave three.
- Easing of requirements:
 - Postponement of deadlines: A postponement of up to two years is envisaged for the second and third waves of reporting companies.
 - Removal of sectoral standards -- the idea of developing the planned mandatory sectoral ESRS is completely removed.
 - Audit of sustainability information: The idea of moving to "reasonable assurance" when expressing an audit opinion is removed and the audit remains at the "limited assurance" level.
 - Reduction of data: A reduction in the scope of reported data is proposed, with an emphasis on

quantitative indicators (KPIs).

Retaining double materiality: Despite the relaxations, this key principle remains mandatory.

In April 2025, the Council of the EU finally approved the "Stop-the-clock" mechanism - a measure to postpone part of the CSRD and CSDDD obligations in order to reduce the administrative burden and increase competitiveness. According to the authors of the proposal, the new deadlines give both large companies and listed SMEs additional time to adapt, providing legal certainty at a key moment for the European economy.

What is striking is the significant reduction in the scope of companies required to comply with the directive - their number will fall below 7,000, representing a reduction of approximately 80%. Under the Omnibus package, the requirement to report according to the European Sustainability Reporting Standards (ESRS) will only apply to the largest companies. In addition, the Commission has announced its intention to ease the disclosure requirements in the ESRS and is conducting public consultations on adjustments to the EU Taxonomy. The proposed reform aims to protect smaller enterprises (with up to 1,000 employees) by limiting the so-called 'trickle-down effect'. It is envisaged that the requirements for data on the value chain will not exceed the amount of information that would be reported under the modified Voluntary Reporting Standard for SMEs (VSME).

The effects that the Omnibus package may have are highly controversial, as are the expectations of the various parties concerned. On the one hand, some EU politicians were quick to praise the changes and even called for even more significant changes towards less reporting by EU companies. Other politicians have come out in favour of more pragmatic, "business-friendly" changes that will reduce the administrative burden, especially on small and medium-sized enterprises. It is interesting that both sides had already supported this legislation in 2023, but a year later they consider it to be an incredible burden on business without it even having been implemented in practice?!?

The EU made a serious mistake when it introduced the ill-conceived NFRD into European legislation, which in practice did not introduce specific reporting indicators and allowed companies complete "freedom". It later attempted to rectify the mistake with the introduction of the CSRD, but the issue is that this change came in the form of "belated legislation" -- the CSRD was adopted late, the ESRS was adopted late, and the time for adaptation was too short. In terms of content, with regard to legislation on sustainability reporting, the EU has gone from one extreme -- the NFRD, which required almost nothing specific from companies in terms of indicators -- to another extreme -- the CSRD and ESRS, which introduced specific indicators, numbering around 1,100, which is actually daunting even for large companies. At the same time, this huge reduction in scope will lead to a lack of comparability, transparency and balance in the information needed for decision-making by all stakeholders.

It even created the impression that the legislation was being changed under pressure and without time to adapt to the changes. And this impression is quite logical -- such drastic changes, proposed at the last minute, create uncertain legislation and a lack of trust on the part of businesses and all stakeholders. It should not be forgotten that companies falling within the so-called "first wave" of reporting had to start building and fine-tuning their information systems and other channels for collecting information, including along the value chain, in some cases retroactively from the beginning of 2024, with unclear requirements and sometimes confusing indicators, in order to be able to report in 2025 for the past reporting period.

Undoubtedly, the existing texts in the CSRD and ESRS create ambiguities in many respects and raise questions regarding their application, but the proposed changes in the Omnibus package do not answer some of these questions, but rather halt and set back the reporting process by several years. Years in which businesses have invested time, effort and financial resources to build capacity, integrate and adjust their work, change their work organisation, thinking, strategic goals, etc., and today they are suddenly being thrown into reverse gear while moving forward.

At the same time, a January 2025 EC report, Delivering the EU Green Deal - Progress towards targets

(EC, 2025), presents worrying data on overall progress towards the European Green Deal (European Green Deal). The main problem identified is actually the lack of data. Data that is stable, verifiable, comparable, reliable for analysis and adequate decision-making. According to the findings, 28% of the targets currently lack sufficient data, which shows that improved data and monitoring systems are needed to track progress. It is through adequate sustainability reporting that this data can be provided. This is further proof that if European policymakers still have ambitions to meet their strategic goals for the development of European business sustainability, there is a huge need for quality sustainability reporting at the corporate level.

It should not be overlooked that legislation is being revised that has not even been fully implemented (only companies from the so-called "first wave" have reported for 2024 and not in all EU countries), which creates a sense of uncertainty and certainly cannot be justified by concerns about administrative burden. Less than three years after the adoption of the CSRD, it remains highly questionable whether reducing the scope of companies by around 80% reflects what the EC itself calls a "more proportionate sustainability reporting framework" and which is supposedly at the heart of the Omnibus package. What is more, the "Draghi Report", which very often serves as a starting point for Omnibus, does not simply propose to remove companies from the scope of the regulations. It proposes "to better consider the scope of companies affected by the regulation, using appropriate mitigation measures in line with the principle of proportionality" (Draghi, Sept. 2024). The Omnibus proposal argues that proportionality is achieved because companies outside the scope can report voluntarily. However, this is unlikely to overcome the information gap highlighted in the original directive.

We believe that reducing the burden on smaller companies is extremely important, especially when they are involved in reporting as part of the value chain, but this needs to be done through better alignment of requirements for company size and scope of reporting (accountability). That is why we believe there is a need for better differentiation and adaptation of what Draghi calls "proportionality" and the introduction of a minimum set of mandatory reporting indicators. Instead, the Omnibus achieves the opposite: a single reporting regime for larger companies, with the option for all others to report voluntarily.

Even if this reduction had been implemented in its originally proposed form, it would probably have been accepted by stakeholders with some adjustments. However, European politicians took a new and unexpected step by deciding to reduce sustainability reporting requirements to an even more minimal level. A new proposal from the Committee on Legal Affairs has appeared in the European Parliament, which is even more drastic than the original Omnibus texts in terms of the scope of companies that will be required to report: 3,000+ employees and €450 million in turnover. In its analysis as of June 2025, Accountancy Europe presents the landscape of proposed changes to the CSRD, which is presented at figure 1.

The analysis of these thresholds can be seen as a serious blow to transparency and the availability of adequate data on sustainability at EU level. Some of the more important conclusions, in our view, are:

- The thresholds mentioned would mean that 1/3 of EU Member States would have fewer than 10 companies subject to CSRD, which could lead to less data available for the industrial transformation and long-term competitiveness of the EU economy.
- Companies with 500 to 1,000 employees make up a big part of the EU economy and are often part of the value chains of bigger businesses.
- Focusing primarily on the number of employees may not be a justified approach to promoting sustainable practices.
- Reducing the scope will limit transparency in complex value chains, which is detrimental to businesses that rely on sustainability data from suppliers and partners.
- As the European Central Bank has already pointed out in its report, excluding companies with between 500 and 1,000 employees could even threaten financial stability. (European Central Bank, 2025, May)

 June 2025		CSRD definition	EC Omnibus proposal	EP Legal Affairs draft report
		250 employees and balance sheet total EUR 25 million or net turnover EUR 50 million **	1000 employees and either EUR 25 million or more total balance sheet or EUR 50 million or more turnover	3000 employees and EUR 450 million net turnover
EU MEMBER STATE	Number of companies affected			
Austria	430 *	233	78	
Belgium	2 300 *	315	74	
Bulgaria	457	121	8	
Croatia	307	66	14	
Cyprus	350 *	9	4	
Czech Republic	125	29	5	
Denmark	2 200 *	383	102	
Estonia	96	13	1	
Finland	1 356 *	252	71	
France	4 000 *	1 006	382	
Germany	13 981 *	3 140	807	
Greece	216	38	4	
Hungary	676	207	39	
Ireland	820 *	198	56	
Italy	4 957	1 397	340	
Latvia	184 *	26	1	
Lithuania	159	35	4	
Luxembourg	239	146	66	
Malta	3	1	-	
Netherlands	3 088	977	264	
Poland	2 226	536	94	
Portugal	999	261	55	
Romania	629 *	262	42	
Slovakia	668 *	74	15	
Slovenia	230 *	37	4	
Spain	4 171	1 295	310	
Sweden	2 003	619	180	
TOTAL	46 870	11 676	3 020	

Fig 1. Number of companies impacted by proposals for CSRD amendments

Source: Accountancy Europe Survey, Available at: [Views on CSRD scope reduction: omnibus proposal - Accountancy Europe](#)

In response to expectations for simplification and in the spirit of the expected changes to the CSRD set out in the Omnibus package, in July 2025 EFRAG proposed for discussion a revision of the European Sustainability Reporting Standards (ESRS), which were to reduce the more than 1,100 data points for reporting set out in their initial version. The proposal includes a reduction in the volume/length of the standards by about 60%, a reduction in mandatory data points by about 57%, provided they are material, and an expected reduction of about 68% in total reporting. Of the data points retained in the revised ESRS, only 33% are legacy data

points. (EFRAG, 2025) The remaining 67% are new or amended data points, which may trigger transition costs. The proposed revision impact is stronger for companies with more data points. According to a study by Sustainability Navigator, this overall reduction mainly affects qualitative datapoints (-56%), while quantitative datapoints remain almost the same, suggesting that even with the new standards, the collection, consolidation and control of data in an economic group will likely look similar to what we saw in 2024 (Sustainability Reporting Navigator, 2025). In fact, EFRAG identified the following levers that it used in developing its proposed revisions to the ESRS to achieve the simplification objectives identified in the proposal (EFRAG, 2025):

Lever 1 - Simplifying the Double Materiality Assessment (DMA).

Lever 2 - Improving the Readability and Conciseness of Sustainability Statements and Their Inclusion in Corporate Reporting as a Whole.

Lever 3 - Making Critical Modifications to the Relationship Between GDRs and Topical Specifications.

Lever 4 - Enhancing the Standards' Understandability, Clarity, and Accessibility.

Lever 5 - Suggesting Additional Reliefs to Reduce Entities' Burdens.

Lever 6 - Enhancing the Interoperability of the Standards With Other Global Sustainability Reporting Frameworks.

It remains unclear how the comparability of reported information will be ensured during the first few reporting periods for Wave 1 companies, for which the "stop-the-clock" rule does not apply, following the proposed changes, some of which relate to the scope of reporting and the double materiality assessment (DMA), which determines which aspects of the activity will be material for reporting. Moreover, it is unclear when these changes will be finally adopted and whether they will enter into force in 2026.

Furthermore, on 4 July 2025, the European Commission adopted a delegated act that finalises the EUT simplification package (EC, 2025, 4 July). Key changes include:

- All entities are excused from assessing taxonomy eligibility and alignment for activities that are not financially material. For non-financial companies, an activity is non-material if it represents less than 10% of total revenue, CapEx, or OpEx.
- Non-financial companies do not need to assess taxonomy alignment for their entire OpEx when those expenses are not material to their business model.
- Financial institutions only have to disclose simplified KPIs---such as banks' Green Asset Ratio (GAR)---and may opt out of detailed taxonomy KPIs for two years.
- Reporting templates are pared back, cutting reported data points by 64% for non-financials and 89% for financials.
- The "Do No Significant Harm" criteria on "pollution prevention and control" (use/presence of chemicals) are simplified.

These changes are expected to take effect on 1 January 2026 and will govern reporting for the 2025 financial year; entities may alternatively choose to apply the measures starting with the 2026 financial year.

In addition, at the beginning of October, another version of the Omnibus was launched, in which the final result looks less like a consensus and more like capitulation. According to this proposal, companies with fewer than 1,000 employees can now be sure that they will be exempt from CSRD reporting, as the Commission, the Council and the Parliament have agreed on this threshold. The question remains open as to whether €450 million will indeed remain the final threshold, as the Commission is proposing €50 million. However, the other proposal regarding the CSDDD is quite different -- 5,000 employees and €1.5 billion, which directly leads to a huge reduction in companies, making due diligence relevant only for a few very large companies, and even those very few will not be subject to the general regime (Fig. 2).

1	Scope	CSRD: 1,000 employee cut + €450mio net turnover (-90%); CSDDD: 5,000 employee cut + €1.5bn turnover (-70%)
2	Transition Plans	compromised version retained in CSDDD; original text in CSRD retained
3	Due Diligence Approach	full risk-based approach towards due diligence (with value chain cap at 5,000 employees)
4	Civil Liability	no EU-wide civil liability regime (possible review clause for 2030)

Fig. 2 European Parliament "Deal" on "Omnibus"

Source: Authors' Compilation, based on the Warborn's Omnibus proposal

On 13 October, the JURI Committee not only voted on the compromise for the Omnibus, but also voted in favour of entering into trilogue negotiations directly without (!) a prior vote in plenary. When presenting the compromise reached, rapporteur Mr Warnborn said that he thought that 'a very good balance has been achieved with the scope we have in the CSRD now, as the exemption of 90% of companies strikes the right balance between simplification and information needs. In fact, the reality is quite different, as investors, businesses, academia and the ECB have warned that such a narrow scope (even well below that of the NFRD) undermines the availability of sustainability information. This is a toxic "compromise" in general. This is not at all the necessary simplification, but simply a reduction. That is why I think this is a politically conditioned consideration of sustainability and shows us de facto how even the best ideas can fail at the cost of political survival.

In practice, if all the changes proposed in Warborn's latest Omnibus proposal are formally adopted by the European Parliament in October or November, this would mean something else important: a significant proportion of medium-sized enterprises in the EU would receive a new message -- you have no direct obligations to report under the CSRD and implement the ESRS. However, this does not mean that they will not be bound by sustainability requirements. It could be said that the new VSME standard will become the lowest common denominator in sustainability reports for all companies, for example in the context of the value chain cap or loan agreements. Banks are increasingly aligning their lending with ESG criteria, investors are actively demanding sustainability information, and supply chain companies are under pressure to provide reliable sustainability information, regardless of their own CSRD obligations. This means that those who understand today's sustainability reporting and auditing regulations (CSRD, ESRS, Taxonomy Regulation, CSDDD) and master their application will gain a decisive competitive advantage tomorrow.

In order to provide more clarity on the future adoption procedures for CSRD, ESRS, CSDDD, they are presented in Fig. 3:

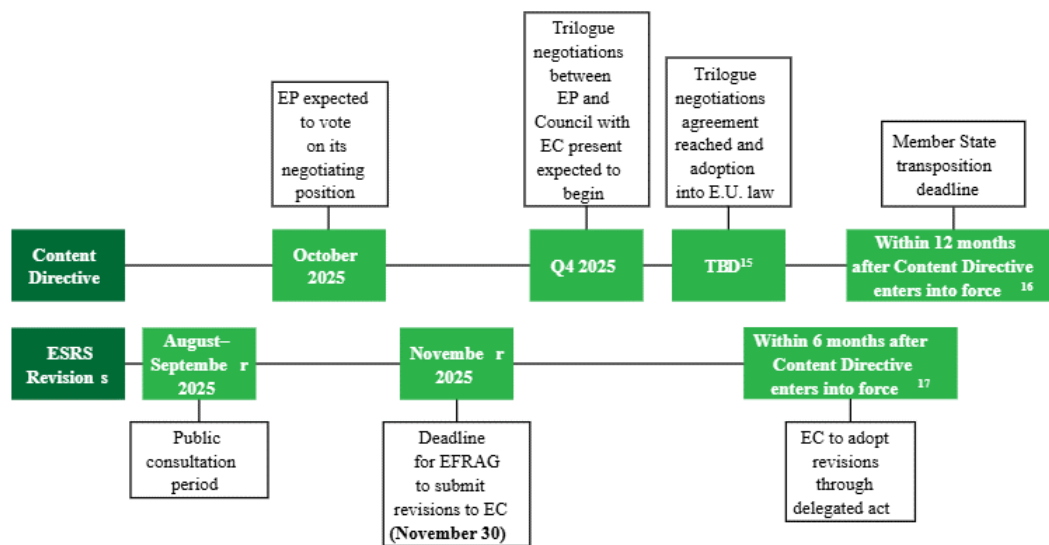


Fig. 3 Timeline of the proposed Omnibus legislation

Source: Deloitte, European Sustainability Reporting --- Omnibus Update and Proposed Revised European Sustainability Reporting Standards (August 21, 2025)

These findings are in line with Zenglein's view that "political rather than technical considerations are increasingly driving standardisation processes in the EU" Zenglein, F. (2025). Against the backdrop of this political mess created by European politicians in the field of sustainability reporting and in the race for the next chunk of the electorate, it is not surprising that, according to a study by the consulting firm Earnst&Yang, businesses in the EU are uncertain about their plans regarding sustainability reporting. According to the results, one-third of companies admit that they are yet to analyse what to do in relation to the changes in regulatory requirements for corporate sustainability reporting (CSRD). This once again confirms our understanding that sustainability reporting should not be reduced to a formal "checklist" to avoid sanctions. The concept of corporate sustainability requires conscious responsibility on the part of management for the content and quality of the information disclosed. This would help improve the comparability of information from published sustainability reports between individual reporting companies, regardless of their sector, and would allow for their more comprehensive integration with specific financial metrics that are already well known to stakeholders and would have a positive impact on achieving harmonisation between the various applicable standards.

Although outside the scope of this in-depth study, we cannot fail to comment on the fact that, on the one hand, there is a communicative and political need to share some figures that confirm the EC's position on reducing the administrative burden on businesses, but this must be approached with caution. Not all data points are created equal, and citing a single aggregate figure certainly does not "tell the whole story" behind them. There is no doubt that the "simplification" that has been carried out is indeed significant and is not actually simplification, but rather pure reduction. Yes, legislation in this area in the EU certainly seems overly ambitious, and there is even talk of "over-regulation" in official European Parliament documents (European Parliament, 2025), but it was these same politicians who drafted this legislation three years ago with the clear understanding that it would be so complex and, at times, cumbersome. We maintain that experience could have been drawn from established practices in the field of financial reporting, which involve a period of early application, several years of full application and only then a summary of the results, a post-implementation review and proposals for changes. It seems that the same politicians who are so concerned about the competitiveness of businesses in the EU did not consider all the businesses that have already set up their systems and processes and prepared data for reporting under the current standards and directive. Apparently,

this remains their problem (and expense)!

In our view, all of the above form the basis for the EU returning to evidence-based policymaking, balancing legitimate concerns about administrative burden with the fundamental need for reliable sustainability data. This requires:

1. *Proportionality through differentiation, not just reduction* - Rather than excluding tens of thousands of companies from reporting requirements, the EU should develop tiered reporting frameworks that scale requirements to company size and complexity while maintaining minimum mandatory disclosures across all significant economic actors with key sustainability KPIs.

2. Future changes must be implemented with *adequate notice and transition periods*, respecting the investments companies have made in compliance systems and allowing for systematic evaluation of existing requirements before implementing major revisions.

3. If the EU remains committed to the European Green Deal and achieving climate neutrality by 2050, *sustainability reporting requirements must be designed to generate the data necessary for tracking progress toward these goals*, not be subject to political whims that undermine data availability.

4. *Stakeholder dialogue* must take *priority over political expediency*. Policy changes of this magnitude should be based on genuine consultation with all stakeholders, including investors, companies, civil society and academia, rather than being driven by last-minute political compromises based on electoral considerations.

Conclusion

Political decisions are the primary driver shaping the sustainability reporting landscape in the European Union (EU). Through the adoption of landmark legislation, the EU has strategically used reporting mandates as a policy tool to direct capital towards sustainable activities, curb greenwashing, and drive the transition to a climate-neutral economy under the European Green Deal. The EU's influence is exercised both through direct regulatory measures and through indirect pressure on the processes for preparing reporting standards, which can ensure necessary information on corporate sustainability at the EU level. This European approach represents a distinct model where clear political leadership and institutionalised frameworks create a significant and multifaceted influence on corporate sustainability reporting practices.

The analysis presented in this study reveals a concerning pattern of policy inconsistency and political expediency that threatens to undermine the very objectives the EU set out to achieve. The trajectory from the overly liberal NFRD, through the ambitious CSRD with its approximately 1,100 data points, to the dramatic scope reduction proposed in the Omnibus package demonstrates a fundamental failure in regulatory coherence. This represents not merely technical adjustments, but a paradigm shift driven by political pressures rather than evidence-based policy evaluation.

It is time for European politicians to decide what they want and how they will achieve it, and to state this in an open dialogue with all stakeholders, because political decisions essentially determine whether sustainability reporting serves as a transformative tool for systemic change or becomes diluted through exemptions and simplified requirements, as a result of which even the best ideas can fail.

The fundamental question remains: Does the EU genuinely seek to lead the global transition to sustainable business practices through robust transparency and accountability mechanisms, or has sustainability reporting become merely another political bargaining chip to be traded away when economically or electorally convenient? The answer to this question will determine not only the future of corporate sustainability reporting in Europe but also the credibility of the EU's broader sustainability agenda and its capacity to achieve the ambitious targets it has set for itself and its member states.

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Short-Run Effects of Consumption on GDP: An Empirical Analysis for Bulgaria**Tatyana IVANOVA¹**¹ University of Economics - Varna, Varna, Bulgaria, tatianai@ue-varna.bg**JEL: E21, E32, C22, O11****Abstract**

Background and aim: Household consumption is the largest component of aggregate demand in Bulgaria, consistently exceeding half of GDP. This study examines its short-run role as a driver of economic activity and tests whether changes in household expenditure significantly influence real GDP growth. *Scope:* The analysis covers 1995–2024 using annual data at constant 2020 prices from the National Statistical Institute. Government and non-profit consumption are excluded to isolate household effects. *Methods:* Following an Augmented Dickey–Fuller test confirming non-stationarity, an OLS regression model in first differences was estimated. Model reliability was checked using Breusch–Pagan, Breusch–Godfrey, Jarque–Bera, and Ramsey RESET tests, with Newey–West robust errors. *Results:* The coefficient of household consumption is positive and close to unity ($\beta \approx 0.96$, $p < 0.01$), indicating an almost proportional short-run transmission of consumption to GDP. The constant term is positive, implying additional sources of growth. *Conclusions:* Household consumption in Bulgaria is strongly procyclical, amplifying both expansions and downturns. *Originality and implications:* The paper provides one of the first post-COVID empirical assessments of short-run consumption effects on Bulgaria's GDP. Findings suggest that consumption-driven growth is rapid but temporary, highlighting the need for policies that strengthen productive capacity and income.

Key words:

household consumption, short-run economic dynamics, procyclicality, real GDP growth, Bulgaria, OLS regression analysis

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1. Introduction

Household final consumption is the largest component of aggregate demand in Bulgaria, consistently accounting for over 50% of GDP, which makes it a key driver of economic dynamics. Depending on the time horizon under consideration, consumption performs different economic functions and affects growth through distinct mechanisms, necessitating a clear distinction between short-run and long-run effects. This distinction is essential both for theoretical analysis and for applications in economic policy and empirical research.

In the short run, consumption is viewed as a major component of aggregate demand and an engine of the business cycle (Blanchard & Quah, 1989; Deaton, 1991; Carroll, 1997). It is typically procyclical (rising during expansions and contracting in recessions) thus transmitting fluctuations to GDP and potentially amplifying both booms and downturns. This dynamic is explained by the multiplier mechanism, grounded in the marginal propensity to consume: the larger the share of income directed toward spending, the stronger the effect on current output and employment (Keynes, 1993 [1936]; Hicks, 1937).

The Keynesian framework assigns a particularly important role to consumption as both a stabilizer and an accelerator of the business cycle in the short term. Household expenditure not only reflects current income levels but can also act as an active driver of growth during upturns and as an amplifier of decline during crises. Changes in consumer spending directly influence economic activity by affecting output, employment, investment intentions, and monetary policy.

Under Bulgarian conditions, consumption has established itself as a leading factor in short-run dynamics. Studies indicate that before the introduction of the currency board, household expenditure mitigated the decline

in GDP, while after 1997 it became a growth driver (Nestorov, 2002; Todorova et al., 2007). Later analyses show that household spending has grown faster than income and exerts a strong positive impact on economic activity (Tsanova & Tsanova, 2012; Ivanova, 2020).

Household expenditure not only mirrors current income levels but also acts as an active engine of growth during expansions and an amplifier of decline during recessions. Changes in consumption directly influence overall economic activity by shaping production, employment, investment behaviour, and monetary conditions. In this context, consumption serves as a key channel for transmitting both external and internal shocks to the economic system, with the intensity of its impact determined by the variability of spending dynamics.

Building on established theoretical foundations, many contemporary researchers test the validity of these postulates and models under specific economic conditions. The growing number of publications reflects both the scientific and practical importance of the issue, as well as the diversity and dynamic nature of the results obtained.

Based on these observations, an empirical examination of the impact of consumption on GDP in the Bulgarian context becomes necessary. The present paper aims to evaluate the short-run effect of consumption on Bulgaria's GDP over the period 1995 - 2024. The object of analysis is the interaction between household consumption and GDP in the short term, while the subject is the quantitative measurement of this relationship through a regression analysis in first differences. The main hypothesis is that changes in household consumption exert a statistically significant and positive short-run effect on real GDP. This relationship is procyclical—consumption increases during economic expansions and contracts during downturns—and becomes more pronounced when income-smoothing mechanisms are limited.

2. Literature Review and Hypotheses Development

Economists' differing views on the short-run role of consumption became more clearly defined after the emergence of the theories of the consumption function and the multiplier. The household propensity to consume determines the strength of the initial impulse on income, while the short-run multiplier describes how autonomous spending multiplies its effect on GDP (Keynes, 1993, p. 115). By transmitting changes in household expenditure to production and employment, consumption acts as an active component of aggregate demand.

The first attempts to assess how changes in consumption influence macroeconomic fluctuations were made by Milton Friedman and Gary Becker (1957). Using the concept of a "statistical illusion," they argued that misinterpreting the consumption function can create the false impression of a stronger link between consumption and income than actually exists. They questioned whether income could be reliably predicted from changes in domestic demand (p. 73). Yet, despite their critical stance, their work laid the foundation for later models that connect consumption dynamics with income behavior and expectations.

Over the following decades, most empirical studies sought either to confirm or reject the relationship between consumer spending and GDP, to estimate its strength and direction in the short and long run, or to forecast economic developments. Researchers have also examined the multiplier effect on GDP, whose magnitude depends on the marginal increase in consumption. Standard econometric methods such as cointegration analysis, error-correction models, Granger causality tests, and optimization approaches have been widely used.

More recent studies emphasize the procyclical nature of consumption and its sensitivity to shocks. Procyclicality means that consumption moves in the same direction as the business cycle, thereby amplifying cyclical fluctuations in economic activity. Empirical evidence shows that short-term GDP movements often mirror changes in demand: Blanchard and Quah (1989) separate demand and supply shocks, highlighting the temporary nature of demand effects; Campbell and Mankiw (1989) and Deaton (1991) find that many

households do not smooth consumption but react directly to current income; Carroll (1997) formalizes the buffer-stock saving behavior, where the absence of assets makes consumption more vulnerable to shocks. In emerging markets with less developed financial systems, consumption tends to be more volatile and more procyclical (Aguiar & Gopinath, 2007). Institutional factors also play an important role: Auerbach and Feenberg (2000) show that progressive taxation and social transfers serve as automatic stabilizers, dampening the transmission of shocks to consumption.

The Bulgarian evidence generally confirms this duality. Before the introduction of the currency board, household consumption helped cushion GDP decline, while after 1997 it became a key driver of growth (Nestorov, 2002; Todorova et al., 2007). Later estimates indicate that household spending has grown faster than income and has had a strong positive impact on economic activity (Tsanova & Tsanova, 2012; see also Velichkov, 2017). This pattern is consistent with international evidence on consumption-led growth phases but raises questions about its sustainability. A key limitation, however, is that most Bulgarian studies cover earlier or shorter periods and rarely test for structural breaks (such as 2008 - 2009 or 2020 - 2021), leaving open the question of how stable the short-run consumption–GDP elasticity has been over time.

Recent research expands the perspective further. Kharroubi (2017) finds that consumption-driven expansions tend to be powerful but short-lived. Chen et al. (2024) document an asymmetric reaction during the COVID-19 crisis - sharp contraction followed by a partial and uneven recovery. Afonso (2025) links consumption responses to household indebtedness and the efficiency of fiscal stabilizers across Europe. For the Middle East, Mohammed (2024) uses an ARDL approach to show that both consumption and investment have significant short-run effects on GDP, with long-term sustainability depending on the speed of adjustment to equilibrium.

In summary, the literature identifies several key patterns:

- consumption is strongly procyclical in the short run;
- access to credit and the availability of financial buffers determine the degree of income smoothing;
- institutional and social factors, including stabilizers and inequality, influence the amplitude of fluctuations; and
- consumption-led growth phases are less durable than those driven by investment or exports.

Because studies differ in their time frames, models, and the types of shocks they consider, the results remain heterogeneous. This underscores the need for an updated and systematic empirical assessment for Bulgaria, covering a long-time span (1995 - 2024) and including robustness checks for stability—an objective addressed in the present analysis.

3. Data and Methodology

The present analysis is based on annual data for real gross domestic product (GDP) and real final household consumption expenditure for the period 1995–2024, obtained from the National Statistical Institute (NSI) of Bulgaria. All values are expressed in constant 2020 prices to eliminate the effects of inflation and ensure comparability over time. The focus is entirely on household consumption, while government and non-profit sector expenditures are excluded in order to isolate the net effect of household spending on economic dynamics.

Over the entire period under review, the dynamics of real GDP and household consumption display a strong mutual dependence – both variables follow a similar trajectory, rising during expansions and contracting during downturns. This synchronicity is not mechanical but reflects the intrinsic link between income and expenditure: as economic activity increases, households expand their consumption, which in turn supports production and employment, whereas during recessions, reduced consumption further constrains growth.

Despite their overall co-movement, fluctuations in consumption are typically more pronounced, as clearly illustrated in Figures 1 and 2.

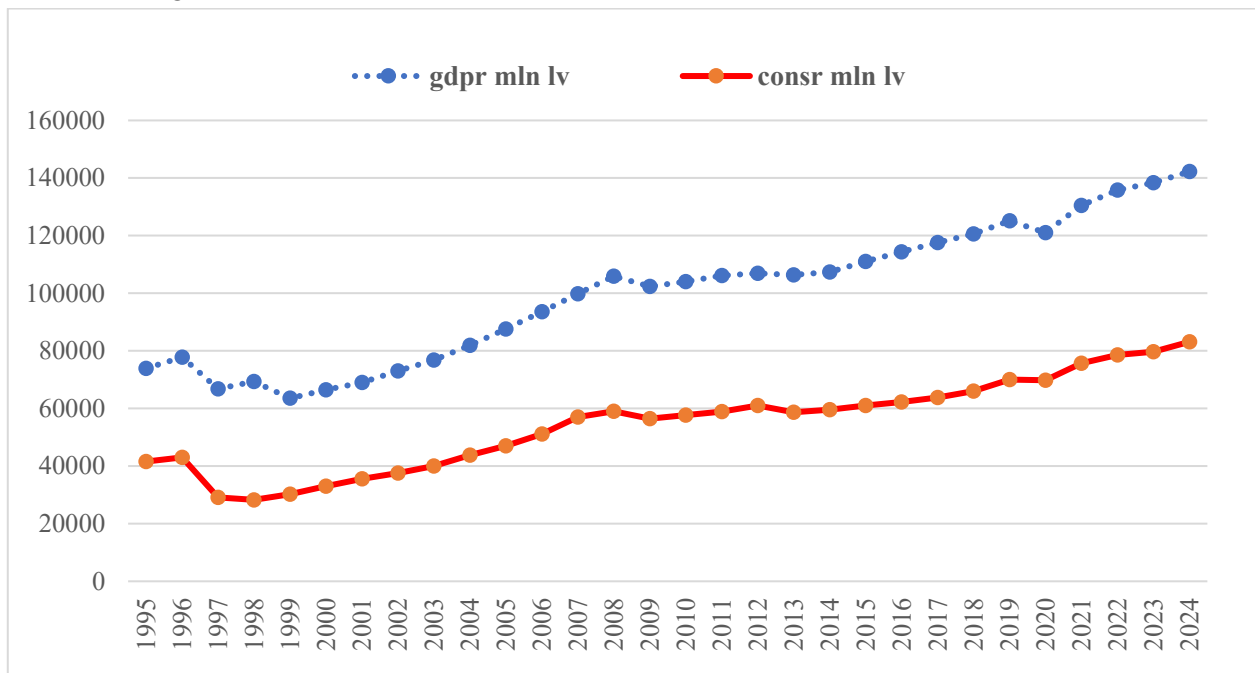


Fig. 1. Real GDP and household consumption (million BGN, 2020 prices)

Source: NSI (Infostat: Final consumption expenditure of households, constant prices (2020=100))

Both series move in the same direction and with comparable magnitude, visually confirming their co-movement (see Figure 1). Figure 2 shows that variations in consumption growth rates exhibit larger amplitudes—particularly during downturns—highlighting its stronger short-run sensitivity to changes in income.

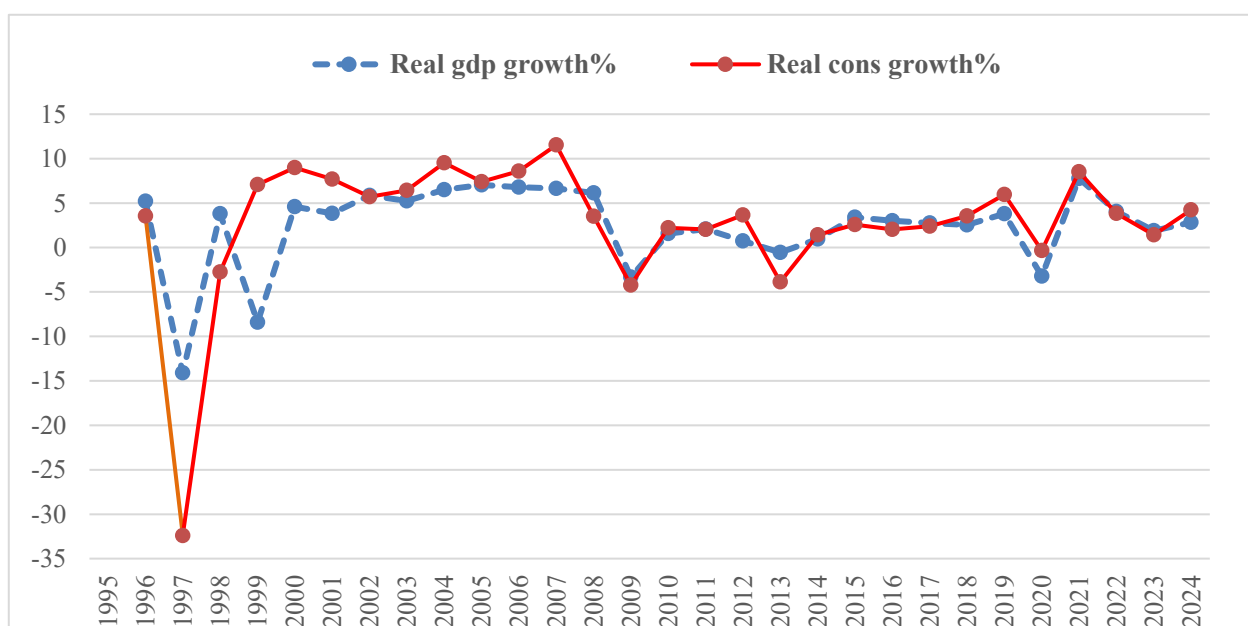


Fig. 2. Growth rates of real GDP and real household consumption

Source: Author's calculations based on NSI data.

In the short run, three distinct subperiods can be identified:

- 1995 - 2008 – a phase of recovery and accelerated growth, during which household consumption played a leading role in GDP expansion. Rising employment, higher incomes, and rapidly expanding credit stimulated household spending, whose growth rate outpaced that of GDP;
- 2008 - 2013 – the period of the global financial crisis and subsequent recession. Consumption contracted sharply due to limited credit access, high interest rates, and increased uncertainty. In 2013, its negative contribution to growth was partly offset by the compensating effect of exports;
- 2014 - 2019 – a phase of gradual recovery, driven by rising incomes, wage growth, and renewed credit activity. Improved consumer confidence and tourism also contributed to higher spending.

After 2020, the COVID-19 pandemic caused a new contraction followed by a rapid but unstable rebound, shaped by rising inflation and global uncertainty.

The share of household consumption in GDP remained consistently high - around 55 percent throughout the period (see Figure 3) - underscoring its structural importance for economic dynamics. Although its contribution to growth was occasionally negative, consumption consistently acted as a key driver of short-term fluctuations.

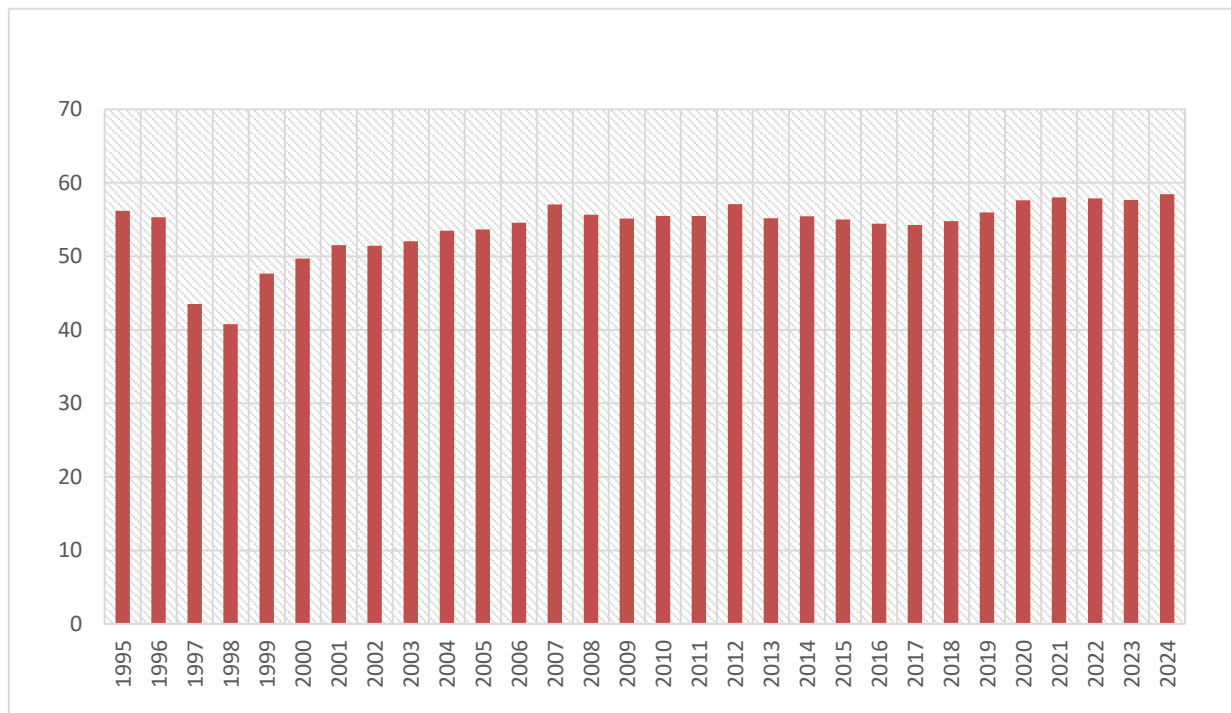


Fig. 3. Share of household consumption in GDP (%)

Source: Author's calculations based on NSI data.

The most important observation is that, regardless of period differences, the dynamics of consumption and GDP move in close synchrony - both accelerate during expansions and decline during recessions. This pattern defines the high procyclicality of the Bulgarian economy and justifies the application of a formal econometric model to quantify this short-run relationship. The observed synchronicity and the differing amplitudes of the two variables motivate the use of a first-difference specification to estimate the short-run elasticity between consumption and GDP.

4. Empirical Results

To assess the short-run relationship between household consumption and real GDP, a regression model was estimated using annual data for the period 1995 - 2024. All computations were performed in STATA 19.5. The Augmented Dickey–Fuller (ADF) test indicated that the original time series were non-stationary; therefore, the analysis was conducted in first differences, eliminating time trends and focusing on short-term fluctuations.

The short-run relationship was estimated by ordinary least squares (OLS) using the following specification:

$$\Delta Y_t = \alpha + \beta \Delta C_t + \varepsilon_t,$$

where:

ΔY_t denotes the annual change in real GDP,

ΔC_t - the annual change in real household consumption,

α - the constant term, β - the marginal effect of consumption changes on GDP changes,

ε_t - the random error term.

Based on the theoretical framework, the expected sign is $\beta > 0$, which would confirm the procyclicality of consumption. The reliability of the estimates was tested using the Breusch–Pagan and White tests for heteroskedasticity, the Breusch–Godfrey test for autocorrelation (lags 1 and 2), the Jarque–Bera test for normality of residuals, and the Ramsey RESET test for specification errors.

Table 1

Regression results (1995–2024)

Variable	Coefficient	Robust Std. Error	95% Confidence Interval
ΔConsumption (ΔC)	0.959***	0.087	[0.781 ; 1.138]
Constant	978.53**	455.31	[44.32 ; 1912.74]
Statistic		Value	
R²	0.6813		
Number of observations	29		
AIC / BIC	534.68 / 537.41		

*** p<0.01, ** p<0.05

ΔC = annual change in real household consumption (mln. BGN)

ΔY = annual change in real GDP (mln. BGN)

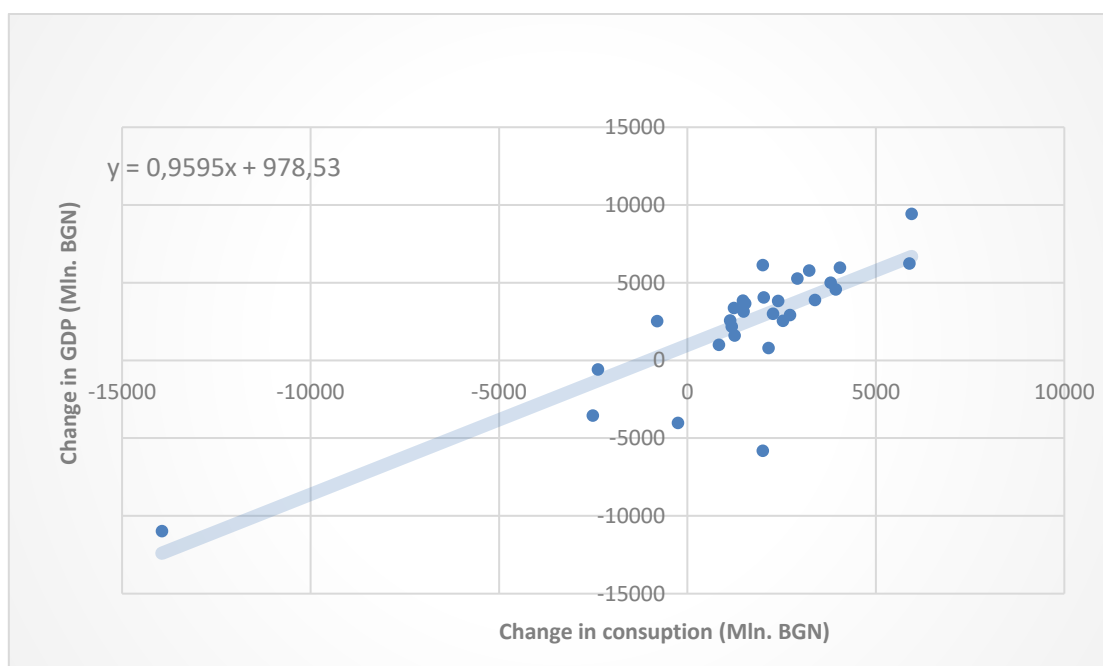


Figure 4. Scatter plot with fitted regression line between ΔC and ΔY

The estimated coefficient β is positive, statistically significant at the 1 percent level, and close to unity. This indicates that a one-million-leva increase in household consumption is associated with an almost proportional increase in real GDP. The positive and statistically significant constant term (~978 million BGN) suggests that other components of aggregate demand also contribute to short-run growth.

To verify the robustness of the estimates, HAC-robust standard errors (Newey–West) were applied. The results did not differ substantially from the classical OLS estimates, and the significance of β remained unchanged, confirming that the findings are not distorted by potential heteroskedasticity or low-order autocorrelation.

Table 2

Diagnostic tests for the regression model (1995–2024)

Test / Diagnostic	Statistic / p-value	Interpretation
Autocorrelation (BG, lag 1)	$\chi^2 = 0.64$, $p = 0.423$	No autocorrelation
Autocorrelation (BG, lag 2)	$p = 0.706$	No autocorrelation
Heteroskedasticity (BP)	$\chi^2 = 0.00$, $p = 0.996$	No heteroskedasticity
Normality (Jarque–Bera)	$\chi^2 = 19.99$, $p = 0.000$	Residuals not normally distributed

RESET (specification) $F(3,24) = 0.44$, $p = 0.727$ Model correctly specified

BG = Breusch–Godfrey test, BP = Breusch–Pagan test.

The Jarque–Bera test ($p < 0.01$) indicates some deviation from normality; however, given the relatively small sample ($n = 29$) and the stability of the estimates under HAC correction, this deviation does not materially affect the reliability of the results.

The estimated coefficient $\beta \approx 1$ confirms the strong procyclical behavior of household consumption in Bulgaria. In the short run, household spending acts as an accelerator of growth: every increase in consumption leads to an almost equivalent rise in GDP. This finding is consistent with the classic Keynesian multiplier mechanism and with the results of Carroll (1997) and Campbell & Mankiw (1989), who document a sensitive

short-term link between income and expenditure.

The positive constant term indicates that Bulgaria also has additional sources of growth beyond consumption, reflecting a moderately diversified structure of aggregate demand. At the same time, since β is close to but below 1, part of the consumption-driven expansion may “leak” through imports or be offset by weaker investment and public spending - typical for small open economies.

Overall, the model suggests that short-term stimulation of consumption in Bulgaria can generate rapid but temporary growth. The sustainability of this link, however, depends on macroeconomic stability, access to credit, and external conditions. From a policy perspective, measures aimed solely at boosting household demand may yield a quick but short-lived impact, while sustainable growth requires strengthening investment, productivity, and external competitiveness. Therefore, demand-side measures should be complemented by policies that raise labor income and productivity and reduce import dependence, so that higher consumption translates into real domestic output rather than external imbalances.

Conclusion

This study assessed the short-run impact of changes in final household consumption on changes in Bulgaria’s real GDP over the period 1996 - 2024. The application of a first-difference regression model, supported by a full set of diagnostic tests, yielded stable and statistically significant results.

The main finding is that the short-run relationship between household consumption and GDP is strong, positive, and robust. The estimated coefficient β is close to unity, indicating that an increase in consumption is almost fully transmitted to GDP within the same period. This confirms the high procyclicality of consumption in the Bulgarian economy and is consistent with the findings of leading international studies.

Diagnostic testing reveals the stability of the relationship even during the global financial crisis of 2008 - 2009. The positive and statistically significant constant term indicates that, in addition to consumption, other components of aggregate demand (investment, exports, and government expenditure), also play a substantial role in supporting growth.

The results add further evidence that consumption is a key component of the short-term dynamics of the Bulgarian economy. The empirical base presented here can serve as a reference point for policy formulation. While stimulating household income and consumption can provide a rapid boost to economic activity, such effects are unlikely to translate into sustainable growth without complementary measures aimed at strengthening productive capacity and promoting investment.

Future research could extend this analysis by incorporating variables such as credit availability, price dynamics, and income structure, as well as by exploring the long-run linkages between consumption and growth.

The principal contribution of this study lies in providing an up-to-date empirical estimate showing an almost proportional relationship between changes in consumption and changes in GDP. The results confirm the leading role of household expenditure in driving Bulgaria’s short-term economic dynamics and carry direct implications for the design of stabilization and growth policies.

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Regulatory Review and Analysis of the Preliminary Control by the Public Procurement Agency (PPA)**Plamena NEDYALKOVA¹**¹ University of Economics-Varna, Varna, Bulgaria, e-mail: plnedyalkova@ue-varna.bg

JEL: M41, M42, M48**Abstract**

Public procurement should not only be viewed in a one-way manner as a specific activity initiated by a person called the contracting authority and implemented by another person/persons called the contractor. Public procurement should be analyzed and viewed as a tool for achieving certain socio-economic goals, both at the national and international levels. It is no coincidence that the European Commission seeks to impose uniform and common criteria for the award of public procurement, so that a uniform approach is applied by the Member States, which will prevent unnecessary fragmentation of public procurement in individual countries and prevent distortion of competition in international European markets. All these factors underscore the importance of public procurement control and the need to systematically conduct checks on them, both during the award process and during implementation. This paper *applies the methods* of literature review, survey, and analysis. *Conclusions and recommendations* are drawn that relate to the improvement of the Agency's control activities.

Key words:

control, public procurement,
activity.

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1. Introduction

The history of the Public Procurement Agency is interesting from the point of view of the fact that its development most accurately reflects everything that concerns the development of the country in the international plan. Initially, the Agency was an administrative structure under the Ministry of Economy and Energy. From 2009 to May 2013, tourism was also included in the scope of the ministry, and thus, the new Ministry of Economy, Energy, and Tourism was established. After May 2013, tourism was again separated into a separate ministry and the old name was returned, namely the Ministry of Economy and Energy, as such it continued to function from May 2013 to November 2014, after which, regardless of the aforementioned changes in the organization of the ministry, the Public Procurement Agency until the end of 2015 was under the relevant ministry. From January 1, 2016, the Public Procurement Agency became a secondary budget spending authority under the Minister of Finance.

The establishment of the Agency is "in response to the commitments made to the European Commission under Chapter One "Free Movement of Goods" in the negotiation process for Bulgaria's accession to the European Union, regarding the implementation of the following regulations: Regulation (EC) No. 2195/2002 of the European Parliament and of the Council of 5 November 2002 on the Common Procurement Vocabulary (CPV), amended by Commission Regulation (EC) No. 213/2008 of 28 November 2007 (OJ, L 74, 15.03.2008) and Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public service contracts and public supply contracts. According to the aforementioned regulations and directives, public procurement is part of the EU's horizontal policies, and it is necessary to have a single established center for their implementation, in the person of the Public Procurement Agency, which would be responsible for:

- "Ensuring operational liaison with the EC services on all issues affecting public procurement;

- Preparing draft regulations through which European and national policies in the field are implemented;
- General methodological support to all contracting authorities, with a view to achieving legality in their actions;
- Exercising prior preventive control over the actions of contracting authorities;
- Ensuring conditions for implementing the principle of publicity and transparency in the process of awarding public procurement".

In this part of the study, we focus our attention on the aforementioned agency, since a large part of public spending, especially those related to the implementation of digital technologies in the budget sector, is carried out through the awarding of public procurement. Public procurement as a new type of economic activity has affected all spheres, not just public sector organizations, since "public procurement is the acquisition by one or several contracting authorities through a public procurement contract of construction, supplies or services from contractors selected by them, regardless of whether they are intended for public purposes - in the case of public contracting authorities, or in the case of sector contracting authorities - when they are intended for the implementation of sectoral activities". According to several researchers and scholars (Hristova, 2022); (Lewa, 2010) in the field of public procurement, "regardless of whether it concerns private economic entities or public bodies, the process is designed to achieve a balance of several key parameters, known as the "5 Rights" of supply chains – right quality, right quantity, right price, right place and time, and right source". The process of awarding, the five key parameters, which are interconnected; this makes public procurement as an activity so attractive for research and analysis from all aspects – accounting, financial, legal, social, etc..

In this paper, the main goal is to present the types of control activities that the Agency carries out, and for this purpose the following tasks have been set to achieve:

1. To present the types of ex-ante controls that the Public Procurement Agency carries out.
2. To present the specifics of each control.

2. Literature Review and Regulatory Review

The external prior control carried out by the Public Procurement Agency is in four areas (Fig,1):

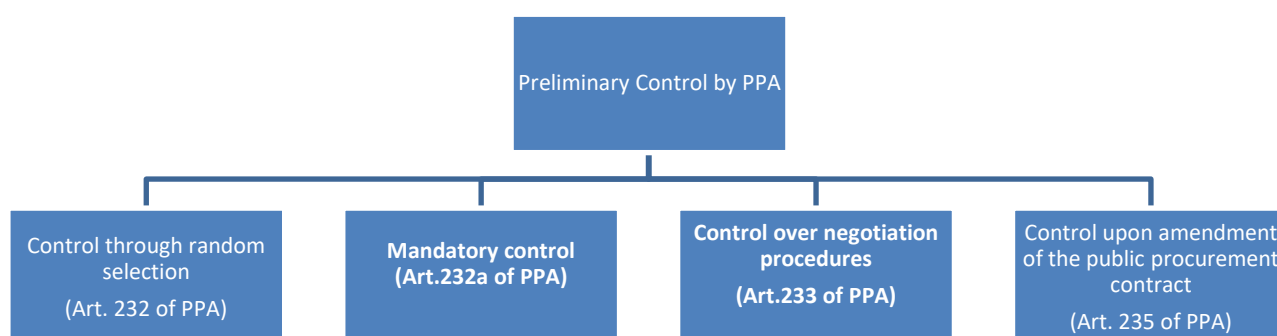


Fig.1 Types of prior control carried out by the Public Procurement Agency.

The first type of control covered by the law is control by random selection (Art. 232 of the Public Procurement Act). The scope of control, which is carried out on a random basis, is for public procurement contracts that must meet the following conditions:

1. the estimated value is:
 - for construction – from 1,000,000 BGN to 5,000,000 BGN inclusive;

- for supplies and services – from 200,000 BGN to 5,000,000 BGN inclusive;
- 2. Their opening is announced by means of an announcement.

According to the approved methodological guidelines of the Public Procurement Agency, control "under Art. 232 of the Public Procurement Act is carried out only on procedures selected by the random selection system (RSS) according to a methodology that takes into account the level of risk (see Art. 121, para. 3 of the Public Procurement Act). At least one procedure is selected for control every working day, which is announced on the Public Procurement Portal. Each procedure can be selected for inspection during the three working days following the day of its registration. If the conditions specified in items 1 and 2 are met for a procedure prepared in the Centralized automated information system "Electronic Public Procurement" (CAIS EOP) and it is not excluded from the scope of control, contracting authorities are obliged to register it in the RSS before opening it. Contracting authorities open directly, without registration in the RSS, procurement procedures whose estimated value is below the threshold for control (e.g., a construction procedure, with a value lower than BGN 1,000,000, respectively lower than 200000 BGN for supplies and services). If, after 3 working days from the entry of data into the RSS, the procedure is not selected for control, the contracting authority may announce its opening (Art. 121, para. 4 of the Regulations for the Implementation of the Public Procurement Act).

The digitalization of the PPA supports both the experts from the agency and the contracting authorities themselves, who rely on the expert opinion and competence of the PPA control persons. The process is mutual, since every quality check that is carried out in advance is important for the contracting authorities. Each stage of the process of carrying out prior control is aimed at the lawful application of the laws. Practice has long proven that if the weaknesses and omissions that the contracting authority makes when announcing a public procurement are not identified at this early stage, these weaknesses and inaccuracies may be identified by other persons and control institutions at subsequent stages, but then the losses and negative effects on the contracting authority may be greater.

The random selection control is carried out in two stages – before and after the announcement of the opening of the award procedure.

The first stage, before the announcement of the opening of the award procedure, covers the entire documentary scope of the award procedure. At this stage, the PPA experts check: 1. the decision to open the procedure; 2. the notice of the announcement of the opening of the procedure; 3. the technical specifications; 4. the evaluation methodology (where applicable).

According to the approved methodological instruction, "documents are sent to the PPA within 3 days of determining the control procedure (Art. 122, para. 1 of the Public Procurement Act). Each submission of information in the centralized automated information system "Electronic Public Procurement" (CAIS EOP) is the responsibility of the contracting authority. When the required documents are submitted incorrectly and do not meet the requirements of the Public Procurement Act and the Public Procurement Act, then control is not carried out. The contracting authority must correctly go through all stages of the PPA electronic platform so that all methodological instructions of the agency are fulfilled.

In the course of preparing a procedure, each contracting authority shall clearly define the parameters of the procurement and the conditions for its conduct. Since the CAIS EOP system does not permit corrections and resubmission of the documents for preliminary control within the same procurement file, it is of paramount importance to ensure the precise structuring and unambiguous designation of a separate file or archived folder entitled "Technical Specification," as well as a file entitled "Methodology," where applicable.

Within a period of 14 days from the receipt of the documents for control, the Public Procurement Agency (PPA) shall issue a preliminary opinion, which shall set out the discrepancies identified in the documents about the requirements of the public procurement legislation. The opinion shall be transmitted to the contracting authority through the CAIS EOP system. The contracting authority shall receive a notification regarding the issued opinion at the email address of the person who submitted the registration form.

Pursuant to the approved methodological guidelines of the PPA: *“for procedures in which the time limit for receipt of requests to participate or tenders is reduced (in the cases under Art. 74, paras. 2 and 4, Art. 75, para. 7, Art. 76, para. 6, Art. 133, paras. 2 and 4, Art. 134, para. 3, Art. 135, para. 3, Art. 136, para. 3, and Art. 137, para. 4 of the Public Procurement Act), as well as in the procedure ‘public competition,’ the control shall be concluded after the completion of the first stage.”*

In the aforementioned cases, the contracting authority may publish the opening of the procedure notwithstanding the fact that it has been selected for control (Art. 121, para. 5 of the Rules for the Implementation of the Public Procurement Act).

The second stage of control, before the announcement is carried out, is carried out after the publication of the documents for the opening of the procedure. The following are subject to verification:

1. the decision to open the procedure, published in the Public Procurement Register (PPR);
2. the notice announcing the opening of the procedure, published in the PPR;
3. the technical specifications, published in the PPR (on the public page of the procurement);
4. the methodology for evaluating offers (where applicable) – published in the PPR (on the public page of the procurement).

In case recommendations from the verification at the first stage of control are not complied with, the contracting authority shall send written reasons to the PPA no later than the next working day after the publication in the PPR of the decision and the notice for the opening of the procedure (Art. 232, para. 7 of the PPA Act).

In compliance with the requirements of Art. 123, para. 3 of the PPA Act, when the contracting authority has not filled in the documents, the number and date of the opinion from the first stage, then it is permissible not to carry out the second stage of the preliminary control, unless the opening of the procedure was established ex officio. It is permissible for the PPA experts to establish that there are any shortcomings in this second stage. Then it is necessary to describe all the identified weaknesses in the opinion, which is provided to the contracting authority. It is permissible for the contracting authority to disagree with the findings made; then it should attach its written reasons, which is again done through the CAIS EOP. After the full final check is made, within 10 days, the PPA should prepare a final opinion on legality. The same is sent through the platform of the contracting authority, the National Audit Office, and the State Financial Inspection Agency. In this way, all interested parties are notified about the procedure for awarding the relevant public procurement.

The second type of prior control carried out by the Public Procurement Authority is the mandatory control under Art. 232a of the Public Procurement Act. Mandatory prior control is carried out in accordance with Art. 229, para. 1, item 2, letter "g" of the Public Procurement Act. Again, the contracting authority is obliged to submit all documents on the public procurement through the CAIS EOP. Public procurement procedures that simultaneously meet the following conditions are subject to mandatory prior control:

1. the estimated value is greater than BGN 5,000,000, excluding VAT;
2. their opening is announced through an announcement.

Here, the scope of control excludes "procedures for the establishment of dynamic purchasing systems and qualification systems, as well as the contracts awarded through them (Art. 84, Art. 86, Art. 141, and Art. 142 of the Public Procurement Act). Procedures in the fields of defense and security, which are awarded under special rules (Art. 148 - 175 of the Public Procurement Act) (see Art. 232a, para. 1 of the Public Procurement Act)".

The control is carried out in two stages:

1. Before the announcement of the opening of the procedure.
2. After the announcement of the opening of the procedure.

During the first stage, i.e., the stage before the opening of a procedure, the following are checked:

1. the decision to open the procedure.
2. the notice announcing the opening of the procedure;
3. the technical specifications, except for cases when they are approved with the decision to approve the call for confirmation of interest;
4. the evaluation methodology, where applicable.

Again, the rule applies to this procedure that documents sent for control activities are not considered if the requirements of Art. 117 and Art. 118 of the Public Procurement Act are not met.

According to the approved methodological instruction, within 14 days of receiving the documents for control, the Public Procurement Authority prepares a preliminary opinion, which contains the inconsistencies found in the documents with the requirements of the legislation in the field of public procurement.

The second stage of control is carried out after the publication of the documents for opening the procedure. The following, published in the public procurement file in the ROP, are subject to verification:

1. decision to open the procedure;
2. notice announcing the opening of the procedure;
3. technical specifications;
4. methodology for evaluating offers (where applicable).

Again, as in the first procedure, the PPA complies with the approved 10-day period from the publication of the documents for opening the procedure to prepare a final opinion on the legality of the public procurement. The same is sent via the platform to the contracting authority, the National Audit Office, and the State Financial Inspection Agency.

The third type of prior control is over negotiation procedures (Art. 233 of the Public Procurement Act). The negotiation procedures under Art. 79, para. 1, items 3, 4, 6, 9, and 10, and Art. 182, para. 1, items 1 and 4 of the Public Procurement Act, which award public contracts, the estimated value of which, excluding VAT, is equal to or higher than:

- a) 1,000,000 BGN – for construction;
- b) 200,000 BGN – for supplies and services, are subject to control under Art. 233 of the Public Procurement Act.

Outside the scope of this control are the procedures for the supply of or services for access, transmission, and distribution of natural gas, heat, or electricity, or drinking water with companies that hold special or exclusive rights (Art. 233, para. 2 of the Public Procurement Act).

Unlike the previous two procedures, participation in this one is not available to all persons, but is limited to economic entities that are invited by the contracting authority. For this reason, the procedures are considered non-competitive. Their application is subject to conditions explicitly specified in the Public Procurement Act, and their conduct should be preceded by disclosure of the factual circumstances that led to the need to ignore the general order". The legislator provides for the possibility of conducting procedures without negotiation in cases of force majeure or urgent events on the basis of Art. 79, para. 1, item 4 of the Public Procurement Act.

The following three conditions must be met for there to be grounds for the lawful application of Art. 79, para. 1, item 4 of the Public Procurement Act, namely:

- the need for the award is caused by exceptional circumstances within the meaning of § 2, item 17 of the Additional Provisions (AP) of the Public Procurement Act. According to the established definition presented in § 2, item 17 of the Additional Provisions (AP) of the Public Procurement Act, the circumstances may be of a different nature, which may be caused by events unforeseeable for the awarding authority, such as a natural disaster, accident or catastrophe, as well as others that damage or directly threaten the life or health of people,

the environment or national security. After the changes to the Public Procurement Act in 2023, the definition of "exceptional circumstances" is approaching the concept of "force majeure" in civil and commercial law. It is necessary to bear in mind that events and/or facts that hinder or disrupt the normal performance of the contracting authority's legally established activities are excluded from the definition. Given the new scope of the definition, proper planning, implementation, and awarding of public procurement is of essential importance. The untimely opening of competitive procedure, the delay in concluding the contract, as well as the impossibility of timely satisfying the needs of the contracting authority, should not lead to the application of negotiation without prior notice on the specified grounds with the grounds that it is necessary for the contracting authority to ensure the continuity of a certain activity or to fulfill other legally defined obligations.“

- to overcome the consequences, an urgent award of the contract is necessary, which excludes the possibility of observing the deadlines, including the shortened ones, for conducting a competitive procedure under the Public Procurement Act. The application of Art. 79, para. 1, item 4 of the Public Procurement Act is also subject to the condition that the result of the award is necessary immediately or in a very short time, i.e. to justify proceeding to this procedure for determining a contractor, it must be objectively impossible to overcome the negative consequences of the extraordinary circumstance by concluding a contract under the general procedure – through an open, restricted or competitive procedure with negotiation”.

- the circumstances justifying the urgency of the award should not be attributable to the contracting authority. The methodological instructions of the Public Procurement Agency specify that "the circumstances justifying the existence of urgency should not be attributable to the contracting authority". The quoted text implies that they should not be the result of his actions or inactions, but should occur objectively and unexpectedly for him and despite the due care taken, i.e. the circumstances justifying the need for urgent award and performance of the contract should not only be beyond the will of the contracting authority, but also beyond his ability to foresee and prevent their occurrence".

The last type of prior control carried out by the Public Procurement Authority is the control upon amendment of a public procurement contract (Art. 235 of the Public Procurement Act). The control under Art. 235 of the Public Procurement Act is carried out upon amendment of a public procurement contract on the grounds under Art. 116, para. 1, item 2 of the Public Procurement Act, when the value of the contract excluding VAT is equal to or higher than:

- a) 1,000,000 BGN – for construction;
- b) 200,000 BGN – for supplies and services.

An additional condition for carrying out control is that the value of the amendment itself is equal to or higher than 20 percent of the value of the concluded contract. When the value of the contract is not specified therein, the amount of the amendment is calculated based on the estimated value of the contract (Art. 229, para. 3 of the Public Procurement Act).

The PPA instructions themselves clearly and precisely emphasize and state that this type of control is not aimed at sanctioning the contracting authority, but is a "form of methodological support for the contracting authority (Art. 229, para. 1, item 2, b. "e" PPA). It is carried out before the conclusion of the additional agreement and consists of checking:

- the reasons for applying Art. 116, para. 1, item 2 of the Public Procurement Act and
- the evidence presented by the contracting authority in support thereof (Art. 236, item 3 of the Public Procurement Act)”.

In all public procurements, not only this one, the requirements of Art. 5 of the Accountancy Act and Art. 117, para. 2 of the Public Procurement Act are complied with, i.e., in the presence of a foreign document that must be provided, it is necessary to accompany it with a translation into Bulgarian. If the document is also accounting, i.e., meeting the requirements of the Accountancy Act, it is necessary for the contracting authority to comply with the latest update of the law, i.e., “accounting documents in enterprises are drawn up in

Bulgarian with Arabic numerals and in euros. They may also be drawn up in the relevant foreign language in foreign currency in cases of transactions agreed in foreign currency with foreign counterparties. When the transaction is agreed in foreign currency, the equivalence in euros is determined as the central exchange rate of the Bulgarian National Bank on the date of the transaction, and shall be applied to the amount in foreign currency.

3. Methods

The Public Procurement Agency is the main institution that monitors the public procurement market and is committed to systematically presenting information on its status and changes. The public interest that comes not only from the public procurement market, but also from the Agency's activities, is the reason why full transparency and public awareness are maintained. All instructions, guidelines, reports, regulations, methodology, etc., are presented in an accessible and public manner, both through the PPA website and through the CAIS EOP. Transparency of information is a prerequisite for the presented data on the PPA to be accurate; they are presented by the institution itself, which proves their weight, comprehensiveness, and reliability. This cannot be achieved with questionnaires, since the surveys are still anonymous and the information presented through them may not be correctly presented by the respondent. In this vein, as evidence, we present the summarized information of the Public Procurement Agency on the total number of public procurement notices through the CAIS EOP for the period from 2013 to 2023.

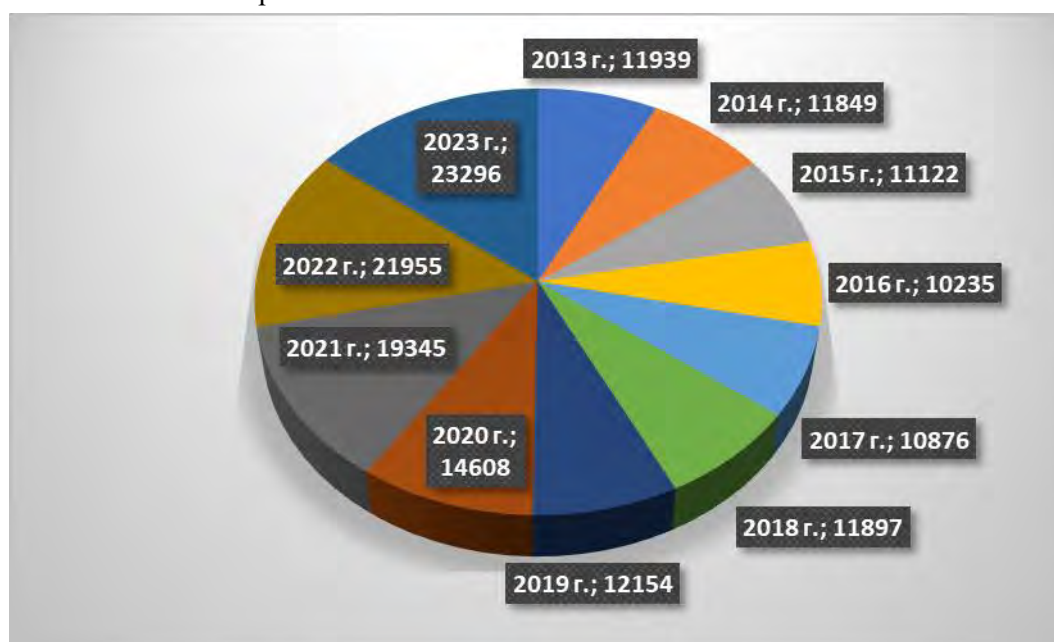


Fig. 2. Number of announced public procurement contracts by year for the period 2013-2023.

According to data from the Public Procurement Agency (PPA) for 2023, the total number of public procurement contracts announced through the Centralized Electronic Public Procurement System (CEPP) is 23,296, distributed as follows:

- Public procurement through an open procedure – 7,191 contracts.
- Public procurement through a restricted procedure – 42 contracts.
- Public procurement through a competitive procedure with negotiation – 4 contracts.
- Negotiation with prior invitation to participate – 258 contracts.
- Negotiation with publication of a contract notice – 29 contracts.
- Negotiation without prior publication – 1,484 contracts.

- Negotiation without prior invitation to participate – 190 contracts.
- Negotiation without publication of a contract notice – 24 contracts.
- Design contest – 5 contracts.
- Public competition – 6,315 contracts.
- Direct negotiation – 1,152 contracts.
- Collection of offers with notice – 6,205 contracts.
- Invitation to selected candidates – 397 contracts.

According to PPA data, in 2021, 2022, and 2023, the control exercised by the Agency included inspections of:

- procedures for awarding public contracts determined by random selection (under Art. 232 of the Public Procurement Act);
- negotiation procedures (under Art. 233 of the Public Procurement Act);
- amendments to public procurement contracts based on Art. 116, para. 1, item 2 of the Public Procurement Act (under Art. 235 of the Public Procurement Act).

First, we focus on the data from the inspections for the period from 2021 to 2023, since on 01.07.2021, the control of the Public Procurement Authority was carried out in the electronic environment of the CAIS EOP, and the data is much more accurate. This is also because in 2021, the electronic platform was updated, and a separate module "External control carried out by the Public Procurement Authority" was added. In the following parts of the presentation, the overall process of digitalization of the Public Procurement Agency will be presented, together with the internal and external control carried out by the Agency. Here we present general information about the control activities and their results during the respective analyzed period.

Table 1

Total number of case files of the PPA from control activities

Year	Total number of case files	Types of case files
2013	1,726 case files	*831 case files at first stage; *802 case files at second stage; 92 case files returned to contracting authorities after review and assessment established that the necessary prerequisites for preliminary control were not present; and one case file not subject to preliminary control due to the contracting authority's refusal.
2014	1,225 case files	According to PPA data for 2014, the case files were categorized by the type of operational programme under which the public procurement was awarded, and not by procedure type. A portion of the procedures initiated in 2014 (389 case files) were not subject to preliminary control under Art. 19, para. 2, item 24 of the Public Procurement Act (PPA).
2015	625 case files	Due to the introduction of minimum value thresholds, effective as of 01.07.2014, 46% of the procedures initiated in 2015 (619 case files) were not subject to preliminary control under Art. 19, para. 2, item 24 of the PPA.
2016	1,030 case files	*272 related to two-stage control under Art. 19, para. 2, item 22 of the PPA (repealed); *442 negotiation procedures subject to control under Art. 19, para. 2, item 24 of the PPA (repealed); *122 case files related to random checks under Art. 232 of the PPA; *80 case files under Art. 233 of the PPA; 10 case files under Art. 235 of the PPA.
2017	822 case files	*226 opinions at first stage of the preliminary control; *210 opinions at second stage; *196 opinions under Art. 233 of the PPA; *19 opinions under Art. 234 of

Year	Total number of case files	Types of case files
		the PPA regarding contracts concluded under legal exemptions; *9 opinions regarding amendments to contracts under Art. 235 of the PPA; <i>162 opinions on procedures selected for monitoring under Art. 114, para. 1, item 2 of the Implementing Regulations of the PPA.</i>
2018	918 case files	*237 opinions at first stage; *226 opinions at second stage; *207 opinions under Art. 233 of the PPA; *48 opinions under Art. 234 of the PPA regarding contracts concluded under legal exemptions; *6 opinions regarding amendments under Art. 235 of the PPA; <i>198 opinions on procedures selected for monitoring.</i>
2019	—	*467 case files under Art. 232 of the PPA; *210 case files under Art. 233 of the PPA; *34 case files under Art. 114; *13 case files under Art. 235 of the PPA; <i>6 case files under Art. 234 of the PPA.</i>
2020	648 case files	*468 related to random checks under Art. 232 of the PPA; *173 negotiation procedures checked under Art. 233 of the PPA; <i>7 case files regarding amendments to contracts (control under Art. 235 of the PPA).</i>
2021	667 case files	*432 related to random checks under Art. 232 of the PPA; *230 related to negotiation procedures under Art. 233 of the PPA; <i>5 related to contract amendments under Art. 235 of the PPA.</i>
2022	634 case files	*449 related to random checks under Art. 232 of the PPA; *74 related to negotiation procedures under Art. 233 of the PPA; <i>11 related to contract amendments under Art. 235 of the PPA.</i>
2023	622 case files	*419 related to random checks under Art. 232 of the PPA; *193 related to negotiation procedures under Art. 233 of the PPA; <i>10 related to contract amendments under Art. 235 of the PPA.</i>

Source: Authors' Compilation, 2025.

For the period under review from 2013 to 2023, the PPA has published two consecutive reports on the most common irregularities in the award of public contracts on a random basis. This once again proves, together with the information presented in Table 1, that the Agency's goal is to support the public procurement process, optimize the document submission processes, and ensure consistent award of public contracts.

Based on the comparative analysis of the data presented in Table 1, as well as based on everything that has been presented so far, the following conclusions can be drawn and the following specifics can be presented, namely:

1. The results of the administrative control carried out by the PPA in the first years before the introduction of the electronic platform CAIS EOP are very limited in the annual reports on the activities of the PPA, unlike the period after the introduction of the electronic platform.
2. The studied ten-year period reveals that the negotiation procedures under the old law in force applied only to public contracting authorities, but not to sectoral contracting authorities.
3. The new point, which definitely improves the activities of the PPA, is that documents are sent electronically, in accordance with the requirements of Directive 2014/24.
4. The changes that occurred with the amendment to the Public Procurement Act in 2014 expanded the powers of the Agency, which allows, in addition to presenting recommendations, to provide specific instructions in the opinions to eliminate weaknesses and inconsistencies with the

law.

5. Not all procedures that are registered in the ROP (Public Procurement Register) are subject to prior control; for this reason, the data in Table 13 refer only to those procedures for which files have been drawn up for carrying out prior control.

6. The opinions of the PPA are not binding on the contracting authorities. More precisely, they aim to direct it, to pay attention to some features of the application of the law, and the contracting authority is the person who can accept or not accept these guidelines. In cases where the contracting authority does not accept the findings presented in the opinion, it is obliged to provide written reasons for the relevant public procurement and to present the reasons in the relevant file (Art. 121 of the Public Procurement Act) for each public procurement to ensure documentary traceability (audit trail) concerning all its actions and decisions, as well as the actions of the public procurement commissions, regardless of whether the contracts are awarded by electronic means. The file contains the contract or framework agreement, as well as all documents related to their implementation and reporting.

7. According to Art. 122 of the Public Procurement Act, electronic documents in the public procurement file are stored in the platform under Art. 39a, para. 1 for a period of 5 years from the year in which the performance of the contract was completed or the award was terminated. After the expiry of this period, they are archived for a period of 5 years in accordance with the Electronic Government Act. When the contracting authorities store the documents on paper, the period is also 5 years.

8. The law exempts specific public procurements from prior control for certain cases and contracting authorities that fall within the scope of Art. 14 and Art. 15 of the Public Procurement Act. However, the law allows, at its discretion, a prior control procedure may be applied, Art. 136 of the Public Procurement Act may be applied, and the selected basis and the evidence for fulfilling the requirements thereto shall be subject to verification.

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Methodology for Developing Reference Budgets in the Republic of Bulgaria

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Abstract

Bulgaria faces persistently high poverty, inequality, and weak social policy instruments. Existing measures, such as the at-risk-of-poverty threshold or the “subsistence minimum,” rely on static indicators that fail to capture real living costs and lack public legitimacy. This report proposes a methodology for developing reference budgets as an alternative, adapting the European Reference Budgets Network (ERBN) framework to the Bulgarian context. The approach combines three elements: focus groups to define socially shared expectations of adequacy, expert panels using the Delphi method to ensure methodological rigor, and systematic market pricing and data processing to produce transparent cost estimates. The Varna pilot project marks the first attempt to apply this process. By grounding standards in both social validation and empirical evidence, reference budgets can enhance policy accountability, strengthen social resilience, and align Bulgaria with European debates on income adequacy.

Key words:

reference budgets, social policy, income adequacy, living standards, Bulgaria.

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1. Introduction

The adequacy of incomes is a prerequisite for social inclusion and the realization of basic rights. Without sufficient resources to access essential goods, services, and public life, dignity and social justice remain unattainable. Despite recent economic growth, Bulgaria continues to register some of the highest poverty and inequality rates in the European Union (Eurostat, n.d.). Addressing this challenge requires moving beyond static poverty thresholds toward methodologies that reflect real living costs and evolving social needs.

Reference budgets, defined as priced baskets of goods and services necessary for a socially acceptable standard of living, offer such an approach. Unlike conventional poverty indicators, they combine normative assumptions with participatory validation (Goedemé et al., 2015). Their integration into welfare systems in countries such as Belgium, the Netherlands, and the United Kingdom illustrates their dual role as scientific instruments and practical tools for wage setting, social transfers, and financial counselling (Davis et al., 2021; Storms et al., 2014; Warnaar & Luten, 2009). At the European level, the European Reference Budgets Network (ERBN) and the 2023 Council Recommendation on adequate minimum income have consolidated their relevance for social inclusion (Council of the European Union, 2023).

Bulgaria, however, lacks a national framework for reference budgets. Current debates rely on the at-risk-of-poverty threshold or the “subsistence minimum” (World Bank, 2022; NSI, 2023), both criticized as outdated and disconnected from actual living costs. Research remains fragmented, with limited experiments in food baskets or local adaptations, but without methodological coherence or policy uptake. This gap hinders evidence-based policymaking against structural poverty and inequality.

Against this background, a pilot initiative has recently been launched in Varna under the coordination of the University of Economics - Varna. While still at an early stage, the project represents the first systematic

attempt to explore the development of reference budgets in Bulgaria. The present conference report does not propose a finalized methodology but outlines its potential components. It maps the conceptual foundations, participatory procedures, expert involvement, and market analyses that could underpin a comprehensive framework. The aim is to stimulate debate and provide a structured basis for future research and policy development.

The report is structured as follows: Section 2 situates reference budgets within the European and Bulgarian context, identifying lessons from international experience and challenges specific to Bulgaria. Section 3 sets out the methodological components of the Varna pilot - focus groups to capture socially shared expectations, expert panels (Delphi) to ensure technical robustness, and systematic market pricing and data processing to establish transparent cost estimates - and details procedures for testing budgets (social acceptability, expert validity, internal consistency) and for regular updating and rebasing. Section 4 outlines the limitations of the approach, clarifying the scope, assumptions, and data constraints that frame interpretation. Section 5 translates the methodology into next steps, covering implementation in Varna, engagement and dissemination, updating schedules, and pathways for regional scaling and policy integration. Section 6 offers the conclusion, drawing together the contribution and its implications for evidence-based policymaking in Bulgaria.

2. Reference Budgets in the European and Bulgarian Context

To understand how a Bulgarian framework might be developed, it is useful to situate the discussion within the broader European experience. Over the past two decades, reference budgets have been elaborated in several member states, combining methodological refinement with growing policy recognition. Their trajectories show that such budgets can evolve into versatile instruments - supporting welfare evaluation, informing collective bargaining, or guiding households in financial planning - depending on national needs and institutional settings.

In Belgium, they form part of the regular assessment of minimum income protection and are integrated into the monitoring of social assistance adequacy (Storms et al., 2014). In the Netherlands, they underpin financial counselling, support wage negotiations, and provide transparent benchmarks for household planning (Warnaar & Luten, 2009). In the United Kingdom, budget standards have long been used in longitudinal research on living standards and have influenced debates on social participation and income adequacy (Davis et al., 2021). These examples highlight the dual function of reference budgets: they serve as empirical instruments for evaluating adequacy while also shaping public and political understandings of what constitutes a dignified life.

By contrast, Bulgaria has yet to embed reference budgets into its social policy toolkit. Existing debates continue to rely mainly on two indicators: the relative at-risk-of-poverty threshold and the so-called “subsistence minimum.” Both offer continuity for statistical monitoring but fall short of capturing what households actually need for participation in society. The poverty line reflects income distribution rather than real costs, while the subsistence minimum has been criticized for its restrictive, survival-oriented focus (Atkinson et al., 2017).

Attempts to move beyond these measures have been fragmented. Studies have experimented with food baskets (Vassileva, 2017) or estimated local living costs, but such initiatives remain isolated and lack institutional anchoring (Mitev, 2025). Without a transparent and methodologically coherent framework, public debate risks revolving around abstract thresholds rather than evidence-based standards. As international research has shown, the credibility of reference budgets depends not only on technical soundness but also on their recognition by policymakers and social partners (Goedemé et al., 2019).

Taken together, the European experience and Bulgaria’s current shortcomings underline a simple conclusion: the challenge is not to prove the usefulness of reference budgets, but to design a methodology that

is both credible in research terms and legitimate in the eyes of society and institutions. The next section outlines how such a methodology could be structured for the Bulgarian context.

3. Outline of Methodological Components

Building on these insights, the methodological design for developing reference budgets in Bulgaria must directly address national constraints while drawing inspiration from international practice. Three systemic barriers define the starting point: the lack of reliable data on household living costs - particularly in rural areas and within the informal economy; the fragmentation of institutional responsibilities across ministries and agencies; and limited political commitment to adopting transparent adequacy measures (Mitev, 2025). These barriers make narrow subsistence indicators or purely statistical extrapolations inadequate. What is needed instead is a mixed-methods approach - combining qualitative, quantitative, and expert-driven components - which the European Reference Budgets Network (ERBN) has consistently recommended as the most effective way to ensure both scientific rigor and social legitimacy (Goedemé et al., 2015).

The rationale for such a design rests on three interrelated principles:

First, triangulation of evidence. Reference budgets gain legitimacy when they are grounded in multiple sources of knowledge. Qualitative focus groups capture the lived experiences and socially shared expectations of households, preventing the baskets from being reduced to technocratic assumptions. Expert panels ensure compliance with professional standards in fields such as economics, sociology, nutrition, and housing, while quantitative price surveys provide transparency and allow for systematic updating. Together, these elements reinforce both validity and credibility.

Second, alignment with comparative experience. European traditions show that methodological choices shape not only outcomes but also acceptance. The UK's *Minimum Income Standard* underscores the value of citizen deliberation in defining acceptable living standards (Davis et al., 2021). Belgium's model, rooted in the Theory of Human Need (Doyal & Gough, 1991), demonstrates how expert consensus can be combined with functional needs assessment and strong social participation (Storms et al., 2014). The Dutch approach highlights the added value of applying reference budgets in practical contexts such as financial counselling and debt management (Warnaar & Luten, 2009). At the European level, the ERBN framework integrates these lessons into a harmonised methodology, balancing cross-country comparability with national specificity.

Third, policy relevance. A Bulgarian framework will only gain traction if it produces outputs that are actionable. Participatory focus groups and policy labs can foster shared ownership among citizens, municipalities, and civil society, strengthening legitimacy. Interdisciplinary expert panels can overcome fragmented responsibilities by building cross-sectoral consensus. Transparent price collection, meanwhile, ensures empirical credibility and facilitates integration into social policy debates. In this way, the methodology is designed not merely as an academic exercise but as a governance innovation capable of supporting evidence-based policymaking and enhancing accountability.

Synthesizing these principles, a Bulgarian methodology should rest on three essential practices: participatory focus groups, interdisciplinary expert panels, and systematic price monitoring. These practices mirror established European models but are adapted to national realities. Importantly, social validation is not treated as a final step but as a principle running throughout the process, ensuring that reference budgets remain legitimate, transparent, and responsive to evolving societal expectations.

3.1. Focus Groups

A core component of the Bulgarian reference budget methodology is the use of focus groups to capture the lived experience and normative expectations of households. This stage operationalizes the participatory

principle emphasized in the ERBN framework (Goedemé et al., 2015) and directly addresses one of Bulgaria's most pressing barriers: the lack of social legitimacy and public ownership of adequacy indicators. International practice, particularly the UK's *Minimum Income Standard* (Davis et al., 2021) and the Belgian CEBUD methodology (Storms et al., 2014), demonstrates that standards of adequacy gain the strongest legitimacy when they emerge from structured deliberation among citizens.

In the Bulgarian pilot, focus groups are organized around household typologies that balance international comparability with national relevance. Four household types were selected for the Varna pilot: single-person households, two-person households without children, single-parent households with one child, and four-person households with two children. These categories correspond to common household structures, allow scaling to more complex compositions, and follow ERBN practice in ensuring methodological coherence.

The household typologies are presented in **Table 1**, which specifies their characteristics, all situated in Varna city. Varna city was chosen because it provides an urban setting with identifiable neighborhood variation and seasonal price pressures; it is large enough for diverse sampling but manageable for intensive fieldwork. Using concrete household scenarios with relatable details strengthens the deliberation process, enabling participants to consider the needs of plausible households while giving researchers a consistent frame for comparing results across household types.

Table 1**Household typologies used in the Varna pilot**

Typology 1	Typology 2	Typology 3	Typology 4
Single adult w/o children	Couple w/o children	Single parent with 1 child	Couple with 2 children
working age	working age	working age	working age
no children	no children	one child	two children
Varna city	Varna city	Varna city	Varna city

Source: Authors' Compilation, 2025.

Focus groups will serve multiple functions across the research cycle. The sessions will be purposively recruited to ensure diversity in age, gender, occupation, and socio-economic background, with the aim of capturing normative expectations rather than statistical averages. Discussions will be moderated using a semi-structured guide and recorded, transcribed, and anonymized. Thematic coding and comparative analysis will allow for the identification of recurring needs, points of consensus, and divergences across household types.

To make this operational, the focus groups will contribute to five specific activities in the methodology:

- **Defining the standard of living considered adequate for social participation.** Participants will be asked to reflect on what it means, in Varna, to live with dignity and not fall behind peers and neighbors. A draft working definition - covering essentials such as food, housing, clothing, transport, health, and modest participation in community life - will be discussed, tested against everyday realities, and adjusted through group consensus.
- **Identifying spending categories and baskets that reflect this standard.** Based on lived routines, participants will map the full range of domains required for a socially acceptable life: housing, food, clothing, healthcare, transport, education, personal care, communication, leisure and social participation, and household goods and services. The household typologies ensure that needs related to children, couples, and singles are captured systematically.

- **Developing specification lists that translate broad needs into concrete goods and services.**
For each basket, groups will help specify the actual items and services that meet socially defined needs. The process will follow key principles: specifications must be based on needs (not preferences), modest rather than luxurious, regionally relevant to Varna, and transparent and reproducible.
- **Validating price estimates against everyday experience.**
Once researchers have collected market price data, participants will review whether the proposed items, brands, service levels, and seasonal variations match how Varna households actually spend. This step ensures that the budgets remain realistic in a city with seasonal income volatility and neighborhood-level price differences.
- **Validating draft budgets to ensure credibility, realism, and social acceptability.**
Finally, participants will assess the overall baskets as monthly budgets, testing whether they allow households to cover essential needs while maintaining modest participation in community and family life. Narratives based on the typologies will be used to walk through typical months and seasons, checking for consistency and internal balance.

Beyond their technical outputs, focus groups also serve an institutional function. By involving citizens directly in defining adequacy, they build trust in the process and create a sense of public ownership over the results. This is particularly important in Bulgaria, where official poverty thresholds are often seen as disconnected from lived realities. Embedding citizen voice strengthens not only the content of reference budgets but also their legitimacy in public debate.

Crucially, the process will not rely solely on citizen deliberation. Expert consultation will complement focus groups at every stage: refining the living standard definition, validating the spending categories, assessing specification lists, and reviewing both pricing and draft budgets. Only when focus groups and experts converge on a common understanding will a component be considered ready for inclusion in the reference budgets. This combination of participatory and expert input ensures that the Varna pilot tests not just the technical feasibility of building reference budgets, but also the process of achieving consensus - a key condition for future legitimacy and policy uptake.

3.2. Experts

While focus groups bring social legitimacy to the methodology, they cannot on their own guarantee methodological soundness. For this reason, expert consultation is integrated at every stage of the Varna pilot. The role of experts is to ensure that the standards emerging from citizen deliberation are technically robust, consistent with professional knowledge, and usable for policymaking.

The Bulgarian framework incorporates expert panels, applying the Delphi technique to achieve structured consensus across relevant disciplines. This approach has strong precedent in international practice. In Belgium, the CEBUD methodology relies on interdisciplinary consultations to translate socially defined needs into functional requirements (Storms et al., 2014). In the United Kingdom, expert checks are systematically applied to the *Minimum Income Standard* to ensure that items identified in focus groups are feasible, nutritionally adequate, and consistent with legal or technical standards (Davis et al., 2021). Following these models, the Bulgarian framework applies a multi-round Delphi process designed to consolidate judgments into a coherent and standardized set of items.

Experts will contribute to all stages of the methodology:

- **Living standard definition:** reviewing the focus group formulation to ensure that it is clear, measurable, and consistent with broader theoretical and policy frameworks.
- **Spending categories (baskets):** checking for completeness, avoiding overlaps, and ensuring that all functional needs are covered.

- **Specification lists:** evaluating whether identified items and services are adequate, feasible, and aligned with technical or professional standards.
- **Price validation:** verifying the sources and representativeness of market data, and confirming that seasonal and regional variations are captured transparently.
- **Draft budget validation:** testing internal coherence across baskets and assessing whether budgets can serve as credible benchmarks for adequacy.

The Delphi process allows these contributions to be made systematically. Panels bring together specialists from nutrition, housing, healthcare, education, transport, economics, statistics, and social policy. Experts receive the outputs of each focus group round- such as draft definitions, preliminary baskets, or specification lists- and are asked to assess necessity, adequacy, and feasibility, flag redundancies, and propose essential additions. Their anonymized responses are aggregated and shared back in subsequent Delphi rounds, giving each expert the opportunity to reconsider judgments in light of group feedback. Consensus is defined not as unanimity but as a stable convergence of assessments.

Beyond its methodological role, the expert stage also addresses a structural barrier in the Bulgarian context: institutional fragmentation. By assembling specialists across domains and policy areas, the panels create a space for cross-sectoral dialogue and shared learning. In this way, they serve not only as a methodological instrument but also as an institutional platform - crucial for moving from a local pilot to a nationally recognized framework.

3.3. Market Pricing and Data Processing

The refinement of socially validated needs through focus groups and expert panels provides the foundation for translating reference budgets into monetary terms. To achieve this, the Bulgarian framework incorporates systematic market and statistical analysis, designed to establish transparent and up-to-date cost estimates for the goods and services included in the reference baskets. This stage ensures that the methodology is not only normatively grounded but also empirically verifiable, addressing one of the key deficits in current Bulgarian poverty measures: the absence of reliable and regularly updated cost-of-living data.

Data collection will combine several sources: small-scale price surveys in outlets identified by focus group participants as realistic points of consumption (possibly supported by university students); scanner data from retail chains where feasible; official statistics from the National Statistical Institute (CPI, Household Budget Survey); and, where relevant, additional sources such as JRC reports or online databases like Numbeo. These will provide a triangulated evidence base rather than relying on any single dataset.

Data processing is the critical step that transforms raw prices into credible budget values. Collected prices will be cleaned to remove outliers and summarized using typical values (such as medians) to avoid both the cheapest and the most expensive extremes. Durable goods will be annualized by spreading costs across their useful lifespan, while recurring expenses (rent, utilities, food) will be expressed as monthly costs. Seasonal variations in heating, cooling, and tourism-related services will be explicitly modelled, ensuring that budgets reflect real fluctuations in household expenditure patterns. Where discrepancies appear between market prices and official statistics, they will be flagged for joint review by focus groups and experts, combining social plausibility with technical validation.

Budget testing is then applied before any results are finalized. Three checks are built into the process:

- **Social acceptability** - does the draft budget make sense to the target households represented by the typologies?
- **Expert review** - does the budget meet the intended living standard and comply with technical and professional standards?
- **Internal consistency** - do the baskets and totals form a coherent whole, without contradictions or

unrealistic assumptions?

Updating and rebasing are essential to keep the reference budgets relevant. It is recommended that the budgets be updated regularly - preferably every six months for volatile categories such as food and energy, and more frequently (monthly or quarterly) during periods of economic crisis or instability. A full updating of all categories should take place every two years, with a complete rebasing every 4-5 years to account for structural changes in consumption patterns. This schedule ensures that reference budgets remain both accurate for current use and adaptable to long-term social and economic transformations.

By moving beyond outdated subsistence indicators to a transparent and replicable procedure for data collection, processing, testing, and updating, the Bulgarian framework strengthens the credibility of reference budgets as a tool for assessing income adequacy, wage levels, and social transfers.

4. Limitations of the Methodology

Before outlining the implementation roadmap, it is important to clarify the scope and limits of the proposed methodology and the Varna pilot. First, reference budgets are unavoidably normative instruments. Even when grounded in deliberation and expert review, they codify socially shared expectations at a particular time and place. This means results will reflect the prevailing values, information, and trade-offs of participants and experts, and may shift as technologies, norms, and policy environments evolve. Transparent documentation, periodic updating, and full rebasing are necessary safeguards, but they cannot eliminate the fundamentally value-laden nature of the exercise.

Second, the participatory strand relies on purposive rather than representative sampling. Focus groups aim to elicit consensual standards, not measure population averages, which raises questions about how far the findings can be generalized. Selection bias, social desirability, and group dynamics may also shape outcomes, particularly for contested domains such as leisure or digital participation. Careful moderation, diverse recruitment across neighborhoods and socio-economic backgrounds, and explicit “needs-not-preferences” prompts help mitigate these risks but do not remove them entirely.

Third, expert panels - despite the discipline of the Delphi technique - carry their own biases. Professional standards can be conservative or fragmented across fields, and experts may overweight feasibility or regulatory compliance at the expense of lived experience. Conversely, consensus can sometimes mask unresolved disagreement. The dual-validation rule reduces one-sided decisions by requiring convergence between citizens and experts, but it can lengthen timelines and still leaves room for judgment calls where evidence is thin or contested.

Fourth, the pilot’s urban focus in Varna enhances internal coherence but limits external validity. Varna’s price structures, service access, climate pressures, and tourism-related seasonality differ from both metropolitan and rural contexts. While the methodology is designed to scale, the resulting baskets and prices should be treated as Varna-specific until replicated elsewhere. Transfer to other regions will require careful adaptation, especially for housing, transport, childcare, and access-dependent items.

Fifth, the conversion of socially validated needs into monetary values depends on data of uneven quality. Small-scale price surveys can be precise but narrow; scanner data may be difficult to obtain or incomplete; CPI sub-indices are comprehensive but not item-specific; and open sources vary in reliability. Price dispersion across neighborhoods, promotional pricing, and rapidly changing tariffs (e.g., energy) complicate estimation. Median-based summaries, outlier handling, and triangulation with official statistics improve robustness, yet residual uncertainty remains - particularly under inflationary or crisis conditions. For transparency, published budgets should include a brief note on uncertainty, indicate typical rather than minimum prices, and document any assumptions used to annualize durable goods or to model seasonality.

Sixth, the specification process can drift over time. As participants and stakeholders become familiar with

the tool, there is a risk of “basket creep,” where preferences subtly enter as needs, or where items proliferate without clear functional justification. The methodology addresses this through explicit functional criteria, iteration logs, and expert gatekeeping; nevertheless, disciplined re-justification during scheduled rebasing is essential to prevent scope inflation.

Seventh, household heterogeneity is only partially captured through the initial typologies set. Important cost modifiers - disability-related needs, chronic illness, migration status, caregiving responsibilities, or atypical housing situations - may require supplements or tailored add-ons. Without these, budgets risk underestimating adequacy thresholds for specific groups. The scaling plan anticipates additional household typologies and modular adjustments, but until those are implemented, results should not be applied mechanically to all households.

Eighth, there are limits to what reference budgets can and should do in policy. They are benchmarks, not entitlement rules. Using them as automatic thresholds may ignore fiscal, behavioral, or administrative considerations; conversely, dismissing them because they are normative misses their value as transparent, evidence-based standards for debate. To avoid misuse, dissemination should emphasize their purpose, the conditions under which they are most informative, and the recommended update schedule.

Finally, ethical and governance considerations persist. Ensuring informed consent, protecting privacy, avoiding stigmatization, and communicating results in plain language are integral to legitimacy. Conflicts between focus-group judgments and expert assessments will sometimes occur; resolving them requires fair procedures, clear rationales, and public documentation of changes. These practices cannot guarantee full agreement, but they make disagreement visible and manageable.

Taken together, these limitations do not weaken the case for reference budgets; they clarify the domain of validity and the safeguards needed. The proposed design - dual validation, transparent pricing protocols, scheduled updating and rebasing, and modular scaling - addresses many risks directly. Where residual uncertainties remain, the remedy is not to postpone the tool but to publish it with its assumptions, iterate in the open, and improve through replication.

5. Next Steps

These constraints do not weaken the case for reference budgets; they define the conditions for responsible implementation. The following section translates these guardrails into a practical roadmap for the Varna pilot and subsequent scaling. Work will begin by putting in place a light but credible governance arrangement centered at the University of Economics - Varna and open to municipal stakeholders, social partners, and civil society organizations. In parallel, the research instruments will be finalized: a semi-structured guide for focus groups, the protocols for Delphi rounds with experts, pricing templates, and a data-processing codebook that specifies how raw prices are cleaned, summarised, annualized and integrated. Recruitment will proceed purposively rather than statistically, assembling diverse participants for the four urban Varna typologies and forming expert panels across nutrition, housing, healthcare, education, transport, economics, statistics and social policy. The empirical work will be organized in two iterative focus-group rounds - moving from the definition of an acceptable living standard to baskets and specifications, and returning to validate prices and draft budgets - with expert review interleaved after each round so that issues are resolved as they arise. Throughout, a transparent audit trail will record instruments, coding decisions and changes to specifications in order to sustain trust in the process.

Price collection will follow a Varna-specific protocol that mirrors how people actually shop - major supermarkets, neighborhood outlets, service providers and relevant online platforms - while negotiations for access to scanner data from retailers will be pursued to strengthen the evidence base. Official statistics, particularly CPI sub-indices and Household Budget Survey data, will be used to triangulate findings and to flag discrepancies that require re-validation with focus groups and experts. Data processing will privilege

typical values (medians), remove outliers, separate recurring from one-off costs, annualize durables over their useful lifespan and explicitly model seasonality in heating, cooling and tourism-related services. Draft household budgets will then be assembled and subjected to three checks before any result is accepted as provisional: social acceptability to the target groups represented by the typologies, expert adequacy against professional standards, and internal consistency so that no basket contradicts another or rests on unrealistic assumptions.

Stakeholder engagement begins at project inception and continues throughout. An open forum convened with the municipality, line ministries, trade unions and employer organizations, NGOs, debt-advice providers and parent or youth associations will co-define the most relevant use cases - adequacy assessment, wage bargaining inputs, local planning and social services - and agree communication norms for public release. Dissemination will combine short policy briefs and infographics aimed at decision-makers with an accessible technical appendix that documents the method. The same forum will help anticipate risks of politicisation, stigmatization or media oversimplification and will inform mitigation measures, including a clearly published “needs-not-preferences” rule, strict moderation and expert gatekeeping, and the use of plain language in all materials.

Ethics and data governance are integral. All participants will give informed consent; transcripts will be anonymized and stored securely; inclusion protocols will ensure diversity without tokenism. Where focus-group judgements diverge from expert assessments, an escalation pathway will document the rationale for retaining, dropping or modifying items and will return contested points to deliberation until a defensible compromise is reached. In addition, a public-facing methodological ledger will capture iterations, evidence sources and justifications, reinforcing transparency.

Because reference budgets must remain decision-useful, the project will establish a maintenance cadence from the outset. Volatile categories such as food and energy will be updated at least biannually and, in periods of instability, monthly or quarterly nowcasts will be considered. A full price update across all categories will be undertaken every two years, while a complete rebasing - revisiting standards, domains and specifications - will occur every four to five years to reflect structural shifts in technology, mobility, childcare and climate-related expenditures. A lightweight indexing tool will automate interim updates using CPI components and will flag when a fresh repricing is warranted.

Scaling will proceed once the Varna pilot is concluded and evaluated. Horizontal expansion will replicate the process in a metropolitan center, a mid-sized city and one non-metropolitan area to capture regional cost differentials and access patterns. Vertical diversification will add household types such as older adults living alone, cohabiting couples, multi-adult shared households and families with differently aged children. A modular specification architecture will preserve comparability across places and households while allowing for regional parameters in housing and transport. To support policy uptake, the project will map integration pathways into minimum-income assessments, wage setting and social dialogue, municipal service planning and debt-advice practice, each accompanied by a simple theory of change that links reference-budget outputs to expected outcomes like improved adequacy assessments, reduced arrears or enhanced participation.

Finally, evaluation and learning will be embedded in the project. Process indicators (participation rates, Delphi convergence), output quality (completeness and comparability of baskets) and early signs of outcome uptake (citations in policy notes, use in wage talks or municipal plans) will be tracked systematically. A mid-term learning workshop will review what worked - such as the prompts that elicited the clearest deliberation in focus groups - and what requires adjustment, for example the way seasonal variation is modelled. The resulting lessons will feed directly into the first rebasing plan.

6. Conclusion

This report has set out a coherent, step-by-step methodology for developing reference budgets in Bulgaria,

anchored in European best practice yet tailored to national realities. It advances three core contributions. First, it reframes adequacy measurement from static thresholds to a socially validated, empirically priced standard that better reflects real living costs and participation needs. Second, it institutionalizes participation by placing focus groups at the heart of norm formation, counterbalanced by expert panels that ensure methodological rigor through structured Delphi consensus. Third, it establishes a transparent pricing and data-processing protocol - median-based, seasonally aware, and regularly updated - that converts validated needs into defensible budget values.

The Varna pilot functions as both a methodological testbed and a governance innovation. By working with four urban Varna household typologies, the project captures how climate, neighborhood access, tourism-linked seasonality, and local social norms shape what is “basic” and what counts as participation. The method’s insistence on dual validation - no component is final until citizens and experts converge - directly addresses two persistent impediments in Bulgaria: limited social legitimacy and institutional fragmentation. In doing so, it creates a shared language through which policymakers, social partners, and citizens can debate income adequacy.

Policy implications are immediate. Calibrated reference budgets can inform minimum income protection, social transfers, and wage setting; guide municipal service planning (transport, childcare, digital access); support debt counselling; and enable more realistic poverty and inequality assessments. Because the approach is modular and documented, it can scale horizontally across regions and vertically across household types while retaining comparability via a common specification schema.

At the same time, the report makes clear the guardrails within which results should be interpreted. Reference budgets remain normative instruments that codify shared expectations in a specific time and place; disciplined moderation (needs versus preferences), transparent documentation of choices, and scheduled updating and rebasing are therefore essential. Methodologically, price volatility is tempered by focusing on typical values and by separating recurring from one-off costs with lifespan adjustments; empirically, triangulation across market pricing, scanner data, where available, and official statistics balances realism and comparability.

Looking ahead, the implementation roadmap sets out how the pilot will be carried forward: early and continuous stakeholder involvement from project inception to public release, an explicit cadence for updates and rebasing, and a plan for scaling across regions and household types. If pursued as outlined, the Varna pilot will deliver more than a set of numbers: it will establish a credible method, a replicable process, and an institutional platform for a national reference-budget framework. By combining citizen participation, expert validation, and transparent price analysis, Bulgaria can move from fragmented indicators to a decision-grade standard that supports resilient, inclusive, and accountable social policy.

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Bulgaria and the Eurozone: Development of the Perceptions**Miroslav KAMDZHALOV¹**¹ University of Economics - Varna, Varna, Bulgaria, kamdzhlov@ue-varna.bg

JEL: F36, E52**Abstract**

Background and aim: On July 8, 2025, Bulgaria officially completed its long journey to the Eurozone. This journey was marked, especially in its final phase, by heated debates "for" and "against." This study aims to examine the development of Bulgarian society's attitude towards this process and to outline some guidelines for its further development; *Scope:* certain limitations should be considered. The study is affected by the lack of available or reliable data and certain biases; *Methods:* Text analysis, induction, and deduction were used for the purposes of the study. Empirical data were extracted from publications and opinions expressed in the broader media space; *Results:* Uncertainty and a clear lack of understanding of the positive and negative effects on the Bulgarian economy on the part of citizens are still significant; *Conclusions:* Bulgarian society is dominated by prejudices about the euro caused by deliberate misleading propaganda, and there is a lack of adequate, argument- and fact-based debate and a real information campaign for the population; *Originality:* The article presents an original, up-to-date author's view of the processes determining Bulgarian society's attitude towards the effects of adopting the single European currency; *Practical implications:* The results would be useful for entrepreneurs and public figures in making adequate business decisions.

Key words:euro, eurozone, currency,
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1. Introduction

For Bulgaria, joining the Eurozone was a long journey fraught with economic and political obstacles. Upon joining the European Union, the authorities in Sofia signed the accession treaty, which included a clause on the single currency and its adoption under certain conditions (the Maastricht criteria). On April 25, 2005, the then president and prime minister of the Republic of Bulgaria, Georgi Parvanov and Simeon Saxe-Coburg-Gotha, respectively, signed the document in question. Actual membership began on January 1, 2007. For a long time after that, the country did not meet the Maastricht criteria for admission to the European Monetary Union. When this was achieved in terms of economic indicators, a heated debate ensued as to whether it was the right time to take this monetary step.

This study aims to examine the development of Bulgarian society's attitude towards the process of eurozone accession and to outline some guidelines for its further development.

Bulgaria's entry into the eurozone is taking place at a time of heightened geopolitical tension. Since 2022, a full-scale war has been raging in Ukraine, the outcome of which will redraw the region's development path for decades to come. In addition to the economic factors arising from this conflict, the country is also subject to purely political and propaganda components in the process of joining the European Monetary Union.

As a complementary factor to this geopolitical situation, we could add the arrival of President Trump in the US for his second term in early 2025. With his policy of distancing himself from the European Union on almost all political, economic, and military issues, the American leader has brought instability not only to the minds of senior political and business figures but also to ordinary people around the world, including in Bulgaria.

It is not surprising that in this colourful and unclear picture of the future, many Bulgarian citizens feel insecure. This insecurity has been present in the Bulgarian national fabric for centuries and is now reinforced by poor management of processes and blatant propaganda messages. The Euro narrative among Bulgarian society is saturated with terms such as "loss of identity", "loss of independence", "the Euro is an artificially created currency and will disappear", "soon the Eurozone will no longer exist", "we will pay the debts of others", and many others like these.

A fundamental issue is the fact that part of Bulgarian society experiences a sharp dichotomy toward its national currency. On the one hand, there is a fully conscious and entirely pragmatic attitude toward currency deposits on the part of the population, while on the other hand, the same population does not want to part with the lev as the national currency. This fact can be seen in data sheets revealed from Bulgarian National Bank (BNB, 2025). Even in the lowest deposit amounts of up to BGN 1,000, the share of the euro currency is remarkable—one to seven in favour of the lev. The picture for deposits over BGN 1 million is even more impressive—one to two in favour of the euro.

Despite relatively positive economic indicators and arguments in favour of adopting the single currency, Bulgarian society remains significantly divided on the issue of the euro. In order to examine this phenomenon, the author sets out to analyse the possible factors driving these processes.

Against these backdrops, this study posed the following research questions:

What is the development of people's perceptions about the Eurozone and Bulgaria's accession into it?

How would the Bulgarian economy be affected after January 1-st 2026?

2. Literature Review

The majority of scientific publications dealing with the Eurozone and Bulgaria have done comparative analyses and evaluated the preparedness of the country. This study aims to examine not so much purely economic parameters as attitudes and social phenomena and their possible manifestations and impacts on the economy. In other words, evaluation is more about the willingness of the people than the preparedness of the country. With this, some research gaps could be fulfilled.

Despite being admitted together to ERM II in 2020, Croatia was able to adopt the euro, whilst Bulgaria remains unable to meet this hurdle. Although no significant changes are seen in the convergence criterion. A settlement was reached with Croatia, but not with Bulgaria. Worse, there is no chance for Bulgaria's entry in 2024. An optimistic alternative is 2025, although this is entirely dependent on the country's economic and financial situation.

In September 2022 Hristozov (2022) wrote that perhaps Bulgaria will surpass Romania, which is not yet a member of ERM II, and neither country will enter the eurozone at the same time. Bulgaria's backwardness can be attributed to inept financial and budget policy in recent years, as well as the indiscriminate injection of money into the economy, which allowed for speculation and cartels, resulting in high inflation in the country.

According to Hristozov (2022), the unstable situation regarding the determination of a specific date for joining the monetary union has created conditions in Bulgaria in which both civil society and civil servants are gradually losing the need to introduce the euro in the country. The inconsistent level of inflation, which dynamically changes every quarter, and government decisions are not always able to stabilize these fluctuations and bring consumer price values into long-term equilibrium.

Another research study conducted by Hristozov et al., "Expected Effects of Euro Adoption in Bulgaria" (2020), shed light on the Bulgarian eurozone agenda. This article examines some of the nations that already use the euro as their national currency, and based on that, the writers attempt to predict the consequences of the common currency on Bulgaria.

A study (Ivanova, 2025) reveals several key similarities and differences between Bulgaria and Croatia on

their path to the eurozone. Croatia's faster accession, supported by political commitment and effective reforms, contrasts with Bulgaria's slower progress due to political instability, inflation, and problems with bringing legislation into line with requirements. Despite these challenges, Bulgaria's strong convergence performance in recent years, such as low debt-to-GDP ratios and exchange rate stability, puts it in a good position. Bulgaria's currency board is seen as a positive factor for joining the eurozone.

Findings show that Bulgaria can learn from Croatia's experience by focusing on public education to address scepticism and implementing economic reforms to stabilize inflation. These actions will help mitigate potential negative effects and maximize the benefits of adopting the euro. The comparative analysis in the above study emphasizes that although Bulgaria's path is not entirely the same as Croatia's, the lessons learned from Croatia's recent experience provide important lessons for policymakers and stakeholders in Bulgaria.

A comparative analysis (Kotseva-Tikova & Dvorak, 2025) of Lithuania and Bulgaria reveals similarities. Both countries use the currency board system as a tool for political and economic stabilization. Both countries view the eurozone as a strategy for exiting the board. Lithuania was in a better situation when it joined the eurozone. It met the Maastricht criteria, albeit at the cost of significant wage cuts, but at a higher level of real convergence ratios than Bulgaria. However, the inflation shock subsequently had a negative impact on it. In the case of Bulgaria, political motives seem to prevail over economic ones in the rush to integrate Bulgaria into the eurozone. In this regard, Bulgaria faces several important challenges on its path to euro area integration:

- Bulgaria is failing to achieve the inflation requirements for eurozone membership. Inflation stability is critical for joining the eurozone since it ensures that the new member's economy can keep prices stable after adopting the euro.
- Bulgaria's high Gini coefficient reflects a high level of income inequality. Addressing this imbalance is critical to creating broader economic stability and ensuring that the advantages of eurozone membership are properly distributed.
- Public support is critical to the ultimate success of eurozone integration.

An article (Gechev, Beev & Hristozov, 2020) examines the probable effects of Bulgaria adopting the euro, focussing on the economic benefits and hazards. It identifies "critical zones" that may suffer unfavourable consequences based on experiences in other EU countries. Concerns about inflation and economic convergence are raised, emphasising the importance of rigorous planning and public involvement. According to authors the main challenges facing the eurozone are:

- Economic Disparities - Significant differences in the economic structures and levels of development among Member States hinder cohesive growth and the benefits of an optimal currency area.
- Diverse Fiscal Policies - Varying fiscal policies across countries limit the effectiveness of a unified monetary policy, complicating economic stability and growth.
- Lack of Convergence - Insufficient economic convergence among Member States poses a challenge for achieving a balanced and sustainable Eurozone, as highlighted by the need for reforms and political consensus.

Bulgaria has been in a currency board arrangement since 1997 and has been effectively pegged to the euro since 01.01.1999. As a result, Bulgaria has no independent monetary policy, except for the limited ability of the central bank to influence bank reserve requirements and, in exceptional circumstances, to be a lender of last resort. This means that Bulgaria has generally internalized, and has done so for a quarter of a century, all the effects of a country joining the eurozone, which have been widely discussed by the political, scientific, expert and civil circles. All theoretical and empirical statements are irrelevant to the situation in Bulgaria. This is because, unlike other EU countries outside the eurozone, Bulgaria has been a member of the eurozone from

January 1, 1999. It has also been a member of the European Union's ERM II and banking union since 2020.

In his paper, Ganev (2024) concludes that, from the point of view of the theoretical and empirical arguments discussed so far, Bulgaria's accession to the eurozone will not change anything. It will only allow the Governor of the Bulgarian Central Bank to sit and occasionally vote in the Governing Council of the European Central Bank, provide Bulgaria with a small share of the ECB's seigniorage, and provide the country with access to financial mechanisms specific to the eurozone.

So, unlike all other EU members that are not in the eurozone, Bulgaria's true choice is whether to adopt the official institutional structure of a currency region that it has already entered for 25 years. None of the theoretical or empirical considerations presented above have any bearing on the decision that Bulgaria must make. Raising such points in today's discussion on how quickly Bulgaria should attempt to join the eurozone is ineffective.

The theoretical and empirical claims that serve as the foundation for the plan to postpone Bulgaria's eurozone membership by about two decades have been thoroughly studied and judged to be unsatisfactory. The theoretical notion that fixing the exchange rate for a catching-up economy can result in higher inflation than usual, is highly valid. The sole exception is that Bulgaria has maintained a fixed exchange rate against the euro for 25 years, so formal membership to the eurozone will make no difference.

Zahariev (2025) elaborate ten positive effects for Bulgarian households as a result of eurozone accession. The author distinguishes two main groups of effects. The first group relates to effects on households' annual financial flows (income and savings). The introduction of the euro is expected to lead to savings for the average household of €1,500-2,000 per year (8-10% of disposable income) within the first 3-5 years (see Table 1). A second group of effects relates to household wealth (see Table 2). The stability of the euro and increased investor interest are expected to significantly increase household wealth, with the total increase reaching €30,000 –50,000 for an urban household and over 70,000–100,000 for households with diverse real estate portfolios within 5 years.

Table 1

Effects, Mechanism and Estimated Benefits on households' annual financial flows

Effect	Mechanism	Estimated Annual Benefit
Loan Savings	Reduction in interest rates on loans by 1-1.5 percentage points.	€600–€900 for a typical €100,000 mortgage (€50–€75 monthly).
Transaction Savings	Elimination of currency exchange fees and bank transfer fees within the Eurozone.	€120–€180 (especially for families receiving remittances).
Price Comparability	Increased competition and price transparency, leading to 3-5% price reductions on consumer goods and services.	€540–€900 (based on €1,500 average monthly expenses).
Investment Diversification	Easier access to European financial products, leading to a 1-2 percentage point increase in return on savings/investments.	€180–€360 (for average savings).
Rental Income Growth	Increased competitiveness of Bulgarian agricultural land, leading to gradual equalization of rents with Central/Eastern European levels (25-35% higher).	€400–€550 for a 5-hectare owner (current €1,250–€1,500 up to €1,650–€2,000).

Source: Authors' Compilation based on data from Zahariev, 2025.

Table 2**Effects, Mechanism and Estimated Benefits on households' wealth**

Effect	Mechanism	Estimated Benefits
Real Estate Price Growth	Housing Prices in major cities could increase by 15–20% within three years; Regulated Plots Prices could increase by 25–35%	adding €16,000–€27,000 in value to a typical 90 sq. meter apartment; leading to a €10,000–€35,000 value increase for a 500 sq. meter plot, driven by investor interest.
Land and Forest Price Growth	Agricultural Land: Expected to see a 30–40% growth due to demand from European producers and funds; Forest Properties: Expected to increase by 20–30%	leading to a €15,000–€40,000 wealth increase for a 10-hectare owner; adding €3,000–€9,000 in value for a 5-hectare owner.
Savings Protection	The euro's stability is expected to protect savings from depreciation	increasing of real value savings by 2–3% annually

Source: Authors' Compilation based on data from Zahariev, 2025.

Cumulative benefits and consequences are reflected in asset value growth, which will significantly improve the financial stability and creditworthiness of households. A typical urban household could see additional creditworthiness of €21,000–35,000.

3. Methods

Text analysis, induction, and deduction were used for the purposes of the study. Empirical data were extracted from publications and opinions expressed in the broader media space. Data from sociological research conducted by European and Bulgarian institutions were used. Google Trends data by specific keywords also were considered in this research. Data from the Bulgarian National Bank were analysed.

4. Data and research findings

In the public debate on the euro in Bulgaria in recent years, several key arguments have been put forward in support of not adopting the single currency or, in a milder version, postponing the country's entry into the monetary union.

One of the major concerns about euro adoption is rising inflation. The introduction of the euro is frequently followed with an unreasonable increase in household perceptions of inflation, which can contribute to negative attitudes towards the single currency, as seen in Bulgaria today. Furthermore, if consumers overestimate current inflation, they may misjudge changes in real wages and purchasing power, leading to a decision to reduce spending. In such cases, the introduction of the euro may have a short-term detrimental impact on the actual economy.

Another concern related to reducing minimum reserve requirements was voiced. An increase in the money supply is a problem largely related to inflation, as the volume of the money supply affects price levels. The argument is that reducing minimum reserve requirements will naturally lead to a multiple increase in the money multiplier, which in turn will stimulate the money supply in the newly acceded country. A key argument in support of this thesis is that the effect of reducing reserve requirements is that the purchasing power of savings and fixed-income bonds after several years in the euro area will be limited or, at the very least, their growth will slow down. The money multiplier is likely to increase, but the effect on the money supply cannot be predicted. However, it is difficult to predict how the general public would react in terms of the amount of

desired cash reserves, and the same applies to commercial banks and their excess reserves. It is unreasonable to assume that a reduction in reserve requirements alone would automatically lead to higher inflation. The experience of countries that have joined the euro area with economic parameters similar to those of Bulgaria does not indicate the existence of such inflationary potential.

The issue of the loss of monetary sovereignty as a result of the adoption of the euro has been raised before, when the advantages and disadvantages of the single currency were discussed. But in the final right before the positive opinion of the European institutions on the adoption of Bulgaria to this day, it is found as the main argument against and is a major concern among the population. To put forward this argument in the case of Bulgaria, which gave up an active monetary policy 25 years ago, is to put it mildly, strange and in reality, extremely untenable. The very presence of such an argument in the debate about the euro shows a desire to leave a specialized debate and enter the field of emotions and feelings. It is even stranger to believe that the loss of monetary sovereignty is an important problem for Bulgaria, but it was obviously not important for Germany, France, Italy and all other members of the eurozone.

The widespread narrative against the adoption of the euro in Bulgaria concerns the state budget and is virtually playing with public fears. "The ECB will determine Bulgaria's budget. Salaries and pensions can only be reduced, but cannot be increased. Social and infrastructure projects and expenditures to improve the quality of life in Bulgaria can be eliminated, but these expenditures cannot be increased. They cannot be increased because the money will no longer be ours. There will be no money in Bulgaria. The money will come from Frankfurt" (BNR, 2025).

Joining the eurozone does not change the fact that national authorities remain responsible for drawing up and implementing their own budgets. What changes is that budgetary policies are more closely coordinated within the euro area. The aim is for Member States using the same currency to be more connected and, through stronger coordination, to ensure stability and growth for all. In this context, the Commission's role is not to interfere in national decisions, but to assess whether the overall fiscal position of the Member State concerned is in line with the common rules that apply to everyone in the euro area. These rules are designed to ensure the stability of public finances and prevent negative spill over effects within the economic and monetary union.

A Eurobarometer survey (European Union, 2023) published at the end of June 2023 revealed that 49% of Bulgarians surveyed strongly welcome the idea of Bulgaria joining the eurozone. This is 5% more than in 2022. In 2023, those who strongly reject the euro are exactly 49%. Two per cent of the participants did not express an opinion on the issue. 81% of Bulgarians say that they have already used euro banknotes. Only 19% have not had any contact with the euro.

Over half of the Bulgarians surveyed (60%) say that they feel well-informed about the euro. 40% answer the exact opposite. When asked what impact the euro will have on their lives, 43% (8% more than in 2022) say that they are convinced that it will be positive, while 51% believe that it will be negative. 27% of Bulgarians are convinced that Bulgaria is ready for the introduction of the euro. And 67% answer negatively.

Asked when they want the euro to be introduced in their country, 26% of the Bulgarians surveyed answer "as soon as possible", 31% say "after some time", 15% answer "as late as possible", and 26% "never". 3% have no opinion on the issue. 53% believe that Bulgaria will lose part of its identity by introducing the euro. And 48% believe that the country will lose control over its economic policy. 79% are worried about price abuses. And again, 79% believe that they will be able to adapt to the euro when it is introduced.

During the year in question, the "Vazrazhdane" party spent months collecting signatures to organize a referendum on preserving the Bulgarian lev. On April 7, 2023, a petition was submitted to the National Assembly, which passed the checks of the authorized institutions. Of the total of over 600,000 signatures collected in support of the referendum against the euro, over 470,000 are regular.

A survey conducted in July 2025 by Alpharesearch (2025), revealed a slight increase in the number of people supporting Bulgaria's entrance into the Eurozone. The comparison is on the basis of data from April,

May and July 2025. A distinction is made between respondents who are ordinary citizens and those who are engaged in entrepreneurial activity.

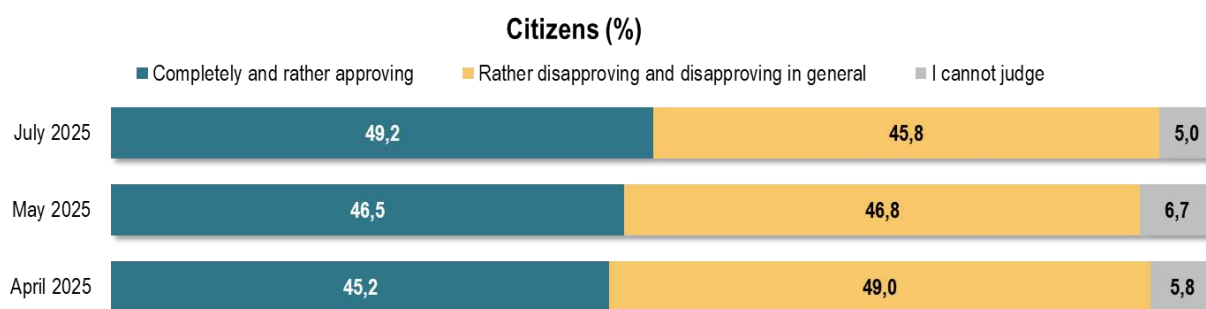


Fig. 1. Support for Bulgaria's accession to the eurozone

Source: Author according to data from Alpharesearch.

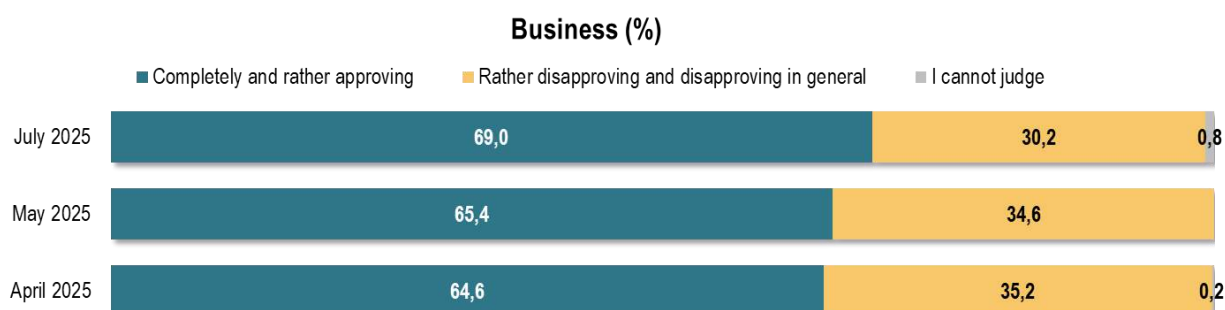


Fig. 2. Support for Bulgaria's accession to the eurozone

Source: Author according to data from Alpharesearch.

The data above shows that in both categories of respondents there is an increase in support for the adoption of the euro in Bulgaria from January 1, 2026. The trend of greater support from the business community continues. Of course, a more detailed analysis can be made based on urban and rural areas and education. Greater support for the euro is reported among the urban and more educated population.

In the same survey conducted in July 2025 by Alpharesearch (2025), respondents were asked if they consider accession into the Eurozone a success or failure. A distinction is made between respondents who are ordinary citizens and those who are engaged in entrepreneurial activity.

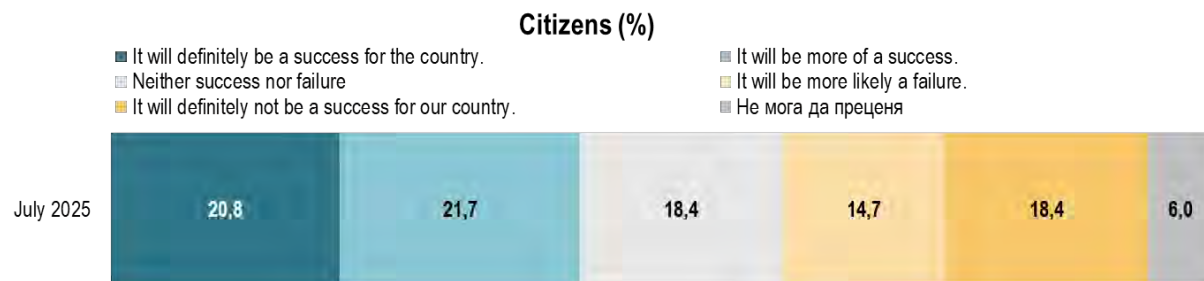


Fig. 3. Eurozone membership from January 1, 2026: success or failure for the country?

Source: Author according to data from Alpharesearch.

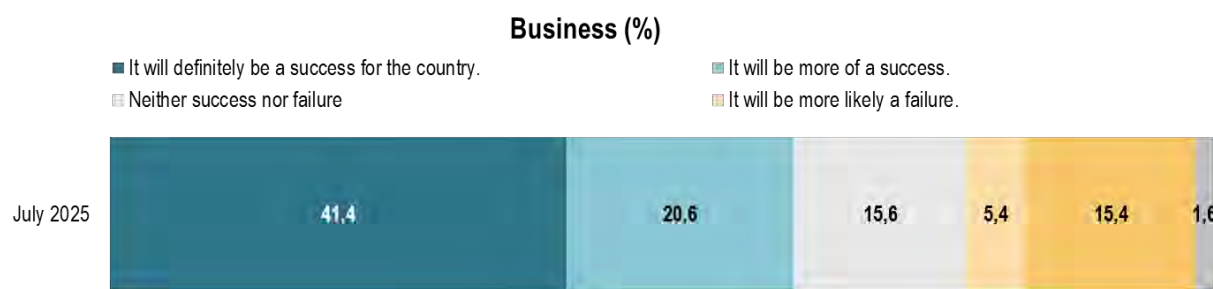


Fig. 4. Eurozone membership from January 1, 2026: success or failure for the country?

Source: Author according to data from Alpharesearch.

The following graphs (Fig. 5 and Fig. 6) show data from Google Trends related to public interest in the adoption of the single European currency.

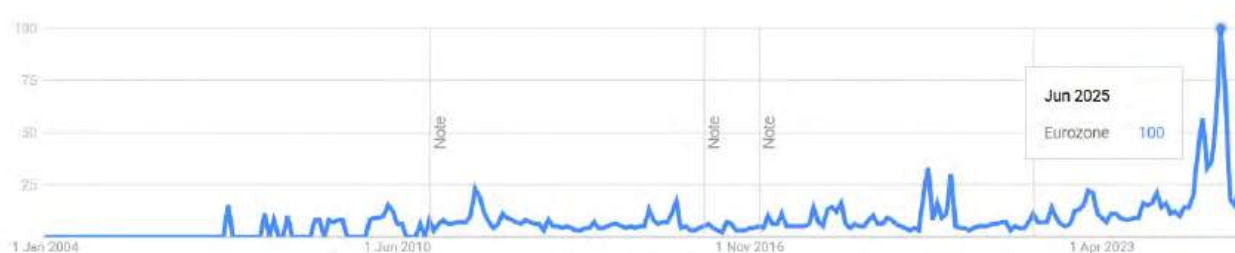


Fig. 5. Public interest in the word “Eurozone” over the period of 2004 to present in Bulgaria

Source: Author according to data from Google Trends.

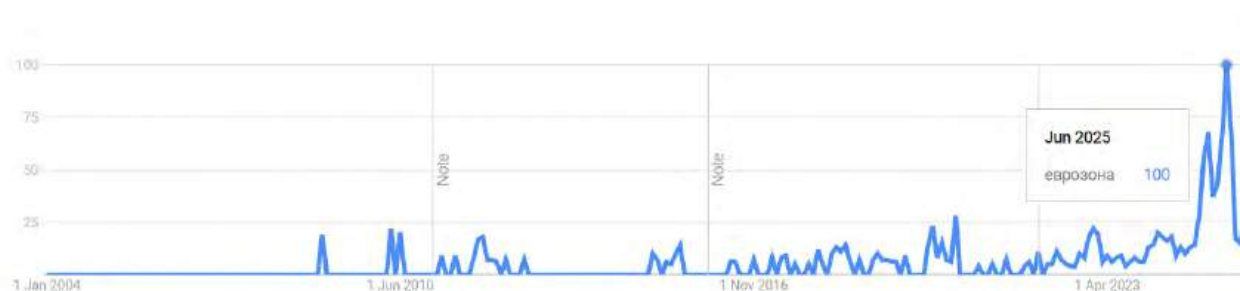


Fig. 6. Public interest in the word “Еврозона” (Cyrillic equivalent of Eurozone) over the period of 2004 to present in Bulgaria

Source: Author according to data from Google Trends.

For the period after Bulgaria's accession to the European Union, the graphs show a relatively constant level of interest among Bulgarian citizens in the Internet search engine for specific keywords such as “Eurozone” and “Еврозона”. A sharp increase in the number of searches on the topic occurred after May 9, 2025, when the public debate once again raised the already concluded (including by a decision of the Constitutional Court (2024)) topic of the referendum on the adoption of the single currency. The reason for

this reactivation of the referendum issue was the opinion of some politicians that the topic was extremely relevant and exciting to the public. The graphs show the reverse sequence - first is a political statement, followed by increased interest on the Internet.

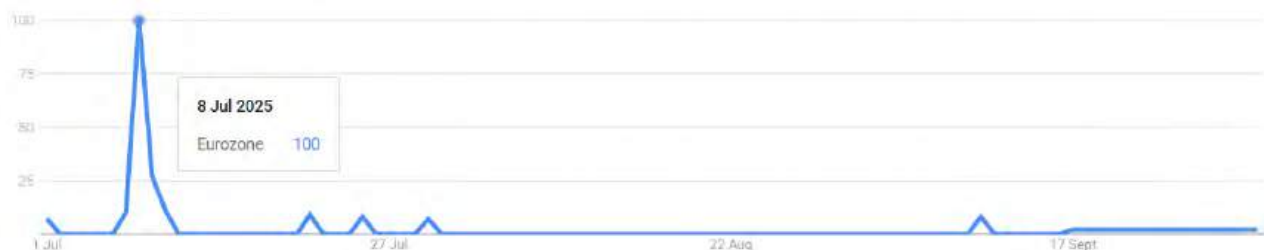


Fig. 7. Public interest in the word “Eurozone” over the period of 2004 to present in Bulgaria

Source: Author according to data from Google Trends.

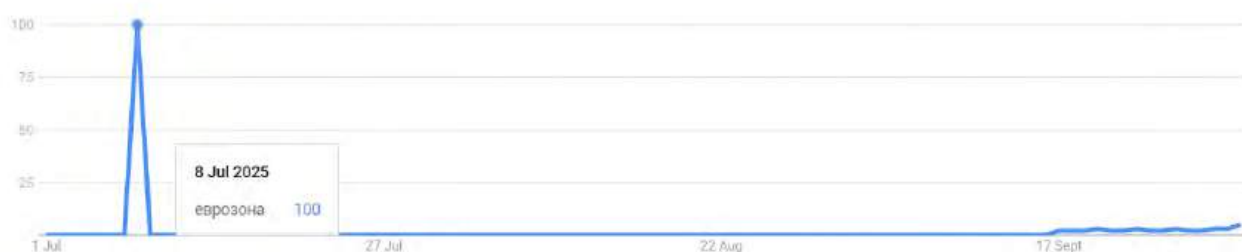


Fig. 8. Public interest in the word “Еврозона” (Cyrillic equivalent of Eurozone) over the period of 2004 to present in Bulgaria

Source: Author according to data from Google Trends.

As can be seen from the data shown in Figures 7 and 8, after the European institutions announced their final decision on Bulgaria's accession to the monetary union, public interest in the topic declined. Of course, this does not change the general uncertainty and the continuing feeling among some Bulgarian citizens that the euro is more of a failure than a success. This does not mean, however, that the job is done and that Bulgarian society is fully aware of this monetary transformation. As a rule, the masses feel uncertainty and distrust towards any significant change in their daily lives. This psychological state complicates the already complicated economic environment. This tension, along with other factors, of course, affects a number of economic indicators, such as inflation, for example. If the Bulgarian authorities fail to keep these indicators stable, it is very likely that the eurozone will be blamed for the resulting political and economic consequences for the country in the minds of a society that is already confused on the subject.

Table 3 shows data extracted from the BNB database on Bulgarian citizens' deposits in euros and leva. The analysis indicates a significant level of euro deposits. This fact can hardly be explained by the daily need of the population to have foreign currency available. It is likely that this significant amount of euro cash is held as a safe investment against financial instability. From this, it can be concluded that Bulgarians have no confidence in their own currency.

Table 3

Deposits to households and non-profit institutions serving households in thousand BGN

up to 1,000 leva	in levs	692 540
	in euros	49 054
over 1,000 to 2,500 leva	in levs	1 415 143
	in euros	141 770

over 2,500 to 5,000 leva	in leva	2 239 786
	in euros	285 455
over 5,000 to 10,000 leva	in leva	4 877 648
	in euros	835 618
over 10,000 to 20,000 leva	in leva	8 560 043
	in euros	1 770 031
over 20,000 to 30,000 leva	in leva	6 838 211
	in euros	1 563 081
over 30,000 to 40,000 leva	in leva	5 292 938
	in euros	1 421 653
over 40,000 to 50,000 leva	in leva	4 315 320
	in euros	1 227 692
over 50,000 to 100,000 leva	in leva	12 642 919
	in euros	4 710 191
over 100,000 to 200,000 leva	in leva	9 887 569
	in euros	5 594 116
over 200,000 to 500,000 leva	in leva	5 265 300
	in euros	2 701 384
over 500,000 to 1,000,000 leva	in leva	1 561 682
	in euros	1 073 283
over 1,000,000 leva	in leva	2 041 140
	in euros	2 235 628

Source: Authors' Compilation based on data from Bulgarian National Bank, 2025.

Only data concerning households and non-profit institutions serving households were extracted in order to avoid some distortion in the analysis. Let's assume that deposits in corporate accounts are intended to facilitate business activities in an international business environment and do not give a true picture of their owners' preferences for one currency or another. The deposits data show that the majority of the Bulgarian population situated in the country voted with their pockets for the euro. In the lowest deposit amounts of up to BGN 1,000, the share of the euro currency is remarkable— 1/7 of the lev deposits. The picture for deposits over BGN 1 million is even more impressive—one to two in favour of the euro. For the purposes of the study, all deposits in BGN and EUR were added together. The result obtained is a ratio of one to one and a half in favour of the BGN. As a result, when considering the total picture of deposits, the value of money in euros and leva for Bulgarian depositors is nearly same. These data irrefutably show that Bulgarians are voting en masse for the euro through their portfolios, as there is no social stratum in Bulgarian society that does not keep part of its savings in euros.

5. Conclusions

Bulgaria's accession to the Eurozone is a significant event, regardless of the many different views held by Bulgarian citizens. The application process, meeting the criteria for admission, and the now achieved entry into the monetary union are quite controversial. Bulgarians are still evenly divided (with a slight preponderance of positive attitudes) on this issue.

Although it is very likely that this tension surrounding the change in the Bulgarian currency will subside within six months to a year, it is particularly important to continue the information campaign on the subject and, even more importantly, to pursue balanced economic policies. Bulgarian society has inherited behavioural

patterns from the communist era, when one thing was said (mostly about a bright and shiny future), but in reality, people did not believe it. This duality in the public spirit and consciousness is still very much present today. That is why it is important that all elements of the policy pursued in this area are reasonable and that Bulgaria overcomes the accompanying risks.

For citizens, the most tangible effects of adopting the common European currency are mainly practical and relate to the elimination of currency risk, lower transaction costs, and greater price transparency. Membership provides new opportunities for sustainable growth and prosperity. However, this is conditional on maintaining fiscal discipline and a balanced budget, which is a major risk in times of strong populist turbulence exploiting citizens' fears. Due to political instability and global volatility, fiscal discipline has been put to the test in recent years. This has resulted in some fiscal instability.

There will probably be no significant deviation from what is observed and reported as inflation. Of course, the heated debate in our society about how high prices are in stores will continue and will influence people's attitudes, but from a macroeconomic point of view, this will not represent a serious imbalance. It is important for economic stability and in order to take advantage of the positive opportunities offered by the euro area to continue the process of increasing real incomes and at the same time restore fiscal buffers. To this end, it is important not to focus attention on the expenditure side of the budget.

In final conclusion, since the attitudes of large groups of people are crucial and shape fundamental economic and political processes, responsible policy-making with regard to these attitudes is crucial for achieving positive economic results from the adoption of the euro, reflected in the increasing prosperity of Bulgarian society.

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Board Structures and AI Leadership in Banking: Evidence from the Top 10 Banks in the Evident AI Index (2020–2024)

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JEL: O14, P24, C41, E13

Abstract

Background and aim: The purpose of this article is to examine the structure and dynamics of the boards of leading banks included in the Top 10 of the Evident AI Index 2025 for the period 2020–2024. The index is used as a reference for identifying banks recognized as leaders in the application of artificial intelligence. After the corporate governance reforms following 2008, bank boards today face new challenges driven by digitalization and AI transformation.

Scope: The analysis covers the period 2020–2024 and uses annual reports, proxy statements, corporate governance reports, and documents from annual shareholders' meetings.

Methods: A mixed approach is applied, combining documentary and statistical analysis of board indicators to identify trends observed among the Top 10 banks from the Evident AI Index.

Results: The results show that the boards of AI-oriented banks are independent but generationally conservative, with long mandates and limited participation of younger leaders. Half of them apply CEO dualism and traditional committees but still do not fully meet the criteria for digital and technological competencies, therefore remaining technologically vulnerable despite their AI-leading position.

Conclusions: The study shows that banking structures adapt slowly to changes in the technological environment. The corporate governance principles adopted in previous years transformed the boards and changed their perceptions of diversification, independence, and security.

Originality: The study offers a new perspective on the characteristics of bank boards through the prism of AI leaders, building upon existing research on corporate governance by evaluating the boards of banks in the context of the requirements of the new digital and AI-oriented world.

Practical implications: The results provide guidelines for strengthening board policies to meet the challenges of digitalization and artificial intelligence. The study emphasizes the need to improve the technological and digital competencies of directors to support the process of technological transformation of institutions. The study also contributes to the discussion of how challenging it is for boards, given their specific characteristics, to successfully adapt to the AI-driven environment of modern banking.

Key words:

bank, board structure, corporate governance, evident AI Index

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1. Introduction

The global financial and economic crisis of 2008 raised numerous questions about the security, stability, and oversight of banking institutions worldwide, particularly in the United States. In seeking answers to many of these issues, analysts turned their attention to the governance of the institutions—the boards of directors and senior management. The accusations directed especially at boards, in their role as internal supervisory bodies, led to changes in both hard and soft banking regulations related to corporate governance. Gradually, institutions accepted the need for reform and began to adapt their boards to meet the new requirements for diversification and a strong expert profile among board members.

Today, seventeen years later—and five years after the COVID-19 pandemic—banks are once again moving along the path of technological and process innovation, seeking ways to balance their business models and to find solutions to key challenges amid uncertainty, heightened political and economic risk, continuous improvement and transformation within the financial sector, and the growing competition from FinTech companies and the emergence of new generations of customers and leaders.

COVID-19 did not lead to major legislative changes or new recommendations for restructuring boards, but it did renew the focus on the quality of corporate governance and on the decisions made by boards and their committees, which—once translated into actions by senior management—aimed to keep institutions as insulated as possible from external negative impacts.

During 2020–2021, COVID-19 temporarily shifted the attention of bankers and the technology community away from artificial intelligence, but after the revival of the stock market and the end of the pandemic, stakeholder expectations initiated an accelerated transformation and a rethinking of banking toward a more technology-driven model.

The present study is focused on analyzing the profile of the boards of the world’s most innovative banks, included in the Top 10 of the Evident AI Index (as of October 2025). The analysis is based on data from the banks’ annual reports, proxy statements, and corporate governance reports for the period 2020–2024. Covering earlier years would be possible but would not reveal the relationship with the banks’ AI profiles, since these began to take shape only after the end of the pandemic.

This period allows for the tracking of board transformations during the challenging post-COVID phase, as well as changes in their profiles in the context of AI leadership—composition, competencies, experience, committee structuring, and other aspects.

The main objective of this analysis is to examine the profiles of the boards of banks leading the Evident AI Index for 2025 and to identify emerging trends in the formation of board structures in an era of increasing AI adoption.

2. Literature Review and Research Framework

2.1. The 2008 Crisis and Board Failures

Retrospective analyses of the global financial and economic crisis of 2008 marked the beginning of serious discussions and initiatives aimed at reforming corporate governance — particularly the profile of boards of directors, their responsibilities, and the expectations placed upon them to safeguard the stability of the institutions under their control.

In numerous post-crisis assessments of the events leading up to 2008, as well as earlier developments, the global financial and economic crisis is not viewed as a “market accident,” but rather as a consequence of human decisions, managerial failures, excessive risk-taking, and inadequate incentives or remuneration structures.

The accusations made by supervisory and regulatory authorities in the United States, along with those from leading international financial institutions, indicated that boards of directors bore significant responsibility for what had happened. In its report “The Financial Crisis Inquiry Report: Final Report of the National Commission on the Causes of the Financial and Economic Crisis in the United States,” the Financial Crisis Inquiry Commission (FCIC) stated that in the case of AIG (FCIC, 2011, pp. 351–352), the failure of corporate governance—particularly in risk management—was substantial, describing the collapses as “dramatic.”

According to the FCIC report, the board failed to exercise effective risk oversight at Citigroup (FCIC, 2011, pp. 267–268) and acted too late in addressing the liquidity crisis scenario at Bear Stearns (FCIC, 2011, p. 289). The lack of understanding of risk and leverage led the boards of Fannie Mae and Freddie Mac (FCIC, 2011, pp. 585–588) to approve risky strategies without a clear vision of their potential consequences.

The Basel Committee on Banking Supervision also drew a number of conclusions regarding the role of boards

during the 2008 crisis. According to the Committee, board members should possess stronger technical expertise, particularly in relation to risk management. However, the Committee found that this function had often been excessively delegated, with control over it placed in the hands of others. It also identified insufficient board involvement in defining and monitoring risk appetite. Many banks admitted to a significant discrepancy between the actual risks they faced and those that boards perceived as normal or acceptable—whether due to unwillingness or inability to assess their true levels. According to the Committee, the active participation of boards in setting risk tolerance is crucial to the resilience of financial institutions during the 2008 crisis, and such a disconnect should not occur (Basel Committee on Banking Supervision; 2009).

Criticism of the boards also came from the Federal Deposit Insurance Corporation (FDIC). According to the FDIC, during the 2008 crisis there was a lack of effective oversight and understanding of risk on the part of the boards of financial institutions. Its reports identified significant shortcomings in risk management and revealed (or suspected) irregularities and/or misconduct by governance (FDIC, 2017, p. 125).

An interesting and multifaceted analysis of the causes of the 2008 financial crisis was provided by the Financial Services Authority (FSA) in the United Kingdom. The Authority found that many boards were ineffective and unable to exercise objective and independent judgment in business situations—during periods of economic prosperity, they tended to leave management without sufficient oversight.

The Financial Services Authority also emphasized the importance of the knowledge and skills of board members, alongside their independence, noting that neither aspect should be compromised. Additional tension in assessing board performance arose from the long tenures of both board members and chief executive officers (often the same individual also serving as chair of the board), which raised questions about their independence—particularly due to long-standing working relationships and close personal ties (Turner, A., 2009).

These observations cast doubt on the boards' ability to challenge management decisions regarding risk-taking and to question the business model, especially when short-term profit was at stake.

In his memoir "The Courage to Act: A Memoir of a Crisis and Its Aftermath," Ben Bernanke (then Chair of the Federal Reserve) stated that both boards and management took part in excessive risk-taking, while governance structures failed to adequately assess vulnerabilities and control exposures.

The Organisation for Economic Co-operation and Development (OECD) provides an exceptionally significant assessment of bank boards in its publication "Corporate Governance and the Financial Crisis: Key Findings and Main Messages" (OECD, Corporate Governance Principles, 2009). The organisation's expectations that banks would adhere to the general OECD Principles of Corporate Governance proved inconsistent with reality. On one hand, there was information asymmetry and poor information flow to the board; on the other, ineffective execution of board members' responsibilities and support for strategies that lacked appropriate risk management, control, and oversight mechanisms.

The OECD also identified insufficient competence among board members. According to the organisation, boards should be both qualified and independent, particularly in the areas of finance and risk. Furthermore, the OECD criticized compensation policies that were tied to short-term performance rather than the long-term prosperity of institutions.

The OECD's criticism was not without purpose. The organisation proposed recommendations for reforming the soft-law framework—the Principles of Corporate Governance—placing emphasis on strengthening the role of the board in risk management (the board should define the institution's risk policy and monitor its implementation, including through the necessary tools and reporting mechanisms). Stricter rules and requirements for boards, as well as evaluations of the effectiveness of their committees, were deemed necessary. The OECD also highlighted new guidance concerning the independence and competence of directors, as well as remuneration policies.

2.2. Regulatory Reforms and Board Competencies

Following the 2008 financial crisis, the Basel Committee on Banking Supervision (BCBS) adapted its

own version of the Principles for Corporate Governance, specifically tailored for banks (2010). These principles became a benchmark for the formation of boards and future directorships in the post-crisis period.

The adapted principles emphasize three main areas: board responsibilities and qualifications, risk management, and compensation incentives. Two of these areas are directly related to the subsequent structuring of boards — the qualification of board members and risk management. The issue of qualification is particularly important for the U.S. banking system, where some of the major weaknesses of boards stem from the presence of unsuitable members with education and experience misaligned with the banking sector.

The content of the principles is also focused on risk management — precisely the area in which inadequately qualified board members often lack sufficient understanding. The new principles require the appointment of a Chief Risk Officer (CRO), as well as comprehensive risk identification and monitoring on both aggregate and individual levels, full alignment with internal and external audit and control functions, effective communication within the bank, and regular reporting to the board and senior management.

This version of the principles also introduces mandatory practices such as the separation of executive and non-executive directors, the establishment of risk committees, and the oversight of the institution's risk culture (Basel Committee on Banking Supervision, 2010; 2015).

2.3. Evolution of Corporate Governance and Supervisory Principles (OECD, 2023; Basel Committee, 2024)

The transformation of the OECD Principles of Corporate Governance, which define the general framework for companies, has continued in recent years. The 2023 edition emphasizes sustainability, digitalization, and the board's accountability to stakeholders. New competencies for board members include technological and ESG expertise, data management and cybersecurity, ethics and responsibility in the use of artificial intelligence, and sustainable business practices.

The 2023 revision also introduces mandatory policies for board structuring — ensuring a balance between executive and independent members to provide objective oversight, as well as the participation of independent directors in the formation of audit, nomination, and remuneration committees. Board members are expected to possess appropriate skills, experience, and knowledge, including in sustainability and digital transformation, while promoting diversity in all its dimensions (cultural, gender, and others).

The study does not aim to test hypotheses but to assess empirically the structure and characteristics of boards in AI-leading banks.

3. Material and Methods

3.1. Theoretical Framework

This study is a quantitative, comparative and longitudinal. It aims to analyze the dynamics in the board profile of the ten leading banks in the world according to the Evident AI Index (2025) for the period 2020–2024. The indicators combine quantitative data and categorical variables, which allows to track the structural and substantive transformations in bank boards and their position in the Evident AI Index. Such an approach helps to detect trends in the evolution of boards towards their modern profile, as well as to subsequently track their development from the beginning of the transition to artificial intelligence to its more comprehensive implementation. The analysis focuses on the evolution of selected board characteristics, including size, average age, generational structure, experience, independence, competencies and their relationship to the banks' AI profile.

3.2. Data Collection

The data were collected through the analysis of documents from banks' official websites, including Annual Reports, Proxy Statements, Corporate Governance Reports; Evident AI INDEX reports from October

2024 and 2025; Announcements and materials related to the annual shareholders' meetings.

The sample includes the Top 10 banks ranked in the Evident AI Index 2025. The index was used solely as a reference for identifying institutions recognized as AI leaders in the banking sector. This ensures a representative selection of globally significant banks with established corporate governance structures.

3.3. Variables and Indicators

For the purposes of the present study, a set of variables and indicators has been developed to help determine the profile of bank boards during the period 2020–2024.

Table 1.

Definition of Variables and Indicators

Variable/ Indicator	Definition
Var.: Board Size Ind.: Number of board members	Board size influences governance and oversight: larger boards add diversity but reduce agility, while smaller ones are more efficient yet easier to influence.
Var.: Average age of board members Ind.: Arithmetic mean age of board members	Higher average age implies experience and expertise, yet may distance directors from new generations and innovations, limiting adaptability to technological change.
Var.: Generation Baby Boomer Ind.: Share (%) of board members from Generation Baby Boomer	The dominant generation within banks' boards, continuing to lead most institutions.
Var.: Generation X Ind.: Share (%) of board members from Generation X	This generation begins to challenge Baby Boomer dominance but remains underrepresented on boards.
Var.: Gender Diversity / Ind.: 1-Herfindahl–Hirschman Index (HHI)	Calculated as $1 - \text{HHI}$, where HHI reflects gender concentration. Values range from 0 (one gender) to 0.5 (full gender balance).
Var.: Generation Diversity Ind.: 1-Herfindahl–Hirschman Index (HHI)	Calculated as $1 - \text{HHI}$, where HHI is the sum of squared shares of each generation. Values range from 0 (single generation) to 0.667 (equal representation).
Var.: Board Independence Ind.: % of independent directors on the board	According to OECD and Basel principles, independence ensures reliable oversight, risk management, and institutional resilience, protecting shareholder and stakeholder interests.
Var.: Board Tenure Ind.: Average years in position	Long tenure suggests trust and experience but may lead to entrenchment, slowing renewal and intergenerational transition.
Var.: CEO duality Ind.: Binary variable (1 = presence of CEO duality; 0 = absence of CEO duality)	CEO duality concentrates power in one person serving as both CEO and Chair. It reduces information asymmetry but may cause management pressure and risk policy distortion.
Var.: Board Committees Ind.: Measured as a binary variable (1 = presence; 0 = absence)	OECD and Basel principles require specialized committees (risk, nomination, remuneration). Future focus should include technology and digitalization committees.
Var.: AI-related skills and competencies of Board members Ind.: Share (%) of board members with formal education and expertise in technology, digitalization, cybersecurity, or risk management	Measures the proportion of directors with relevant technical and digital skills for AI-related transformation.

Source: Author's compilation based on banks' annual reports, proxy statements, and corporate governance documents (2020–2024)

4. Results and Discussion

4.1. Demographic and Structural Profile of Boards

The first group of variables (Table 2) characterizes the boards and presents the leading dimensions of their structure. These include: the average board size, the average age of board members, the share of each generation within the board composition (averaged for the ten banks), and board diversity in terms of gender and generation.

Table 2.

Dynamics of Board Structure Indicators (2020–2024)					
Indicator/Year	2020	2021	2022	2023	2024
Avg. Board Size (number)	12,5	12,4	12,6	12,5	12,3
Avg. Age (years, number)	62,7	62,8	63,3	63,6	64,1
Avg. Tenure (years, number)	5,5	5,8	6,1	6,3	6,6
GenBoomers (%)	88,70%	87,50%	84,20%	81,70%	82,50%
GenX%	11,30%	12,50%	15,80%	18,30%	17,50%
GenY_Z%	0%	0%	0%	0%	0%
Gender Diversity (1–HHI)	0,4433	0,4531	0,4629	0,4607	0,4711
Generation Diversity (1–HHI)	0,1776	0,1905	0,2306	0,2645	0,263

Source: Author's calculation based on bank's annual reports and Proxy documents, 2020-2025

The data in Table 3 show that the minimum board size varies between 9 and 10 members, while the maximum values of 17 and 16 are observed in the pandemic years 2020 and 2021. The average board size remains relatively constant – around 12,5, with a fluctuation of only 0,1 over the five observed years. This shows that banks do not undertake significant transformations in their management structures in the period 2020–2024, at least with regard to the number of directors on the board. The decreasing values of the standard deviation over four consecutive years indicate a process of homogenization of the boards, which is interrupted in 2024.

Table 3.

Descriptive Statistics of Board Size (2020-2024)					
Indicator / Year	2020	2021	2022	2023	2024
Mean	12,5	12,4	12,6	12,5	12,3
Median	12,5	12	13	12	13
Min	9	10	10	10	9
Max	17	16	14	14	15
StDev	2,37	1,90	1,35	1,27	1,64

Source: Author's calculation based on bank's annual reports and Proxy documents, 2020-2025

The second variable analyzed is the average age of board members, which was among the main points of criticism directed at them back in 2008.

Table 4.

Descriptive Statistics of Age (2020-2024)					
Indicator / Year	2020	2021	2022	2023	2024
Mean	62,7	62,8	63,3	63,6	64,1
Median	62,5	62,5	63,5	63,5	64,5
Min	58	59	59	58	60
Max	68	69	69	69	69
StDev	2,79	3,05	3,02	2,99	2,38

Source: Author's calculation based on bank's annual reports and Proxy documents, 2020-2025

The descriptive statistics show not only that the range of variation in the average age is relatively high, but also that the boards are aging — and this is happening at a time when Generation X is trying to take its place in ensuring a smooth generational transition within the governing bodies of the institutions.

The mean age of board members, together with the standard deviation values, outlines a clear picture of the predominance of the Baby Boomer generation on the boards. Without taking into account the official retirement age in different countries — since board members follow the internal rules of the banks themselves and the confidence of shareholders — additional data should be specified to reveal the complete picture of directors' ages.

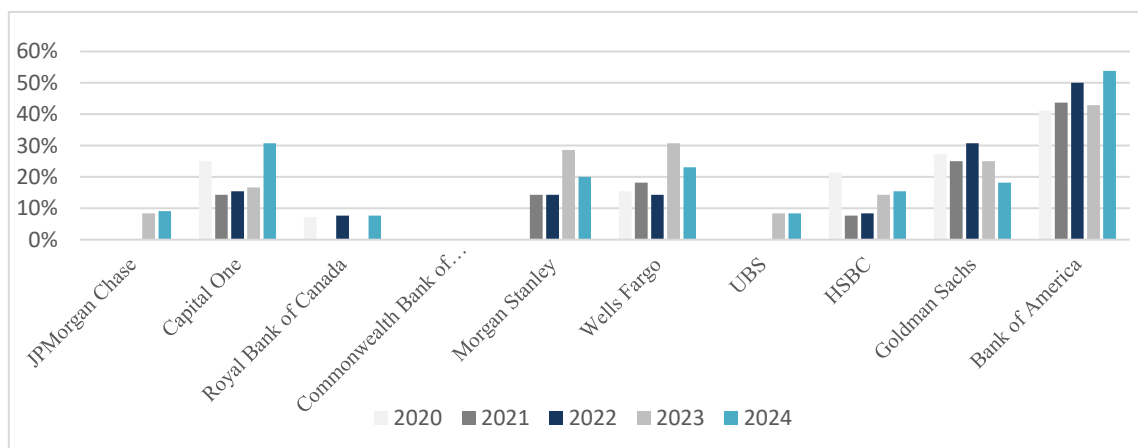
Table 5

Directors aged 70+ on the boards of the Top 10 banks in the Evident AI Index (in %)

Bank/Year	2020	2021	2022	2023	2024
JPMorgan Chase	0%	0%	0%	8%	9%
Capital One	25%	14%	15%	17%	31%
Royal Bank of Canada	7%	0%	8%	0%	8%
Commonwealth Bank of Australia	0%	0%	0%	0%	0%
Morgan Stanley	0%	14%	14%	29%	20%
Wells Fargo	15%	18%	14%	31%	23%
UBS	0%	0%	0%	8%	8%
HSBC	21%	8%	8%	14%	15%
Goldman Sachs	27%	25%	31%	25%	18%
Bank of America	41%	44%	50%	43%	54%

Source: Author's calculation based on bank's annual reports and Proxy documents, 2020-2025

The data by individual banks reveal another important aspect – several institutions allow directors of retirement age to remain active board members. Bank of America leads in this regard, with a growing share of directors in this age group (54% in 2024). Similar high proportions of directors aged 70+ are observed in other major U.S. investment banks such as Morgan Stanley, Wells Fargo, Goldman Sachs, and Capital One. JPMorgan Chase stands out as an exception, with only 9% of directors belonging to this age group.

**Figure 1. Percentage distribution of directors aged 70+ for the period 2020–2024**

Source: Author's calculation based on bank's annual reports and Proxy documents, 2020-2025

Such data do not correspond to the recommendations issued by regulatory bodies after the Global Financial and Economic Crisis, which called for the “rejuvenation” of boards. Nevertheless, these directors continue to earn the trust of shareholders, as a result of their proven performance over the years. And while shareholders tend to seek security and reliability in decision-making, legislation clearly states that boards must adapt to the new era and that their members should acquire the knowledge and skills necessary not only to understand but also to critically evaluate innovations, including artificial intelligence.

Since directors born in the middle of the Baby Boomer generation generally do not align with the profile of innovation, the likelihood that the banks they lead will establish successful technology-related committees and “ride the wave” of change is considerably lower than their potential capacity. Yet, despite this, they succeed and hold leadership positions among the 50 most innovative banks in the world according to the Evident AI Index.

The characteristics of boards do not end there. The experience of directors is particularly important in times of tension, when boards with seasoned members tend to inspire more confidence than younger ones. This explains why shareholders support longer board mandates — as confirmed by the analyzed data, the average tenure of a director increases from 5,5 to 6,6 years.

Table. 6

Descriptive statistics (Tenure, 2020-2024)

Indicator / Year	2020	2021	2022	2023	2024
Mean	5,5	5,8	6,1	6,3	6,6
Median	5,5	5,5	6,5	6,5	6
Min	2	3	3	3	3
Max	9	9	10	10	10
StDev	2,64	2,57	2,73	2,50	2,50

Source: Author’s calculation based on bank’s annual reports and Proxy documents, 2020-2025

The descriptive statistics also show that the composition of the boards is not constant but changes over time (the minimum average level remains the same, suggesting that new directors replace those who have left the board). Again, as in the analysis of board size, the variation is low (ranging from 2.5 to 2.73), confirming the process of board homogenization in terms of directors’ tenure.

Of course, the exceptions that somewhat distort the interpretation of the results should not be left without comment. In some banks, the boards are chaired by leaders with significant experience. For example: Richard D. Fairbank (Capital One, since 1994), James Dimon (JPMorgan Chase, since 2004), Jacynthe Côté and David McKay (Royal Bank of Canada, since 2014), James Gorman (Morgan Stanley, 2010–2023), and Brian T. Moynihan (Bank of America, since 2010).

The next two variables reflect the diversity of the boards — generational and gender-based. The analysis of the average age of board members showed that the boards are dominated by the Baby Boomer generation. This previous conclusion is confirmed by the diversity index, which, despite increasing from 0.156 to 0.193, remains far from balanced values for this type of indicator. The data also show that some boards are composed entirely of a single generation, as evidenced by the minimum value in the descriptive statistics of the diversity index.

Table. 7

Descriptive Statistics of Generation Diversity (1-HHI)

Indicator / Year	2020	2021	2022	2023	2024
Mean	0,156	0,158	0,175	0,197	0,193
Median	0,157	0,166	0,161	0,212	0,200

Min	0	0	0	0	0
Max	0,444	0,426	0,497	0,48	0,494
StDev	0,16	0,16	0,18	0,18	0,19

Source: Author's calculation based on bank's annual reports and Proxy documents, 2020-2025

The conclusion for this indicator, as well as for the average age of board members, is that at a time when a transition to Generation X is necessary, banks are not allowing this process to occur in a timely manner, thereby delaying change.

The second type of diversity indicator is gender diversity. The participation of women in governance is no longer a taboo topic. Women are represented on the boards of major financial institutions at levels that are balanced in accordance with national legislation. Several conclusions can be drawn from the descriptive statistics. The average value increases from 0,443 to 0,471 (with the optimal level being 0,5), which suggests an almost complete gender balance on the boards. The standard deviation values are extremely low, indicating that banks maintain relatively similar levels of gender balance. The median over the five observed years ranges between 0,458 and 0,480, showing that banks sustain a stable and nearly ideal gender ratio of 0,5 in their boards.

Table. 8

Descriptive Statistics of Gender Diversity (1-HHI)

Indicator / Year	2020	2021	2022	2023	2024
Mean	0,443	0,453	0,463	0,461	0,471
Median	0,458	0,471	0,461	0,480	0,480
Min	0,355	0,397	0,408	0,375	0,426
Max	0,49	0,486	0,497	0,5	0,497
StDev	0,04	0,04	0,03	0,04	0,03

Source: Author's calculation based on bank's annual reports and Proxy documents, 2020-2025

The noticeable, steady increase in the values and the nearly achieved balance indicate the presence of sustainable equality-oriented policies within financial institutions in recent years (a pattern not observed in earlier periods, particularly where no mandatory legislation was in place).

4.2. Board Activity and Governance Structure

In addition to demographic criteria, boards can also be analyzed in terms of their activity and governance structure. The first indicator of activity is the number of meetings the board holds annually.

Table. 9

Descriptive Statistics of Board Meetings (2020–2024)

Indicator / Year	2020	2021	2022	2023	2024
Mean	17,0	14,5	14,1	15,9	14,8
Median	16,5	14,5	15,0	13,5	14,0
Min	8	8	8	8	8
Max	28	23	22	29	28
StDev	5,83	4,81	4,41	7,53	6,37

Source: Author's calculation based on bank's annual reports and Proxy documents, 2020-2025

According to the descriptive statistics, the average number of meetings ranges between 14.1 and 17 per year, which suggests an active level of board engagement (at least one meeting per month for the full board, excluding committee meetings). The minimum value of 8 remains the same across all years, indicating that

banks follow a similar policy regarding the minimum number of meetings or that this requirement is embedded in their internal regulations. The standard deviation values also show that the boards' activity levels vary, with some boards approaching their work more thoroughly and responsibly than others.

The year-by-year data indicate higher activity during the pandemic year 2020, when banks were subjected to particular (multifaceted) pressure. In the calmer post-pandemic environment, board meetings were less intensive, while in the last two years their number has increased again. The reasons for this have not been disclosed, but pressure from the external environment — political, economic, and technological — has likely contributed to it.

The activity of the board also directly depends on its independence, as independent directors form the core of its key committees. In most jurisdictions, the percentage of independent directors is legally defined (a minimum threshold set by legislation), which means that its level should not be particularly volatile. In the United States, for example, the Audit Committee, Compensation Committee, and Nominating/Governance Committee must consist entirely of independent directors.

Table. 10

Descriptive Statistics of Board Independence (% , 2020–2024)

Indicator/Year	2020	2021	2022	2023	2024
Mean	88%	88%	90%	89%	89%
Median	90%	90%	91%	92%	92%
Min	79%	77%	79%	79%	73%
Max	94%	94%	93%	93%	92%
StDev	0,06	0,06	0,05	0,06	0,06

Source: Author's calculation based on bank's annual reports and Proxy documents, 2020-2025

The data in Table 10 illustrate this situation – exceptionally high average levels of board independence, minimal variation, and narrow gaps between the maximum and minimum values. Independent directors are sufficient in number to form committees whose decision-making processes are free from executive influence.

The establishment of the main board committees in banks is legally defined and, for the majority of the analyzed institutions (mainly U.S. banks), includes: Audit Committee (Sarbanes–Oxley Act), Compensation/Remuneration Committee and Nominating and Governance Committee (in accordance with *NYSE* and *Nasdaq* rules), as well as the Risk Committee for banks with assets over USD 10 billion (*Dodd-Frank Act*).

The Basel Committee on Banking Supervision also mandates the presence of such structures, emphasizing that “governance structures must include audit, risk, compensation and other committees with experienced, independent directors, commensurate with the bank's risk profile and systemic importance.”

The establishment of Technology/Innovation Committees is not legally required but is becoming increasingly common, particularly among institutions with AI and digital profiles, following the introduction of the concept of *technology risk* by the Basel Committee on Banking Supervision (2024, p. 60).

Of similar nature is the recommended ESG/Sustainability Committee, supported by the *OECD* and the *U.S. SEC*.

In this context, the question arises: Which committees are included in the board structures of the AI-oriented banks ranked in the Top 10 of the Evident AI Index?

All banks examined in the study, in one form or another, have an Audit Committee, Nomination & Governance Committee, and Risk Committee. Of these, 80% have established a Compensation/Remuneration Committee, 60% — committees related to ESG factors, and only 20% have committees in the field of technology and digitalization. One of the reasons for this is that, in most cases, when technological risk is discussed, the meetings are conducted by the Risk Committee together with one of the other committees, without establishing a separate unit for this purpose.

Table. 11**Composition of Board Committees in the Top 10 AI-Oriented Banks Ranked in the Evident AI Index (2025)**

Bank	Audit Committee	Compensation / Remuneration Committee	Nomination & Governance Committee	Risk Committee	ESG Committee	Tech
JPMorgan Chase	+	+	+	+	+	
Capital One	+	+	+	+		
Royal Bank of Canada	+	-	+	+		
Commonwealth Bank of Australia	+	+	+	+		
Morgan Stanley	+	-	+	+	+	+
Wells Fargo	+	+	+	+	+	
UBS	+	+	+	+	+	
HSBC	+	+	+	+	+	+
Goldman Sachs	+	+	+	+	+	
Bank of America	+	+	+	+		

Source: Author's calculation based on bank's annual reports and Proxy documents, 2020-2025

The new directors, however, according to the requirements of the legislation, should also have knowledge and skills related to technology, the digital world, and artificial intelligence. This suggests that, in the future, internal structures may be established within banks to deal with issues related to technological innovations.

A direct connection with the boards is also observed in the so-called CEO duality, implying a strong concentration of management and leadership in the hands of one person. How many of the most innovative banks prefer this form of concentrated power?

Table. 12**CEO Duality among Top 10 Banks in Evident AI Index (2020–2024)**

Bank	2020	2021	2022	2023	2024
JPMorgan Chase	1	1	1	1	1
Capital One	1	1	1	1	1
Royal Bank of Canada	0	0	0	0	0
Commonwealth Bank of Australia	0	0	0	0	0
Morgan Stanley	1	1	1	1	1
Wells Fargo	0	0	0	0	0
UBS	0	0	0	0	0
HSBC	0	0	0	0	0
Goldman Sachs	1	1	1	1	1
Bank of America	1	1	1	1	1

Source: Author's calculation based on bank's annual reports and Proxy documents, 2020-2025

The equal division between the supporters of CEO duality and those who prefer the separation of powers is consistent with general research findings, which do not take a definitive position either for or against it. An interesting observation is that the banks supporting duality are all American. Of the six U.S. banks included among the world's Top 10 AI-oriented banks, five apply the CEO duality model, while only Wells Fargo operates with a separated leadership structure and no concentration of power (the third-largest U.S. bank by assets at the end of 2024).

However, it is a fact that the other five institutions perform excellently, and among them are the giants of

the American banking industry. This suggests that the concentration of power cannot always be viewed as a negative factor — on the contrary, it may sometimes contribute to effective and stable governance.

4.3. Technological and AI-Oriented Competencies of Boards

The last part of the analysis is focused on the digital and AI competencies of the board members. The overview of the information about the skills of directors and boards for the first 10 banks included in the *Evident AI Index* is presented in Table 13. The requirements for having such skills were introduced in 2023, which is why the disclosure started from that period onward.

Table 13

AI-Related and Technological Competencies of Board Members (2022–2025)

Bank	AI-related skills and competencies of Board members	2022	2023	2024	2025
JP Morgan Chase	Technology	80%	83%	73%	75%
Capital One	Digital and Technology		83%	77%	83%
	Cybersecurity		42%	38%	42%
	Technology Executive		33%	31%	33%
Royal Bank of Canada	Technology / Digital	31%	42%	31%	31%
Common Wealth	Digital and technology	73%	60%	78%	70%
Morgan Stanley	Cybersecurity / Technology / Information Security	50%	50%	47%	40%
Wells Fargo	Information Security, Cybersecurity, Technology	29%	31%	38%	46%
UBS	Technology, including artificial intelligence and cybersecurity	33%	33%	33%	
HSBC	Digital technology	33%	29%	31%	
Goldman Sachs	Technology/ cyber threat/ information security		50%	55%	43%
Bank of America	Cybersecurity, Technology, and Information Security		36%	38%	43%

Source: Author's calculations based on banks' Annual Reports and Proxy Statements (2020–2025).

The data in the table show the level of technological and digital competencies of the board members. The clear leaders are the first two banks – JP Morgan Chase and Capital One, which corresponds to their ranking in the *Evident AI Index*. Third in terms of technological competencies is Commonwealth Bank. The other institutions are within the threshold of up to 50% of board members, which clearly distances them from the possibility that all committees, including a potential structured one for technology, work in synergy to achieve alignment with the pace of development in digitalization, artificial intelligence, and the banks themselves.

5. Conclusion

The analysis of the boards of the top 10 banks according to the Evident AI Index found that they have medium-sized compositions, are highly independent, and show no clear support for CEO duality. The boards are generationally unbalanced but maintain gender equilibrium. In some banks, directors significantly exceed retirement age yet continue to lead their institutions without sufficient digital and technological competencies, despite the expectations placed on them and the requirements imposed by the banks' AI-oriented profiles.

The institutions examined are among the largest banks in the world. They possess the financial capacity to support initiatives for adopting and adapting AI within their organizations, yet the directors themselves mostly belong to the generation that provoked the previous financial crisis — one for which stability has become paramount, avoiding disruptions or even minor process-related uncertainties. In the context of Banking 5.0, the directors lag behind in understanding and promoting this type of change, which likely slows the

transformation of business models and the overall efficiency of banks.

All this highlights the need to transform boards — from guardians of security and stability into innovators and proactive actors, standing both on the side of regulation and on the side of innovation.

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Liquidity Management in Times of Global Uncertainty: Contemporary Approaches to Working Capital Analysis and Forecasting

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Abstract

In the context of growing global economic instability, liquidity management has emerged as a critical determinant of organizational resilience. The purpose of this article is to present the theoretical foundations of liquidity management, analyze contemporary approaches to working capital assessment, and synthesize recent research developments in the field. The study conducts a systematic review of the literature, focusing on both developed and developing economies, and incorporates findings from academic publications and empirical studies. The analysis reveals contrasting trends: a marked deterioration in the cash conversion cycle in 2023—when, for the first time in a decade, all key indicators declined simultaneously—followed by a 4% improvement in 2024. The article integrates up-to-date data from 2023–2024 into the theoretical framework, thereby systematizing the latest insights into the effects of global instability. The findings suggest that effective liquidity management requires the integration of both traditional and modern approaches, including stress testing, scenario analysis, and probabilistic modeling. The proposed integrated model provides financial managers with practical tools for optimizing working capital under conditions of heightened uncertainty.

Key words:

financial analysis, working capital, cash flow optimization, corporate resilience, financial stability

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1. Introduction

Liquidity management is an essential component of the financial management framework of any organization. It is particularly important in the context of rising global economic instability. To remain competitive, each enterprise must maintain sufficient liquidity to meet its short-term obligations on time while making optimal use of its financial resources.

Global economic challenges arising from geopolitical crises, pandemics, and disruptions in supply chains have introduced new requirements for the methodology of working capital management. Traditional approaches to analysis and forecasting are no longer sufficient on their own in today's dynamic business environment, requiring the development and implementation of new tools and techniques.

The relevance of the topic is also confirmed by a number of studies conducted by leading consulting firms. A study by The Hackett Group covering 1 000 of the largest U.S. public companies found that in 2023, for the first time in a decade, all three key indicators of the cash conversion cycle (DSO, DIO, and DPO) deteriorated simultaneously (The Hackett Group, 2024). JPMorgan likewise reported a 2.4-day decline in the CCC for S&P 1 500 companies, attributed to increases in both Days Inventory Outstanding and Days Sales Outstanding (JPMorgan, 2024).

In this context, the purpose of this article is to present the theoretical foundations of liquidity management in the environment of global instability, to analyse contemporary approaches to the assessment and forecasting of working capital, and to summarize current scientific research on the subject.

2. Literature Review

2.1. Theoretical Framework and Key Concepts

The theoretical foundations of working capital management date back to the early work of Gitman (1974), who identified cash flows as a central element of working capital management with a direct impact on a firm's liquidity. Richards and Laughlin (1980) further developed this understanding through the theory of the cash conversion cycle (CCC). According to this framework, the effectiveness of working capital management is evaluated based on the management of components such as Days Sales Outstanding (DSO), Days Inventory Outstanding (DIO), and Days Payables Outstanding (DPO).

Although more than half a century has passed since Gitman's (1974) initial contribution, the cash conversion cycle theory remains a significant determinant of firms' financial performance. Research by Kiyamaz et al. (2024) confirms the continued relevance of this concept, showing that the cash conversion cycle is inversely related to firm efficiency across different economic sectors.

Liquidity refers to a company's ability to convert its assets into cash to settle current obligations without incurring substantial losses. It serves as a fundamental indicator of both financial health and operational efficiency. The concept of liquidity comprises three key dimensions: accounting liquidity (the ratio between current assets and current liabilities), market liquidity (the ability to quickly sell assets), and cash liquidity (the availability of immediately accessible funds).

Working capital, defined as the difference between current assets and current liabilities, represents the financial buffer that ensures the continuity of the operating cycle. Its main components include inventories, trade receivables, cash, and short-term liabilities. The cash conversion cycle (CCC) serves as a core metric for assessing the efficiency of working capital management. It measures the time required to transform inventories and other resources into cash inflows from sales. The CCC is calculated as:

$$CCC = DSO + DIO - DPO,$$

where a shorter cycle indicates more efficient management and faster conversion of investments into cash.

The literature identifies three main strategies for working capital management: conservative, moderate, and aggressive. The conservative strategy maintains a high level of liquidity by keeping current assets relatively large, which, however, reduces profitability due to the immobilization of funds. The aggressive strategy seeks to maximize profitability by minimizing working capital levels, though it increases liquidity risk. The moderate strategy represents a balanced approach between these two extremes. Research shows that approximately 84% of companies in the Gulf region follow a conservative strategy, particularly during periods of economic crisis (Ahmad et al., 2022).

2.2. Empirical Studies and Financial Results

Empirical research has established a significant relationship between working capital management and the financial results of organizations. Chasha et al. (2024) report a strong correlation between working capital management and profitability in the context of small and medium-sized enterprises in Kenya. Their findings indicate that inadequate management of working capital has the potential to trigger failure even among otherwise successful corporations.

Panigrahi (2024) identifies a negative relationship between financial performance—measured by return on assets (ROA) and both the inventory turnover period and the accounts payable period in the Indian cement industry. At the same time, the results show that liquidity indicators such as the current ratio and quick ratio exhibit a significant positive relationship with ROA. A recent study by Kiyamaz et al. (2024) analyses firms from both developed and developing economies and demonstrates that the cash conversion cycle is inversely related to firm efficiency across both groups.

The COVID-19 pandemic provided a unique opportunity to examine working capital management under extreme conditions. Harris et al. (2024) investigate the effect of working capital efficiency on the performance of firms exposed to cyberattacks and find that aggressive working capital management policies enhance both immediate and subsequent stock market performance, as well as the operational efficiency of firms affected by external or malware-induced attacks.

Mengstie et al. (2024) study examines the impact of working capital management on the profitability of private commercial banks in Ethiopia and establishes the critical importance of effective current asset management. Holding excessive amounts of liquid assets tends to reduce profitability, whereas maintaining insufficient liquidity can lead to financial distress. Habib and Mourad (2022) analyse the efficiency of working capital management in the Gulf region before and during the coronavirus crisis, employing the Malmquist index, data envelopment analysis (DEA), and Tobit regression.

2.3. Global instability and its impact on working capital

The influence of uncertainty on corporate financial decisions has become a major focus in contemporary research. Huynh J. (2024) examines how firms adjust their cash conversion cycles in response to banking sector uncertainty, using microdata from Vietnam. The study finds that firms employ different approaches to managing their cash cycles during periods of heightened uncertainty: some shorten their cycles to ensure faster liquidity conversion, while others extend them in response to declining sales.

Dbouk et al. (2020) analyse the impact of macroeconomic risk, measured through the Economic Policy Uncertainty (EPU) index, on the working capital of U.S. manufacturing firms from 1990 to 2018. Their results indicate that various components of working capital respond differently to policy uncertainty. In the context of Asian emerging economies (China, Pakistan, India, and South Korea), Muzaffar et al. (2024) show a statistically significant inverse relationship between liquidity and volatility, with economic policy uncertainty raising investor concerns and reducing market liquidity.

The current economic environment is marked by an unprecedented level of uncertainty and volatility. Key contributing factors include geopolitical tensions and conflicts (particularly the war in Ukraine and the situation in the Middle East), the lingering economic effects of the COVID-19 pandemic, high inflation, climate change and environmental risks, as well as technological disruptions, including advances in artificial intelligence.

Research by the Hackett Group (2024) points to contradictory trends in working capital management of large U.S. firms. In 2023, all elements of the cash conversion cycle deteriorated for the first time in a decade, with the average cycle lengthening from 36.4 days in 2022 to 37.7 days in 2023. However, in 2024, the cash conversion cycle improved by 4%, averaging 37 days.

JP Morgan's Working Capital Index (2024) emphasizes that, despite a relative reduction in supply chain disruptions in 2023, uncertainty is expected to return in 2024. Key drivers include supply chain relocations, elections in 77 countries, high refinancing costs of COVID-related debt, sustainability pressures, and increased investment in artificial intelligence.

Contemporary research in working capital management employs a broad range of methodological approaches, including panel data models with fixed and random effects, System GMM estimators to address endogeneity concerns, Data Envelopment Analysis (DEA) for efficiency assessment, as well as quantile regression models for risk analysis. Emerging research areas include the impact of digital transformation and artificial intelligence on working capital management, the role of ESG factors, and the use of alternative data sources for measuring uncertainty. The IMF Global Financial Stability Report (October 2024) highlights the potential of artificial intelligence to enhance risk management and deepen market liquidity.

3. Methods and Methodology

3.1. Traditional and Modern Analytical Methods

Classical financial analysis of working capital relies on liquidity ratios (the current ratio, the quick ratio, and the cash ratio) and turnover indicators for the principal components of working capital. These measures provide a static snapshot of the firm's financial position and facilitate historical comparisons and benchmarking.

The modern approach extends traditional analysis by integrating cash flow analysis, which focuses on actual movements of cash rather than on accounting classifications alone. Classifying cash flows by activity type (operating, investing, and financing) clarifies sources and uses of funds. Calculating net cash flow yields insight into the firm's ability to generate surplus funds after meeting operating requirements and obligatory investments.

Stress testing constitutes a methodology for assessing the firm's liquidity resilience under adverse conditions. It entails identifying critical risk factors (for example, a decline in sales, delayed customer payments, or cost increases), constructing extreme but plausible scenarios, and quantifying their impact on liquidity. Scenario analysis broadens this framework by considering multiple alternative future states (optimistic, baseline, and pessimistic) and assessing the probabilities of their realization. These methods support proactive planning and strategy development, which is particularly important in the high-uncertainty environment typical of contemporary business.

For systematic working capital analysis, an integrated model can be employed that combines traditional and modern approaches within a unified analytical framework (see Table 1).

Table 1

Integrated Working Capital Analysis Model

Indicator	Formula	Target values	Method
Cash Conversion Cycle (CCC)	$CCC = DSO + DIO - DPO$	Shorter is preferable; industry benchmark 30–50 days	Trend analysis
Current Ratio	Current Assets / Current Liabilities	1.5–2.0 (depends from industry)	Static
Quick Ratio	$(\text{Current Assets} - \text{Inventory}) / \text{Current Liabilities}$	≥ 1.0 (conservative approach)	Static
Operating Cash Flow	Cash flows from operating activities	Positive and increasing; should cover obligations	Dynamic
Days Sales Outstanding (DSO)	$(\text{Receivables} / \text{Sales Revenue}) \times 365$	30–60 days (depends from industry)	Trend analysis
Days Inventory Outstanding (DIO)	$(\text{Inventory} / \text{Cost of Goods Sold}) \times 365$	Shorter is preferable; minimizes immobilization	Trend analysis
Liquidity Stress Test	Simulation of extreme scenarios (e.g., revenue decline 20–30%)	Adequate liquidity under pessimistic scenario	Scenario-based
Rolling Cash-flow Forecast	Monthly/quarterly forecast updates	Forecast accuracy $\pm 10\%$	Dynamic

The model integrates static and dynamic indicators, enabling a multifaceted assessment of liquidity. Static measures (liquidity ratios) offer a snapshot of financial condition, while dynamic indicators (CCC, DSO, operating cash flow) reveal trends and managerial effectiveness. Scenario analysis and stress testing introduce an assessment of resilience under adverse conditions, and rolling forecasting ensures adaptability and proactive management.

3.2. Advanced Quantitative Techniques and Probabilistic Forecasting

Contemporary technologies make it feasible to apply advanced simulation techniques to working capital modelling. The Monte Carlo method employs stochastic processes to generate numerous potential trajectories for key variables and to estimate the probability distribution of future liquidity. Dynamic modelling captures the interrelationships among various working capital components and relevant external factors.

Machine learning and artificial intelligence open new avenues for identifying complex nonlinear dependencies and for adaptive modelling. Algorithms such as neural networks, Random Forest, and Gradient Boosting can process large volumes of structured and unstructured data, incorporate many predictors, and adapt automatically to shifting conditions. The IMF Global Financial Stability Report (October 2024) highlights that artificial intelligence can improve risk management and deepen market liquidity.

Rather than relying solely on deterministic forecasts, the contemporary approach recommends probabilistic forecasting that explicitly recognises and quantifies uncertainty. This practice includes producing confidence intervals instead of point estimates alone, developing probability distributions of possible outcomes, and applying Bayesian methods to update forecasts continuously as new information arrives.

Rolling forecasting processes, in which forecasts are updated regularly (monthly or quarterly) using the most current information, supplant static annual forecasts. This approach maintains a continually relevant forward-looking horizon and facilitates more rapid responses to changing circumstances.

3.3. Integrated Approach and Technological Solutions

Contemporary best practice recommends an integrated approach that combines multiple analytical techniques and perspectives. Establishing a system of key performance indicators (KPIs) specific to working capital management enables continuous monitoring and timely corrective action. Treasury management systems automate cash management processes, provide real-time visibility into liquidity, and optimize fund usage.

The digitalisation of financial processes offers unprecedented opportunities for optimisation. Business intelligence and analytics platforms facilitate in-depth data analysis, visualization of key metrics, and the generation of actionable insights. As the Hackett Group (2024) notes, technological improvements must be accompanied by appropriate processes and governance to realise full benefits.

The growing adoption of supply chain finance (SCF) programmes is an important trend, as firms seek to unlock cash and manage supplier relationships more effectively. Digital transformation in optimizing financial operations and advancing working capital performance is crucial to maintaining competitive advantage and operational resilience.

Companies are investing in real-time cash management technologies, process automation, and advanced analytics. Global organisations face several principal gaps in adopting liquidity management technologies, including resource constraints, persistent manual processes, and knowledge gaps. The integration of ESG factors into liquidity assessment and management is becoming not only a matter of corporate reputation but also of long-term financial sustainability.

4. Conclusion

Liquidity management under conditions of global instability is a complex, multidimensional challenge that requires integrating traditional and contemporary approaches, quantitative and qualitative methods, technological solutions, and organisational capabilities. The present literature review and methodological analysis yield several key findings.

First, the theoretical framework of the cash conversion cycle, developed more than half a century ago, remains relevant today but requires adaptation to contemporary conditions of heightened uncertainty. Empirical studies consistently demonstrate a strong relationship between effective working capital management and firms' financial performance across diverse economic contexts.

Second, global instability, manifested through geopolitical tensions, pandemic shocks, supply-chain disruptions, and financial-market volatility, has a significant impact on all components of working capital. Data for 2023–2024 show mixed trends, ranging from substantial deterioration of indicators in 2023 to partial recovery in 2024.

Third, economic-policy uncertainty plays a critical moderating role in the relationship among liquidity, market volatility, and financial results. Firms typically respond to heightened uncertainty by adopting more conservative working capital strategies; in the analysed sample, roughly 84% of firms in emerging markets followed a conservative approach.

Fourth, contemporary methods of analysis and forecasting extend beyond traditional static techniques to incorporate stress testing, scenario analysis, machine learning, and probabilistic modelling. The proposed integrated model for liquidity analysis combines static and dynamic indicators to deliver a comprehensive assessment of liquidity and resilience under adverse conditions. Rolling forecasting and adaptive planning provide flexibility and faster responses in dynamic environments.

Fifth, balancing liquidity and profitability remains a central managerial challenge. The identified working capital optimisation opportunity of \$1.7 trillion among leading U.S. firms underscores the substantial potential for improvement. The widening gap between median performers and best-in-class organisations demonstrates that a strategic, systematic approach to liquidity management can create significant competitive advantage.

Sixth, effective liquidity management requires not only technical and analytical capabilities but also the right organisational culture, cross-functional integration, and adaptability. Technological innovations — including artificial intelligence — afford new opportunities for automation, analysis, and optimisation; nevertheless, technology alone is insufficient. Appropriate processes, governance, and human capital are necessary to realise full benefits.

In the context of ongoing global instability and increasing business complexity, organisations' ability to manage liquidity effectively will remain a critical determinant of resilience and success. Future research should examine the long-term effects of artificial intelligence on working-capital management, the role of ESG factors in liquidity decisions, and the effectiveness of alternative strategies across specific industries and geographic regions.

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THE SOCIAL DILEMMA – SOME THEORETICAL ASPECTS

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Abstract

Modern economic reality is complex and requires decisions that weigh individual, group and public interests. The behavior of societies, people, corporations, governments, central banks and groups in such situations is an attempt at rationality. The search for an optimal solution in the context of the economic policy of governments and central banks requires dealing with social phenomena that are usually not included in the models. The interests of all are located in different corners of the common puzzle - all will gain more if cooperate, but they fail to do so because of their divergent and subjective, conflicting and short-term interests. An applicable option for solving dilemmas turns out to be game theory. In combination with the theory of rational choice and expected utility, they provide a common toolkit.

Key words:

social dilemma, game theory,
financial crisis

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1. Context of the term

The complex contemporary reality implies problems in economies that require solutions that weigh individual, group and public interests. Such global problems are environmental protection, resource use, overpopulation. In a financial and economic context, the last 20 years provide numerous additional and less general examples.

One such example is the September 2008 crash, a huge challenge for the most influential central banks and governments trying to deal with the aftermath of the Lehman Brothers bankruptcy. Their response was to lower interest rates to zero, but also to provide unlimited liquidity for credit institutions. The Federal Reserve proceeded to reduce interest rates from 2% through 1.5%, to 1%. The yield on three-month bills issued by the US government fell even lower than 1%. The way was opened for the controversial policy called “Quantitative Easing” and it was followed by all authoritative national treasuries. Quantitative easing allowed the implementation of a strategy in which central banks created new money (reserve balances) and through them bought long-term and asset-backed bonds (secured with assets) from private banks. This monetary policy should allow banks, through the money refinanced by central banks, to continue to lend to companies' investment spending, people's home purchases and consumer spending. One of the first results is the achievement of even lower interest rates on prime government debt - between 0 and 0.25%. The quantitative easing strategy is also applied by other major central banks, negative yields on prime debt are becoming a market fact, fully expected.

The next big challenge begins in early 2020. Even before Covid, as a result of attempts to contain the 2008 crisis, the European Central Bank's interest rates were -0.5% on deposits, 0% on refinancing operations and 0.25% on lending (https://www.ecb.europa.eu/stats/policy_and_exchange_rates). March 2020 will be associated by everyone, not only financiers, with the devastating shock that the pandemic is inflicting on the global economy. Prospects for growth and recovery are turning into expectations of a nightmarish economic collapse and against this background the ECB, like other leading central banks, is rapidly introducing large-scale measures to mitigate the impact of the Covid crisis on the financial and real sectors, writes Kamelarov (2021). The 2008 financial collapse opens the way for large-scale financing by central banks and interest rates logically break through the zero anchor. Covid since the beginning of 2020 has left people confined to their

homes, businesses are at a standstill, transport corridors are disrupted, governments have to foot the bill. More money is demanded, central banks are on the move, and circumstances are extraordinary. This, according to Kamelarov (2021), puts monetary policy entirely at the service of fiscal policy and changes the traditional mix between the two, adopted as the rule decades before.

In the European Union, there is a categorical ban on monetary financing of governments, state bodies of member states and Community institutions. This is considered to be of key importance for guaranteeing the independence of the central bank and the monetary policy it conducts. Such a restrictive principle prevents the possibility of paper money issuance to finance budget deficits and the risk of inflation in the event of a monetary policy-supported inflation of budget expenditures, according to Kamelarov (2021). However, the disputes and discussions about whether the ECB is crossing the border of monetary financing and sacrificing its independence as a central bank in an attempt to save the shaky public finances of some countries on the periphery of the eurozone have logically ceased.

No official statement from a central bank or government directly acknowledges the application of MMT, neither in dealing with the 2008 crisis nor in managing the shock of the closure of economies since spring 2020. The actions taken do not lead to a comprehensive change in the foundation of monetary policies - the goals of preventing deflation and a financing crisis in both cases seem to have been achieved, and the place of inflation as an anchor for monetary programs remains far from discussion. Focusing on quantitative easing programs also does not lead to the whole truth - according to Kamelarov (2021), the balance sheets of official monetary authorities can be misleading, since it is not necessary for newly created central bank money to be made available to economic entities. This is a fact until the end of 2021, the exception being the stock prices of risky securities and energy prices.

Financial markets at that time are also subject to additional shocks – models for valuing securities and currencies are collapsing due to uncertainty, which is known to offer no methods for quantifying threats. The reaction of the authorities in the democratic and market world to lock people in their homes, in financial terms, means a business shutdown, a critical reduction in sales, an inability to service obligations, bankruptcies. The forced shutdown of companies naturally leads to aid for both employees and companies, and this is a second shock, this time for public finances. Businesses that, despite the closure, have markets cannot sell due to interrupted supply chains, i.e. the collapse in sales is not only for companies whose business is classified as non-essential and may stop. The problem of the state budget with financing aid for workers is doubled by aid for businesses, and the financing of closures, along with the financing of reduced revenues in the budgets, is transferred to the sphere of financial alchemy. For the second time in 12 years, the financial markets are flooded with money and financial institutions are only doing what they can – businesses have no projects to finance, the money is being directed to securities. Not all money is being taken to risky investments, the phenomena of “flight to liquidity” and “flight to quality” have the force of a physical law and zero interest rates on prime government debt remain a fact, at times becoming negative. This is a time bomb that explodes in early 2023 with the bankruptcy of SVBank, and the explanation should be simple – portfolios of bonds issued with a zero or almost zero coupon are depreciated immediately after the market required yield normalizes.

The interests of individuals and corporations, the interests of markets as institutions, national interests, proved difficult to reconcile when governments and central banks dealt with the crises of 2008 and 2020. Both cases represent challenges to the survival of the systems themselves, and Covid solutions complicate the picture due to forced lockdowns. The final effects, for example, negative prices and interest rates, directly confront industries. The clash of public and private interests has long been no longer just a theoretical issue. The complexity of macro decisions in finance and the difficulty of balancing the interests of different social groups and industries have long been a fact.

The behavior of societies, people, corporations, governments, central banks and groups, in such situations, represents an attempt at rationality. The search for an optimal solution to the problems of societies

and companies in the context of the economic policy of governments and central banks requires dealing not only with financial and economic categories, but also with social phenomena. Everyone's interests are located in different corners of the common puzzle. The theory of social dilemmas tries to offer solutions.

An additional complication is the integrative tendency registered by sociologists to belong to a group. It is necessary to pay attention to non-economic components such as the collective intelligence of Le Bon (1895) and the hierarchical structure of Jantsch (1980). The collective intelligence of the group changes individual decisions and there is a suppression of the individuality of the members due to the value system of the group. When searching for a solution to social dilemmas, belonging to a group is a factor to be taken into account. This is done by Dawes and Messick (2000). According to them, in such conflicts, people care more about the profits of the group to which they belong, at the expense of individual benefits. They define dilemmas between groups, not between the individual and society, as the most extreme. Group identity is defined as critical for resolving dilemmas. The authors also found that when people act as individuals interacting with other individuals, they are much more cooperative than when they are in a group interacting with another group. This is confirmed by Olson (1965) who found that individual rationality does not necessarily lead to group rationality.

2. Nature of Dilemmas

The problem of “social dilemma” (collective action problem) has been of interest to scholars for centuries. A social dilemma is a situation in which parties would gain more by cooperating, but fail to do so because of their divergent and subjective, conflicting and short-term interests. Reaching an agreement on common action seems impossible, it is discouraged, and neither group achieves the desired results. The broad definition of Van Lange et al. (2013) implies a conflict between the immediate expected individual benefit and the long-term collective interest. Olson (1965) notes that subjective economic interests do not necessarily coincide with those of society, and this is in contrast to Adam Smith’s “invisible hand”, according to which, by pursuing their own goals, people achieve the common good.

For years, scholars have defined various situations of social dilemmas, and the theory today has some nuanced aspects of the problem. Attention is paid to social traps, social fences, public good dilemmas and resource dilemmas.

The social trap implies a choice between a possible short-term solution (quick profits), which is preferred, but with long-term negative results – collective losses in the future.

Some of the examples above can be qualified as a social trap. There is a desire to find a quick solution to crises that require long-term efforts. In the search for solutions, short-term well-being is at the forefront - refusing to destroy in the crisis of late 2008 and ordering closures in the one of 2020, combined with high government spending.

The result of easy solutions is usually inflation, and it is a tool for widespread taxation of income received without work.



Figure 1. Inflation in the Eurozone

Source: <https://tradingeconomics.com/euro-area/inflation-cpi>



Figure 2. Inflation in the USA

Source: <https://tradingeconomics.com/united-states/inflation-cpi>

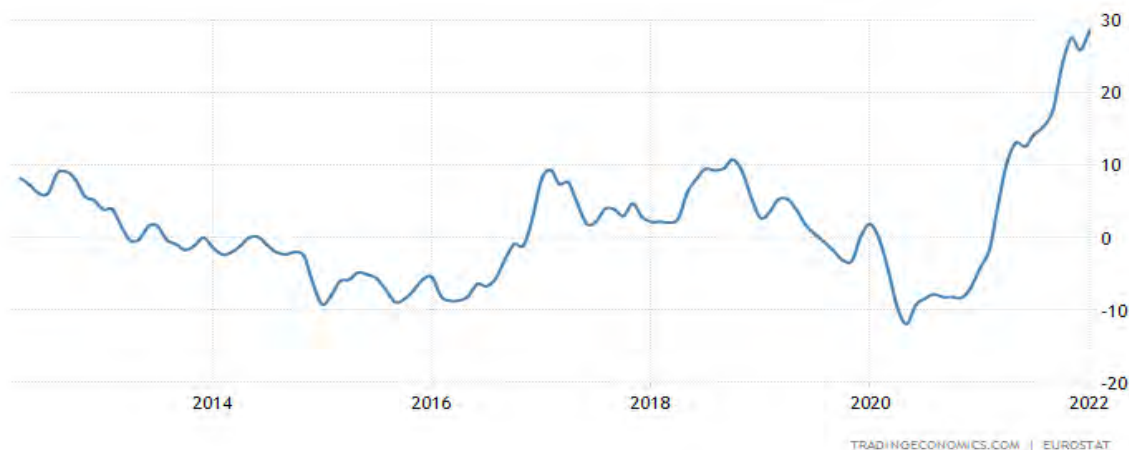


Figure 3. Percentage increase in energy prices in the Eurozone

Source: <https://tradingeconomics.com/euro-area/energy-prices>

Social fences refer to the definition of public structures – rules and regulations. The goal is to achieve resource management with a long-term positive effect for society. An example of such social fences are laws and regulations and rules. Normative acts are the basis of the rule of law and market structures, among the institutions of modern civilization, the implementation of contracts and the protection of property rights have a special place, as far as the economy is concerned. More norms should mean more protection and certainly today's complicated social, political and business life, within large interstate communities and cross-border trade, require more rules. The complication here comes from overregulation and the burden that this places on companies.

In 2004, Peter Mandelson estimated that EU directives and regulations in the EU cost businesses 4% of the total gross product per year. For 2020, the amount is about 600 billion euros. According to EC data, the administrative burden on businesses in the EU countries is 3.7% of the total GDP and this is only part of the total regulatory burden. After adding the burden of national regulations, the figure could rise to 6.7% (or €844 billion in 2008). When including the costs of compliance with regulations, the percentage increases to 12.3%, which in 2020 is already close to €2 trillion. Naturally, these costs should be offset by the benefits to markets and consumers, but this is difficult to calculate and is also the responsibility of the authorities that implement the rules (Ambler, Chittenden, Bashir, 2009).

The problem associated with the public goods dilemma is classic and involves making an individual decision to participate in the financing of a given good, even when part of society refuses to contribute, but uses the good. Resource dilemmas refer to the use of a resource that is significant for everyone, which increases personal benefits, but its depletion implies future serious negative effects for the community.

In the crisis of late 2008, governments and central banks faced the dilemma of whether to let systems fail but obtain institutions free of toxic assets, or to bail out systemically important financial institutions. “Too big to fail” became a term with more than one meaning and gave rise to a multitude of non-market associations. There are also additional problems related to whether the small ones left to fail were actually the real culprits. In Covid solutions, the interests of health systems were pitted against those of business. Closures have more than one interpretation, mandatory vaccinations too.

Solutions to social dilemmas are always the result of compromises and are usually not undisputed. They often give rise to additional problems, again requiring complex procedures for finding new equilibria. Researchers define these situations as a problem of the solution or a second-order dilemma.

Conflict resolution can be achieved in different ways, but it is important to pay attention to (according to Malook, 2024):

Coercion - some force to make the parties to act. An arbitrator may force the actors or parties to accept the proposed decision or the decision of the most powerful is accepted.

Bargaining – actors have to change their demands during bargaining. This is the cooperation that makes bargaining successful, the non-cooperative behaviour refers to defection.

Discourse is a strategy that refers to sharing thoughts in order to try to achieve an agreement.

Balloting is casting votes to reach decisions.

Tossing is refers to the application of the probability theory.

Competition is an other alternative.

Arbitration requires a neutral agent who can settle the disputes among people.

The social dilemma challenges scientists to look for ways to find a sustainable solution, and game theory turns out to be an option.

3. The Game theory as a solution

In social dilemmas, the problems awaiting a solution are more complex due to the intervention of non-economic factors. The perception of alternatives and the judgment of what is useful and good are individual, there are also expectations of the subjects, and these subjects are people, but also companies.

Game theory¹, in combination with rational choice theory and expected utility theory, provides a common toolkit. According to game theory, individuals are rational actors motivated to maximize benefits to themselves, and utility is often defined narrowly as economic self-interest. Determining the best action for an individual or group of individuals depends on expectations about what one or more other individuals or groups will do, and firms are no exception. Their best actions (for them) similarly depend on expectations about what the first individual (the first group) will do. Game theory attempts to determine the ways in which the interacting choices of economic agents (players) produce outcomes consistent with the preferences of these players (their utility function). It is possible that the outcomes achieved at the end of the game are not expected/sought by any of the players, but are acceptable to all.

Game theory uses utility as a relative measure of the player's most important preferences, those to which the player is most sensitive, if the player can have them or not have them when playing out the game strategies. There are at least two players in the game and predicting the order of the other player's priorities is also important. The goal is to establish the possible moves and the value of these moves to the opponent.

Based on common practice in economics, in game theory the solution of the game is called an equilibria. In principle, if a physical system is in equilibrium, it is stable, all external forces are balanced and the system is at rest. This is valid until a new external threat appears.

The solution of the game requires the formulation of concepts for achieving a maximum result (Solution concepts). It is precisely the understanding of which result is optimal that is the basis of modern game theory. The desired result of the game is the unique solution called the Nash equilibrium. Strategies achieve a Nash equilibrium if no player can improve his payoff, given the strategies of all other players in the game, by changing his strategy. This is very close to the idea of strict dominance - no strategy can be a Nash equilibrium strategy if it is completely dominated or dominant. Thus, by repeated elimination of strictly dominant strategies, a single result is reached. This is the unique Nash equilibrium, represented by a vector of strategies. Avoiding strictly dominant strategies is the minimum requirement for economic rationality.

From the point of view of the standard mathematical theory defining basic principles in economics, in

¹ The presentation of the essence of Game Theory throughout the chapter is based on the course at Stanford University (<https://plato.stanford.edu/entries/game-theory/#Mot>) and Prof. Slatinsky (Nikolai Slatinsky. Security – the life of the network).

Nash equilibrium the Pareto optimum is available and this makes the equilibrium (as a desired final effect) an objective criterion. In game theory, any upward deviation from the payoff vector for one player leads to a decrease in payoff for another, i.e. no one can achieve more without causing losses to the other party. In other words, an outcome is rational (equilibrium) if and only if no player can improve it unilaterally without the other players changing their strategy.

4. Classic Games

The most popular, due to their significance and representativeness, are the games Prisoner's Dilemma, Deadlock, Stag Hunt and Chicken. They present different situations, the plot is too close to everyday life and the alternatives are easy to understand, but they actually manage to work as a model in a wide range of cases.

The Prisoner's Dilemma is a strategic game. The utility function of the two players is identical and is presented in Table 1. The different options show the available equilibrium and it is achieved when both players refuse to cooperate simultaneously. The Prisoner's Dilemma is critical in understanding the social dilemma. The task shows the consequences of a conflict of individual interests. In more complex real-life situations, the players are much more numerous and finding solutions that are good for the group becomes very limited in practice.

Table 1

Measure of variables

Release	>>	4
2 years in jail	>>	3
5 years in jail	>>	2
10 years in jail	>>	0

Source: <https://plato.stanford.edu/entries/prisoner-dilemma/>, 2025.

Table 2

Prisoner's Dilemma

	Cooperate	Defect
Cooperate	2, 2	4, 0
Defect	0, 4	3, 3

Source: <https://plato.stanford.edu/entries/prisoner-dilemma/>, 2025.

A possible application of the matrix used in the prisoner's dilemma is the solutions to the 2008 financial crisis. Cooperation and non-cooperation are the only options in a situation where large financial systems are threatened with collapse, with consequences for the global market. A possible set of players in such a model are governments and central banks on the one hand and banking institutions on the other.

The game of chicken demonstrates a conflict model in which the "brave" expects the "coward" to stop first in oncoming traffic, otherwise both will die. The best outcome is for one player to give way, but each refuses to do so as not to appear weak. "Who is the chicken?" or "who is the coward", who will be scared first and stop, saving two lives but losing his reputation. The utility function of the two players is identical and the values visualize the four possible outcomes.

This model is also suitable for describing the critical situation in decision-making for an exit from the financial crisis in 2008, by the authorities in the US and the Eurozone countries. Non-intervention by supervisory and public authorities seems like a conservative solution, but the collapse of basic market systems

puts societies at risk.

Table 3**Chicken**

	Swerve	Straight
Swerve	0, 0	-1, +1
Straight	+1, -1	-1000, -1000

Source: <https://plato.stanford.edu/entries/prisoner-dilemma/>, 2025.

The stag hunt game depicts a conflict between safety and social cooperation, but the stakes are the hunger of one family or the abundance of the table for two families. The hunters know that a successful stag hunt requires the help of the other. They may decide to hunt rabbits alone, but the stag have more meat. They also know that if they do not leave to catch a rabbit, the other hunter may do so. Thus, the first player risks returning home empty-handed. The second player will miss out on a successful stag hunt, but the family will have a rabbit for dinner. The utility function here is also identical.

Table 4**Stug Hunt**

	Stug	Hare
Stug	3, 3	0, 2
Hare	2, 0	2, 2

Source: <https://plato.stanford.edu/entries/prisoner-dilemma/>, 2025.

The described model is suitable for presenting the situation and the choices made in dealing with the last two major challenges of countries – the financial crisis of 2008 and the pandemic solutions. The big goal related to achieving a stable economic and financial environment turns out to be an impossible compromise. The survival of the systems, on the other hand, leads to equilibrium.

The game “The Unscrupulous Diner's Dilemma” (the unscrupulous diner's dilemma / diner's dilemma) is interesting. It can be defined as a prisoner's dilemma with many players. A company goes out to dinner and the agreement is that the bill is to be divided equally. Whether the player orders a cheap or an expensive dish – he would prefer to choose the cheaper menu, but he knows that the others will order the most expensive. Thus, everyone pays a higher bill than what he would pay if he dined alone.

The diner's dilemma can be used as a basis for presenting the conditions in which investors in the capital markets make decisions. Stock investors do this at extremely high P/E ratios, far from normal. Bond buyers in crisis years sometimes buy securities on which they will almost certainly lose money. They cannot stop doing this - a bubbled market is the only option for quick profits to erase losses from previously toxic assets, and negative-yielding bonds are needed as a regulatory requirement or as a safe haven for spare cash.

The centipede game can be used as a measure of trust and greed. It is played by two people, with two piles of coins on the table - 4 coins in one and 1 coin in the other. Each player has two available moves - take the larger pile of coins and give the smaller one to the other player, or push both piles across the table to the other player. Each time the piles of coins pass across the table, the amount of coins in each pile doubles. The game continues for a certain number of rounds or until a player decides to end the game by putting a pile of coins in his pocket.

The “centipede” seems to be an adequate model that can improve choices in situations where budget spending has to be made, companies have to rely on state aid, or central banks have to implement expansionary monetary policy. It is obvious that greed in distributing “nobody's” money is high, but even expansionary policy has limits. In any case, a real experiment, supported by representative studies, would be useful in the next scenario of necessary financial assistance. In both crises under consideration, the optimal amount of

assistance can be calculated through such an experiment.

The “Deadlock” game is used in foreign policy and military affairs and visualizes the available moves in potential military conflicts. A treaty concluded between two countries to eliminate nuclear warheads can be respected by both countries, but false information can also be given, which is why the cheating country gains a huge advantage over the one that respects the treaty. The equilibrium solution here requires cheating, otherwise the contract-holder is left without protection. The model can be used to represent the situation in the closures of the Covid pandemic years.

Table 5

Deadlock

	Cooperate	Defect
Cooperate	1, 1	0, 3
Defect	3, 0	2, 2

Source: <https://plato.stanford.edu/entries/prisoner-dilemma/>, 2025.

*The Pardoner’s Dilemma*² (table 6, presented here according to Malook, 2024) allows for different game strategies, including communication, tossing, negotiation, compromise, chance, or arbitration, which helps resolve conflicts among human agents or institutional agents for the common good. The Pardoner’s Dilemma shows that if players cooperate, they will achieve a common good, such as their survival, peaceful coexistence, and a good life.

Because the Pardoner’s Dilemma is not often applied, the question how to use it when resolving the crisis started at the end of 2008 was asked to Meta AI. The answer is presented below.

Meta AI response: To resolve a financial crisis like the one in 2008, consider the following strategies that relate to the Pardoner’s Dilemma:

1. Cooperation over competition: Encourage cooperation among financial institutions to prevent a collective collapse. This could involve collaborative efforts to restructure debts or provide mutual support.
2. Regulatory oversight: Implement or strengthen regulations to prevent institutions from taking excessive risks, thereby reducing the likelihood of a collective failure.
3. Transparency and trust: Foster an environment of transparency and trust among financial institutions, governments, and the public. This can help prevent panic and promote cooperative behavior.
4. Incentivize cooperation: Design policies or incentives that encourage financial institutions to prioritize collective stability over individual gain.
5. Government intervention: In times of crisis, governments can play a crucial role in stabilizing the financial system through bailouts, guarantees, or other forms of support, thereby mitigating the effects of the Pardoner’s Dilemma.

² The standard version of the Pardoner’s Dilemma, presented by Malook (2024), comprises three players, Charles, François, and Hubert, who discover a treasure in a woodland. The monetary value of the treasure is 12 million. They agree for equal distributions. The three decide to take the treasure home at night, but since it is only morning, one of them goes to the city to get food and water. When he leaves, the other two decide to kill him and divide what they have found in two. During this time, the first one decides to kill them and take all the treasure and puts poison in the food. When he returns, he is killed, and the other two are poisoned by the brought food.

Table 6**Pardoner's Dilemma**

		Conflict	
C	1	Charles	0 mln
		Francois	0 mln
		Hubert	0 mln
o	2	Charles	0 mln
		Francois	0 mln
		Hubert	12 mln
o	3	Charles	6 mln
		Francois	6 mln
		Hubert	0 mln
p	4	Charles	0 mln
		Francois	12 mln
		Hubert	0 mln
e	5	Charles	8 mln
		Francois	0 mln
		Hubert	4 mln
r	6	Charles	12 mln
		Francois	0 mln
		Hubert	0 mln
a	7	Charles	6 mln
		Francois	0 mln
		Hubert	6 mln
t	8	Charles	0 mln
		Francois	6 mln
		Hubert	6 mln
e	9	Charles	4 mln
		Francois	4 mln
		Hubert	4 mln

Source: Malook, S. (2024).

The search for equilibrium is a tool for analysis, the procedure does not lead to a prediction. The games considered above, supplemented with specific and adequate utility functions of the players and the composition of the players themselves, on real election procedures, can offer additional alternatives. The use of the toolkit of game theory can contribute to achieving equilibrium faster and with more conviction from the participating groups. Public discussion of utility functions would certainly lead to the search for a fairer outcome, as far as public perception is concerned.

Conclusion

Modern economic theories offer a broader view of purely economic problems. More and more often they return to the beginning - economics arose as a moral discipline (moral philosophy) and, in the words of Marshall (1890), it deals with the study of man, along with and more importantly than the study of wealth. Some scientists today define economic relations in society as a socio-economic-political game. It is no longer taken for granted that people are rational, and the choices they make are the best for them under the existing conditions. The theory of social dilemmas weighs in the same way, because it takes into account not only the

need for equilibrium, but also the complexity of the choices that people make.

Analyzing alternatives, choices, and actions, but also consequences, through game theory, can help in attempts to resolve social dilemmas. They are defined, the contradictions are on the table, and participation is required.

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Stock Market Crashes - Critical Issues in the XXI Century and Lessons for Emerging Markets

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Abstract

Stock market crashes are a phenomenon which continues to occur also in the XXI century, although they differ from previous periods due to the growing importance of emerging markets and their behavioral patterns. Emerging markets have played a much more important role in the global economy in the last over two decades with growing shares both in global GDP as well as in global trade. Given the special place of the economy in China in global trade and economy, Chinese stock market crashes form a particular niche of scientific interest. In this paper is made an overview of contemporary stock market issues with an emphasis on Chinese and other emerging market stock market crash episodes.

Key words:

stock market crash, emerging economies, global investment

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1. Introduction

Stock market crashes are a phenomenon which continues to occur also in the XXI century. However, the difference to previous periods lays in the growing importance of emerging markets and their behavioral patterns. Emerging markets have played a much more important role in the global economy in the last over two decades with growing shares both in global GDP as well as in global trade. Given the special place of the economy in China in global trade and economy, Chinese stock market crashes form a particular niche of scientific interest. In this paper is made an overview of contemporary stock market issues with an emphasis on Chinese and other emerging market stock market crash episodes.

2. Literature Review and Hypotheses Development

A stock market crash is usually defined as a sudden steep fall in common stock prices within a major cut of the stock market (Folkinshteyn, Meric, G., Meric, I. 2014).

There is no generally accepted threshold value for durability or magnitude of the stock market crash. Nevertheless some authors (Wang et al., 2009; Gulko, 2002) define the stock market crash as a minimum 5% fall in the weighted daily return of the market index. In many cases a stock market crash is preceded by a growing market balloon.

Market balloons are of a significant interest for different groups of investors, since the burst of a market balloon leads to important consequences for the financial markets and for the economy as a whole. The stock market crash from October 1929 is perhaps the most dramatic example of a balloon burst in the whole world. As a consequence of it, multiple other important events were observed, such as the 1937-1938 recession, the 1959-1962 Tronics boom, the Nifty fifty of the 1970s, the bio-technological balloon of the 1980s, the crash of the Brazilian markets from 1971 together with the oil crisis from the 1970s and the debt crisis in Latin America in the 1980s, the crash of the Black Monday of October 1987, the Japanese balloon of asset prices from 1986 to 1991 together with the Asian financial crisis of 1997, the dot-com balloon from 2000, the Global financial crisis of 2007-08, the default of Dubai in 2009, the European government debt crisis in 2010, the turmoil in the Chinese capital market of 2015-16 and the referendum in UK about EU in 2016 exert a significant negative

impact on global economies. All these events lead to strongly dramatical change in stock market prices. Since the probable costs of the balloon burst are significant, economists and politicians start to reconsider the known facts about balloons in the stock market and whether they can be guided or managed in favor of the general public interest. (Rahman, Hossain, Habibullah, 2017).

All financial specialists, independently of their experience or level of knowledge, make in some occasions a faulty assessment of the situation and make decisions according to their predilection, confidence and emotion. Besides, the decisions of the investors are often influenced by psychological factors, which deliver systematic biases, able to influence the market price of the financial assets and to lead to ineffective placement of the resources. For that reason many scientists suggest theories of behavioral and psychological decisions, in order to explain the 'abnormal' effects of the stock market, such as overregulation, underreaction, excessive self-confidence, group behavior, growing and bursting of balloons (Rahman, Hossain, Habibullah, 2017).

Research in experimental psychology shows that contrary to the Bayes rule, most people are inclined to demonstrate an 'overreaction' to prompt and dramatic news. De Bondt and Thaler (1985, 1987), studying market efficiency, analyse whether this behaviour has an impact on the stock market prices. Their conclusion is that investors are prone to overreact to economic events.

Folkinshteyn et al. (2014) presents other studies, such as Chopra et al. (1992), Rozeff and Zaman (1998), Bauman et al. (1999), which give additional empirical evidence for the overreaction of the investors. Wang et al. (2013) show that investors have demonstrated an overreaction towards the risk of default and the technical risk characteristics for insolvency of companies during the stock market crash in 2008. Many possible explanations exist for the phenomenon of 'overreaction of investors', which range from problems in behavior, (Baker, Wurgler, 2006; Barberis et al., 1998), through behavior of type 'following the herd' (Puckett, Yan, 2008), to market limitations of microstructure (Kaul, Nimalendran, 1990), to appropriate answer to the changing risk (Brown et al., 1993; Folkinshteyn, Meric, G., Meric, I., 2014).

Dreman and Lufkin (2000) make the conclusion that the overreaction of investors is a psychological one. Although the efficient market hypothesis states that, with small exceptions, securities match the conditions of rational pricebuilding, in the practice are observed perpetual proofs about predictable overreaction or its lack. The existence of overreaction of the market is important as well as for making decisions and for the theory, as in certain cases it can be the fundamental reason for financial balloons and panic. The authors provide evidence of overreaction, in showing that the most important basic criteria, used in the assessment of common stock show the least motion compared to the big changes in the return of the preferred stock and the not so preferred stock. No other explanation for the phenomenon is found but psychological impacts, which are to explain this constatation (Dreman, Lufkin, 2000). These conclusions are one of the proofs for the more and more important place of behavioral economics in explaining phenomena in economy.

Market research is elaborated also by Bulgarian scientists - Nedev (2008) explores the so-called 'momentum effect' as an alternative for the theory of efficient markets, an effect appearing broadly in capital markets. Among the aspects of financial markets research are also the effects of common stock buy-backs (Valkov 2016). Also studied is the formation of dividends in Bulgaria - Kasabov (2017), Zahariev (2011), Manchev (2002).

Naydenova (2005) discovered that trust in the stock market regulators in Bulgaria is not at the required level, emphasizing also that for the period 2008-2014 the number of listed emissions dropped by one fifth. The importance of institutions for the economic agents is rendered in the Bulgarian scientific literature, as emphasized by Sedlarski (2008). Even before the crisis Georgiev (2005) brought to the front information transparency, as a key factor in the process of diminishing traditional banking and boosting investment banking. The same author (Georgiev, 2017) synthesizes later the problem of 'overbanking' and gives central place to its working out to structural reform and regulation measures.

Gerunov (2014) studies the hypothesis of efficient markets in a GARCH (1,3) model for the period 1998-

2013, and finds out that for 6 of the 12 countries studied data is able to foresee the changes in indexes. Stoykova (2018) finds that the equity markets of Southeastern Europe countries are not efficient, similar results have been found by Lomev et al. (2008).

Naydenov (2016) makes a clusterization of EU countries by some of their macroeconomic indicators and emphasizes the existence of leaders and a mass of followers. The studying of stock market crashes is of great importance for the theory and the policies, since only the knowledge of processes and the analysis of the policies before and after the balloon burst can contribute if not to a full preventing the crash, at least for the diminishing of its scale and the longevity of its effects. The application of behavioral economics and the respective psychological analysis of situations before, during and after the respective crash allows for a more detailed and deep analysis of the attitudes, which have important influence on market changes. Even if overreaction is relative as a phenomenon, which acts in short periods of time, it is linked to attitudes which even if can not be counteracted in a short period of time, they can be deeply researched in order to develop long-term policies for action. Knowing the experience of different countries from the point of view of the reasons for the respective crash and the policies before, during and after the phenomenon give valuable information, which can serve in elaborating regulatory measures for prevention or limiting the consequences of crashes in local financial markets.

3. Stock market crashes and policies

Of interest for our analysis and research are the periods of crash in two markets, which are characterized by relative differences in the traditions for their regulation. On the one side is the stock market of Bangladesh, which is known for weak government policies and regulations, and on the other side is regarded the market of China, which is held for 'firmly linked' to politics.

3.1. The example of Bangladesh

The Bangladesh stock market has been notorious for the 'worst stock market in the world'. Bangladesh is a growing market with two stock exchanges, Dhaka Stock Exchange Ltd. (DSE) and Chittagong Stock Exchange Ltd. (CSE).

DSE is the bigger of the two, as well as the first for the country. In the country there are in general two types of investors: institutional investors and small investors. The institutional investors include: Mutual Fund, commercial banks, pension funds (Provident Fund companies), insurance companies and investment corporations. They have the right to invest in the stock market, but their potential for buying is limited by rules and regulations. On the other hand there are the retail investors, which invest on the market to draw profits. Their capital is not defined and limited by no laws or other limitations. They are invited by the companies to participate in the IPO. After the IPO the shares enter the secondary market for trade. In the recent crashes in stock markets, retail investors are the general victims. Ca. 3.3 mln. small investors are considered to have participated in the stock market of Bangladesh during the market crisis of 2010. (Choudhury, 2013).

As in Bangladesh there are ambitions of a developing country, the capital market can be a driver of economic growth, if the market becomes a structured and efficient one. In the whole world the most considered stock markets such as the NYSE, LSE, SSE, TSE, ASX, DFM etc. are regulated and work efficiently, which provides a large contribution to their individual economies. Because the stock exchange can be defined as a 'game, based on knowledge, but not a gambling place', there always has to be a rational situation of the type 'win-lose'. However the stock market in Bangladesh experienced inefficient and irrational fluctuations in 1996 and 2011, which more resembles a 'place of gambling' (Sarker and Nargis 2012).

There are many theories in finance and economics, which try to explain the reasons for balloons and their eventual bursts. Exploring stock market crash in Bangladesh, Choudhury (2013) reveals, that the speculations through the omnibus account, the lack of limitations to open B/O accounts (Beneficiary Owner), the improper

Initial Public Offerings (IPOs), the relations to banks as general investors, rumors from brokers and dealers, and lack of monitoring from the regulators, all this leads to a crash as the final result. Besides, the development of the stock market balloon in Bangladesh cannot be entirely explained with economic theories such as the capital asset pricing model (CAPM), internal or external economic factors and regulatory initiatives, there exist rather some intrinsic characteristics or psychological factors (Rahman, Hossain, Habibullah, 2017). Of interest is the statement of Warren Buffett, which is important for small investors - 'The market as God, helps those who help each other. But unlike God, the market does not help those who do not know what they do and what they are not supposed to do'.

Different analysis about the reasons for the balloon burst in the stock market of Bangladesh lead to roughly the same conclusions. So as an example according to Rahman, Hossain, Habibullah (2017) reasons are found in several directions. On the one hand are the individual investors, who do not possess enough knowledge to identify balloons, what makes them grow and burst and what are the outcomes. On the other hand pointed out are the not sufficient government policies and regulations to achieve market stability. On the third place indicated is the stimulation of rational investors behavior. On the fourth, but not last place, attention is drawn to the psychological factor in investment. To build a mature stock exchange in Bangladesh as a long-term and secure place for the investors, Bangladesh investors have to be taught to control the psychological side of investment, and the government has to work additionally in the direction of limiting the key market participants to misuse with market power. Similar in this sense conclusions are made also by Sarker and Nargiz (2012) - a big difference between demand and supply of stock, overpricing of stock, manipulation of the market, lack of knowledge about the stock market mechanism among the general investors, price biases, inefficient regulations, political turmoil etc., which lead to the biggest down in the index DGEN in 2011. The recommendations are again in the direction of short and long term initiatives of the government and the Commission for securities and exchange for the stabilization of the market. Regulatory bodies of the stock market of Bangladesh have to inform the current and future potential investors about the market mechanism and to provide them exact information, so that investors can trade prudently their shares. If the necessary measures are not taken, the stock market in Bangladesh will face the same irrational downwards DGEN index in the near future.

3.2. The example of China

Despite its peculiarities and the reputation of being 'worse than a casino', the stock market of China has grown significantly after the opening of the stock exchanges in Shanghai and Shenzhen in 1990. From 2007 on the total market capitalization of these two exchanges is bigger than almost all stock markets, outrun only by NYSE and NASDAQ. Regarding the funds amassed with IPOs, China is ranked in first place in 2007, 2010 and 2011, and second in 2008, 2009 and 2012 (Zhang, 2016).

From the policies of salvation to Shanghai - Hong Kong Stock Connect 2015, the influence of politics on the Chinese stock market changes in time. Since May 2015 the global investors can invest directly in a more legalized and normalized Chinese stock market, although they are still worried about the market policies and the risks related to them. Even if many policies improve or stabilize the stock market, some policies lead to a significant instability. Among them are the policies of macrocontrol and correction of transaction costs, they have to be used with care. The Chinese stock market enters a new stage, concerning the international capital markets. As a result, the bigger risks can lead to a turning point (Wang, Tsai and Li, 2017).

The Chinese stock market includes the Shanghai, Shenzhen and Hong Kong stock exchanges. Research shows that the Chinese market is typically 'politically oriented market (Ma et al., cit. by Wang, Tsai and Li, 2017) choose nine political events between 2000 and 2003 and find out that the stock market in China is significantly influenced by politics. Since the policies on the stock market have endogenous dynamic inconsistencies, some policies can provoke fluctuations, whereas others can stabilize the stock market (ibid.).

After a period of extreme volatility, starting in May 2015, Chinese stock experienced extreme downfall. In the weeks after the peak of June 12, the core stock market index of China, Shanghai Composite, dropped by 25%, whereas the Shenzhen index, the smaller stock market dominated by technologies, dropped by 35%. After both exchanges start to go down, investors lose 3.5 bn USD, equivalent to the total market capitalization of China in 2012. This crash undermines the trust in the government and the commitment to reform.

The Chinese government responds to the crash with a serious inclusion, ordering the middlemen to buy and forbidding the shareholders to sell - a dramatic turn after the promise of President Xi Jinping made on the Third plenary session in 2013 that the market will play a 'decisive' role in all aspects of the economy. Even when the government rejects the new policies of market intervention and holds the collapse, shares continue to shrink. It is only on July 9 when Chinese stock marks a growth, with Shanghai growing by 5.8% and Shenzhen by 3.8%. Despite the fall, both exchanges grew with 74% and 84% to the same period of the previous year (Salidjanova, 2015).

There are several reasons for the stock market intervention of the Chinese government. First, the intervention of the state is used widely to complement the markets. According to Stiglitz (1993), government intervention in financial markets to overcome market failure is widespread globally. In the stage of transition and reform, the non-mature Chinese stock markets, with their excessive volatility, need efficient government intervention to support the stability. Second, government intervention can reduce the systematic risk on the stock market and to protect the whole economy under certain conditions. Lu (2006, cit. by Wang, Tsai and Li, 2017) shows that through posing norms and governing the development of the stock market, the final goal of the Chinese government is to give an opportunity to the stock market to serve the economy. Third, a state intervention can protect the rights and the interests of investors, especially of small and middle investors. When in the market appear unusual fluctuations, government actions help investors to reconstitute their trust and to avoid mass panic. Of course this protection can lead investors to expect government action and to become dependent on government policy, so that the balance between market powers and the government is of utmost importance for China (ibid.). Most research on the Chinese stock market agrees with the idea that political factors influence the stock market. Han and Tang (2002, cit. by Wang, Tsai and Li, 2017) claim that the Chinese stock market and the government policies are inextricably linked. Wang et al. (2003, cit. by Wang, Tsai and Li 2017) show that the Chinese stock market reacts strongly to political information and that this is obviously a 'political market'. Peng and Xiao (2002, cit. by Wang, Tsai and Li 2017) make the conclusion that 60% of the policies have led to big volatility in the stock market from 1991 to 2001. Nevertheless the answer to the question how the policies concern the stock market is not ultimate. Guo, Deng and Dong (2013) claim that the impact of policies on the Chinese stock market is great and can lead to market leap. Xu and Li (2001, cit. by Wang, Tsai and Li, 2017) remark that compared to the non-discretionary policy, most short-term policies generate more direct impact and cause more shocks. Du (2009, cit. by Wang, Tsai and Li, 2017) supposes that political interventions increase the volatility. Despite this, after studying the volatility of the Chinese stock market caused by the 'New National Ten', Tsai, Weng and Wang (2015) prove that announcing and executing policies are efficient to stabilize the stock market (Wang, Tsai and Li, 2017).

According to other research, however, Chinese jurisprudence in general and the protection of investors more specifically, are extremely weak. According to the Global Governance Indicators, between 1996 and 2012, China has been in the range of the 36.36 to 38.36 percentile in rule of law among all 215 economies. In the World Bank report 'Doing Business', China is ranked 93 in 2010 and 97 in 2011 among 183 economies in the 'investor protection' ranking. In the next decade the rank of China in this rating significantly improved, however the 2020 scandal put an end to the whole idea of trying to measure the administrative efficiency of the country in this mode. Even if the Global competition report 2013-2014 ranks China on place 75 among 148 economies in 'protection of minority shareholders' interests' (Zhang, 2016), according to the Global financial development report 2012 (WEF, 2012), the Chinese stock market falls behind the most advanced and many developing markets (i.e. Brazil or India) in categories such as sophistication of the financial market

(place 49 of 62), 'financial market supervision' (place 38), protection of minority shareholders' interests (place 39) and corporate governance (place 31). The position of China in this ranklist presents the Chinese market as still underdeveloped in many areas (Marszk, 2014).

Exploring the linkages between law, finance and economic growth, Franklin Allen concludes that China is 'an important anti-example' for the meaning of the law (Zhang, 2016). At the same time according to Zhang (2016) the experience of China shows that the scope of investor protection, studied by law and financial research and assessed by the World Bank and the World economic forum, is too narrow. It focuses on the rights of shareholders against their companies and managers. But the severe crisis, which faced the Chinese stock market in the beginning of the 2000s is a result of market abuse, fraudulent discovery of registered companies and asset absorptions by controlling shareholders. The protection of shareholders in China in these areas improves significantly, but this has not been taken into account by these assessments due to their narrow scope. The study which presents China as an anti-example also misses the progress, not only because of its narrow scope, but also due to its static research approach (Zhang, 2016).

As a whole, the general overview of the development of the Chinese stock market concludes that the law is of decisive importance for the maintenance of growth. On the other hand, the trajectory of development in China is growth first, followed by law, where the improvement in law is due to market growth. Chinese experience suggests that law and market growth show bi-directional, and not uni-directional causality, and the pace of development is 'growth-law-further growth'. Nonetheless this cycle is not a guarantee and market growth can not lead to stronger law in all cases. Policies and ideologies, in addition to economic growth, are of basic importance for the development of the stock market, because they not only explain the stagnation of law in China despite the market growth, but also the market growth or its lack in the first place. Besides, the experience of China shows also that the power of law is not predetermined by the legal origin of a country, and that no country is foredoomed for its history only. Law improves in some aspects even in China, a country without traditions of state with rule of law. For China itself, for the further political and ideological liberalization is key to the development of the potential for market growth.

They are of significant importance for strengthening the protection of investors and for improvement of corporate rentability and return on investment in the market. For countries which would like to develop their stock markets, although the Chinese lessons are not directly applicable, Chinese experience can provide the analytical framework needed, which is to lead the development of policies (Zhang, 2016).

4. The empirics of stock exchange indexes in Bangladesh and China

In order to test for breaks in the time series, applied were several unit root tests suitable for finding breaks in data. For the purposes of this paper, the closing values of the respective indexes - the Shanghai stock exchange 50 index (SSE 50) and the Dhaka stock exchange 30 index (DSE 30) were used. The data for the Dhaka stock exchange are from Muhammad et al. (2024), covering the period 28.01.2013-20.02.2024 (2162 observations). Data for Shanghai stock exchange was extracted from the Macrotrends database (Macrotrends 2025), the period covered is 19.04.2010-30.04.2025, 3356 observations.

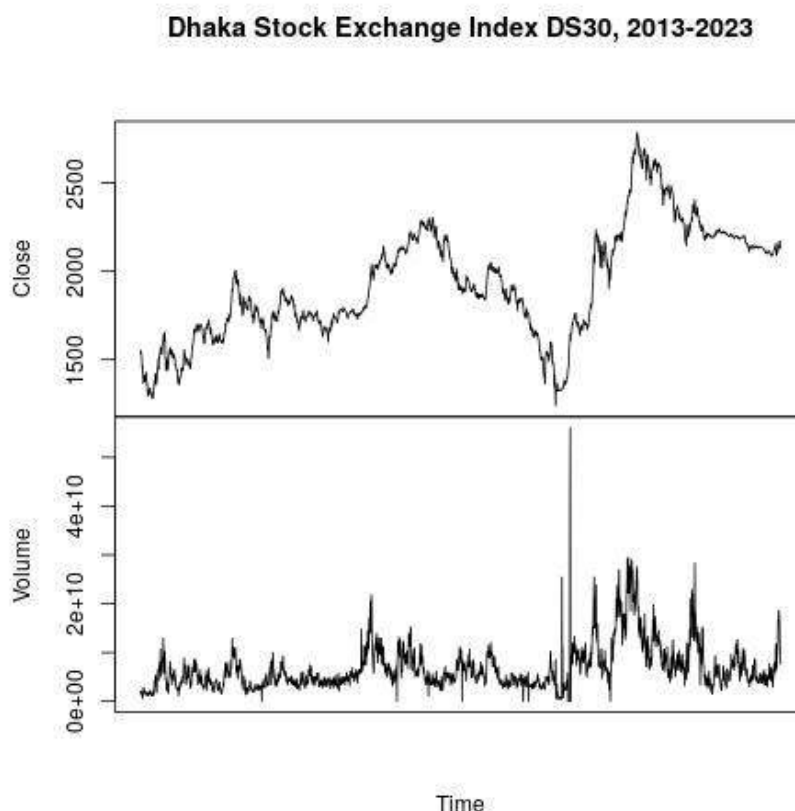


Fig. 1. Dhaka Stock Exchange Index DS30 of 30 biggest companies.

Source: Author's calculations on Muhammad et al. (2024) data.

First, we apply the Elliott, Rothenberg and Stock (1996) unit root test (ERS) to test for lack of stationarity in the series. The test is regarded as superior to the traditional ADF (Augmented Dickey-Fuller test), since it takes account of possible trends in the series. In applying the package *urca* (Pfaff, 2008; Pfaff et al., 2016), critical values in MacKinnon (1991) are used.

The findings show that the series is non-stationary (test statistic -0.56, critical 5% value -1.94). Another test for breaks in the series was also applied. According to the Zivot-Andrews ZA test (Zivot et al., 1992) the test statistics is -2.62 with 5% critical value -4.8, suggesting that breaks in the series do exist. The most probable potential breaking point is at position 1830, corresponding to 30.11.2020. This result can be tracked also in the graph of the series, in both the value of the index and in the volume of trade (Figure 1). This result fits well with the Covid-19 crisis and the related turbulence in all the markets, including the equity market.

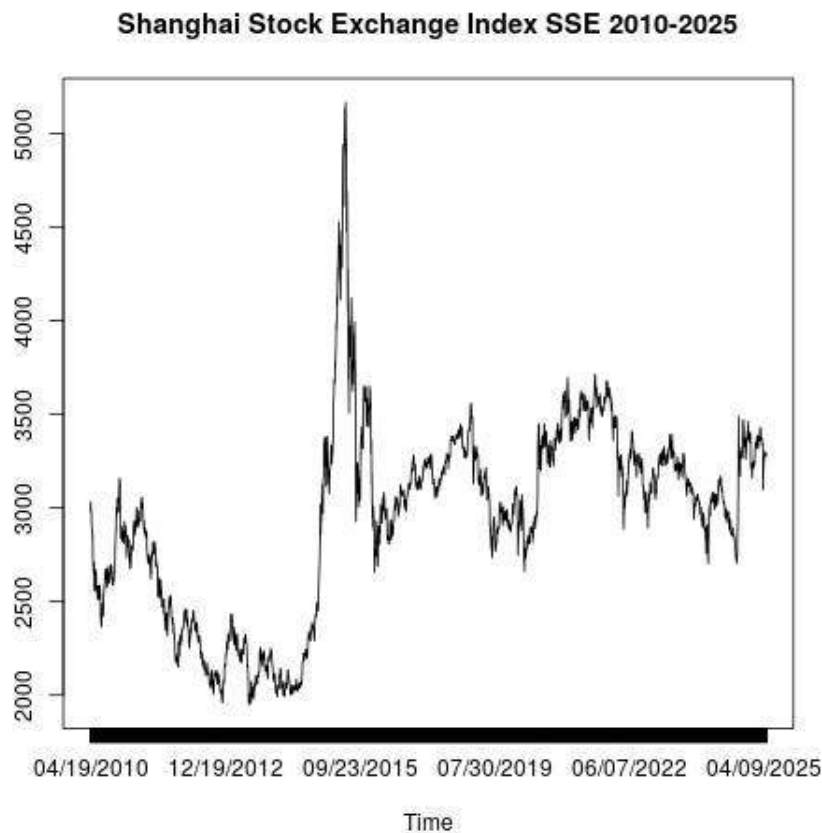


Fig. 2. Shanghai Stock Exchange Index SSE.

Source: Author's calculations on Macrotrends (2025) data.

For the Shanghai stock exchange results are different (see Figure 2). First, the ERS test shows there is no reliable evidence about the existence or no existence of the lack of stationarity in the series, with test statistics -2.47 and critical 5% value -1.94 and critical 1% value -2.57. Given the ability of the authorities of China to interfere with the market, this result is rather plausible. The ZA test also gives questionable results, with test statistics -4.80 and critical 5% value -4.8. If the hypothesis of existence of a break is not rejected, the most probable date of the break would be 27.10.2014, a date around the peak of 2014, the market balloon is distinctly perceivable.

5. Conclusions

Market balloons are of significant interest for various groups, because their bursting leads to serious consequences for financial markets and for the economy as a whole. The 2 examples reviewed - that of Bangladesh and that of China - demonstrate two models of state intervention and regulation of state markets. In China the development of the stock market is directly linked to the law framework, predetermining growth. Even if historically China is not a country with strong traditions in rule of law, lawmaking marks its development and can, although indirectly, be applied as a model to follow by other countries. In comparison the stock market in Bangladesh is characterized by weak regulation, weak information, and weak knowledge of investors. Regulatory bodies of the stock market in Bangladesh have to improve the information of investors about the market mechanism. Taking additional measures in regulation is necessary to stabilize the market and to avoid new crashes. Not in the last place the experience of Bangladesh is a proof also for the importance of individual investors, their behavior, knowledge and information, for the stability of the stock market, which

are subject of other studies.

In summary, measuring the efficiency of the stock market is very important for all interested parties - investors, policymakers etc. Mature levels of efficiency of the stock market are regarded in the whole world as a barometer of economic prosperity and perspective for the country studied. The link between stock prices and interest rates is negative, and the impact of the interest rate on the stock exchange is characterized by important effects for the monitoring, risk management, and government policy geared towards the financial markets and the assessment of financial securities.

Development of real economy and economic theory with the entry of the behavioral economy for analysis of financial behavior of investors, as well as the study of the reasons for the excesses in the development of the financial markets, bring out the individual investor as an important and vulnerable participant in the financial markets. All this requires deepening of the analysis on this segment of the financial markets and synthesizing of recommendations for its regulation and protection.

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Determining the Optimal Ratio Between Internal and External Public Debt for the Latvian Economy

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JEL: F21, F34, F36, G15

Abstract

Public debt or public borrowing is considered an important source of income to the government. If revenue collected through taxes and other sources is not adequate to cover government expenditure, government may resort to borrowing. Public debt may be raised internally or externally. Internal debt refers to public loans floated within the country, while external debt refers loans floated outside the country. According to economic theory, the state should primarily borrow on the domestic market. Domestic debt limits the state's risks to the domestic market. In a crisis, the domestic debt can be monetized by the central bank through the purchase of government debt obligations. But domestic debt is associated with the redistribution of financial resources in the state's domestic market. If the state's domestic financial market is small and poorly developed, it is difficult for the government to attract the necessary financial resources. If there is a shortage of funds in the domestic financial market, the government can borrow on foreign financial markets. Foreign markets allow the state to attract the necessary capital to finance important projects. However, with external borrowing, the state loses part of its income, which is paid to external creditors in the form of interest. Foreign borrowing is usually accompanied with vulnerability that may result in debt crises since central bank is unable to produce the foreign currency required to repay external debt. The paper examines the relationship between internal debt and external debt in public debt structure. The aim of the paper is to analyse the main models of public debt management and to develop an optimal ratio between internal and external debt for the Latvian economy.

Key words:

public debt, internal debt,
external debt

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Introduction

When faced with public budget deficits, governments face a choice between external and domestic financing. Given the options, the choice comes down to cost and risk. This choice is not easy, as governments typically pursue different objectives, such as low inflation; a stable exchange rate; low interest rates and favourable yield curves; adequate foreign exchange reserve coverage; and active domestic capital markets. Due to its actual or potential size, meeting government borrowing needs has a significant impact on the economy. Moreover, public sector financing instruments and mechanisms facilitate financial intermediation and thus contribute to sustainable growth. The goal of public financing is to mobilize financial resources, taking into account cost and risk, as well as any macroeconomic and monetary implications. Typically, government officials responsible for debt management seek primarily to minimize the financial burden, that is, the direct costs of public debt. However, the choice between various options for meeting government borrowing needs must be based on numerous considerations. In practice, this requires close coordination between the agencies responsible for macroeconomic management, in particular the Ministry of Finance and the central bank.

This paper examines the principles and practical aspects of public sector financing, in particular the choice between domestic and foreign debt, and offers a number of recommendations for the Latvian economy. It should be noted from the outset that any decision on how to meet government borrowing needs depends largely

on their scale, especially in countries where access to financing is extremely limited. Available financing is often a constraint, as it sets a ceiling on the government's ability to borrow and, consequently, to repay debt. At the same time, each financing operation entails significant costs, which, in turn, affect subsequent financing needs. This position justifies the "orthodox" approach, which emphasizes the primary importance of limiting the budget deficit and establishing an effective public debt management system to minimize financing costs.

Any government budget deficit entails costs, regardless of the method of financing it. The choice of financing method should be aimed at minimizing costs and risks for the economy as a whole. The government's overall financing needs can be covered through money emission, borrowing from the domestic banking system and the private sector, including the accumulation of overdue debt, or external debt (concessional and non-concessional). The primary objective in choosing a specific method is to minimize costs and risks for the economy. There is no single optimal approach for all cases, since everything depends on the availability of financing, the economic situation, the institutional structure, and the degree of development of domestic financial markets. This section presents some theoretical issues that should be considered when deciding on deficit financing. Three main factors can help decision makers choose between various financing options: 1) macroeconomic consequences, in particular for private investment and the external current account; 2) cost and interest rate, foreign exchange and other risks; 3) the impact of the proposed borrowing on debt sustainability.

1. Definitions of external and internal debt

There are three possible definitions of external (and, consequently, domestic) debt. The first definition focuses on the currency in which the debt is issued (with external debt defined as debt denominated in a foreign currency). The second focuses on the residency of the creditor (external debt is debt owed to non-residents). The third focuses on the place of issue and the legislation governing the debt contract (external debt is debt issued in foreign countries and subject to the jurisdiction of a foreign court). The first definition appears to be inappropriate, as countries can issue foreign currency debt in domestic markets and can also issue national currency debt in international markets. Moreover, this definition is problematic for countries adopting the currency of another country. Finally, a definition based on the currency composition of government debt would be difficult to implement given the limited information on the currency composition of domestic debt. This does not mean that countries should not provide information on the currency composition of their external debt. In fact, such information is key for assessing a country's vulnerability to currency mismatches and potential responses to a debt crisis. Nevertheless, the currency composition of external debt is important, as it reveals the dependence of financial flows in foreign currency. The National Central Bank cannot print foreign currency, so the state is limited in its ability to repay foreign currency debt.

The second definition is officially adopted by the main compilers of public debt statistics. The External Debt Statistics: A Guide for Compilers and Users, jointly published by the Bank for International Settlements (BIS), Eurostat, the IMF, the OECD, the Paris Club, UNCTAD, and the World Bank, states the following: "Gross external debt at any point in time is the outstanding amount of actual current, not contingent, liabilities that require payment of principal and/or interest by the debtor at a given point in the future, owed by residents of a given economy to non-residents." This definition makes sense from a theoretical perspective because it focuses on the transfer of resources between residents and non-residents; it allows us to measure the extent of international risk sharing and the impact of debt fluctuations on income, as well as to estimate the political cost of default on public debt. However, this definition is virtually impossible to apply in the current environment, where most external debt to private creditors is in the form of bonds (when most external debt to private creditors was distributed through syndicated bank loans, things were simpler). Of course, countries could attempt to determine the residency of the bond buyer in the primary market and monitor the situation in

the secondary market through periodic surveys. However, few countries attempt (or have the ability to) identify the ultimate holders of their bonds. Even those that do attempt to do so cannot do anything about bonds held in offshore financial centres. As a result, most countries end up reporting data on external and domestic debt using information on the place of issue and the jurisdiction governing the debt contract. This is not a problem in itself; the problem is that this information is misleading, as it does not measure what it promises to do (i.e., transfer resources from non-residents to residents).

This discussion would be irrelevant if the place of bond issue and the residence of the ultimate bondholder were precisely the same, as was previously the case. However, in recent years, a trend has been observed in which more and more international investors are entering the domestic markets of other countries, and domestic investors often own bonds issued internationally. Therefore, a third definition, which classifies as external all debt issued under foreign law (this is the definition used in CLYPS), may be more accurate. While the second definition is theoretically correct, a jurisdiction-based definition is quite feasible and does not provide misleading information about who the intended holders of a country's debt are. Consider, for example, the standard definitions of external and domestic debt. According to economic theory, external debt should be understood as debt owed to non-residents. However, because some countries are unable to track the ultimate holders of their bonds, the external debt data presented in official statistics ultimately reflects debt issued on the international market, not debt owed to non-residents. This is a significant source of confusion. For example, a change in the place of issue of government debt is not always associated with a change in the residence of the debt holders.

2. Literature review

The macroeconomic impact of government deficits can be analysed from two main perspectives. According to Ricardian theory, government deficits have no macroeconomic impact in the long run (Barro, 1974). This theory posits that budget deficits have no effect on either investment or the current account. The Ricardian equivalence theorem states that, in principle, increasing government spending or cutting taxes leads to an equal increase in private saving and, therefore, has no long-term impact on the real economy. This is because an increase in current public sector debt implies a future increase in the tax burden. Rational and forward-looking economic agents inevitably anticipate higher taxes and, therefore, increase their current savings rate. However, Ricardian equivalence theory assumes, among other things, no restrictions on borrowing and a neutral tax system, which is unlikely to be the case in practice. A number of empirical studies have refuted the practical significance of the Ricardian equivalence theorem, particularly for developing countries (Haque and Montiel, 1989; Veidyanathan, 1993). According to the traditional view, the government budget deficit has a significant impact on the economy, particularly on private investment and the current account. For a given general saving rate, an increase in the government budget deficit entails a decrease in private investment. Similarly, for a given private saving rate and under conditions of limited domestic borrowing capacity, there is a close relationship between the budget deficit and the current account. However, this relationship is not always direct, as it depends in part on the level and composition of government spending, the stance of monetary policy, and associated changes in interest rates and the real exchange rate (Fischer and Easterly, 1990). The macroeconomic consequences of the need for borrowing also depend on the financing method.

A budget deficit can be financed directly by money creation by the central bank or, more generally, by increasing lending to the banking system. The direct costs may be minimal or even zero, but the macroeconomic risks are significant. Excessive monetary financing leads to excess general demand, which in turn leads to inflation or, under a fixed exchange rate, to pressure on the balance of payments. However, the relationship between monetary financing of the budget deficit and inflation is neither direct nor linear, especially in the short run (Fischer and Easterly, 1990). The unstable nature of this relationship is usually explained by several factors: 1) private saving can change as a result of changes in inflation expectations; 2)

the composition of budget financing can change over time; 3) the demand for money is sometimes unstable; and 4) expectations can shape future government policy (Sargent and Wallace, 1981).

Domestic borrowing from the banking system (excluding the central bank) and the private sector requires a relatively well-developed system of financial intermediation. This reduces inflationary pressure and the risk of external debt crises. However, this typically has the effect of crowding out private investment (especially in the context of capital flow restrictions) and thus negatively impacts economic growth. Government recourse to domestic financing (excluding the central bank) reduces the supply of borrowed funds. In countries with relatively flexible interest rates, rising real interest rates lead to a reduction in private investment. If the exchange rate and interest rates are controlled by the government, the use of domestic financing has a more direct effect of crowding out private investment, reducing the amount of credit available to the private sector and leading to credit rationing.

External borrowing often appears attractive due to its reduced crowding-out effect on private investment and reduced risks of inflationary pressure. Moreover, recourse to external financing may promote greater fiscal and monetary discipline by eliminating any incentives the government might have to promote inflation to reduce the real debt burden. However, theory requires highly restrictive conditions to confirm these benefits, while empirical research shows that external financing is not a panacea for governments (see de Fontenay, Milesi-Ferretti, and Pill, 1995 and Gray and Woo, 2000). Although government external borrowing does not directly affect domestic interest rates and the supply of loanable funds, it can also crowd out private investment through its impact on prices or the nominal exchange rate (under a flexible or managed exchange rate regime). When the budget deficit is driven by spending on domestically produced goods, foreign borrowing leads to an appreciation of the real effective exchange rate (under a fixed or managed exchange rate), which has a crowding-out effect on some domestic producers (Gray and Woo, 2000). Under similar circumstances, domestic financing would lead to higher interest rates and a reduction in domestic private investment, which could be partially offset by increased foreign private investment.

3. External debt and vulnerabilities

With open capital accounts and the presence of foreign investors purchasing domestically issued bonds and domestic investors purchasing internationally issued bonds, the old dichotomy of external/domestic debt becomes meaningless. Legislation, residency, holder type, currency, and maturity are all characteristics associated with sovereign financing risks, and an ideal dataset should contain information on all these characteristics of public debt (Arnone and Presbitero, 2006). For example, jurisdiction matters in the event of a debt default. Knowing who owns the debt is important for assessing whether debt flows are linked to a net transfer of external resources between countries and for assessing the likelihood that holders will panic and trigger a run on the country's public debt. The currency of denomination is important for determining the risk of currency mismatches, and the maturity is important for determining rollover and interest rate risks. However, the overemphasis on the external/internal divide has led to a situation where the maturity and currency composition of domestically issued debt are generally not included among the vulnerability indicators used to predict financial crises.

External financing aimed at increasing foreign exchange reserves may, if the domestic counterparty is fully sterilized, be more expensive than domestic borrowing (taking into account the cost of the central bank's open market operations). In other words, sterilizing external funds leads to the same consequences as domestic financing: higher interest rates and crowding out private investment. If funds are not sterilized, external financing is accompanied by excess domestic demand and, consequently, puts pressure on inflation or the balance of payments. An increase in external debt tends to weaken the economy. First, external borrowing increases vulnerability to external conditions. With floating-rate lending, higher external interest rates lead to higher debt servicing costs. This increases fiscal spending, which may lead to an increase in the deficit or a reduction in non-debt-related spending. Similarly, a weakening of the domestic currency leads to higher debt

servicing costs (in domestic currency) and has the same consequences as those mentioned earlier. Second, when the government borrows to cover a growing deficit, external borrowing leads to unsustainable debt levels, an excessive share of debt servicing in total government spending, and significant reliance on foreign exchange for debt servicing. In the long term, this could lead to a debt crisis.

In general, long-term domestic currency debt reduces maturity and exchange rate mismatches and is therefore safer (from the borrower's perspective) than short-term foreign currency debt. This is important for the choice between external and domestic borrowing, as most developing countries cannot issue domestic currency bonds (either short-term or long-term) in the international market (Eichengreen, Hausmann, and Panizza, 2005a). However, while most emerging market countries issue domestic currency bonds in their own markets, few are able to issue long-term domestic bonds at a reasonable interest rate; those that cannot may face a tradeoff between maturity and exchange rate mismatch. It is unclear what policy measures are needed to avoid this potential tradeoff. While most analysts agree that a recent history of low inflation and macroeconomic stability is key to a country's ability to issue domestic long-term bonds in its own currency (Hausmann and Panizza, 2003; Mehl and Reynaud, 2005; and Jeanne and Guscina, 2006), there is less agreement on the potential role of other policy variables, including the presence of capital controls, the role of domestic institutional investors, and the participation of foreign investors in the domestic market.

While Hausmann and Panizza (2003) suggest that the presence of capital controls is positively associated with a country's ability to issue domestic long-term bonds in its own currency, Mehl and Reynaud (2005) find that this result is not robust to a larger sample of countries. The behaviour of individual countries also provides mixed signals.

Size matters for bond market development (Borensztein, Cowan, Eichengreen, and Panizza 2007), and policies aimed at increasing market size include broadening the investor base by promoting the growth of institutional investors and encouraging foreign investor participation in the domestic market. Pension funds, mutual funds, and insurance companies hold a significant portion of government debt (Borensztein, Levy Yeyati, and Panizza 2006). Thus, it is not surprising that the presence of large institutional investors is positively associated with domestic bond market development (Borensztein, Cowan, Eichengreen, and Panizza 2007). However, institutional investors can become victims of their own success and become dependent investors on fiscally constrained governments. This suggests that the presence of large institutional investors may have mixed effects. Consider, for example, a government with sound fiscal fundamentals that faces a liquidity squeeze caused by herd behaviour by poorly informed investors with short-term objectives. In this case, the presence of better-informed institutional investors with a long-term investment horizon can enhance financial stability and help the government weather a crisis of confidence. Instead, consider a government pursuing unsustainable policies. In this case, the presence of institutional investors willing (or forced) to absorb growing public debt could exacerbate a potential debt crisis. Domestic banks often hold significant amounts of public debt. These large bank holdings of public debt alter the effective maturity of public debt, since during banking crises, long-term public debt held by banks becomes *de facto* overnight debt. This could leave a banking system overburdened with public debt, potentially leading to a financial crisis.

Policies aimed at encouraging foreign investor entry into the domestic market are also controversial. Proponents argue that the presence of foreign investors can facilitate market expansion and, by increasing the net inflow of external resources into the country, limit crowding-out. In this sense, a significant presence of foreign investors in the domestic market is equivalent to the ability to issue domestic currency debt in the international market. However, policies aimed at encouraging foreign investor entry can lead to a loss of policy space. For example, such policies are often incompatible with the presence of capital controls and the country's ability to manage its exchange rate. Moreover, policies aimed at attracting foreign investors can lead to a sudden influx of "hot money" and, thus, high capital flow volatility and financial instability. There is also disagreement regarding what measures should be used to encourage foreign investor participation in the domestic market (Ito and Park, 2004).

The government is a major player, and the presence of a large and liquid government bond market can facilitate the development of the corporate bond market by creating the required minimum size, providing a benchmark yield curve, and providing the necessary trading infrastructure. Furthermore, a well-functioning domestic debt market can provide domestic savers with an alternative to investing abroad, thereby reducing capital outflows and persuading domestic investors to return their savings to the formal financial system, which has significant benefits in terms of financial depth and the reduction of the shadow economy (Abbas and Christensen, 2007).

There is also an important interaction between domestically issued government debt and the functioning of the banking sector. Here, too, the effect can be reversed. Most analysts believe that in emerging economies, banks are the primary holders of government bonds, which is a source of vulnerability and a signal that government debt is crowding out credit to the private sector. However, Kumhof and Tanner (2005) suggest that, rather than being a symptom of financial repression, these investments in government debt are largely voluntary and improve financial sector performance in countries characterized by poor institutional quality and a lack of collateral. In some countries, a liquid government bond market can facilitate financial sector development, lead to more competitive interest rate conditions, and enhance the effectiveness of monetary policy.

4. Analysis of internal and external debt of Latvia

Governments borrow in foreign currency in three main situations. First, to build foreign currency reserves. To maintain a stable exchange rate, the central bank needs to hold foreign currency reserves. If reserves are insufficient, a foreign currency loan is typically used. It's important to note that such loans are used for weak currencies, when the private market cannot provide an adequate supply of foreign currency. Second, foreign currency debt may be required to implement large-scale infrastructure projects. Such large-scale projects require significant financial resources, often in foreign currency. If the government doesn't have sufficient foreign currency resources, it must borrow. Third, foreign currency debt can be used to finance a trade deficit. If imports exceed exports in foreign trade, a foreign currency deficit may develop in the long term. To cover this foreign currency deficit, the government may borrow. This option is the most dangerous, as it can lead to a debt crisis and government default.

The main disadvantage of foreign currency debt is its high vulnerability. The central bank cannot print foreign currency, so the government cannot repay foreign currency debt. This means that in the future, the economy must ensure an inflow of capital denominated in foreign currency, meaning the economy must operate with a positive current account balance. If the economy cannot maintain a positive current account balance, the government may face problems repaying its foreign currency debt.

According to Eurostat data, almost all Eurozone countries do not use foreign currency debt. The only exception is Latvia, which issued US dollar bonds worth one billion – it is 6% of total public debt. In this case, Eurozone countries simply have no need to incur foreign currency debt. The euro is the second most widely traded currency after the US dollar, and it is the world's reserve currency. The size of the EU economy allows for the financing of any project, and its vast and developed financial market allows for the attraction of foreign currency in the necessary volumes. This raises the question of how justified Latvia's US dollar-denominated public debt is. The only advantage of US dollar debt is its market size. The US dollar debt market is the largest in the world and the easiest to attract financial resources through. However, this comes with interest rate and currency risk. The base rate for US dollars is 4%, while for euros it is 2.15%. Therefore, servicing US dollar debt will be more expensive than for euros. Negative exchange rate fluctuations could further increase borrowing costs. Although Latvia's foreign currency debt is less than 10% and within recommended standards, from the perspective of effective public debt management, using the national currency is recommended.

The globalization of financial markets and the free movement of capital make it possible to issue debt

worldwide. In this case, the issuer's ownership of government bonds is largely irrelevant. Developed countries therefore issue their debt globally. According to international banks, the average external debt share in the Eurozone is 56%, while in the United States it's 45%, and in Japan it's 14%. However, external debt is also considered vulnerable during financial crises. It's precisely this low level of external debt that allows Japan to maintain a massive debt of 235% of GDP. Another disadvantage of a high external debt share is that interest payments on the debt are diverted abroad rather than retained in the economy. In Latvia, the external debt share is 90.4%. This high external debt share is due to the size and low liquidity of the domestic market. In Latvia, it's difficult to issue large volumes of government bonds on the domestic market. It's much easier and faster to issue debt on global financial markets, where interest rates are lower than domestic ones. Therefore, since 2008, the share of external debt has increased from 48.4% to 90.4% in 2024. (Fig.1.)

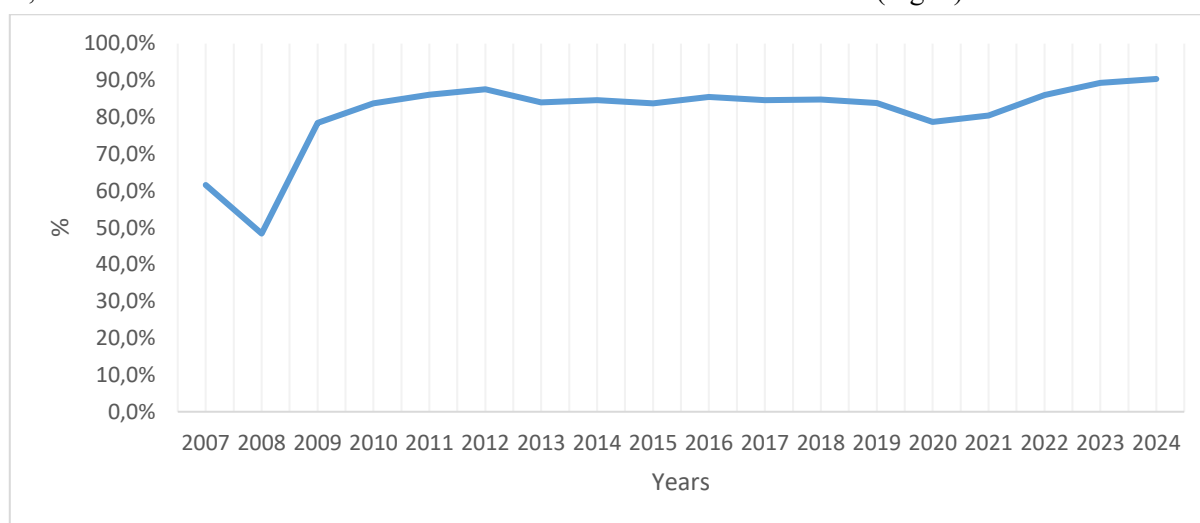


Fig.1. Share of external debt of Latvia, %.

Source: author's calculations based on Ministry of Finance of Latvia data

The main reason for the increase in the share of external debt is that during the 2008 economic crisis and the 2019 coronavirus pandemic, Latvia borrowed heavily, which was unable to attract funds domestically. However, Latvia has not implemented measures to develop its domestic financial market or increase its liquidity. In modern financial markets, the main buyers of government debt are pension funds, investment funds, commercial banks, and insurance companies. Given the size of Latvia's financial market, the potential volume of government bonds that pension and investment funds could purchase could be EUR 3.5 billion, commercial banks EUR 1.5 billion, and insurance companies EUR 500 million. The volume of government bonds purchased by the European Central Bank should also be taken into account. If these targets are achieved, the share of external debt will be reduced to 55%, which is equal to the average for the European Union.

Conclusion

Taking all factors into account, Latvia does not need to issue foreign currency bonds. All of Latvia's necessary financial needs can be met in euros. Therefore, the recommended foreign currency debt level is 0. Latvia has a very high level of external debt by jurisdiction—90.4%. The high level of external debt is associated with the negative consequences of the 2008 economic crisis. To reduce the share of external debt, Latvia needs to develop its domestic financial market and encourage domestic market participants to purchase government bonds. It is also necessary to increase the liquidity of the domestic market and develop the use of government bonds as collateral. The recommended level of external debt by jurisdiction is 55%.

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2. BUSINESS, INNOVATION, AND ENTREPRENEURSHIP

Impact of Non-Technological Innovations on the Sustainable Development of European Small and Medium-Sized Enterprises in the Textile Industry

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JEL: O31, O14, Q56, O12

Abstract

Background and aim: Innovations, including non-technological ones, within European small and medium-sized enterprises (SMEs) significantly influence the level of sustainable economic development. The main objective of this article is to examine the impact of non-technological innovations on the sustainable development of the economic activities of SMEs in the Member States of the European Union during the period 2012 – 2022. *Scope:* The study focuses on SMEs operating in the textile industry within the Member States of the European Union. The selected explanatory variable is the indicator of innovations in marketing methods related to market promotion, pricing, packaging, product positioning, and after-sales customer service – while the outcome variable is the level of net turnover. *Methods:* In the data analysis, the method of linear regression and correlation is applied, utilising the capabilities of the IBM SPSS software package and Microsoft Excel. *Results:* The relationship between non-technological innovations and the sustainable development of the enterprises under study is analysed. *Conclusions:* Non-technological innovations exert a positive influence on the sustainable development of the economic activities of the examined enterprises. *Originality:* The paper highlights the contribution of non-technological innovations to the sustainable development of small and medium-sized enterprises. *Practical implications:* The selective conclusions formulated in the study are useful for managers promoting the transformation towards sustainable development of SMEs in the European textile industry through the implementation of non-technological innovations.

Key words:

non-technological innovations,
SMEs in the textile industry,
sustainable development.

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1. Introduction

The European textile industry is among the most globalised value creation chains. Key indicators of the socio-economic significance of the sector include the employment it provides and the share of value added it generates within the overall manufacturing industry. In 2022, European enterprises producing textiles and textile products employed over 2.20 million people (Eurostat, 2025). The value added generated by the sector exceeds 1.10% of Europe's manufacturing industry (Eurostat, 2025). Part of this increase in value added is explained by the adoption of more efficient production processes that reduce manufacturing costs. This economic effect is further reinforced by relocating certain stages of production to countries with lower labour expenses.

More than 99.50% of active enterprises in the textile industry are SMEs (European Commission, 2020). According to a report by the Centre for Industrial Studies, the production units comprising this ecosystem are strategically important for the development of the European Union's economy, contributing to the creation of a stronger, unified market (European Commission, 2020). The EU Strategy for Sustainable and Circular Textiles recognises the economic significance of the sector. At the same time, it is emphasised that the

production and consumption of textiles require urgent and necessary measures to limit environmental impacts. The need for the introduction of mandatory and harmonised rules to extend the responsibility of textile product manufacturers across all Member States is highlighted, as well as the encouragement of more sustainable production (European Commission, 2020). In turn, promoting the market for sustainable and circular textile products, including the recycling of textile goods, supports the adoption of new business models.

The study of the opportunities and challenges facing Europe's textile industry is both relevant and of practical significance for assessing the sector's state of innovation. Through innovations, the modernisation and transformation of the production and placement of textile products towards technologically improved or more complex processes is further supported. Innovations are identified as a key instrument for development and growth, exerting a substantial influence on the business activities and competitiveness of SMEs (Ndiaye, Razak, Nagayev, & Ng, 2018).

In the specialised literature, numerous studies conducted at the level of European Union Member States examine the impact of different types of innovations, including non-technological innovations, on the business performance of SMEs in the industrial sector (Van Auken, Madrid-Guijarro, & Garcia-Perez-de-Lema, 2008); (Exposito & Sanchis-Llopis, 2019); (O'Regan & Ghobadian, 2005); (Aksoy, 2017). In this context, the explanation of part of the differences in the rates of economic development of industrial SMEs in the 27 EU Member States producing textiles and textile products should be linked to their level of non-technological innovativeness.

Particular importance is attached to outlining theoretical and methodological frameworks that focus on a set of indicators, on the one hand, of the sustainable development of ongoing economic activity, and, on the other hand, of the non-technological innovations being undertaken. Suitable indicators that allow the representation of the sustainable development of the economic activities of the enterprises under study in the textile industry include: the number of enterprises in the sector; the number of newly established enterprises in the sector; the age of enterprises; the number of employees; sectoral labour productivity and the relative contribution of enterprises to it; the volume of investments made; net turnover realised; and others (Gunday, Ulusoy, Kilic, & Alpan, 2011); (Hall, 2011). For the purposes of the present study, the net turnover indicator is selected as the outcome variable through which the sustainable development of the economic activities of the enterprises under investigation is measured.

Regarding the innovativeness of European SMEs producing textiles and textile products, Eurostat collects comparable statistical data that allow the measurement of different types of innovations, including non-technological innovations. These include: new business practices for organising procedures or external relations with clients; marketing methods related to market promotion, pricing, packaging, product positioning on the market, and after-sales customer service; new methods for accounting or other administrative operations; and others.

For the purposes of the present study, in assessing the non-technological innovations undertaken by the enterprises under investigation in the 27 Member States of the European Union, the analytical focus is placed on the indicator: "marketing methods related to market promotion, pricing, packaging, product positioning, and after-sales customer service of SMEs in the textile industry". The indicator thus selected provides necessary information on part of the non-technological innovations carried out by the small and medium-sized enterprises under study in Europe. A research challenge lies in collecting and presenting data that allow for a better measurement of certain dependencies and relationships between the indicators of non-technological innovations and the sustainable development of the economic activities of SMEs operating in the European textile industry sector.

This study adopts the view that non-technological innovations are among the determinants influencing the level of sustainable development of the economic activities of SMEs in the textile industry sector within the member states of the European Union. The research interest lies in determining the direction of this

influence – whether positive or adverse.

Structurally, the study comprises the following sections: introduction; literature review concerning the scientific problem under discussion; methods and methodology employed, with particular attention to the application of the linear regression and correlation method; research results; discussion; conclusions, focusing on the theoretical and practical relevance of the study; and references.

2. Literature Review

The textile and clothing industry generate over USD 1 trillion annually, account for a significant share of total global exports, and employ tens of millions of workers worldwide (Costa, Azoia, Silva, & Marques, 2020). This industry forms a basis for achieving sustainable economic growth, increasing export revenues, prioritising the development of small businesses and private entrepreneurship, and addressing social challenges, i.e., ensuring employment, raising incomes, and ultimately improving living standards (Burkhanov & Bakhodirovna, 2021). The vast majority of active enterprises in the textile industry are SMEs (European Commission, 2020).

At the same time, the textile industry is responsible for significant environmental challenges throughout its entire supply chain and is among the most polluting industries globally. This sector is regarded as a major contributor to environmental pollution and is accountable for various ecological problems, including water basin contamination, waste generation, and air pollution, across the supply chain from fibre production to the finishing processes of fabrics (Medrano, Cornejo-Canameres, & Olarte-Pascual, 2020). The issues making the life cycles of textiles and clothing unsustainable range from massive consumption of water resources, energy, fuel, and various harmful chemicals on a large scale, to the use of non-biodegradable packaging materials, and the generation of substantial amounts of solid and gaseous waste, carbon emissions, and greenhouse gases. Industrial estimates indicate that over 35% of chemicals released into the environment result from various textile processing and dyeing operations, while the textile industry's freshwater consumption amounts to approximately three trillion gallons globally (Desore & Narula, 2018).

The contribution of innovations, including those within the SME sector, to economic growth and development, market success, the acquisition of sustainable competitive advantages, and the enhancement of labour productivity is widely acknowledged (Fletcher-Chen, Al-Husan, & ALHuss, 2017), (Aboal & Garda, 2016), (Camison & Villar-Lopez, 2016). Innovations are also recognised as a primary driver of sustainable economic development that considers social and environmental challenges, including climate change (Sebestova & Sroka, 2020).

Although some authors argue that the distinctions between types of innovations are rather artificial and conceptually and operationally similar, the methodological guide known as the Oslo Manual classifies innovations into four groups: product innovations, process innovations, organisational innovations, and marketing innovations (Edquist, Hommen, & McKelvey, 2001), (OECD, 2018).

In the innovation literature, it is also widely recognised that innovations can be classified as technological – product and process innovations – and non-technological – organisational and marketing innovations (Aboal & Garda, 2016), (Armbruster, Bikfalvi, Kinkel, & Lay, 2008), (Garcia Alvarez-Coque & Mas-Verdu, 2017). While technological innovations are typically characterised by the development or use of new technologies, i.e., new technical knowledge and inventions, non-technological innovations do not necessarily involve changes in technology or the adoption of new technologies, but may instead be based solely on the implementation of new business methods, new organisational concepts, or other non-material approaches of altering business activities (Schmidt & Rammer, 2007).

In an effort to further clarify this emerging field of research, a group of theorists adopts a broader perspective on non-technological innovations, defining them as all innovations that incorporate a non-technical component, using a relatively objective and quantitatively measurable approach (Cerne, Kase, & Skerlavaj,

2016). This distinction in innovation classification arises from critiques of the traditional view that technological innovations – both product and process – are insufficient to fully explain the scope of innovation (Geldes, Felzensztein, & Palacios-Fenech, 2017).

Furthermore, considering that non-technological and technological innovations are interconnected, it is of primary importance to analyse their determinants – how they interact and how they influence the economic performance of SMEs. In this context, some authors argue that the determinants (key factors) of both types of innovations are generally the same, that is, the decision to innovate is mainly driven by the same factors regardless of the type of innovation (Aboal & Garda, 2016), (Schmidt & Rammer, 2007). This supports the descriptive findings of a rather close relationship between technological and non-technological innovations.

Innovations are associated with investments whose potential returns emerge over time. Investing in innovation can sometimes be substantial and include the purchase of both tangible and intangible assets, as well as some types of current expenses, such as research and development activities. Regarding the investments needed, technological and non-technological innovations differ, because the costs for implementing organisational and marketing innovations can be significantly lower and rarely involve fixed investments or lengthy periods between expenditure and return (Schmidt & Rammer, 2007). Non-technological innovations require innovative activities that are less dependent on the volume of invested funds.

The literature review reveals that most studies focus on technological innovations, while non-technological innovations remain neglected. Several researchers note that SME innovation policies are directed towards production and pay relatively limited attention to non-technological innovations (Aboal & Garda, 2016). In this regard, it is noted that the numerous confusing typologies and conceptualisations of non-technological innovations complicate the mapping of the entire knowledge landscape, thereby hindering the consolidation of the field of non-technological innovations and slowing its development (Damanpour & Aravind, 2012).

At the same time, an increasing number of studies acknowledge the significant potential of non-technological innovations to enhance organisational efficiency, create sustainable competitive advantages, improve the market performance of SMEs, and boost customer engagement and satisfaction. A better understanding of innovations and their impact on SME competitiveness is captured in the notion that productivity can be further enhanced when technological and non-technological innovations are implemented concurrently (Cerne, Kase, & Skerlavaj, 2016), (Olazo, 2023), (Melibaeva, 2024), (Quaye & Mensah, 2019), (Camison & Villar-Lopez, 2016), (Gonzalez-Blanco, Coca-Perez, & Guisado-Gonzalez, 2019). Non-technological innovations also serve as an important precursor and facilitator of product and process innovations, as the success of these more tangible and visible innovations largely depends on the extent to which organisational structures and processes evolve alongside new technologies (Armbruster, Bikfalvi, Kinkel, & Lay, 2008).

Technological and non-technological innovations are interconnected and mutually complementary. SMEs that introduce technological innovations reorganise their production, workforce, sales, and distribution systems. Consequently, they have an impact on the development of non-technological innovations (Mothe & Nguyen-Thi, 2012). This means that non-technological innovations are often implemented concurrently with technological innovations, and specifically, marketing innovations often coincide with product innovations, while companies with organisational innovations frequently also introduce new technological processes (Radicic & Djalilov, 2019), (Schmidt & Rammer, 2007). It is asserted that the combination of technological and non-technological innovations has a positive impact on the sales returns of SMEs (Mothe & Nguyen-Thi, 2012). Non-technological innovations stimulate the success of product and process innovations from a sales perspective by reducing costs through new processes and introducing market novelties (Schmidt & Rammer, 2007).

The existing literature on organisational innovations is diverse and scattered. There is no consensus on

the definition of organisational innovation. Different research domains develop their own approaches in an effort to understand the complex phenomenon of organisational innovations. This lack of a widely accepted definition of organisational innovation creates difficulties in designing and applying measures and indicators that maintain validity across a broad scope (Armbruster, Bikfalvi, Kinkel, & Lay, 2008).

According to the Oslo Manual, organisational innovation is the implementation of a new organisational method in a firm's business practices, workplace organisation, or external relations that has not been used before and results from strategic decisions made by management (OECD, 2018). Consequently, organisational innovations encompass three types of practices: management practices, such as teamwork, knowledge management, flexible working conditions; manufacturing approaches, relating to changes in work organisation, total quality management, business re-engineering; external relations – outsourcing, networking, customer relations (Mothe & Nguyen-Thi, 2012).

By implementing organisational innovations, SMEs reduce their administrative or transaction costs and enhance workplace satisfaction, thereby achieving higher productivity. Organisational innovations involve changes in the structure and processes of the organisation, resulting from the adoption of new management and work concepts and practices, such as the introduction of teamwork in production, supply chain management, or quality management systems (Armbruster, Bikfalvi, Kinkel, & Lay, 2008).

Organisational innovations refer to new ways in which business activities can be organised and conducted, and to approaches for managing work processes in areas such as customer relationships, employee recruitment and retention, and knowledge management. This type of innovation encourages employees to think creatively about organisational challenges and to strive for solutions that may be new to the enterprise and even novel to the industry or business community as a whole (Grimpe, Sofka, Bhargava, & Chatterjee, 2017).

Marketing innovation, as part of non-technological innovations, is the implementation of a new marketing method involving significant changes in product design or packaging, product positioning, product promotion, or pricing (OECD, 2018). The implementation of marketing innovations leads to better satisfaction of customer needs, opening of new markets or new market positioning of produced goods, and an increase in sales volume.

Marketing innovations are defined as the process of searching for and implementing new and significantly improved methods to increase the value that the customer and the enterprise derive from current or potential market offerings, through customer perceptions or actual experiences triggered by marketing activities (Grimpe, Sofka, Bhargava, & Chatterjee, 2017). This type of innovation is understood as the degree of novelty in the application of three core business processes: product development management; supply chain management; and customer relationship management. Thus, they have a direct impact on firm performance because they effectively encompass the organisation's ability to innovatively apply marketing activities embedded in core business processes.

In the context of the interconnectedness and interdependence of technological and non-technological innovations noted above, it should be highlighted that marketing innovations are often considered complementary to product innovations. This naturally raises the question of whether marketing innovations should be regarded separately from technological innovations (Purchase & Volery, 2020).

Researchers such as L. Olazo have concluded that SMEs in the textile industry possess sufficient personnel capable of implementing marketing innovation activities and utilising new technologies related to the products they manufacture, including their pricing, placement, and promotion (Olazo, 2023). A practically useful direction for the development of marketing innovations is their alignment with the sustainable development opportunities of the enterprises under study.

In line with the purpose of the present study, the focus is placed on exploring the possibilities for identifying and measuring the relationship between marketing-related non-technological innovations and the sustainable development of SMEs in Europe's textile industry sector. The contribution of the studied SMEs to achieving the sustainable development goals of the European economy is among the key factors with a

multifaceted impact on the environment. The environmental issues created, and the air and water pollution occurring throughout the entire production and supply chain, necessitate the adoption of serious measures and responsibilities by the sector toward sustainability.

The literature review reveals that one group of researchers holds the position that the two types of innovations – technological and non-technological – interact and collectively influence the economic performance of SMEs and, consequently, their potential for sustainable development. Another group of authors adopts the view that non-technological innovations, particularly marketing innovations, stimulate consumption and thus greater depletion of natural resources, which contradicts the principles of sustainability. This raises the research interest in determining the extent to which marketing innovations of SMEs in the European textile industry can contribute to the sustainable development of their economic activities. Thus, the emphasis is placed on the economic aspect, relative to the social and environmental aspects, of the manifestation of sustainability in the economic activity of the enterprises defined as the study object.

3. Material and Methods

The conducted study is based on data from the European Statistical Office – Eurostat. Within the chosen econometric model, the size of net turnover is used as the outcome variable to represent the sustainable development of the economic activity of European SMEs in the textile industry. The explanatory variable, through which the types of non-technological innovations implemented are assessed, is defined as: "marketing methods related to market promotion, pricing, packaging, product positioning, and after-sales customer service of SMEs in the textile industry". The time span of the study covers the period 2012–2022, for which the statistical data required for the analysis are available.

The methodological framework of the present study involves the analysis and evaluation of the relationship between the two selected variables. The method of linear regression and correlation is applied, using the capabilities of the IBM SPSS Statistics software and Excel program for data processing.

For the purposes of the study, both a null and an alternative hypothesis are adopted and formulated as follows:

H_0 : There is no relationship between the sustainable development of the economic activity of European SMEs in the textile industry – measured by the realised net turnover – and the implemented non-technological innovations, namely marketing methods related to market promotion, pricing, packaging, product positioning, and after-sales customer service.

H_1 : There is a statistically significant relationship between the sustainable development of the economic activity of European SMEs in the textile industry – measured by the realised net turnover – and the implemented non-technological innovations, namely marketing methods related to market promotion, pricing, packaging, product positioning, and after-sales customer service.

4. Results

The available statistical data on the realised net turnover of European SMEs in the textile industry sector make it possible to determine the current state and the dynamics observed in the values of this indicator. According to data published by Eurostat, a relatively fluctuating trend can be observed, characterised by alternating periods of growth and decline in the evaluated variable: see Figure 1. By the end of the analysed period, in 2022, there was an increase compared to the base year, amounting to more than 23.97%.

To a certain extent, the reported dynamics in the indicator's values are determined by the influence of factors exerting both favourable and unfavourable effects within the macro- and micro-environment in which the studied enterprises operate.

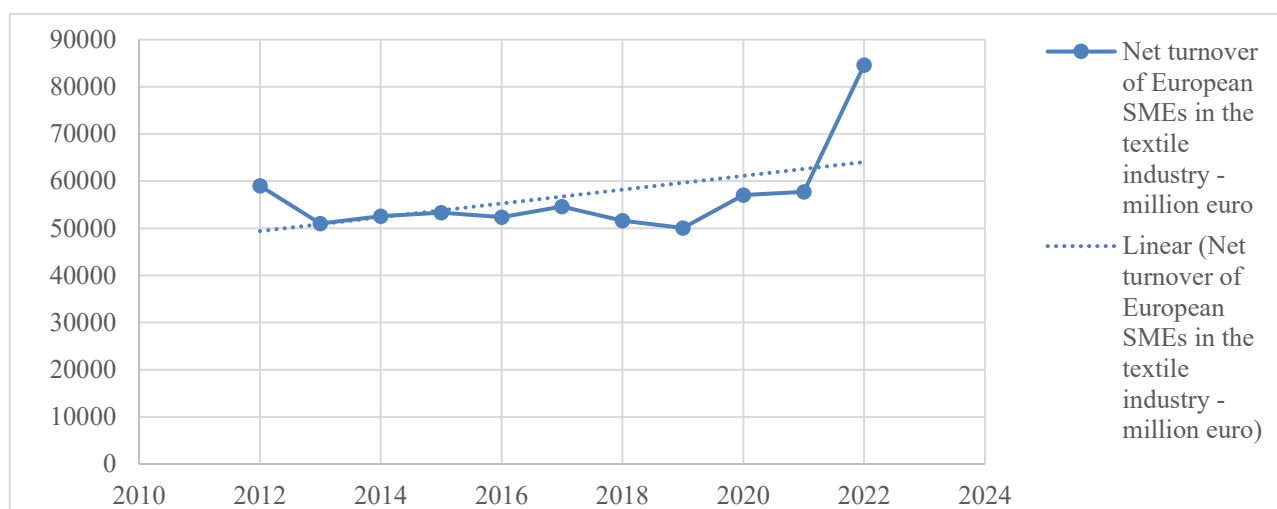


Fig. 1. Dynamics of the net turnover of SMEs in the textile industry within the 27 Member States of the European Union over the period 2012–2022, million euro

Source: Eurostat

The change observed in the value of the net turnover of European SMEs in the manufacturing sector of textiles and textile products makes it possible to determine both the growth rate and the average annual growth rate. The values of these two indicators are presented in Table 1.

Table 1
Change in the net turnover of SMEs in the textile industry of the 27 European Union Member States for the period 2012–2022

Region	Growth rate (2022/2012)	Average annual growth rate (2022/2012)
EU-27	0.2397	1.0217

Source: Eurostat

During the period 2012–2022, the growth rate of the total net turnover of European SMEs in the textile industry sector amounted to 0.2397. This recorded value describes the development dynamics of the analysed variable over the ten-year period under review. The second indicator represents the average annual growth rate of the studied sector and has a value of 1.0217. Its practical significance lies in its ability to measure the average pace of development. Over the entire period, a positive increase was achieved in the value of the total net turnover of the studied enterprises by 1.0217 times.

The application of linear regression analysis provides a basis for examining the relationship between the outcome variable – the net turnover of European SMEs in the textile industry – and the explanatory variable representing non-technological innovations, such as marketing methods related to market promotion, pricing, packaging, product positioning, and after-sales customer service. The selected outcome variable reflects the sustainable development of the economic activity of the analysed enterprises, while the explanatory variable corresponds to a specific type of non-technological innovation. This leads to the formulation of the intended research tasks concerning the identified relationship between the two variables. The results are visualised in the following tables. Table 2 illustrates the key indicators of the regression statistics, presenting the values of the correlation and determination coefficients.

Table 2**Model Summary**

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.639	0.409	0.343	2389.519
The explanatory variable is innovations in marketing methods related to market promotion, pricing, packaging, product positioning, after-sales customer service of SMEs in the textile industry - number.			

Source: Eurostat

The correlation coefficient (R) takes the value of 0.639. This coefficient measures the strength of the linear correlation between the two assessed variables. Given that $0.3 < R = 0.639 < 0.7$, a moderate dependence is established, indicating a moderate degree of correlation between the outcome variable of net turnover of European SMEs in the textile industry and the non-technological innovations carried out in marketing methods related to market promotion, pricing, packaging, product positioning, and after-sales customer service.

The value of the coefficient of determination (R^2) is 0.409, which allows the conclusion that the regression model explains over one-third of the variation in the measured type of non-technological innovations among the studied SMEs in the textile industry. Consequently, nearly 41% of the differences in the net turnover realised by European SMEs producing textiles and textile products are explained by the differences in the extent of the implemented types of non-technological innovations in marketing methods related to market promotion, pricing, packaging, product positioning, and after-sales customer service in business process innovations. The same table also reveals the value of the adjusted coefficient of determination, which takes the favourable value of 0.343.

Table 3**Anova**

	Sum of Squares	df	Mean Square	F	Sig.
Regression	35545523.039	1	35545523.039	6.225	0.034
Residual	51388211.831	9	5709801.315		
Total	86933734.870	10			
The explanatory variable is innovations in marketing methods related to market promotion, pricing, packaging, product positioning, after-sales customer service of SMEs in the textile industry - number.					

Source: Eurostat

The data presented in Table 3 show that the test statistic, i.e. the F-criterion, has a value of 6.225. Assuming a 5% risk of a Type I error ($\alpha = 0.05$), it can be concluded that the explained variance of the outcome quantitative variable is more than six times greater than the residual (error) variance. Since the level of significance (Significance F = 0.034) is lower than the threshold value of 0.05 ($\alpha = 0.05$), there are grounds to conclude that a statistically significant relationship exists between the outcome variable – the net turnover of the surveyed SMEs in the European textile industry – and the explanatory variable, representing the implementation of non-technological innovations in marketing methods related to market promotion, pricing, packaging, product positioning, and after-sales customer service as elements of business process innovation.

The data in Table 4 illustrate the values of the regression coefficients of the explanatory variable analysed in this study.

Table 4

	Coefficients		Mean Square	t	Sig.
	Unstandardised Coefficients				
	B	Std. Error			
Innovations in marketing methods related to market promotion, pricing, packaging, product positioning, after-sales customer service of SMEs in the textile industry - number	7.277	2.916	0.639	2.495	0.034
(Constant)	44027.400	3882.438		11.340	0.000

Source: Eurostat

The interpretation of the numerical value of the partial regression coefficient of the explanatory variable – innovations in marketing methods related to market promotion, pricing, packaging, product positioning, and after-sales customer service – allows certain conclusions to be drawn. The empirical value of the analysed variable is 7.277. Therefore, an increase of 1 euro in this type of non-technological innovation corresponds to an average increase of 7.277 euros in the net turnover of the studied enterprises producing textiles and textile products.

At the level of the 27 European Union Member States, the available data on SMEs in the textile industry allow the manifestation of a positive correlation between the two analysed variables to be visualised: see Figure 2.

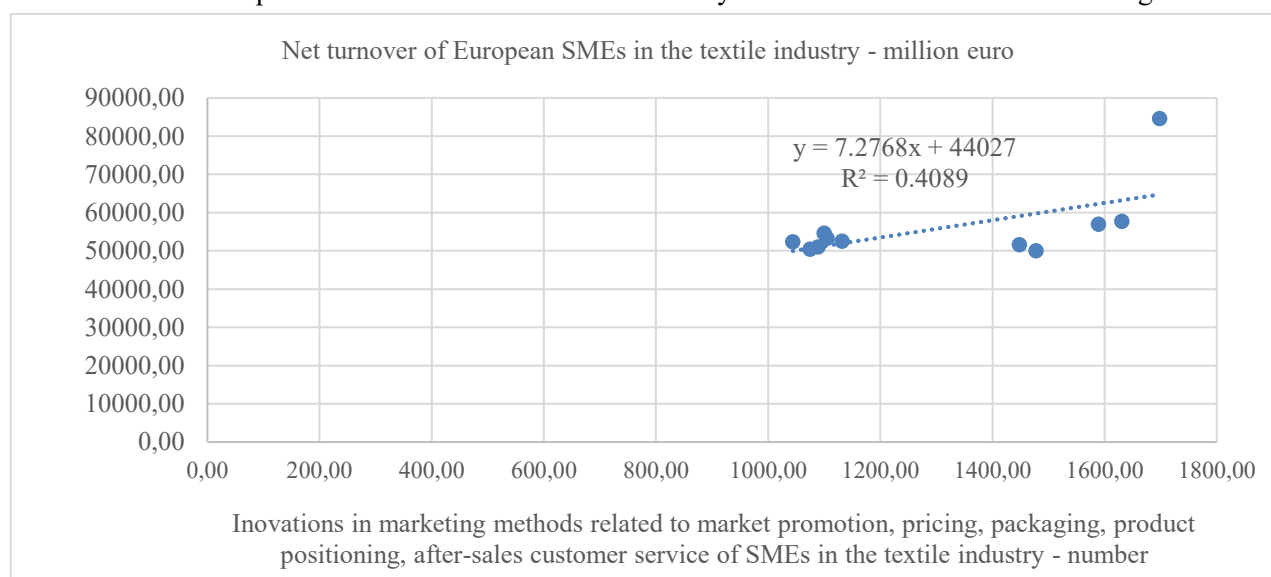


Fig. 2. Correlation between innovations in marketing methods related to market promotion, pricing, packaging, product positioning, after-sales customer service, and the net turnover of SMEs in the textile industry of the 27 European Union Member States during the period 2012–2022.

Source: Eurostat

Using Figure 2, the trend model is visualised, illustrating the quantitative outcome analysed in this study. Over the period 2012–2022, an upward trend is observed in the growth of net turnover generated by SMEs in the textile industry across Europe. During the assessed period, its values range between 50 billion euros and 84 billion euros. Comparing the results across individual European countries reveals certain similarities and differences. In 2022, considering their relative contributions to total net turnover, the surveyed enterprises in Italy (27.69%), Germany (18.32%), France (8.98%), and Spain (8.40%) exceeded the EU average, while Cyprus and Malta recorded the lowest relative shares, at approximately 0.04%.

A positive increasing trend is also observed in the other variable expressing the assessed type of non-technological innovations – innovations in marketing methods related to market promotion, pricing, packaging, product positioning, and after-sales customer service. The already highlighted countries – Italy, Germany, France, and Spain – exhibit the highest values.

The conducted linear regression analysis of the marketing innovation activity of enterprises operating in the textile industry in Europe enables a discussion of the obtained results, as well as the formulation of significant conclusions and summaries.

5. Discussion

The research results obtained provide a basis for noting a moderate relationship between the two quantitative variables analysed in this study. Conducting a linear regression analysis enables an interpretation of changes in the marketing innovativeness of European SMEs in the textile industry across the 27 EU member states. The specific analytical focus on the examined type of non-technological innovations allows for measurement of their impact on the net turnover generated through economic activity. It is found that the analysed type of innovations explains a certain portion of the disparities in the net turnover amount generated by enterprises producing textiles and textile products in Europe.

In this regard, it is relevant to draw a comparative parallel with results from other researchers reported in the specialised literature. There is a conceptual view that the need to adopt innovative marketing practices has never been more urgent. This means that only SMEs in the textile industry that successfully integrate marketing innovations into their strategies can better respond to changing market demands, identify new opportunities, and establish a distinctive position relative to competitors (Melibaeva, 2024). Such a necessity is driven by the state of the textile product markets, which are becoming increasingly saturated, while consumer preferences evolve at ever-faster rates.

6. Conclusions

Analysing non-technological innovativeness, represented by marketing innovations, in European SMEs within the textile industry allows for certain conclusions and generalisations to be drawn. Within the assessed sector across the 27 EU member states, small and medium-sized enterprises constitute the predominant share of established and operating businesses. The production units that make up this ecosystem are strategically important for the development of the European economy. Building a stronger market necessitates the sustainable development of textile and textile product manufacturing. At the same time, it should be emphasised that these production activities are significant contributors to environmental pollution, requiring urgent and effective measures to mitigate their adverse impacts. Promoting more sustainable manufacturing practices aligns with the principles of sustainability.

The linear regression and correlation analysis reveal a moderate or medium-strength statistically significant relationship between the sustainable development of the economic activity of European SMEs in the textile industry – measured by the realised net turnover – and the implemented non-technological innovations, specifically marketing methods related to market promotion, pricing, packaging, product positioning, and after-sales customer service. The regression model explains over one-third of the variance in the realised net turnover of the surveyed enterprises producing textiles and textile products, attributed to the differences in the extent of non-technological innovations in marketing methods implemented by them. Comparisons among individual European countries show that Italy, Germany, France, and Spain achieve the highest levels of marketing innovation activity, whereas countries such as Cyprus and Malta report the lowest results relative to the European average.

In summary, marketing innovations can be seen as a determinant with multifaceted effects on the sustainable development of the economies of EU member states, both positive and adverse. Examining the opportunities and challenges faced by European SMEs in the textile industry is practically important for assessing the sector's level of innovation. Non-technological innovations, represented by marketing innovations, further support the

modernisation and transformation of textile production and distribution toward technologically enhanced or more complex processes. These selective conclusions are valuable for managers fostering the transition to sustainability in European textile SMEs.

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Is Bulgaria Ready to Restrict Short-Haul Flights?

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JEL: O14, P24, C41, E13

Abstract

The assessment of the implementation of certain measures aimed at reducing or eliminating environmental pollution caused by the transport sector must go through a comprehensive review of the state of the rolling stock, transport infrastructure, and a wide range of effects that can be caused by decisions to limit flights on conditionally short distances within a country. Currently in Bulgaria, the density and level of satisfaction of the population with the railway and road transport network give priority to their use over that of the air transport alternative. At the same time, the contribution of road transport to the formation of harmful emissions in the air is the most significant compared to all other transport alternatives.

Key words:

Carbon footprint, domestic flights, rail transport, transport infrastructure.

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1. Introduction

Taking measures to limit the carbon footprint caused by the daily activities of human society and business is becoming the top priority of the resource neutrality objectives in the long-term strategy of the so-called European Green Deal. One of the areas of application of reforms and policies is the transport sector, which has the highest contribution to the formation of greenhouse emissions in the EU, accounting for 29% in 2022, compared to a 17% share in 1990 (European Federation for Transport and Environment AISBL, 2024). Moreover, it will continue to dominate with a growing share of 44% in 2030 (Transport & Environment, 2024) against the background of reductions achieved in other economic sectors and the expected overall reduction of all pollution caused by human activity. This puts the sector in the spotlight of the challenges of finding effective solutions that simultaneously achieve their environmental goals without affecting business competitiveness and the universal European philosophy of free movement.

In 2022, France introduced a ban on short-haul domestic flights, which affects those transport alternatives that can be made by rail in less than 2.5 hours. The ban concerns direct air transport connections and does not include so-called connecting trips that can be made on short flight distances. At the same time, in order to be applicable, according to the regulatory provisions, train alternatives must meet certain requirements for: frequency of the transport schedule, strictness of execution, complexity, and capacity of the transport service, so as to meet the potential increase in passenger traffic. The specific requirement is that if a person uses the train connection, they can benefit from a round trip, provided with an eight-hour stay at the final destination within 24 hours. This practically means that the travel time from the starting point to the final destination and back, together with an 8-hour break in between, must be able to be completed within one day (Asuene, 2025).

The main consideration for the ban on short-haul flights is related to the environmental effects that can result from reducing the carbon footprint of air transport. The targeting of the restriction for this type of transport stems from the fact that it traditionally uses fossil fuels, while in the rail transport alternative, there are ample opportunities to replace the used motive power with electrical energy, which can come from renewable and more sustainable sources. This means in practice that rail transport, in a comparative aspect with air transport, can be categorized as one with a lower carbon footprint, along with the other advantages

and disadvantages that accompany it.

The aim of this paper is to review the state of the road and rail transport network and, in the context of the possibility of introducing a restriction on the use of air passenger transport for short-haul distances and the related challenges and limitations of the Bulgarian transport infrastructure, to consider possible guidelines for improving transport policy in the country.

To achieve the goal formulated in this way, the following main tasks should be solved:

1. Study of the current state of the transport infrastructure in Bulgaria during the period 2010-2024 in the context of the provision of a road and railway network as alternatives to air transport over relatively short distances, such as those within the borders of the country.

2. Formulation of some possible guidelines for improving the country's transport policy, which correspond to the implemented transport policies in other European countries.

The empirical study is based on data published by Eurocontrol, by BDZ – Passenger Transport Ltd., by the National Statistical Institute of Bulgaria (NSI), and by other specialized information sources during the period 2010-2024, from which the main limiting condition arises, related to the lack of free access to the most up-to-date information.

The study period includes 15 years and is characterized by numerous events of an economic, political and social nature, which have a direct or indirect impact on the transport policy of Bulgaria. Such events are: the strengthening of China's role globally and its “One Belt, One Road” initiative (2013), the annexation of Crimea (2014), Brexit in 2016, the health crisis from 2020 to 2022, the military conflict between Ukraine and Russia, which began in February 2022, Bulgaria's membership in Schengen from 2024, preparations for the country's upcoming inclusion in the Eurozone (from August 2025), and many other events that mark the development of transport in Bulgaria, Europe and around the world.

2. Methods and hypotheses

The present study applies the methods of content analysis and comparison, it uses data from official secondary information statistical sources.

The first research hypothesis is related to the fact that the application of the restriction on air passenger transport on the territory of Bulgaria is achievable in the presence of adequate road and railway infrastructure, ensuring the transport of passengers at high speed and guaranteed implementation of the timetable and transport schedule when using public carrier operators.

For the purpose of confirmation of the first hypothesis, indicators for the density of the road and railway network per 1,000 sq. km of territory have been calculated, comparing the length of roads and, in particular, motorways, measured in kilometres, with the territory of the country in square kilometres and, respectively, the length of railways, measured in kilometres, was compared with the territory of the country in square kilometres:

$$\text{– road density in km/1,000 sq. km} = \frac{\text{length of roads in km}}{\text{the territory of the country in sq.km}} \times 1\,000;$$

$$\text{– motorway density in km/1,000 sq. km} = \frac{\text{length of motorways in km}}{\text{the territory of the country in sq.km}} \times 1\,000;$$

$$\text{– railway density in km/1,000 sq. km} = \frac{\text{length of railways in km}}{\text{the territory of the country in sq.km}} \times 1\,000.$$

Another indicator included in the survey methodology for assessing the country's transport infrastructure provision is the level of satisfaction with roads and railway networks per 10,000 inhabitants:

$$\text{– level of satisfaction with roads in km/10,000 inhabitants} = \frac{\text{length of roads in km}}{\text{population}} \times 10\,000;$$

$$\text{– level of satisfaction with railways in km/10,000 inhabitants} = \frac{\text{length of railways in km}}{\text{population}} \times 10\,000.$$

The second hypothesis concerns the contribution of short-haul air passenger transport to the formation of a carbon footprint compared to rail transport. To prove it, estimates of the amount of greenhouse gas emissions generated by air transport are provided.

3. Research on the state of transport infrastructure

Within the scope of the European airspace, there has been a decline in interest in the so-called regional flights by 3% over a 6-year period (see Fig. 1), with regional flights being understood as: commercial flights by a list of regional aircraft types (19-120 seats). The objective of this segment is to better illustrate the connectivity between regions (so, short- and medium-hauls) (Eurocontrol, 2022). At the same time, the relative share of the so-called “Mainline”: other scheduled flights, usually hub & spoke operations by airlines’ main operating units, using larger aircraft (>120 seats) and including long-haul operations (Eurocontrol, 2022) is clearly maintained. This means that solutions must be sought to reduce the operational activity of these flights, given the fact that long routes over 4,000 km account for 46% of carbon emissions in 2023 (EASA, 2025), while flights shorter than 500 km generate less than 4% of total EU aviation emissions (Karamfilov, G., 2021). This practically calls into question the understanding of the contribution that short air distances have to the formation of greenhouse gas emissions but also puts the emphasis on whether other existing transport alternatives have better economic, social and, above all, environmental parameters.

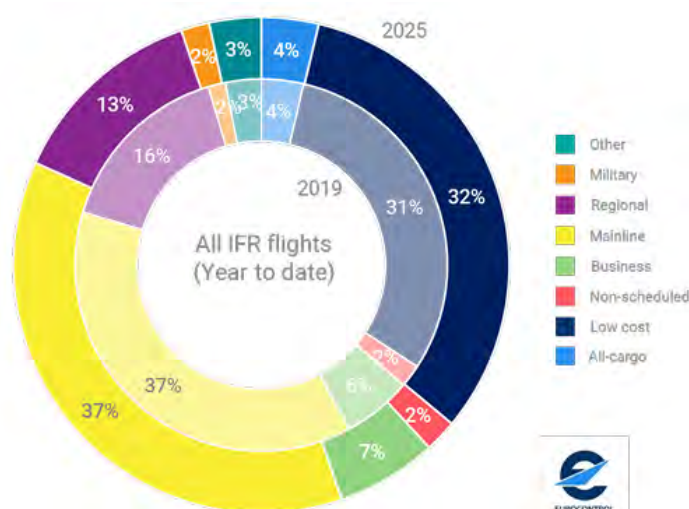


Fig. 1. Average share of total flights in 2025 and 2019

Source: (Eurocontrol, 2025, p. 8)

The decrease in regional flights, according to Eurocontrol data, is reported by destinations not only in France (Paris-Lyon) but also in Spain (Madrid-Barcelona), as well as between the cities of London and Brussels (Eurocontrol, 2025), which is the result of the extensive development of high-speed rail networks in Europe. The efficiency and convenience of transporting passengers by rail as an alternative to air transport implies a serious degree of development of high-speed lines, such as those offered by carriers in these countries, such as Eurostar, TGV, ICE and AVE. Prioritizing the development of transport networks in the EU is also set out in the multiannual financial framework for the period 2021-2027, where EUR 11.4 billion is set aside for transport, of which EUR 1.4 billion is for basic missing cross-border rail connections between countries (Publications Office of the European Union, 2021a). This will lead to the achievement of a main result, expressed as “90% reduction in emissions by 2050, delivered by a smart, competitive, safe, accessible and affordable transport system” (Publications Office of the European Union, 2021b). Thus, placing transport

policy at the centre of the ongoing transformation in the EU seeks to achieve sustainable and smart mobility, ensuring the free movement of people, goods and services. The main drivers for the implementation of this concept are the application and effective deployment of the European Rail Traffic Management System (ERTMS) and the expectation of the gradual introduction of the Open Sales and Distribution Model (OSDM). Thus, by the beginning of 2027, rail transport connectivity in Europe can be developed in the dimensions of improved synchronisation between booking platforms and consumer protection for passengers for international travel within the EU (Main Line for Europe Initiative, 2025), as it functions in air transport. Efforts in this direction can be a driver for increasing international passenger transport by rail and increasing its competitiveness compared to other transport alternatives.

In Bulgaria, the railway infrastructure is relatively stable in terms of the length of railway lines, and as of 31.12.2024, it is 4,025 km, which is also reflected in the key indicators calculated for the period 2010-2024, where the level of satisfaction with railway lines increased by 0.835 km/10,000 people, while the density of railway lines for the same period fluctuates between 36.919 km/1,000 sq. km of territory (2010) and 36.261 km/1,000 sq. km of territory (2024) (see Table 1).

Table 1**Dynamics in the development of Bulgaria's railway network in the period 2010-2024**

Years	Indicators		
	Length of railway lines (km)	Density of railway lines (km/1,000 sq. km of territory)	Level of satisfaction with railway lines (km/10,000 people)
2010	4 098	36,919	5,460
2011	4 072	36,685	5,557
2012	4 070	36,667	5,589
2013	4 032	36,324	5,565
2014	4 023	36,243	5,586
2015	4 019	36,207	5,618
2016	4 029	36,297	5,673
2017	4 030	36,306	5,716
2018	4 030	36,306	5,757
2019	4 030	36,306	5,797
2020	4 029	36,297	5,825
2021	4 031	36,315	5,894
2022	4 029	36,297	6,249
2023	4 029	36,297	6,251
2024	4 025	36,261	6,253

Source: (NSI, 2025a) and authors' computations.

The problem of the Bulgarian railways is not the quantitative parameters but the condition of the infrastructure and rolling stock, which affect the transport performance. According to the latest data from “BDZ Passengers” Ltd., for the period from 01.01.2024 to 30.09.2024, the movement of 152,449 trains was planned. The average performance of the train schedule for the referred period is 88.54%. Significant delays

were reported in terms of compliance with the announced schedule. During the period under review, the late trains at the final station are 16,144 pcs. with a total delay of 556,061 minutes. The average daily number of delayed trains at the final station is 58.92, with an average delay per day of 2,029.42 minutes, or 34.44 minutes/train. A total of 9,456 trains departed from their starting station with an overall delay of 267,927 minutes. The average daily number of trains delayed from their starting station is 34.51, with an average of 977.84 minutes per day, or 28.33 minutes/train. There were also cancelled trains: During the period, the movement of 28,795 trains was cancelled for the following reasons: 4,391 trains were cancelled due to the fault of “BDZ-P” Ltd. (15.25% of the cancelled trains); 24,070 trains were cancelled due to the fault of SE “NRIC” (83.59% of the cancelled trains), and 334 trains were cancelled due to external reasons (1.16% of the cancelled trains) (“BDZH-Patnicheski prevozi” EOOD, 2024, pp. 10-11).

Therefore, the railway alternative offered on the Bulgarian transport market does not stand out in terms of reliability in the performance of transport, and the consumer, if possible, seeks an option in the face of air carriers and mainly prefers road transport, which is operated in the presence of rolling stock and built roads. At the same time, air transport is distinguished by the long-term possibility of planning, the use of well-synchronized reservation systems between the various carriers, and strong consumer protection in the performance of the transport service, which deviates from certain standards and regulations. For road transport, these are the expanded possibilities for personalization of routes and breaks in transport, the wide accessibility in territorial terms, and the various categories and groups of passengers.

An important prerequisite for reducing domestic flights is the development and condition of the road network. The indicators for the degree of satisfaction with roads (km/10,000 people) and road density (km/1,000 sq. km of territory) in Bulgaria have seen some growth over the last 15 years (see Table 2); respectively, the degree of satisfaction has increased from 25.925 km/10,000 people (2010) to 31.047 km/10,000 people (2024). As Figure 2 clearly shows, the main reason why this indicator outlines an upward development trend is the drastic decline in Bulgaria's population. Obviously, the growth in road satisfaction is of an extensive nature, given the fact that Bulgarian citizens have decreased by 1,067,508 within the studied period.

Table 2

Dynamics in the development of Bulgaria's road network during the period 2010-2024

Years	Indicators					
	Length of road network (km)	Length of motorways (km)	Road network density (km/1,000 sq. km of territory)	Level of satisfaction with roads (km/10,000 people)	Motorway density (km/1,000 sq. km of territory)	Level of satisfaction with motorways (km/10,000 people)
2010	19 456	437	175,279	25,925	3,937	0,582
2011	19 512	458	175,784	26,629	4,126	0,625
2012	19 602	541	176,595	26,918	4,874	0,743
2013	19 678	605	177,279	27,158	5,450	0,835
2014	19 728	610	177,730	27,392	5,495	0,847
2015	19 853	734	178,856	27,752	6,613	1,026
2016	19 895	733	179,234	28,014	6,604	1,032
2017	19 861	734	178,928	28,171	6,613	1,041
2018	19 876	757	179,063	28,394	7,117	1,081
2019	19 879	790	179,090	28,597	7,261	1,136
2020	19 917	806	179,432	28,796	7,261	1,165

2021	19 925	806	179,505	29,135	7,432	1,179
2022	19 942	825	179,658	30,929	7,568	1,280
2023	19 942	840	179,658	30,940	7,613	1,303
2024	19 986	845	180,054	31,047	7,117	1,313

Source: (NSI, 2025b) and authors' computations.

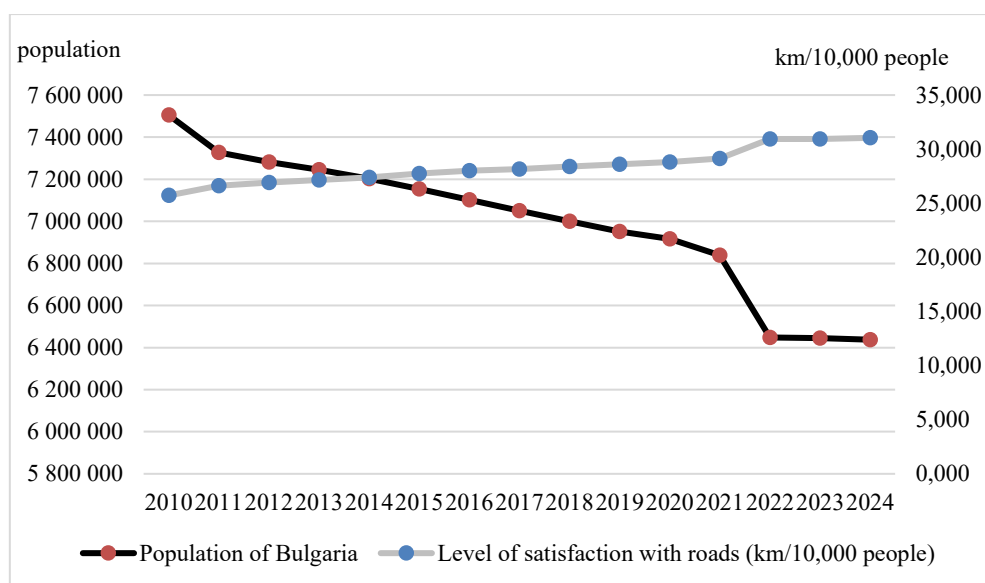


Fig. 2. Dynamics in the development of indicators for the level of satisfaction with roads in Bulgaria and the population in the period 2010-2024.

In terms of road density, the indicators report an increase from 175,279 km/1,000 sq. km of territory (2010) to 180,054 km/1,000 sq. km of territory (2024), with the highest growth recorded for motorways, which, from 437 km in 2010, reached a length of 845 km at the end of 2024. This is precisely where the main problem lies, in terms of the length of the national road network, which is related to the slow pace of construction of motorways. They are the main road arteries and provide fast access and connectivity by road to the main economic centers of the country. Another significant problem of the Bulgarian transport system, in the road transport segment, is the quality of the constructed roads, which affects the efficiency of the use of the rolling stock of this type of transport, its speed of movement, productivity, cost of transport, etc. As a specific point in road transport, the mechanism of payment for the use of the road infrastructure must also be considered. It is divided depending on the dead weight of the vehicle, its category and the type of road used. Thus, in practice, heavy goods vehicles carrying goods and passengers that use highways and first-class roads also pay higher fees when passing through the national road network, where the entire complex of factors: “the technical characteristics of the road or road section, the distance travelled, the category of the road vehicle, the number of axles, the total technically permissible maximum mass, the EURO environmental category, CO₂ emission class and specific CO₂ emissions” is taken into account (Zakon za patishtata, 2025), which leads to the determination of tolls between every two points on each individual road direction.

The inclusion of an environmental component in the price of compensation for the use of the road network is subject to the general “polluter pays” approach. This principle means that “polluters shall bear the costs associated with pollution, including the costs of measures taken to prevent, control and eliminate pollution, as well as the costs it imposes on society” (European Court of Auditors, 2021, p. 4). Although it aims to shift the responsibility for the pollution caused to its source, in general, through the price of the good or service, this cost is transferred to the end consumer. Thus, in practice, “the prices of goods that depend on the quality and/or quantity of environmental resources more accurately reflect their relative scarcity and that the relevant

economic agents respond appropriately ...; thus, the costs of these measures should be reflected in the price of goods and services that cause pollution in production and/or consumption” (OECD, 2025, p. 4). Therefore, the principle should operate in such a way that all participants in the economic process are stimulated to take active measures to reduce their carbon footprint and to bear responsibility for protecting the environment according to the contribution they make to its pollution. Thus, once again, transport is the sector that is indicated for its significant contribution to impact on planetary systems. This is actually the basis of the practical decision to limit short-haul flights, which, on the one hand, can be a source of harmful emissions, and, on the other hand, there are alternatives that have a lower carbon footprint in the present or in the stages of production or in the subsequent stages of their disposal and utilization.

Despite the fact that there are about 20 airports and airfields in the country (including civil and military), those that allow their use for passenger transport are limited to four, and these are Sofia, Plovdiv, Varna and Burgas. Here, of course, the market strategies of the companies that operate an air fleet are also linked to their desire to serve one of the indicated possible passenger destinations. This means that consumer preferences clash with the economic rationality of entrepreneurship in the field of air transport. Thus, if a given destination fails to meet certain criteria for transport efficiency, it is not implemented. In the opposite case, in air transport, decisions to launch a certain transport line have their conditional time frame and, in a purely economic context, are not implemented for each individual case, as may be the case with irregular transport (ad hoc) and transport for own costs in road transport.

Determining factors of the flight schedule market of a particular air passenger destination are, first of all, sufficient market potential, competition in the given destination, its attractiveness in the context of an established airport infrastructure, the distance between destinations, the associated airport fees, local legislation and its restrictions regarding aircraft, etc. All these drivers, to varying levels, determine the economic potential for the realization of the transportation of passengers and cargo transport in a particular flight alternative.

In the context of the hypothesis of air transport distances in Bulgaria, the only ones that fall within the scope of the adopted restrictive mechanism are the connections between the four main airports in the country – Sofia, Plovdiv, Varna and Burgas (see Table 3). An important specificity of the distance between the starting and ending points of the transport directions in practice may be different, as much as what is indicated in Table 3 depends on the specific railway or air route and the specific information source. In real economic operation, this is associated with the different parameters of each individual transport implementation (vehicle, adaptation of the route depending on specific current circumstances, filling the capacity of the vehicle, etc.), which means that each economic or environmental assessment of a particular transport alternative takes into account precise factors in their current state during their implementation, but within the framework of each subsequent initiation they are subject to re-evaluation.

Table 3

Comparative characteristics of rail and air transport by main routes

Directions	Railway			Air	
	No. of scheduled connections*	No. of direct connections per day**	No. of train connections per day	Duration in minutes	Companies
Sofia-Plovdiv	14	9	19	-	-
Sofia-Varna	10	3	17	52	Bulgaria Air и Wizz Air
Sofia-Burgas	9	6	15	50	Bulgaria Air***

Burgas-Plovdiv	8	2	8	-	-
Burgas-Varna	6	1	8	-	-
Varna-Plovdiv	7	3	11	-	-

*Source: Authors' Compilation, 2025. * Information about train schedules was retrieved from <https://razpisanie.bdz.bg> on 15.05.2025, and information about the number of connections from [**https://virail.bg](https://virail.bg) *** Only during the summer season.*

Within the framework of the review of the existing directions of domestic air flights, for which there is an alternative to rail transport, the lack of real direct air connections between most destinations was found, which is the direct evidence of the functioning of the mechanism of economic rationality. It determines that in case of insufficient capacity for the transport of passengers and/or cargo on a given route, it will not be implemented in practice. Moreover, the market capacity must have its uniformity, expressed as the number of customers for a sufficiently long period of time. Economic reality indicates that in situations of well-expressed seasonality during the summer tourist season in Bulgaria, the air transport alternative is realized with all restrictions and activity only within the peak period of sea tourism in the country. This means that the economic principle of the free functioning of the market economy is a sufficient guarantee that only alternatives for transport directions with sufficient economic potential are realized and attract entrepreneurial interest. Additional confirmation of this is the lack of strongly expressed competition in terms of the number of participants in air transport in the two domestic air directions carried out in the country. This means that even without an explicit prohibition, the restriction of short-haul flights has found its practical implementation.

Nowadays, in the comprehensive assessment of the effects of any business activity, it is necessary to consider not only the economic aspects, but also the increasingly relevant dimensions related to its impact on the environment. Within the framework of the official NSI statistics (NSI, 2025c) on emissions of harmful substances into the air from main economic activities for 2023, the contribution of the “Other Transport” segment formed 0.23% of pollution with sulfur oxides (SO_x), nitrogen oxides (NO_x) 5.2%, non-methane volatile organic compounds (NMVOC) 1.64%, methane (CH₄) 0.01%, carbon monoxide (CO), carbon dioxide (CO₂) 1.76%, nitrous oxide (N₂O) 1.28%, ammonia (NH₃) 0%, fine particulate matter up to 2.5µm (PM_{2.5}) 0.87% and fine particulate matter up to 10µm (PM₁₀) 0.55%. By comparison, “Road Transport” accounts for 0.09% of pollution with sulfur oxides (SO_x), nitrogen oxides (NO_x) 42.25%, non-methane volatile organic compounds (NMVOC) 8.93%, methane (CH₄) 0.33%, carbon monoxide (CO) 25.91%, carbon dioxide (CO₂) 28.3%, nitrous oxide (N₂O) 2.06%, ammonia (NH₃) 1.16%, fine particulate matter up to 2.5µm (PM_{2.5}) 9.9% and fine particulate matter up to 10µm (PM₁₀) 8.35%.

Within the framework of the considered aspects of the functioning of the various transport alternatives in Bulgaria, there is a potential opportunity regarding air connections between the two sea destinations (Varna (378 km) and Burgas (339 km)) and the capital of the country. Only these two transport connections can fall within the scope of the hypothesis of restricting short-haul air transport. In order for this measure to be effectively implemented and achieve its social and mainly environmental results, several conditions must be present:

- Firstly, these are the magnitudes of climate change and their urgent need for simultaneous measures in all possible areas to combat temperature rise and environmental pollution. In this regard, the debate on the effectiveness of this measure remains relevant, since the International Air Transport Association (IATA) estimates its effect at a conditionally insignificant reduction in emissions in France by 0.12%, which is disproportionate to the “inconvenience caused to travellers on these routes” (IATA, 2024);
- Secondly, this is the guaranteed right to free movement within the EU, which means that for consumers and products, there must be transport alternatives that fully and without serious difficulties meet the

need for transport services. Of course, here, through certain environmental standards and the associated fees, a compensation mechanism can be derived that effectively implements the “polluter pays” principle;

- Thirdly, state intervention in one transport sector should not be at the outlay of incentives and restrictions on competition in other transport alternatives. This should be expressed most strongly in terms of the economic and environmental justification for the introduction of restrictions affecting certain groups of economic operators or entire economic sectors.

The study formulates several possible guidelines for improving transport policy:

1. Creating common solutions for synchronization between the individual transport alternatives for the transport of passengers and freight to optimally utilize the capacity of the means of transport, which will be implemented through air-rail transport connections and vice versa in optimal synchronization of transport schedules. In this context, it is imperative to renew the rolling stock operated by the railway transport of Bulgaria, with a view to increasing the speed and accuracy of train movements and ensuring guarantees for providing an adequate transport service in accordance with European standards, which will allow the implementation of combined and multimodal transport solutions. At the same time, it is necessary to direct investments towards improving the service, mainly by refining the positive and comprehensive user experience and improving the tools and mechanisms for consumer protection.

2. Increasing accessibility to fast and safe transport, which guarantees not only the achievement of certain economic and environmental effects but also mainly the reduction of the time for the provision of the transport service. For this purpose, in the segment of road transport, it is imperative to accelerate investment activity in the construction of motorways on the territory of the country, which are designed and will contribute to a significant increase in the metrics of density and level of satisfaction with the road network, both in general and specifically for this class of roads. At the same time, adequate rehabilitation of the constructed road network and improvement of the parameters of its use must be carried out in parallel, mainly in the context of safety, development and modernization of the accompanying commercial network of outlets (gas stations, charging stations for electric vehicles, convenience stores, etc.), parking lots and rest areas for passengers and drivers, information provision to road network users in real time about its condition and other useful information, etc. All these aspects can have positive effects in terms of road safety and comfort of travellers. Additionally, suitable solutions can be created for automated components and traffic management systems integrated into the road infrastructure.

3. Investments in the production and use of “drop-in” fuels, including sustainable aviation fuel (bio-kerosene) and renewable bio-diesel in rail transport, but also a priority search for hybrid transport solutions that can easily use both modern “green” fuels and clean electricity. In this regard, sustainable solutions already exist on the market in this area. For rail transport, these are hydrotreated vegetable oil (HVO), which “stands out for its ability to reduce emissions while maintaining compatibility with existing diesel engines” (UNION TANK Eckstein GmbH & Co. KG, 2025). It is obtained from vegetable or waste oils that are processed and can be used both in their pure form and as a combination with traditional fossil fuels. Bio-diesel has an identical composition to that produced from petroleum raw materials and meets the requirements of environmental standards (Euro category). This type of synthetic fuel is a sustainable alternative to traditional fossil fuels and can produce “up to 90% less CO₂, 24% less CO, 9% less NO_x, 33% less fine particles, and 30% less hydrocarbons” (UNION TANK Eckstein GmbH & Co. KG, 2025). Bio-kerosene ensures “to a large extent that the global carbon cycle is closed; i.e., during growth the biomass absorbs CO₂ from the atmosphere, and during combustion in the aircraft turbine the CO₂ is released back into the environment” (Kaltschmitt & Neuling, 2018, p. v). Their mass application requires not only the discovery of the process in a laboratory environment but also its successful implementation in production, distribution, storage and, above all, application in every type of transport as an alternative to traditional fossil fuels.

The transition to a carbon-neutral economy requires the discovery of sustainable solutions that are not uniquely defined in restrictions and deadlines but rely on the awareness and acceptance of lifestyle changes that are sustainable for the present and future generations.

Conclusion

Based on the research conducted, the following conclusions are reached regarding the formulated hypotheses:

The first hypothesis of this study, related to the possibility of limiting short-haul air passenger transport on the territory of Bulgaria in the presence of adequate road and railway infrastructure, cannot be rejected unequivocally, since Bulgaria has a relatively good level of road and railway network. The country's problem with transport security lies in the quality of railway and car roads, since there is no extensive investment in motorways and in the maintenance of already existing roads, and in the case of railways, it is obvious that there is a clear lack of interest in updating the technology by which transport is carried out in the short term, and on this basis, the alternative to travel by train is not competitive with the service provided to passengers in Europe. Given these circumstances, it can be argued that there are options for providing transport with alternative transport solutions to air transport within the country, but with lower quality, a wider time range, and therefore lower levels of customer satisfaction.

Regarding the second hypothesis, there is limited implementation of direct air transport between the capital and the two largest coastal cities in the country, while other directions are not served. This means, without providing specific estimates, that the contribution of this source of air pollution to the formation of overall pollution is insignificant compared to the intensive and more widespread use of the other two transport alternatives (rail and road).

Therefore, there is no clear answer to the question of Bulgaria's readiness to limit short-haul flights. In reality, four airports operate in the country, and domestic flights are carried out between three of them: Sofia-Burgas and Sofia-Varna, i.e., Plovdiv Airport does not appear on this map, and the Varna-Burgas direct air link is not served. Obviously, even today, passengers primarily use the services of railway transport, bus lines and their own passenger and cargo vehicles, regardless of the infrastructure features, the challenges of the current state and the projects for the development of the national transport network.

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Comparing Distance- and CO₂-Optimized Heuristics and Metaheuristics for the Multi-Depot Capacitated Vehicle Routing Problem in Agricultural Logistics

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Abstract

In this study, we tested three algorithms to solve a real-world agricultural logistics problem based on real geographic data. The task involves optimizing the collection and delivery of agricultural containers across multiple depots, using a fleet of capacity-constrained trucks. Two optimization scenarios were investigated. In the first, edge weights represented distances between points in kilometers. In the second, they represented emissions of CO₂ equivalent per route, calculated using Life Cycle Assessment (LCA) according to the *Global Warming Total (fossil + biogenic)* impact category of the Product Environmental Footprint (PEF), following the IPCC methodology. Each algorithm — a greedy heuristic (Eu) and two Ant Colony Optimization (ACO)-based metaheuristics (Meta 1 and Meta 2) — was executed under both distance-based and CO₂-based scenarios. The heuristic, being deterministic, was run once per matrix, while each metaheuristic was executed ten times per scenario. Total distance and CO₂ emissions were computed for each solution, and results were compared through boxplots and summary tables. Although differences between the two optimization criteria were minimal, CO₂-based optimization slightly outperformed distance-based optimization, yielding marginally lower total distances and emissions. Both ACO-based metaheuristic algorithms consistently outperformed the greedy heuristic, confirming their superior robustness. These findings suggest that, in this context, optimizing routes for CO₂ emissions or distance leads to comparable results, indicating that ecological and efficiency objectives may align in real-world logistics scenarios.

Key words:

capacitated vehicle routing problem, agricultural logistics, metaheuristic, ant colony optimization, heuristic, life cycle assessment, carbon footprint

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1. Introduction

This study focuses on a practical logistics problem encountered by an agricultural company: efficiently collecting full containers from known locations using a fleet of trucks based in multiple depots, and delivering these loads to processing facilities. Such operations are common in the agricultural sector, where harvested materials or by-products are temporarily stored in containers distributed across the territory and must be periodically retrieved for processing (14, 3). Efficient route planning is crucial, as transportation typically accounts for a substantial portion of operational costs and environmental impacts (4).

The main goal is to reduce the total distance traveled while respecting both vehicle capacity and depot availability constraints (10). Each truck can only carry a limited number of containers, and depots may have restrictions related to working hours or fleet size (34). Therefore, finding an optimal allocation of routes among depots, while minimizing redundant travel, represents a complex combinatorial optimization challenge (37, 22). From a modeling perspective, this scenario can be represented as a multi-depot extension of the Capacitated Vehicle Routing Problem (CVRP) (13, 11), in which each vehicle departs from a specific depot, collects a set of containers, and delivers them to designated processing centers (29).

To address this problem, three algorithms are applied: one heuristic and two metaheuristics based on Ant Colony Optimization (ACO). Heuristic methods generate feasible solutions by following simple decision rules or approximations, often prioritizing computational speed over guaranteed optimality (26, 24, 30). These approaches are particularly useful when dealing with large-scale, real-world problems where exact algorithms become computationally infeasible (31). Metaheuristics, on the other hand, are higher-level strategies designed to explore the solution space more effectively and escape local optima by incorporating adaptive mechanisms, randomness, and learning processes (33, 18).

Ant Colony Optimization (ACO) is a population-based metaheuristic inspired by the foraging behavior of real ants (6). In nature, ants collectively discover efficient paths between their nest and food sources by depositing and following pheromone trails (21). Similarly, in ACO algorithms, artificial agents (ants) iteratively build candidate solutions, communicating indirectly through virtual pheromone updates that reinforce good solutions and fade over time (16, 17, 15, 5, 36, 27). This positive feedback mechanism enables the algorithm to balance exploration of new routes with exploitation of previously successful ones, gradually converging toward high-quality solutions (38).

In this work, two optimization criteria are considered: minimizing the total distance traveled and minimizing CO₂ emissions per route. While distance minimization is a classical objective in routing problems (23), incorporating environmental performance adds a sustainability dimension that reflects current trends in green logistics. CO₂ emissions are estimated using Life Cycle Assessment (LCA), a standardized methodology for quantifying the environmental impacts of a process throughout its entire life cycle (35, 32). In this study, the LCA-based calculation of emissions accounts not only for total distances but also for the specific types of roads traversed by the trucks, as different road categories (e.g., urban, rural, highway) are associated with varying fuel consumption rates and corresponding CO₂ outputs. This provides a more accurate and context-sensitive estimation of the environmental footprint of each route (20, 28, 25).

The main objective of this article is to evaluate and compare the performance of the routes obtained under these two criteria, assessing both total distances and total emissions to determine whether optimizing one measure significantly affects the other. By contrasting efficiency-oriented and sustainability-oriented optimization, the study aims to provide insights into the potential alignment—or divergence—between economic and environmental objectives in agricultural logistics. All datasets and scripts employed in this study are publicly available at: https://github.com/hyacinthus/ACO_MDCVRP-PF_D_vs_CO2, ensuring full reproducibility of the results and transparency of the computational workflow.

Road map of the paper: The remainder of this paper is structured as follows. Section 2 presents the formal definition of the studied problem, introducing the Multi-Depot Capacitated Vehicle Routing Problem (MDCVRP) and providing a brief overview of the three algorithms applied. This section also introduces the Life Cycle Assessment (LCA) approach and motivates the use of CO₂ emissions as an optimization criterion. Section 3 describes the experimental setup, including the real-world datasets and geographic context. It details the construction of the distance and CO₂ matrices, the simulation parameters, hardware used, and the evaluation metrics considered. Section 4 reports the results of the simulations, including comparative analyses through boxplots and tables. Statistical analyses are presented to evaluate the differences between the distance- and CO₂-based optimization scenarios, along with discussion of their practical implications. Finally, Section 5

summarizes the main findings, discusses the implications for sustainable agricultural logistics, and outlines potential directions for future research.

2. Methodology

This section presents the formal definition of the studied problem, introducing the Multi-Depot Capacitated Vehicle Routing Problem (MDCVRP-PF) and providing an overview of the three solution algorithms applied. We also describe the Life Cycle Assessment (LCA) approach and motivate the use of CO₂ emissions as an optimization criterion.

2.1. Problem Definition

The logistics problem addressed in this study involves the collection and delivery of agricultural bins from multiple fields to processing facilities, using a fleet of vehicles distributed across several depots. Each vehicle has a limited carrying capacity, and the goal is to efficiently plan routes that minimize the overall travel distance or the total CO₂ emissions.

This problem is modeled as a variant of the Capacitated Vehicle Routing Problem (CVRP), enriched with features typical of Multi-Depot VRP and VRP with Intermediate Facilities. Specifically, vehicles depart from assigned depots, visit collection points to pick up bins, and deliver the load to processing facilities.

Key constraints include: ensuring all bins are collected, respecting vehicle capacities, starting routes from depots and ending at processing facilities, and maintaining route continuity among visited fields. Figure 1 provides a visual representation of the problem, showing depots, fields, processing facilities, and the interconnecting routes.

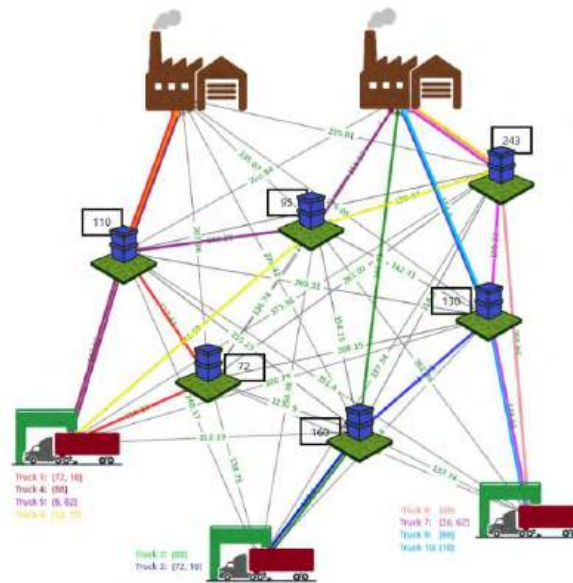


Fig. 1. Illustration of the MDCVRP-PF problem. Depots are shown at the bottom, each with assigned vehicles. Fields with available bins are depicted in the central area, while processing facilities are located at the top. Arcs connecting all nodes represent possible travel routes between depots, fields, and facilities.

2.2. Solution Algorithms

To address the MDCVRP-PF, we compare three algorithms: a simple greedy heuristic and two metaheuristics based on Ant Colony Optimization (ACO). The greedy heuristic follows a local decision

logic: each vehicle moves to the closest available field, collects the maximum allowable bins until capacity is reached, and then proceeds to the nearest processing facility. This approach is computationally inexpensive but does not account for global optimization.

The ACO-based metaheuristics are inspired by the foraging behavior of ants, where collective memory and pheromone trails guide the search for efficient routes (1). Vehicles (modeled as ants) iteratively construct routes, with the selection of the next field influenced by both heuristic guidance—typically related to distance or travel cost—and a probabilistic component encoded in the pheromone levels, which reflect the quality of past solutions (2, 12). The first ACO variant uses pheromone information to determine the visiting order of fields, while the collected quantity at each stop is always maximized. The second ACO variant extends this approach by adaptively deciding how many bins to collect at each field, up to the vehicle's remaining capacity, allowing partial collection and greater routing flexibility. After each iteration, pheromone levels are updated to reinforce promising routes and quantities, while evaporation prevents premature convergence and encourages exploration (19). Global parameters, including the number of simulated fleets, maximum number of iterations, and weights for pheromone and heuristic components, are tuned to ensure high-quality and robust solutions across different problem instances. The Python scripts implementing all three algorithms are available at the following link: https://github.com/hyacinthus/ACO_MDCVRP-PF_D_vs_CO2

2.3. Life Cycle Assessment (LCA) and CO₂ Optimization

In addition to distance-based optimization, this study evaluates routes based on environmental impact, specifically CO₂ emissions. Emissions are estimated using the Life Cycle Assessment (LCA) methodology, which quantifies environmental impacts across the full life cycle of transportation activities. The impact category Global Warming Total (fossil+biogenic) adopted in the context of the Product Environmental Footprint (PEF) and performed by the Intergovernmental Panel on Climate Change (IPCC) was considered according to the guidelines for the development of Product Environmental Footprint (7, 8).

In this context, LCA accounts not only for fuel consumption during truck operation but also for the type of road segments traversed, capturing differences between principal roads and local streets (9). This approach provides a more comprehensive and realistic estimation of the environmental footprint associated with each route, allowing us to compare distance-based and CO₂-based optimization scenarios.

3. Experimental Setup

3.1. Problem Definition and Data

The experimental analysis focused on a realistic scenario including 31 points, comprising fields with containers, 4 depots as starting locations for the vehicles, and 1 final delivery center. The coordinates of all points, the number of containers per field, and the fleet composition are provided as CSV files at the following link: https://github.com/hyacinthus/ACO_MDCVRP-PF_D_vs_CO2/tree/main/Experiment

For this scenario, two distinct matrices were constructed:

- 1. Distance matrix:** calculated as the road distance between each pair of nodes. This matrix represents the length of the routes in kilometers between all points in the system (fields, depots, and delivery center).

- 2. CO₂ equivalent emissions matrix:** derived from LCA data, calculated by accounting for routes on rural roads and on urban roads, assuming diesel articulated trucks with a maximum load capacity of 25 t. The emissions per kilometer for each road type were multiplied by the corresponding distances traveled, generating two partial matrices which were then summed to obtain the total matrix of emissions

in kilograms of CO₂ equivalents.

The graphical representation of the problem scenario is shown in Figure 2.

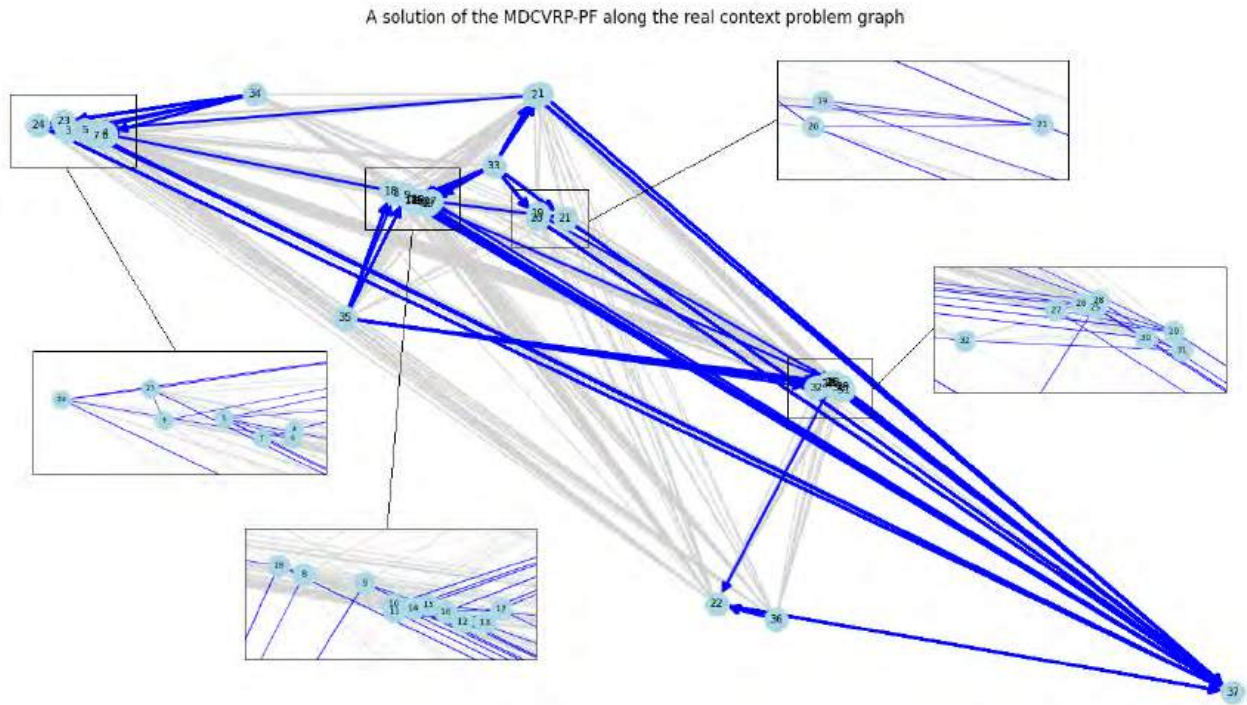


Fig. 2. Example solution of the MDCVRP-PF. The underlying graph connecting depots, fields, and processing facilities is shown in gray, while the routes of all vehicles constructing the solution are highlighted in blue.

3.2. Simulation Parameters

The comparison involved the baseline heuristic, Metaheuristic 1, and Metaheuristic 2. For both metaheuristics, the hyperparameter values previously identified as optimal for this scenario were adopted: $(\alpha, \beta) = (0.5, 0.5)$ for Metaheuristic 1, and $(\alpha, \beta) = (1.5, 0.5)$ with $(\alpha_Q, \beta_Q) = (0.5, 2.0)$ for Metaheuristic 2, as summarized in Table 1. The values of N_{fleet} and N_{iter} were both set to 200, based on previous simulations, which were found to be the most suitable for obtaining high-quality solutions with this dataset.

Table 1
Selected ACO hyperparameters for the execution of Metaheuristic 1 and Metaheuristic 2 in the experiments.

Metaheuristic	N_{iter}	N_{fleet}	α	β	(α_Q, β_Q)
1	200	200	0.5	0.5	
2	200	200	1.5	0.5	(0.5, 2.0)

In the ACO algorithms, the values of the CO₂ weight matrix was multiplied by a factor of 8500 to produce numerical values comparable to those of the distance matrix. This scaling was necessary so that the other hyperparameters, originally tuned for the distance matrix, would still perform effectively in terms of algorithm convergence when applied to the CO₂ data. The factor 8500 was determined by comparing the average numerical values of the two matrices.

3.3. Simulation Procedure and Evaluation Metrics

The algorithms were executed separately on the two matrices: the distance matrix and the CO₂ emissions matrix.

- The deterministic heuristic was run once for each matrix.
- The ACO metaheuristics were run 10 times for each matrix to assess variability due to the probabilistic component.

For each execution, regardless of the matrix used for optimization, both the results in terms of total distance traveled (km) and total CO₂ equivalent emissions were recorded. This is possible because each solution represents a set of sequences of visited nodes and collected quantities: knowing the route, it is therefore possible to retrospectively calculate both the total distance traveled using the distance matrix and the total emissions using the CO₂ matrix.

This approach allows for comparing the performance of each algorithm both from a logistical perspective (kilometers traveled) and an environmental perspective (CO₂ equivalents), even when the optimization was performed considering only one of the two metrics.

4. Results

The simulation results are presented using two main types of visualization: two boxplot figures and a summary table of the best values obtained by the three algorithms.

4.1. Boxplots of the simulations

Two boxplot figures (Figures 3 and 4) display the distribution of results obtained in each algorithm execution:

- The first figure reports results in terms of total distance traveled (km).
- The second figure shows results in terms of total CO₂ equivalent emissions.

Since the heuristic is deterministic, it produced a single result for each matrix. These values are represented as horizontal lines in the figures.

In contrast, the metaheuristics (Metaheuristic 1 and Metaheuristic 2) were executed 10 times for each matrix, so their results are shown as boxplots. For each metaheuristic, there are two boxplots: one for optimization with the distance matrix and one for optimization with the CO₂ matrix.

Thus, each figure contains six elements: two horizontal lines for the heuristic (distance and CO₂ optimization) and four boxplots for the two metaheuristics.

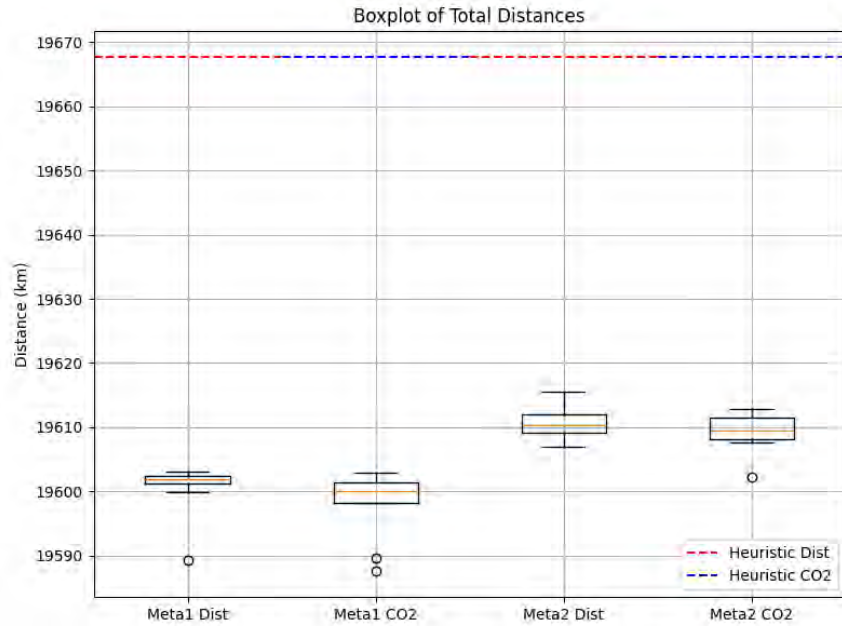


Fig. 3. Boxplots showing the distribution of total distance (km) for each algorithm and optimization matrix. Horizontal lines indicate the results of the deterministic heuristic, while boxes represent the distributions from 10 runs of each metaheuristic.

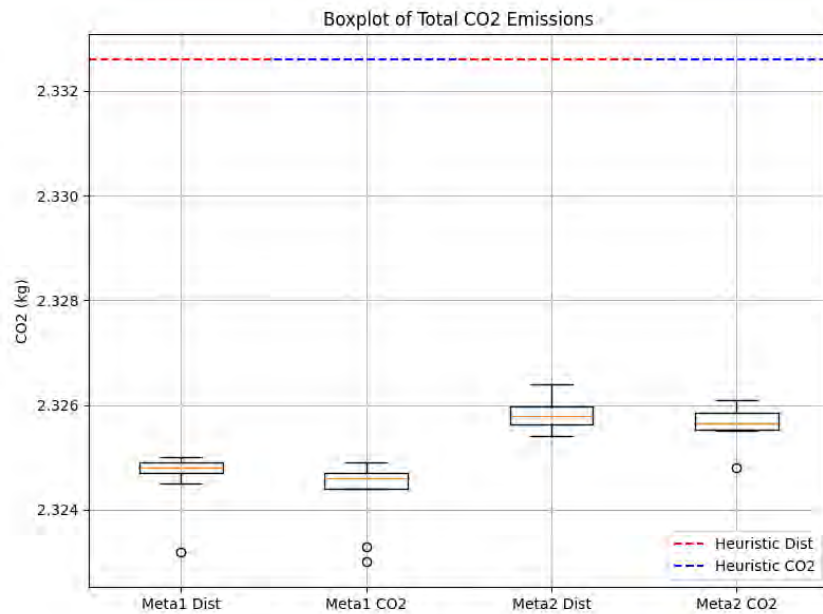


Fig. 3. Boxplots showing the distribution of total CO₂ equivalent emissions for each algorithm and optimization matrix. Horizontal lines indicate the results of the deterministic heuristic, while boxes represent the distributions from 10 runs of each metaheuristic.

Visual inspection of the boxplots indicates that all algorithms produce similar results, with the metaheuristics showing slightly better performance than the deterministic heuristic in terms of both distance traveled and CO₂ emissions. Moreover, Metaheuristic 1 appears to perform slightly better than Metaheuristic 2 overall. Additionally, for the same algorithm, optimization based on the CO₂ matrix generally leads to better results compared to optimization based on the distance matrix.

4.1. Table of best results

Table 2 summarizes the best solutions obtained by the three algorithms for the two optimization matrices. The table has six columns (three algorithms $\times$ two optimization matrices) and two rows (distance optimization and CO₂ optimization).

Table 2.

Summary of the best results obtained by the heuristic, Metaheuristic 1, and Metaheuristic 2 for both optimization matrices.

Metric	N_{iter}	N_{fleet}	α	β
Distance (km)	Distance CO ₂	19667.69 19667.69	19589.30 19587.50	19608.50 19602.19
CO ₂ (kg)	Distance CO ₂	2.3326 2.3326	2.3232 2.3230	2.3254 2.3248

From the table, it can be observed that although the differences among algorithms are generally negligible, optimization with the CO₂ matrix tends to produce slightly better results even in terms of total distance traveled. This suggests that CO₂-based optimization may lead to more efficient routes overall without compromising logistical performance.

5. Conclusions

This study presented a comparative analysis of three algorithms for solving a real-world agricultural logistics problem, involving the collection and delivery of containers from multiple depots using capacity-constrained trucks. Two optimization scenarios were investigated: one based on total distance (km) and the other based on CO₂ equivalent emissions derived from Life Cycle Assessment (LCA) following the Product Environmental Footprint (PEF) methodology. The experiments showed that:

- Both metaheuristic algorithms (Metaheuristic 1 and Metaheuristic 2) consistently outperformed the greedy heuristic in terms of both total distance and CO₂ emissions.
- Metaheuristic 1 generally produced more consistent and robust results across multiple runs, while Metaheuristic 2 provided comparable solutions but with slightly higher variability.
- The deterministic heuristic, while computationally inexpensive, failed to reach the quality of solutions obtained by the ACO-based approaches, confirming the advantage of metaheuristic strategies in complex routing problems.
- The differences between distance- and CO₂-based optimization were minimal. Generally, CO₂-based optimization yielded slightly lower total distances as well as lower emissions, suggesting that ecological and logistical objectives can be aligned in this scenario.

Overall, the results indicate that in realistic agricultural logistics contexts, optimizing for CO₂ emissions does not compromise operational efficiency. The proposed ACO-based metaheuristics provide reliable and flexible tools for achieving both environmental and logistical objectives, supporting sustainable decision-making in agricultural supply chains.

Future work may explore the integration of additional sustainability metrics, such as fuel consumption or other environmental impacts, as well as the application of hybrid metaheuristic approaches to further improve solution quality and computational efficiency.

Declaration

Availability of data and material: The data are available at:

https://github.com/hyacinthus/ACO_MDCVRP-PF_D_vs_CO2

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From Plants to Packaging: The Role of Natural Waxes in Sustainable Food Preservation

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JEL: O14, P24, C41, E13

Abstract

Background and aim: Food safety is a key priority of the food industry. Increased food waste and the spread of foodborne illnesses can result from contamination of food products due to incorrect handling, packing, and storage. Customers frequently have an unfavorable opinion of the usage of synthetic compounds as additives or as substances that form films. Consequently, there is interest in developing alternative kinds of food packaging materials that are more environmentally and consumer-friendly. This study aimed to conduct a literature review and update previous overviews of the recently reported edible films, summarizing their applications. *Methods:* Major electronic medical databases—PubMed, Scopus, Science Direct, Web of Science, and Google Scholar—were systematically searched for publications to 2025. *Results:* A total of 127 studies met our inclusion criteria, combining search words “edible coating” and “natural wax-based coating”. *Conclusions:* Natural wax-based coatings have shown great potential in preserving the quality of fruit and can be effectively applied to reduce postharvest losses across the supply chain. These coatings can help maintain the fruit’s overall quality, thereby extending shelf life and enhancing marketability.

Key words:

food preservation, plant-based wax, biodegradable packaging, edible films

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1. Introduction

The food industry is driven by the growing demand for fresh products to develop innovative and improved methods for preserving fresh produce's quality and prolonging its shelf life (see Senna, Al-Shamrani & Al-Arifi, 2014). A variety of postharvest technologies, including as chemical treatments, controlled environment storage, ethylene antagonists, low storage temperatures, and edible coatings, were employed to improve the quality and extend the shelf life of fruit. As living standards have steadily increased, several of the methods for preserving fruit that have been outlined may have unanticipated repercussions and leave customers unhappy (see Nguyen, Tran, Bach, & Thuc, 2024).

Uneven ripening, high expense, and chilling injuries are some of the drawbacks of most of these methods (see Shinga, Silue, & Fawole, 2025). Additionally, customers worldwide require high-quality food free of chemical preservatives (see Senna, Al-Shamrani & Al-Arifi, 2014). Among other methods, edible coating has become a viable choice among these techniques as a natural preservative, due to its affordability, environmental friendliness, safety, and additional features like antibacterial and antioxidant activity (see Shinga, Silue, & Fawole, 2025).

Consequently, there is interest in developing alternative kinds of food packaging materials that are more environmentally and consumer-friendly.

Waxes are used in coatings, food packaging, and the cosmetics industry, among other areas (see Trivedi, Karppinen, Klavins, Kviesis, Sundqvist, Nguyen, Heinonen, Klavins, Jaakola, Väänänen, Remes, & Häggman,

2019).

Waxes are esters of high molecular weight monohydroxy alcohols and high molecular weight carboxylic acids. They are waterproofing substances called plant waxes and are present on the outer surface of plants. They differ chemically from hydrocarbon or paraffin waxes, fats and oils, and synthetic waxes as carbowax (see Bodmier & Hermann, 1997). Commercially and industrially significant plant waxes, including candelilla wax, carnauba wax, rice bran wax, sunflower wax, etc., are obtained from the plants and are used to make cosmetics, ink, polish, varnish, candles, crayons, and other products. Additionally, they are employed to create edible coverings for a variety of food items. It was discovered that they preserve the qualities and characteristics of food when it is being stored (see Lan, 2019).

The Brazilian palm tree, *Coernicia cerifera* Martius, often known as the carnauba wax palm, is the primary source of carnauba wax, sometimes referred to as the "Queen of Waxes." The wax is found on the surface of the palm leaves. The long-chain alcohols and esters found in carnauba wax—unesterified alcohols (12%), x-hydroxy esters (14%), and esters of hydroxylated cinnamic acid (30%)—are among its distinctive features. Carnauba wax melts between 82.5 and 83 degrees Celsius, making it one of the toughest plant waxes. Due to these properties, it is frequently used to raise the melting point of wax compositions. It's the most significant plant wax and is widely used in emulsions, edible coatings, oleogels, and other products (see Tinto, Elufioye & Roach, 2017), as well as in foods, confectionery coatings, cosmetics, cars, furniture wax, and more (see Néstor, Ledesma, Bautista-Hernández, Rojas, Aguilar-Zárate, del Pilar Medina-Herrera, Castro-López & Cristian Guadalupe Martínez-Ávila, 2022).

Candelilla wax (The "Great Wax Rush"), on the other hand, is mainly obtained from the leaves of the plant *E. antisiphilitica* Zuccarini, native to northern Mexican and southwest Texas (see Tinto, Elufioye & Roach, 2017), as well as in foods, confectionery coatings, cosmetics, cars, furniture wax, and more (see Arato, Speelman, & Van Huylbroeck, 2014). About 42% hydrocarbons, 39% wax, resin, and sitosteroyl esters, 8% free wax and resin acids, 6% lactones, and 5% free wax and resin alcohol are all present in unpurified candelilla wax.

The berries and stems of the *Rhus succedanea* tree are the source of Japan Wax, sometimes referred to as sumac wax. It is a pale-yellow, waxy, water-insoluble solid with a sticky texture. It contains 5% fatty acid, and it is not a genuine wax, but it has a higher viscosity than other waxes. It gives the blend a pleasant, pliable feel and thickens recipes. Candles, furniture polishes, floor waxes, wax matches, soaps, food packaging, cosmetics, pharmaceuticals, metal lubricants, buffing compounds, pastels, crayons, adhesives, thermoplastic resins, are beeswax alternatives and are all made with Japanese wax. It is not frequently used in food since it becomes rancid (see Krendlinger & Wolfmeier, 2022).

Ouricury wax is a brown-colored substance that is extracted by scraping the surface of Brazilian feather palm (*Syagrus coronata*) leaves. Compared to carnauba wax, ouricury wax is more challenging to harvest because it does not flake off the leaf surface. When light color is not needed, such as in carbon paper inks, molding lubricants, and polishes, ouricury wax can be used as a substitute because of its similar physical characteristics to carnauba wax (see Lan, 2019; Pashova, 2011).

Another high-melting vegetable wax is rice bran wax. It is present in rice husks (*O. sativa*). It is a by-product of rice bran oil's de-waxing process (see Lan, 2019). After being extracted from rice bran oil, the dark, reddish-brown rice bran wax possesses good nutritional qualities. It is distinguished from rice bran, which has a number of health-promoting ingredients. Because of its abundance in Asia and very inexpensive cost, it has several uses. Because of its superior film-forming qualities, it can be utilized as an effective edible coating material. Numerous food applications, including the creation of oleogels, structured lipids, and edible food product coatings, have successfully employed reddish-brown rice (see Modupalli & Natarajan, 2022).

The seeds and hulls of sunflowers (*H. annuus*) contain sunflower wax. Sunflower oil is winterized in order to extract it. It is a firm wax, just like rice bran wax. It's not approved by the FDA and therefore its main uses are in cosmetics, including emulsions, lipsticks, mascaras, and lip balms. It controls the hardness, texture,

and mold release of cosmetic compositions and acts as a consistency modifier. Additionally, it can be used to replace rice bran wax, carnauba wax, and candelilla wax (see Tinto, Elufioye & Roach, 2017).

Fresh fruits and vegetables have a natural skin-like shell that is covered by a cuticle (a higher plant's natural shell that shields the fruits, vegetables, flowers, and leaves from harmful environmental factors – Figure 1) or a shell for nuts (see Bai, Plotto & Baldwin, 2011; Maringgal, Hashim, Syafinaz, Amin Tawakkal & Tengku Muda Mohamed, 2020; Nor, & Ding, 2020; Fernández-Muñoz, Heredia & Domínguez, 2022). These organic barriers limit the loss of volatile taste and fragrance compounds and control the flow of oxygen, carbon dioxide, and water.

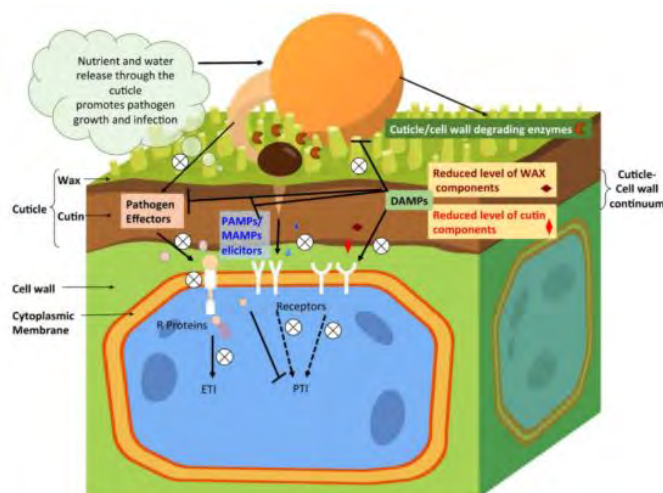


Figure 1. Plant Cuticle

Source: (see Ziv, Zhao, Gao & Xia, 2018)

The cuticle, which acts as a barrier between the plant surface and the surroundings, is produced in the epidermal cells of many different types of plants, including leaves, fruits, stems, and flowers. Cuticular wax and cutin, two lipophilic substances, make up the hydrophobic layer known as the cuticle. The hydrophobic waxes that make up the cuticle play one of their most crucial roles (see Bhanot, Fadanavis & Panwar, 2021). Cuticular wax, which is derived from the peels and leaves of fresh produce, is a continuous layer that can be found inside or outside of a plant's cuticle. The degree of colorization is influenced by the waxes present on the leaf or fruit surface, and the result differs depending on the species of plant (see George, 2005). The cuticle of many berry fruit types is used to extract berry wax. It is a possible source of natural waxes and is made from the peel berry wastes from the berry juice business. Plant-based wax coatings help preserve food products by reducing the loss of moisture, gases, and volatile organic compounds.

Edible films made from plant-based resources are viewed as environmentally friendly substitutes for plastic, with the potential to reduce food waste and offer sustainable packaging options.

Therefore, our main goal was to evaluate edible and biodegradable packaging from plant waxes and how they enhance food preservation and promote sustainability.

2. Literature Review and Hypotheses Development

An edible coating is a thin layer that is applied to the surface of fresh food by brushing, spraying, dipping, and other methods to provide physical protection and prevent solvent, gas, and water vapor from penetrating (see Senna, Al-Shamrani & Al-Arifi, 2014; Al Lawati, Al Shukaili, Al-Dairi & Pathare, 2024).

The thin films are semi-permeable to various gases, such as O₂, CO₂, and C₂H₄; they can create a modified atmosphere around the coated fruit [14]. Edible films can be classified as polysaccharide-based, lipid-based, and

protein-based coatings. Polysaccharides and protein coatings, such as pectin/agarose-based coating (see Pham, Tran, Phung, Bach, Van Nguyen & Nguyen, 2023), aloe vera, starch, and Arabic gum (see Tchinda, Anoumaa, Tazo, Phounzong, Kenfack, Lekeufack, Doumdi, Nguemezi & Fonkou, 2023), and soybean protein (see Li, Sun, Sun, Chen, Wu & Le, 2019), have been shown in numerous studies to be effective in preserving banana fruit by preventing microbial and mechanical damage, enhancing the fruit's appearance, retaining volatiles, and postponing the deterioration of its quality (see Pham, Tran, Phung, Bach, Van Nguyen & Nguyen, 2023; Tchinda, Anoumaa, Tazo, Phounzong, Kenfack, Lekeufack, Doumdi, Nguemezi & Fonkou, 2023; Li, Sun, Sun, Chen, Wu & Le, 2019; Le, La, Nguyen, Nguyen, Vo, Nguyen, Tran, Chang, Nguyen & Nguyen). Additionally, by giving fresh fruit gloss features and preventing color changes, edible films can improve their look. According to certain reports, edible coating can effectively delay the ripening process, increase the bananas' shelf life (see Thakur, Pristijono, Bowyer, Singh, Scarlett, Stathopoulos & Vuong, 2019), and preserve their flavor sugars and organic acids (see Al-Yahyai, Al-Yahyai, Janke, Al-Dairi & Pathare, 2025).

A variety of health benefits have been linked to the use of vegetable oils as an edible coating for fresh fruit and vegetables because they are readily available, nonvolatile, affordable, nontoxic, non-depletable, and a source of monounsaturated fatty acids (see Khalid, Niaz, Saeed, Afzaal, Islam, Hussain, Mahwish Khalid, Siddeeg & Al-Farga, 2022). Additionally, it has been reported that fruit and vegetable coatings are made with edible oils such as coconut, olive, custard, butter, paraffin, etc. Another edible coating made especially from moringa seeds is moringa oil. Moringa oils have a variety of compositional characteristics, including proteins, phenolic content, and antioxidants. Moringa oil is a promising, low-cost substance used to reduce harmful germs from fresh vegetables.

Another natural edible covering that is used to improve postharvest life on fresh produce is olive oil, which contains antifungal qualities (see Sherani, Murtaza, Kamaran, Altaf, Jilani, Sajid, Manan & Bashir, 2025). Using olive oil, either by alone or in combination, has been shown to prolong the freshness of apples (see Khalifa, Barakat, El-Mansy & Soliman, 2016), bananas (Al-Yahyai, Al-Yahyai, Janke, Al-Dairi & Pathare, 2025), grapes (see Baraiya, Ramana Rao & Thakkar, 2016), and sweet cherries (see Zam, 2019).

Edible coatings and films are a sustainable and effective method of preserving food and increasing its shelf life by acting as passive barriers that alleviate the need for chemicals, protecting products from moisture, oxidation, mechanical stress, and microbial infestation (see Yaashikaa, Kamalesh, Kumar, Saravanan, Vijayasri & Rangasamy, 2023). According to Oduro (2021), edible coatings can be generally classified into the following main groups: Protein-based edible coatings, Polysaccharide-based coatings, Lipid-based coatings, Agro-Industrial Waste, and Composite Materials (Table 1).

Table 1.

Classification of edible coatings, source: (see Oduro, 2021)

Coating Material Type				
Polysaccharides	Animal/Plant Proteins	Lipids	Agro-Industrial Waste	Composite Materials
Cellulose and derivatives	Whey and Casein	Vegetable Oils	Fruit Residues	Polysaccharides and Proteins
Starch and derivatives	Gelatin or Collagen	Mineral Oils	Vegetable Residues	Polysaccharides and Lipids
Alginate and carrageenan	Egg Albumin	Wax	Silk Wastes	Lipids and Proteins
Chitin and chitosan	Soy or Corn protein		Sugarcane Bagasse	
Pectin	Wheat Gluten		Wine Manufacture Wastes	

Numerous studies demonstrate the potential of edible coatings and films, such as vegetables, fruits, fish, meat, cereals and their derivatives, and dairy products. The bioactive compounds that improve their functionality and health benefits, including antioxidant, anti-inflammatory, and cardioprotective effects; improving gut and immune health; aiding in disease prevention; and enhancing nutrient absorption, have also been investigated (see Sáez-Orviz, Rendueles & Diaz, 2023; Khin, Ahammed, Kamal, Saqib, Liu & Zhong, 2024). Edible coatings may include bioactive compounds transforming food products into “functional” foods (see Sáez-Orviz, Rendueles & Diaz, 2023). Among these compounds, polyphenols stand out due to their antioxidant, anti-inflammatory, and antimicrobial functions, which not only help protect food quality but may also confer health benefits after long-term storage. These natural plant-derived molecules can modulate oxidative stress and are associated with a reduced risk of chronic diseases such as cancer, diabetes, osteoporosis, neurodegenerative diseases, and cardiovascular disease. In addition to polyphenols, other compounds such as vitamins, minerals, probiotics, and prebiotics, among others, may also be incorporated depending on the functional goal of the coating (see Guan, Zhang, Li, Cui, McClements, Wu, Chen, Long, Jiao, Qiu & Jin, 2022; Pellegrino, Elechi, Plastina & Loizzo, 2024).

According to a number of studies, the addition of natural components such as proteins, polysaccharides, and plasticizers not only maintains the fruit's organoleptic qualities but also increases its resilience to unfavorable environmental factors, allowing for longer storage (see Nischitha, Shravya, Pooja & Mahesh, 2023). Fruit, including mango, papaya, and grapes, has benefited greatly from these compositions' successful application, which has shown notable increases in firmness, color retention, acid content, and resistance to physical damage (see Kandasamy, Yoo, Yun, Kang, Seol, Kim & Ham, 2021; Himanshu Maru, Goswami & Goswami, 2019). But in the particular instance of bananas, coatings that are suited to their physiological traits—like high respiration rates and ethylene sensitivity—still need to be developed.

Al-Yahyai et al. applied moringa oil and olive oil-based edible coatings as an effective, eco-friendly postharvest strategy to extend the shelf life of bananas by acting as semi-permeable barriers to moisture and gases (see Al-Yahyai, Al-Yahyai, Janke, Al-Dairi & Pathare, 2025).

Similar findings were observed by Medina et al., who used a protein-polysaccharide coating in order to prolong the banana's life (see Ruiz Medina, Quimbata Yupangui & Ruales, 2025).

A 10% w/v rice bran wax emulsion was used by Abhirami et al. (2020) (see Abhirami, Modupalli, & Natarajan, 2020) to successfully extend tomato shelf life to 27 days, compared to the control's 18 days.

Gonzales et al. used a lemon peel, a by-product of the lemon juice, and especially the phenolic compounds from lemon peel for enhancing the postharvest quality of cherry tomatoes (see González-Cuello, Hernández-Fernández & Ortega-Toro, 2025).

Hromiš et al. investigated a novel composite biopolymer hydrogel-based film composed of a Pressed hull-less pumpkin (*Cucurbita pepo* L. cv. *Olinka*) oil cake layer and a paraffin wax layer. The authors successfully applied this film in apricot coating and storage (see Hromiš, Ostojić, Pezo, Popović, Šumić, Milić, Kocić -Tanackov & Šuput, 2024).

Mari et al. evaluated the effects of edible coatings from *Chlorella vulgaris* proteins on the shelf life, nutritional attributes, and quality of berries. Specifically, the research assesses the coatings' ability to reduce spoilage, maintain physicochemical properties, and preserve essential nutrients during storage, providing comprehensive insights into their potential as a sustainable postharvest preservation strategy (see Mari, Stergiopoulos, Vasileiou, Krokida, 2025).

3. Materials and Methods

This review aimed to evaluate available research on edible coatings and organize and present the findings. An attempt was made to include all articles published from 2015 to 2025. Relevant studies were identified using databases such as PubMed, Scopus, ScienceDirect, Web of Science, and Google Scholar. Keyword

combinations such as “edible coatings”, “plant-based waxes”, “bioactive compounds”, “antioxidant”, “anti-inflammatory”, and “functional foods” were among the search results. Original research studies and review articles that discussed the chemical, nutritional, botanical, or commercial aspects of edible films were taken into consideration. To conduct this literature search, various databases were utilized, including PubMed, Google Scholar, Springer Nature, Scopus, Medline, ScienceDirect, and Elsevier. Our search strategy included recently published accessible data. Due to the heterogeneity of the included studies, results were synthesized narratively and presented. No quantitative meta-analysis was performed.

4. Results and Discussion.

Edible coatings and films provide an efficient and sustainable way to preserve food and extend its shelf life by functioning as passive barriers that reduce the need for chemicals and shield products from moisture, oxidation, mechanical stress, and microbial infestation (see Yaashikaa, Kamalesh, Kumar, Saravanan, Vijayasri & Rangasamy, 2023). Edible coatings and films have been demonstrated in numerous studies to have the potential to enhance the functionality and health benefits of foods, including vegetables, fruits, fish, meat, cereals and their derivatives, and dairy products, by extending their shelf life and enriching their content in bioactive compounds. These benefits include improved gut and immune health, disease prevention, improved nutrient absorption, and antioxidant, anti-inflammatory, and cardioprotective effects (see Khin, Ahammed, Kamal, Saqib, Liu & Zhong, 2024; (see Sáez-Orviz, Rendueles & Diaz, 2023).

The potential of nanocomposite systems as carriers of bioactive compounds to improve edible coatings, enhance the controlled release and dispersibility of bioactives within the food matrix, and increase the overall functionality of food systems is of significant interest, despite the lack of research on functional food applications (see Pellegrino, Elechi, Plastina & Loizzo, 2024). An oral disintegrating film (ODF), a practical and amiable substitute for patients who have trouble swallowing, was created by Khatreja & Santhiya (2024) (see Khatreja & Santhiya, 2024). It is made of hyaluronic acid, okra mucilage, suspended vitamin C-loaded bioactive glass nanoparticles, and clove essential oil as a possible functional food. The created ODF exhibited hemocompatible, antioxidant, and antibacterial qualities.

Since edible films and coatings are often created at lab scales and are difficult to get, they must contend with a scalability issue that drives up production costs. Furthermore, depending on their extraction method and place of origin, these biopolymers show significant variation in molecular weight, chain branching, and purity in every batch (see Reichert, Bugnicourt, Coltelli, Cinelli, Lazzeri, Canesi, Braca, Martínez, Alonso, Agostinis, Verstichel, Six, De Mets, Gómez, Ißbrücker, Geerinck, Nettleton, Campos, Sauter, Pieczyk & Schmid, 2020). Their brittleness, thermal stability, and barrier or mechanical qualities are thus impacted by this discrepancy, which makes reproducible processing more difficult. Many biopolymers are unable to resist the shear and heat stress of extrusion, which can lead to changes in film thickness or problems with adhesion. While other technologies, such as electrospraying or electrospinning, have shown promise in the lab for producing active coatings, industrial upscaling is challenging due to their low yields and lack of homogeneity (see Shah, Bhatia, Al-Harrasi & Khan, 2024).

Furthermore, compared to conventional plastics and biobased alternatives like polyhydroxyalkanoate (PHA), polylactic acid (PLA), and poly(butylene adipate-co-terephthalate) (PBAT), the production of biopolymers uses less non-renewable energy, produces less CO₂, and emits fewer greenhouse gases overall. However, when taking into account their life cycle assessments, environmental issues are expressed (see Hermann, Debeer, De Wilde, Blok & Patel, 2011). Few studies have been conducted on biopolymers; most have concentrated on the most widely used biobased and biodegradable materials (see Merino, Bellassi, Paul, Morelli & Athanassiou, 2023; Plasencia, Arrieta, Lazaro-Hdez, Gomez-Caturla & Quiles-Carrillo, 2025). Therefore, taking into account the end of life of bioplastics, recycling (thermomechanical, chemical, and biological) may lower greenhouse gas emissions because it has a greater than 80% chance of replacing virgin

materials (see Rossi, Cleeve-Edwards, Lundquist, Schenker, Dubois, Humbert & Jolliet, 2015; Lamberti, Ingram & Wood, 2021). The quantity of recycling cycles, however, remains a topic of debate (see Barletta, Aversa & Puopolo, 2020).

Although it is possible to landfill bioplastics without first separating or cleaning them, this process results in uncontrolled methane emissions with energy recoveries of less than 20%. According to other writers, industrial composting has the greatest detrimental effects because it produces a lot of CO₂ and N₂O or causes soil acidification, all of which hinder seed germination (see Hermann, Debeer, De Wilde, Blok & Patel, 2011; Van Roijen & Miller, 2022). On the other hand, because biogas is used to generate power, anaerobic digestion has been identified as the degradation pathway with the smallest footprint (see Hermann, Debeer, De Wilde, Blok & Patel, 2011).

Therefore, the use of recovered, recycled, natural materials in the creation of edible coatings was the main focus of contemporary trends in food technology and the main object of the present report. Food qualities are thus maintained and enhanced, while the cost and price of the corresponding items are influenced by how effectively they are used. The fact that plant wax-based edible coatings are eaten along with the food they are applied to is a significant benefit over conventional synthetic films. Their use helps to protect the environment from pollution and maintains the ecological balance by limiting and reducing the use of natural oil supplies, which are depleting annually. In this context, it is suggested that plant waxes be extracted (separated) industrially from the cuticle (fresh fruit and vegetable peel wastes), peeled, and separated before processing into various products (fruit juices, vegetable concentrates, vegetable juices, fruit-sugar products, wines, etc.). Wax-based or pectin-based edible coatings should be made from the separated plant waxes. Edible coatings based on lipids are primarily used to prolong the shelf life and maintain their quality while being stored. The suggested technique should be used in the food business, namely in the stage prior to the use of fresh fruits and vegetables for processing into various goods (fruit and sugar products, vegetable concentrates, wines, and vegetable juices, among others). The issue of fully utilizing and separating plant waxes from the cuticle of fresh fruits and vegetables, which are not currently the focus of attention and are not utilized by fresh fruit and vegetable processors, is resolved. The potential to separate the plant waxes from the cuticle and use them in the creation of plant wax-based edible coatings and pectin or wax-based emulsion coatings is an advantage of the suggested method.

The method should find application in the food industry and, more precisely, in the stage before using fresh fruits and vegetables for processing them into different products (vegetable juices, fruit juices, wines, vegetable concentrates, fruit and sugar products, etc.).

The present method solves the problem of full utilization and separation of plant waxes from the cuticle of fresh fruits and vegetables, which are currently not the object of attention and are not used by fresh fruits and vegetable processors. The advantage of the proposed method is the possibility of separating the plant waxes from the cuticle and using them in the composition of edible coatings based on plant waxes and emulsion coatings based on pectin or wax (see Pashova, 2011).

The method for industrial separation of plant waxes from the cuticle of fresh fruits and vegetables involves the following stages (see Pashova, 2011; Pashova, 2023; Pashova & Zhivkova, 2010 – Figure 2):

1. Cleaning and sorting of the fresh fruits and vegetables.
2. Separate the peels from the surface of fresh fruits and vegetables.
3. Extraction of the plant waxes from the separated peels with chloroform heated to 40–50 °C for 1–3 min.
4. Filtration of the obtained warm solution, followed by its concentration (separation of the organic solvent from the filtrate).
5. The obtained plant waxes are finally dried and stored in dark conditions, at a temperature of 1–3 °C. They can be used to preserve fresh fruit and vegetables, freshly-cut fruit and vegetables, fresh and processed meat and fish products.

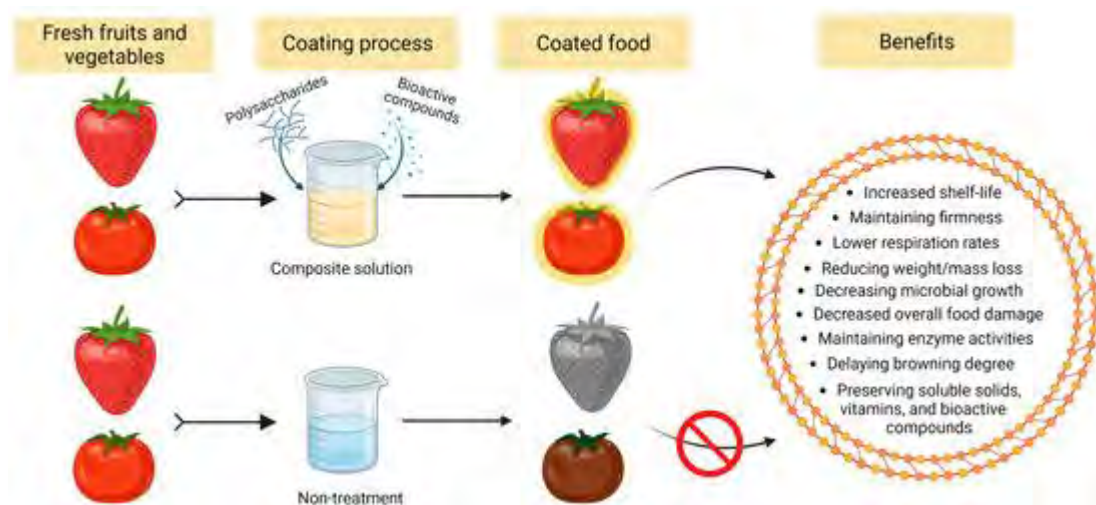


Figure 2. Schematic representation of the method for industrial separation of plant waxes

Source: (see Cruz-Monterrosa, Rayas-Amor, González-Reza, Zambrano-Zaragoza, Aguilar-Toalá, Liceaga, 2023)

Since waxes are not found in significant amounts in most plants, organic solvents are used to remove them. The best solvent for extracting waxes is hexane; hard, high-melting waxes and waxes with triterpene acids can be extracted using methylene chloride or chloroform (see Jouret & Puech, 1972). Cutin is insoluble in chloroform, which mostly dissolves hard wax, triterpene compounds, and trace amounts of soft wax, according to Nawrath (see Nawrath, 2002). The plant waxes that are part of the plant cuticle composition and the plant waxes on the surface can be separated from the waste products using the suggested approach.

The amounts of plant wax produced using the outlined approach can be used to make plant wax-based edible coatings. The cheap cost of the extracted plant wax will also have an impact on the cost of the food items that will subsequently have the edible coating applied. The resulting plant wax-based edible coatings will limit and minimize the utilization of natural oil deposits and the manufacturing of petroleum-based packaging that degrades slowly. Since consumers discard this disposable packaging every day, their production is currently a major global issue that pollutes the environment.

The need to import expensive carnauba and candelilla waxes is reduced by the suggested process and the potential for industrial plant wax extraction from fresh fruit and vegetable peels. The process is efficient, simple to use, and combines the financial interests of producers with the potential to create edible coatings using plant waxes. These coatings are widely utilized in the food business today to maintain the shelf life and quality of food.

Conclusion:

Edible coatings and films are an efficient and sustainable way to preserve food and extend its shelf life. They serve as passive barriers that reduce the need for chemicals and shield products from moisture, oxidation, mechanical stress, and microbial infestation. These naturally occurring compounds from plants have the ability to control oxidative stress and are linked to a lower chance of developing chronic illnesses like diabetes, cancer, osteoporosis, neurological diseases, and cardiovascular disease.

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Development of Innovation in Bulgarian Enterprises through European Funding**Plamen PAVLOV¹, Vladi KURSHUMOV²**¹ University of Economics - Varna, Varna, Bulgaria, pavlov@ue-varna.bg² University of Economics - Varna, Varna, Bulgaria, vl_kurshumov@ue-varna.bg**JEL: O30, O38, Q55****Abstract**

Innovation is of critical importance for the development of business organizations and for maintaining a high level of competitiveness. Therefore, managers are looking for opportunities to support the innovation activity of enterprises, including the development of new products and technological solutions and their integration into business. The aim of this paper is to explore the possibilities for financing the development of innovations in enterprises with a focus on European funds. The research reveals the main priorities in European and national policies for stimulating innovations, as well as trends in the absorption of European funds by Bulgarian enterprises.

Key words:

Innovation, European funding, innovation policies, business development.

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1. Introduction

In today's highly competitive and dynamic world, innovations are of great importance. Their benefits are both for business through the advantages they give to highly innovative companies, and for areas such as healthcare, education, etc. What's more, in addition to being an opportunity to improve the quality of life, they model the future of work and human relationships.

Regarding the importance of innovation for business and the whole society, all leading countries in this field follow certain innovation policies and implement some specific incentives for innovative companies and organizations, pursuing an increase in the competitiveness of both the entire economy and business units. From this point of view, innovation policy could be a very powerful tool in the hands of governments, because increased economic growth usually also leads to increased well-being of people and an improved quality of life.

The aim of this scientific report is to examine the possibilities for stimulating and supporting the innovation activity of business organizations in Bulgaria focusing on the implementation of projects funded by European Union (EU). The study comprises an analysis of the funded projects under two analogous grant procedures, implemented respectively in the period 2014-2020 (procedure BG16RFOP002-1.001 "Support for the introduction of innovation in enterprises" under the Operational programme "Innovations and Competitiveness") and in the period 2021-2027 (BG16RFPR001-1.003 "Introducing Innovation in Enterprises", part of the programme "Competitiveness and Innovation in Enterprises"). To achieve the aim set, the following tasks are defined in the scientific paper:

- theoretical overview of the essence, scope and types of innovations, as well as the importance of national innovation policies for the development of business and society as a whole;
- overview of approaches and good practices for stimulating the innovation activity of enterprises;
- content analysis of the two grant funding procedures' implementation in order to define their main characteristics, including similarities and differences;
- analysis and assessment of the general profile and some specific features of the procedures and projects

implemented within their scope;

- definition of main conclusions, summaries and recommendations regarding national policies and strategic orientation in the field of innovation.

As a limiting condition it should be noticed that the study covers and analyzes the projects approved for funding and the goals and activities planned therein, without concerning the assessment of the achieved final results, i.e. the degree of completion of the individual projects is not taken into account. This is dictated by the fact that as of October 2025, over 60 % of the projects under procedure BG16RFPR001-1.003 "Introducing Innovation in Enterprises" 2021-2027 are still in the process of implementation, which makes it impossible to analyze the final results and the economic effect achieved from their implementation.

2. Literature Review

2.1. Main characteristics of innovation and innovation policy

Innovation is one of the important factors for competitiveness and growth in developed economies (Babu, 2024; Pece et al., 2015). It promotes productivity growth and competitive advantages of businesses (Australian Government, 2018). It is associated with finding new solutions to existing problems and offering opportunities for new activities (The World Bank, 2010).

According to the official classification adopted in the EU, innovations can be product or process (Eurostat, 2025). The former represents new or improved products offered by the enterprise on the market. The latter refers to newly created or significantly improved processes, technologies, methods, organizational solutions, as well as the creation and provision of services.

Innovation policy is a course of action, a choice of goals and directions, the adopted line, containing the necessary measures and resources to achieve them and is related to the elements of power, dominance and management. It includes, in addition to the main goals, strategies, responsible institutions and other participants in its implementation, as well as specific mechanisms, incentives, funds and programmes supporting innovation in a country or region. An important part of innovation policy is the financing of innovation activity, relating to the allocation and use of funds for the design, development and organization of new products, new services, for the creation and introduction of new equipment, new technologies, development and introduction of new organizational forms and management tools (Toxanova et al., 2017).

Innovation policy can encompass a wide variety of measures in economic regulation, taxation, depreciation policy, patent-licensing and antitrust legislation, regulation of the technology market, stimulation of small and medium-sized innovative businesses and attraction of funds for the implementation of novelties. But in addition to all these indirect measures, some specific direct approaches can also be applied to implement an innovation policy, such as:

- direct payments; low-interest or interest-free loans;
- specific state orders for the supply of innovative products;
- services or processes, as well as specific financial projects for the development of innovative;
- high-tech or key businesses for the specific country.

It is this last element, financed through EU funds, that is a very suitable tool for stimulating innovation activity in EU countries and has an important role in promoting innovation in European companies, as well as those from the European Economic Area and from countries that have applied for EU membership. It is especially necessary for small or micro-enterprises, whose assets are often insufficient to obtain financing through any of the classic methods, including bank lending. The lack of company history and the difficulty of valuing intangible assets (if any) are also an obstacle to traditional financing.

We must emphasize that European funds for stimulating innovation activity aim not only to provide

financial resources, which are of particular importance for this type of activity in enterprises due to the higher risk in this area and, in this regard, the more difficult access to traditional financing, but also to create a strategic framework for sustainable development, technological innovation and economic progress, both for business units and for entire economies.

According to Eurostat (2024), the private sector in the EU finances about 55–60 % of total Research and Development (R&D) spending, national public budgets about 30 %, and European funds less than 5 %. Regardless of the above facts, if this opportunity is used effectively enough, it would help companies improve their competitiveness and take better positions in the global market, especially since in addition to R&D spending, funds are also provided for other types of innovation activity. This is even more valid for small and medium-sized enterprises, which, in addition to programmes such as Horizon Europe, can also receive support from European funds offering instruments for venture capital, microfinance and loan guarantees.

2.2. Stimulating innovation in Bulgaria

Countries with limited natural resources, including Bulgaria, depend heavily on scientific and applied research and innovation to promote economic growth. However, Bulgaria has a relatively low level of innovation¹ (European Union, 2025; WIPO, 2024), despite the adopted strategies, programmes and other similar official documents. The implementation of national policy in the field of innovation and R&D is primarily the prerogative of the Ministry of Economy and Industry and the Ministry of Education and Science. In addition, in Bulgaria in 2005, a National Innovation Fund was established, the objectives of which are to promote the implementation of research and development projects initiated and implemented in enterprises; develop new or improved products, processes or services aimed at enhancing economic efficiency; increase the innovative potential and technological level of enterprises; increase private investment in them; increase the dynamics of innovation processes.

Another state body for stimulating economic development, including innovation, is the Fund Manager of Financial Instruments in Bulgaria (FMFIB, 2025), established in 2015 and 100 % state-owned, whose goal is better access to European public funds, as well as mobilizing private capital to strengthen the country's economic development.

It should be noted that in Bulgaria, innovations can be financed, in addition to own funds and various bank loans, also from funds, entirely with EU financial resources and those that are jointly financed by the EU and the national budget. The various programmes under which funding for innovation activities can be obtained are EU programmes operating within the scope of the Cohesion Policy, but most notably Horizon 2020, which from 2021 has been inherited by Horizon Europe, OP Innovation and Competitiveness and others.

It can be summarized that the sources of financing innovation in Bulgarian enterprises, similar to other EU countries, can be divided into three large groups: Own funds of the enterprise; Borrowed funds, including bank loans; Subsidies under various programmes financed by the European, national or both budgets. Although during certain periods in the last 20 years, options for introducing tax preferences specifically aimed at stimulating innovation and R&D have been considered but currently there are no such active measures in the country.

In Bulgaria, there is a certain lag behind global practice, but not in relation to the presence or absence of various financing opportunities. The lag refers to firstly – correct absorption of funds allocated both at the national level and by the EU, and secondly - the mechanisms for financing and supporting innovations at the regional level are not yet sufficiently well developed, which is probably one of the many reasons for the relatively low level of innovation in the Bulgarian economy.

¹ In the GII 2024 ranking, Bulgaria is in 38th place in the world, but according to the European Innovation Scoreboard 2025, the country is in the “emerging innovators” group.

2.3. European programmes for stimulating and developing innovation in Bulgaria

After Bulgaria joined the European Union, the opportunities for European funding of the country's innovative development, including business organizations, are increasing. To date, two programming periods have been successfully completed, and the third is in the process of implementation. During the period 2014-2020, an operational programme "Innovations and Competitiveness" is operating in Bulgaria, which in the next period (2021-2027) has been renamed the programme "Competitiveness and Innovation in Enterprises". It is the main mechanism for financing the innovative activity of Bulgarian business. Within its scope, a number of procedures for collecting project proposals are announced, some of which are focused on the implementation and transfer of innovations, others are focused on the process of their development. Some of the procedures relate to start-ups, while others allow projects from already existing organizations. Part of the funding under the programme is provided by the European Regional Development Fund, and another part is national co-financing. In general, when implementing projects, beneficiaries also participate with a financial contribution.

3. Methodological characteristics of the research

For the purposes of the research, information from the Information System for Management and Monitoring of EU Funds in Bulgaria 2020 (UMIS 2020) is mainly used, presenting the main parameters of the funded and implemented projects. The methodological toolkit includes evaluation indicators, including "Total value of projects"; "EU projects grants"; "Own financial contribution of beneficiaries"; "Number of projects", etc. It focuses on analyzing the projects structure in relation to:

- the legal form of the beneficiaries;
- their territorial distribution by settlements;
- their territorial distribution by statistical regions;
- structural assessment in relation to the type of innovation being implemented and
- number of projects with an environmental focus and those related to the use of artificial intelligence as a tool for implementing innovations.

The research methods and approaches used include: content analysis; method of comparison between the procedures operating during the two programming periods; evaluation based on average values; structural analysis, induction, deduction, historical approach, etc.

4. Main results and discussion

During the period 2014-2020, the planned funding under procedure BG16RFOP002-1.001 "Support for the introduction of innovation in enterprises" amounts to BGN 97,791,500, of which BGN 83,122,775 is from the European Regional Development Fund and the remaining BGN 14,668,725 is in the form of national co-financing. The funds are pre-allocated according to the category of candidate enterprises, as follows: micro and small enterprises – 30%; medium-sized enterprises – 30% and large enterprises – 40%. Micro, small and medium-sized enterprises can apply for amounts between 100,000 and 1,000,000 BGN, and large enterprises for amounts between 100,000 and 1,500,000 BGN.

The main objective of the support is "Providing focused support to Bulgarian enterprises to increase innovation activity in the thematic areas of the Innovation Strategy for Smart Specialization (ISSS), as the implementation of the projects supported under the procedure should lead to the market realization of a product (goods or services) or the implementation of a process in the priority areas of the thematic areas of ISSS." (Opic.bg, 2021). The percentage of co-financing by enterprises is again according to their category, as well as according to the applicants' affiliation to a certain planning region in the country, and varies between 30% and 75%. The highest co-financing is required by large enterprises located in the South-West planning region (75%), and the lowest by micro and small enterprises outside the South-West region (30%).

The expected results are an increase in the share of enterprises implementing and disseminating innovations and a corresponding increase in their innovation potential and competitiveness. Projects must lead to the market realization of a product (goods or services) or the implementation of a process in the field of ISSS and implement innovation based on own development or on the basis of acquired intellectual property rights (without minor changes and improvements; routine modernizations; changes in design, etc.). Eligible activities include: acquisition of new equipment necessary for the implementation of the innovative product or process; acquisition of intellectual property rights; acquisition/development of software necessary for the implementation of the innovation; consulting and support services in support of innovation. The maximum project implementation period is 18 months. The evaluation of the submitted project proposals is carried out on the basis of the following summarized indicators:

- innovativeness and market applicability of the supported innovation - maximum 35 points;
- innovative capacity and financial stability of the applicant - maximum 28 points;
- competitiveness of the enterprise as a result of the project implementation (forecast data) - maximum 16 points;
- prioritization of projects - maximum 16 points;
- realistic project costs - maximum 5 points.

The analogous procedure for the period 2021-2027 is under number BG16RFPR001-1.003, with the planned funding amounting to 305,546,693 BGN, of which 253,488,242 are from the European Regional Development Fund, and the remaining 52,058,451 BGN are national co-financing. The funds are also distributed according to the category of enterprises, but also according to their territorial affiliation. 50% of the funds are allocated to micro and small enterprises, and the remaining 50% are allocated to medium-sized enterprises. Large enterprises are not eligible applicants. It is interesting that during the period 2021-2027, the funds are further differentiated according to the priority pursued in the following two groups:

- projects related to innovation and growth and
- projects related to the circular economy.

This distinction is a consequence of the changes in ISSS and the addition of a new thematic field, namely "Clean technologies, circular and low-carbon economy". Micro and small enterprises can apply for amounts between 50,000 and 500,000 BGN, while medium-sized enterprises can apply for amounts between 50,000 and 800,000 BGN.

The main objective of the procedure is "Providing focused support to Bulgarian enterprises for the implementation of product innovations or business process innovations in the thematic areas of the Innovation Strategy for Smart Specialization 2021-2027" (Ministry of Innovation and Growth, 2025). The percentage of co-financing by enterprises varies between 50% and 85%, with the highest percentage for small companies with medium market capitalization located in the city of Sofia (85%), and the lowest percentage for micro and small enterprises outside the Southwestern Planning Region (50%). It is mandatory that the projects be aimed at implementing a product innovation or innovation in business processes (production of goods and services), which is an in-house development or based on intellectual rights; to be within the scope of the thematic areas of ISSS 2021-2027. Among the eligible activities are: Implementation of product innovation (goods or services) or innovation in business processes through the acquisition of machinery, facilities and equipment; Implementation of product innovation (goods or services) or innovation in business processes through the acquisition of specialized software (incl. development), patents, licenses, "know-how", etc.; Protection of industrial property rights on the implemented innovation; Consulting and support services in support of innovations. The maximum project implementation period is 15 months. The evaluation of the projects is based on the following summarized indicators:

- innovativeness and applicability of the supported innovation – up to 39 points;

- financial stability of the applicant – up to 41 points;
- prioritization of projects – up to 15 points;
- realistic project costs – up to 5 points.

During the period 2014-2020, a total of 155 projects were financed with a total value of BGN 182,474,452.7. The total grant amounted to BGN 114,871,351.9 (62.95% of the total value of the projects), while the own financial contribution was BGN 67,603,100.77 (37.05%) (Table 1).

Table 1

Summary indicators for the funded projects under procedure BG16RFOP002-1.001 "Support for the introduction of innovation in enterprises" 2014-2020 and procedure BG16RFPR001-1.003 "Introducing Innovation in Enterprises" 2022-2027

Indicator	2014-2020	2021-2027	growth/decline
Total number of projects	155	561	261,94%
Total value of projects	182 474 452,7	479 383 382,5	162,71%
Total value of the grant	114 871 351,9	217 584 158,1	89,42%
Share of grants in the total cost of projects	62,95%	45,39%	-27,90%
Total value of own financial contribution	67 603 100,77	261 799 224,4	287,26%
Share of own financing in the total cost of projects	37,05%	54,61%	47,41%

Source: Authors' Compilation based on data from UMIS (2020)

During the period 2021-2027, a total of 561 projects were financed, worth 479,383,382.5 BGN. The total grant is 217,584,158.1 BGN, which is 45.39% of the total value of the projects. The beneficiaries' own contribution forms the remaining 54.61%, which equals a total of 261,799,224.4 BGN.

In a comparative aspect between the procedures during the two periods, a very significant increase in the number of funded projects (an increase of 261%) and a corresponding increase of 162% in their total value is noticeable. On a smaller scale, the amount of grants is increasing, while the funds as own contribution have increased by over 287%. From the above information it is obvious that the main changes in project financing (support for the implementation of innovations) are related to support for more but smaller scale initiatives (the average value of a funded project decreases by 27.41%), in which the beneficiaries' own contribution is greater. Fig. 1 presents information on the average values of a funded project for each of the procedures, which prove the findings made above.

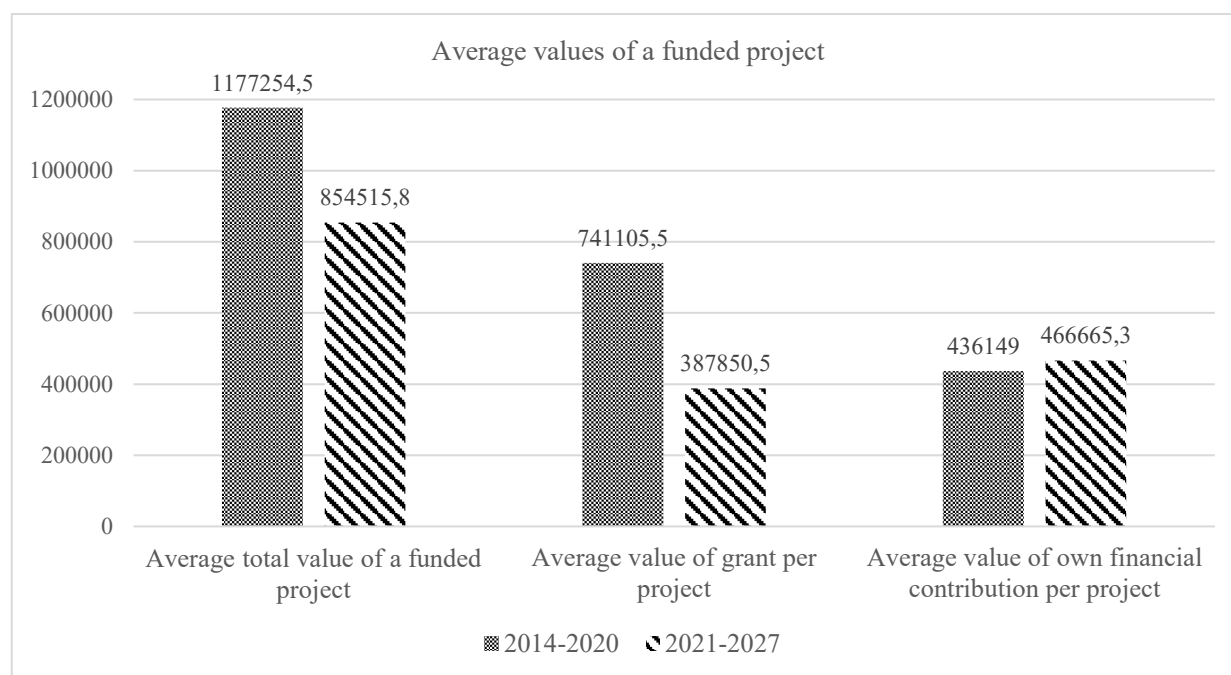


Fig. 1. Average values of a funded project

Source: Authors' Compilation based on data from UMIS (2020)

Obviously, the policy is aimed at expanding the opportunities for participation of a greater number of enterprises, but the requirement for a greater own financial contribution (an increase in the average value by 7%) has a selective function in terms of their financial capacity. In this situation, smaller and less developed enterprises are again facing serious challenges in trying to apply for financing from European funds, i.e. the concentration of financial resources is present, but through a different mechanism and a differentiated approach. In this regard, the average grant per funded project decreases by 47.67%. In line with this is the average duration of the projects, which in the 2014-2020 procedure is 15.25 months, while in the 2021-2027 period it decreases by 6.62%, reaching 14.24 months.

The profile of the beneficiaries is also of interest, including by territorial basis and by legal form (Table 2). Given the overall structure of enterprises in the country, it is logical that the largest share of beneficiaries in both programming periods would be limited liability companies, followed by joint-stock companies. Sole proprietorships, general and limited partnerships, as well as cooperative society, are the least active.

Table 2

Relative share of beneficiaries according to their legal form

Legal form	2014-2020	2021-2027	growth/decline
Limited Liability Company and Single-person Limited Liability Company	78,71 %	86,63 %	10,06 %
Joint-stock company and Single-person Joint-stock company	19,35 %	12,30 %	-36,45 %
Sole Proprietorship	0,65 %	0,89 %	38,15 %
General Partnership/ Limited Partnership/ Cooperative Society	1,29 %	0,18 %	-86,19 %
Total	100,00 %	100,00 %	-----

Source: Authors' Compilation based on data from UMIS (2020)

Several trends are striking: First, during the period 2021-2027, the relative share of limited liability companies implementing innovation support projects is increasing (growth by 10 %). At the same time, the share of joint-stock companies decreased by 36 % compared to the period 2014-2020. Second - during both periods, the remaining legal forms (Sole Proprietorship, General Partnership, Limited Partnership and Cooperative Society) are extremely poorly represented.

During the first period, there is one beneficiary company with the legal form of a sole proprietorship, one - a general partnership and one - a cooperative society, while during the second period there are 5 sole proprietorships and 1 limited partnership. It is interesting to note that in 2014-2020, the first three largest projects (over 3 million BGN each) were implemented by joint-stock companies as beneficiaries. In 2021-2027, the three largest projects (also over 3 million BGN) were implemented by two limited liability companies and one joint-stock company.

By regional basis according to the settlement of implementation of the project activities, it becomes clear that during the period 2014-2020, all 155 projects are implemented on the territory of 44 settlements, including 35 cities and 9 villages. For comparison, during the next programming period, the settlements covered number a total of 166, of which 97 cities and 69 villages. It can be summarized that the larger number of projects in the second programming period leads to a reduction in territorial concentration and allows for a widespread stimulation of innovations in the country.

During the period 2014-2020, the cities with the most implemented projects are Pleven (31); Sofia (27); Montana (22); Vratsa (15) and Plovdiv (10). In 2021-2027, the cities with the most projects are: Plovdiv (79); Sofia (74); Varna (33); Stara Zagora (25); Ruse (24); Burgas (17); Gabrovo (14); Pazardzhik (14); Pleven (13); Vratsa (13) and Kazanlak (12).

The other important dimension of the project profile from a territorial perspective is their distribution by statistical regions of the country (Table 3). This allows, by relating the projects to a specific region, to define the focus of the national innovation policy through differentiated stimulation of some statistical regions (more or less developed) at the expense of others.

Table 3

Number and value of projects by statistical (planning) regions

Region	Indicator	2014-2020		2021-2027	
		number/BGN	relative share	number/BGN	relative share
Northeastern	Number of projects	10	6,54%	72	14,60%
	Total value	12908468,91	7,07%	49877450,3	10,44%
Northern Central	Number of projects	9	5,88%	65	13,18%

	Total value	17309732,29	9,49%	60627686,57	12,69%
Northwestern	Number of projects	78	50,98%	58	11,76%
	Total value	75190817,15	41,21%	51926808,95	10,87%
Southeastern	Number of projects	17	11,11%	95	19,27%
	Total value	28132868,57	15,42%	81538004,27	17,07%
Southern Central	Number of projects	20	13,07%	159	32,25%
	Total value	32457484,6	17,79%	143046704,2	29,95%
Southwestern	Number of projects	29	18,95%	116	23,53%
	Total value	16475081,19	9,03%	90585578,25	18,97%

Source: Authors' Compilation based on data from UMIS (2020)

It is distinctive for 2014-2020 that nearly 51 % of all financed projects are implemented in the territory of the least developed region (Northwestern), where 41 % of the value of all projects is focused. During the same period, a relatively balanced distribution of the remaining part of the projects is observed in the other 5 regions of Bulgaria, with a slight predominance of the Southwestern and Southern Central at the expense of the Northeastern and Northern Central. All this is indicative of the intention to direct investments in support of innovation to less developed regions with a view to achieving a widespread increase in regional competitiveness.

Under the procedure implemented in the programming period 2021-2027, this disproportion has been overcome both in terms of the number of projects and their total value, with a more even distribution being noted. Of course, the leading regions are those with the highest concentration of businesses in the country (Southwestern and Southern Central) where 23.5 % and 32 % of all projects are implemented, respectively, involving 19 % and 30 % of the total value of the procedure.

The considered financing procedures aim to support the implementation of innovations considering that the financial assistance contributes to improving the business activities of enterprises, including the implementation of new products and/or services, process improvement, implementation of technologies, etc. In accordance with these objectives, Figure 2 presents information on the nature of the specific innovation solutions planned and/or achieved within the framework of the individual projects.

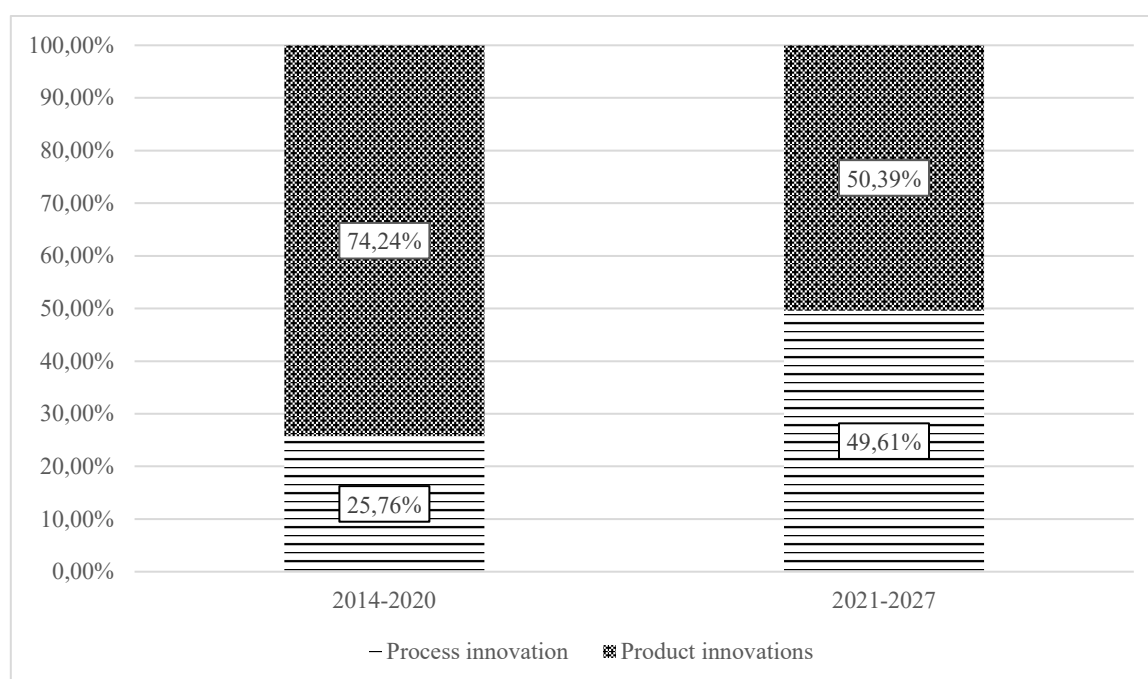


Fig. 2. Relative share of projects with implemented or planned innovations (by innovation types)

Source: Authors' Compilation based on data from UMIS (2020)

The main trend identified is a strong predominance of product innovations in the period 2014-2020, which are implemented in 74.24% of the funded projects. Among them are the implementation of new products offering new solutions for different consumer needs and their market positioning; new services, including those using different technological platforms, etc. In 2021-2027, the relative share of projects related to product and, respectively, process (technological) innovations is almost equal.

Process innovations under both grant procedures encompass a variety of technological solutions related to the introduction of high-tech equipment and technological reorganization of processes, and they usually result in more efficient production processes; shorter production cycles; more rational use of resources; better quality processes; transition to technologies based on digitalization and artificial intelligence, etc.

In addition to the above-mentioned distribution of projects by type of innovation, Table 4 presents information on the relative share of the value of the projects and the grant provided in relation to whether product or process innovation is supported.

Table 4

Relative share of projects supporting product and process innovations (relative to their total value and the amount of grant aid)

Type of innovation	2014-2020		2021-2027	
	Relative share of projects (compared to their total value)	Relative share of projects (compared to grants)	Relative share of projects (compared to their total value)	Relative share of projects (compared to grants)
Process innovations	36,48 %	31,91 %	54,35 %	53,57 %
Product innovations	63,52 %	68,09 %	45,65 %	46,43 %
Total	100,00 %	100,00 %	100,00 %	100,00 %

Source: Authors' Compilation based on data from UMIS (2020)

The data confirm that the general policy in the field of innovation in Bulgaria is changing from encouraging product (during 2014-2020) to encouraging process (technological) innovations to a greater extent during 2021-2027. It is during the second period that 54.35 % of the total value of the procedure for implementing innovations in enterprises is directed towards new technologies and processes, compared to 36.48 % for the previous period. The data are similar with regard to the provided grant aid for the implementation of projects.

In recent years, changes in the environment in which businesses operate have imposed some new key success factors related to the implementation of innovations. Such are the use of artificial intelligence as a tool for optimizing certain business processes and the so-called "green innovations", leading to environmental protection, improving resource efficiency and achieving environmental sustainability. In this regard, the research of the innovations implemented in the projects shows that during 2014-2020, just a few projects were funded, entirely focused on environmental solutions and waste management. There was one funded project entirely focused on usage of artificial intelligence as part of the planned innovation.

For comparison, during the period 2021-2027, dozens of projects mainly focused on ecology, green innovations and waste management were approved and just as many are the projects mainly focused on artificial intelligence. Based on this, it can be concluded that in Bulgaria, enterprises that apply for grant funding to support their innovation activity, attach increasing importance to "green" innovations and artificial intelligence regardless of the following two circumstances:

- the relatively late inclusion of a new area in ISSS, related to the circular economy;
- artificial intelligence is just entering business and economic processes, which suggests a significant increase in its application in the near future.

4. Summary of findings and recommendations

In a comparative aspect between the procedures operating during the two programming periods, it can be concluded that the overall innovation policy is developing in a positive direction, as far as stimulating innovation activity through European funds and programmes is concerned. The main positive points can be defined in the following areas:

- shifting the focus towards stimulating micro, small and medium-sized enterprises at the expense of large ones;
- promoting green innovation by including a new priority area in ISSS;
- reducing the territorial concentration of beneficiaries, including by statistical (planning) regions, which favors the widespread development of business innovation activity in the country;
- balancing the ratio between support for the implementation of product innovations and incentives for the implementation of process innovative solutions.

It would be beneficial for the business climate in the country if these trends were continued in the future, and in addition, the implementation of the following two recommendations is also important:

- increasing the intensity of financial assistance and accordingly reducing the amount of financial contribution required from beneficiaries. This would eliminate the "financial capacity" factor in the selection of beneficiaries and would ensure access to financial resources for a larger number of enterprises, especially micro and small ones.
- integrating various instruments to stimulate innovation in the country, including linking the results of the implemented projects with other measures, such as tax preferences for more innovative enterprises, relating to corporate or income taxation, for those employed in research units in innovative organizations.

5. Conclusion

Despite the difficulties, the existing opportunities for financing innovations in Bulgaria are not few, but access to capital depends on several very important factors, such as: the size of the enterprise, the availability of sufficient assets for collateral, positive financial results reported in recent years, market reputation, the effectiveness of the innovation project, the industry in which the company operates.

Of interest for future research are the real results and the achieved economic effect of the projects considered in the paper, which will be possible after the completion of those that are currently still in the process of implementation. However, the opportunities for the implementation of innovations by enterprises are available and they should more actively develop their innovation activity in order to maintain a high level of competitiveness.

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Optimizing the Digital Landscape: Research and Applications in SEO and Social Media with keyword planning

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Abstract

Key words:

SEO, keywords, optimization,
keywords application, SEO
application.

This paper aims to clarify the relationship between keyword definitions and Search Engine Optimization (SEO). It focuses on identifying the critical stages of keyword optimization and analyzing the essential metrics used to streamline business-marketing activities through SEO strategies.

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1. Introduction

In times of a developing economy, it is very important to bridge the gap between business and customer or to build excellent relationships in the process of communication between the organization and its users. For marketing, which is developing at an extremely fast pace, it is especially important that these relationships are not only built, but also updated in a timely manner in order for the user to receive value and thus add value to the business organization.

The purpose of the paper is to clarify the definitions of keywords and SEO optimization, thereby paying attention to the most important steps in the process of optimizing marketing activities in business through keywords optimization in SEO. At the same time, to track the key steps and the most important metrics in optimizing marketing processes through SEO in marketing.

2. Used methodology

The methodology used in the report is based on conclusions drawn from processes of definition tracking, comparison and extraction of new definitions. Content analysis of the sources examined, based on various web pages related to the research topic, was also used.

3. Literature Review and Hypotheses Development

The strategic use of keywords can significantly enhance visibility and engagement of the company.

Before examining the applications of SEO, it is necessary to present its definitions and extract the most significant characteristics of the concept.

There are many definitions of the concept of keyword/s, but among them stand out those of the Cambridge Dictionaries, the Merriam Webster Dictionary, and others described below.

According Harris-creative, 2025 keywords are defined as the specific words and phrases that users type into search engines or social media platforms to find services, products, or solutions. (Bradshaw, E., Palazli, Z., (2025)

Another definition is that of the Cambridge dictionary, which states that Keywords definition - a word that you type into a computer, for example when you are using the internet, so that the computer will find information that contains that word (Cambridge dictionary, (2025). On the other hand, Merriam-Webster claims that Keyword is a significant word from a title or document used especially as an index to content

(Merriam-Webster Dictionary, 2025). The popular website dictionary.com, says that the keyword is Also called catchword is a significant or memorable word or term in the title, abstract, or text of a document or other item being indexed, used as the index entry. On the same page from the point of view of Digital Technology a keyword used to classify or organize digital content, or to facilitate an online search for information. Search the database for the specific keyword (Dictionary.com, 2025).

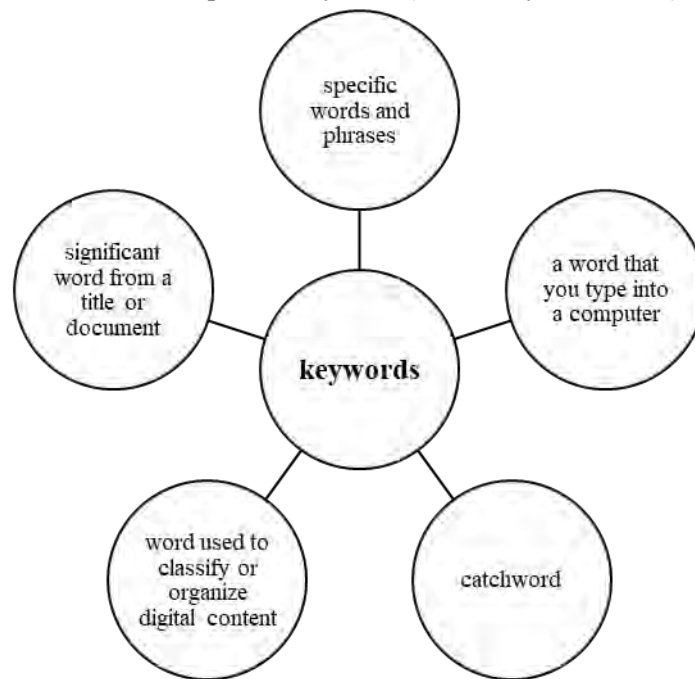


Fig. 1. Keyword definition

Source: made by the author's in connection with the conducted research

From the considered definitions, it can be concluded that the keyword is a “catchword”, which is specific, can be a separate word or phrase, is written on the computer, is most often used when searching on the Internet, is significant, and is extracted from the title or text of a document and is used to classify or organize digital content.

Keywords in marketing are used by companies and consumers, by the former to attract customers for certain products and services, and by the latter to find the most suitable products and services that satisfy their needs and create value and a user experience.

Keywords in marketing are used to optimize the processes of search engines in the Internet space.

Keywords planning is crucial for the process of optimizing marketing activities in business. This it's possible to happen with tools for SEO in marketing. SEO is definition, which took place in specific marketing environment and it is necessary to clarify for the purposes of the paper.

According Coursera definition SEO (search engine optimization) marketing (Coursera staff, 2025) is the process of optimizing your website and its content for visibility. This visibility is defined as the presentation of the web page on the Internet, making the organization visible to business partners and users. These users and partners can be both real and potential. Search Engine Optimization is the process of optimizing your website to rank higher on search engines like Google, making it easier for customers to find you when they search for products, services, or information. <https://www.ama.org/marketing-news/what-is-seo-marketing/>, SEO marketing is the work you do to make your site rank higher in search results like Google. <https://c2cmedia.ae/what-is-seo-marketing-definition-importance-types/>, search engine is a database that indexes web pages, and then displays a listing of those that are relevant when a user performs a search query.

“Search engine” can refer to a program loaded on an individual website, or one on a major website such as Google (The Universal marketing dictionary, 2025).

Common characteristics between definitions

All definitions are united around a few key pillars:

- Optimization Process: SEO is not seen as a one-time action, but as an ongoing process of improving the website and its content.
- Goal – Visibility and Ranking: The main goal is to achieve higher positions (rank higher) in search engine results (such as Google).
- User Connection: The ultimate goal is to facilitate discoverability – to make the business visible to those who are actively searching for information, products or services.
- Search Engine Focus: Actions are directed at the algorithms and databases that index and sort information on the Internet.

Highlights of the differences

Each of the definitions adds a specific detail to the overall picture. From a business perspective, the definition expands the scope beyond end customers to include business partners (actual and potential).

From a technical perspective, the text clarifies what a "search engine" is - a database that indexes pages and displays them according to their relevance.

From a scope of work perspective, it is specified that a search engine can be both a global platform (Google) and a program integrated within an individual website. One of the definitions simplifies the concept to "the work you do", emphasizing the practical nature of marketing.

In summary, the definition of SEO optimization states that SEO marketing is a complex of activities for optimizing web content, the purpose of which is to increase the visibility of the organization to customers and partners by achieving high positions in search engine algorithms.

4. Components of analysis

The components included in the analysis are as follows:

4.1. Strategic Analysis. This is an analysis beyond basic search.

Instead of simply listing words, the emphasis should be on how they reflect user intent (Search Intent). This is a critical point for the marketing process. Keywords should be classified first, as they can be divided into informational (knowledge search), navigational (brand search) and transactional (ready to buy).

- When analyzing, it is necessary to pay attention to long-tail keywords, as longer and more specific phrases generally have a higher conversion rate (Conversion Rate), despite the lower volume of searches by users on the web.

4.2. Toolkit and Process Automation

Marketing processes are optimized through speed and accuracy. Software helps eliminate manual labor.

- Use of AI and tools: The role of platforms like Google Keyword Planner, SEMrush or Ahrefs.
- Clustering: How automatically grouping thousands of words into thematic clusters helps in faster content planning.

4.3. The Connection Between SEO and PPC (Synergy)

One of the strongest points in your report can be how keyword optimization saves money.

- Quality Score: Explain how better keywords reduce the cost per click (CPC) of your ads.

- **Data Sharing:** How paid advertising (PPC) data tells us which keywords are working so we can incorporate them into our long-term SEO strategy.

4.4 Optimization of the “Buyer’s Path” (Content Mapping)

Keywords should be distributed across the stages of the sales funnel:

- **Awareness:** General terms.
- **Consideration:** Comparative terms (“best”, “review”, “price”).
- **Action:** Specific product codes or local phrases (“buy in Sofia”).

Measuring Success (KPIs)

5. Key CRO metrics to track

5.1. Plan for successful CRO (conversion rate optimization) implementation: Unified CRO Optimization Process

Step 1: Defining Goals and Key Performance Indicators (KPIs)

- **What to do:** Before you begin, you need to decide what exactly a “conversion” is for your business (sale, subscription, inquiry). In this phase, clear goals are set and the metrics you will track are selected, such as: Conversion Rate (total and e-commerce), Microconversions, Cost Per Acquisition (CAC), and CTR. Without a clear goal, you cannot measure success.

Step 2: User Research and Data Analysis

- **What to do:** Here you collect quantitative and qualitative data. You use funnel analysis tools to see where users drop off (Bounce rate, Exit rate). You study their behavior through heat maps or surveys to understand their “drivers” (why they buy) and “barriers” (what stops them). You analyze time on site and number of pages viewed.

Step 3: Prioritize and create hypotheses

- **What you do:** Based on the data you collect, you identify which pages have the greatest impact on revenue (e.g., product page or shopping cart). Instead of guessing, you create hypotheses: “If we change [element], it will lead to [result] because [reason].” You decide which features to add, adjust, or remove.

Step 4: A/B Testing and Experimenting

- **What you do:** This is where you turn hypotheses into reality through experiments. You run A/B tests, where you split traffic between the original page and the new version. It’s important to test only one change at a time to make sure what exactly affects the result. You stop relying on assumptions and trust real user behavior.

Step 5: Analyze results and continuously improve

- **What you do:** After the tests are complete, you review the data. If the change is successful, you implement it permanently. If it’s not, you analyze why and use what you learned to test again. CRO is not a one-time action, but a constant cycle of “review and repeat” to keep your site effective in the long term.

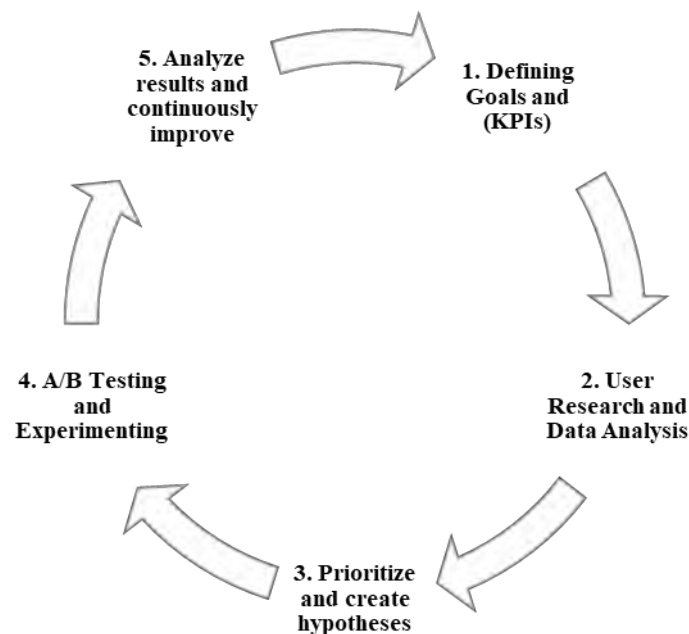


Fig. 2 Plan for successful CRO

Source: made by the author's in connection with the conducted research

In Summary they are some important Metrics to Track. The (Checklist) consists by several numbers as follows:

1. Overall Conversion Rate- it measures the number of conversions divided by the total number of visitors.
2. Ecommerce Conversion- the percentage of visitors who convert from browsers to buyers, or sometimes from visitors to leads (ex. email subscribers).
3. Micro Conversion Rate (Intermediate Steps)- it shows the percentage of users completing intermediate steps-such as adding to cart, account creation, or newsletter sign-ups—that signal progress toward a primary (macro) goal
4. Cost Per Acquisition (CAC) - the total sales and marketing expenses—including ad spend, salaries, and software—required to gain one new paying customer
5. Bounce Rate- the percentage of visitors to a particular website who navigate away from the site after viewing only one page
6. Average Time On Site- the mean duration visitors spend on a website during a session, calculated as total session duration divided by the number of sessions
7. Pages Per Session- the average number of pages a user views during a single visit, calculated by dividing total pageviews by total sessions
8. Click-Through Rate (CTR)- measures the percentage of users who click on a specific link, ad, or email after viewing it, calculated as $\frac{\text{Clicks}}{\text{Impressions}} \times 100$.
9. Exit Rate- It measures the percentage of sessions that end on a particular page, regardless of how many other pages were visited during that session.

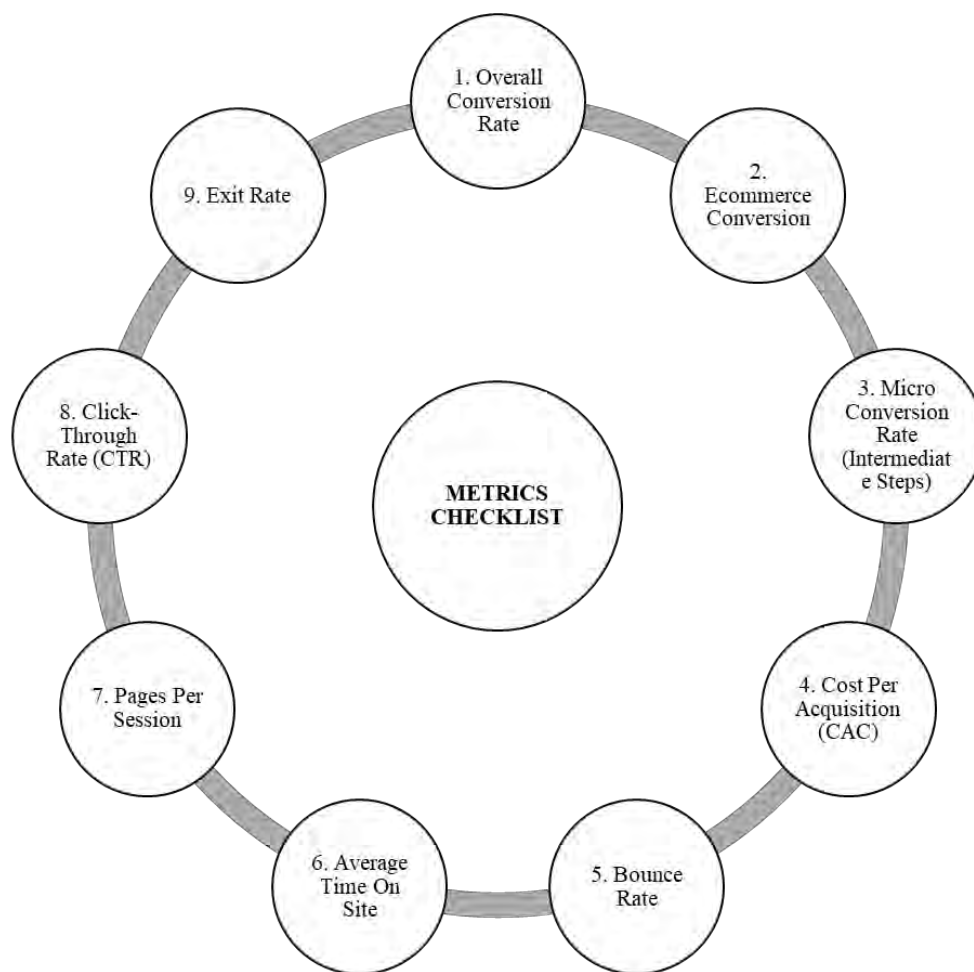


Fig. 3 Metrics checklist

Source: made by the author's in connection with the conducted research

By measuring and strictly tracking all of these indicators, marketing process optimization specialists through keyword optimization can achieve excellent results in marketing and management activities, which are an integral part of every business organization. SEO and Search Engine Visibility: Improves rankings and organic traffic by helping search engines understand content relevance and optimizes for voice and AI search. Furthermore, the SEO provides many advantages. Some of the more important are defined at the following table (Table 1).

Table 1

Interpretations of advantages in using metrics

№	Advantages	Interpretation
1.	Advertising and Marketing Performance:	Optimizes paid (PPC) campaigns for higher profitability and helps create content that converts users into customers.
2.	Audience Insights:	Tracks consumer trends and evolving interests, ensuring content accurately matches search intent.
3.	Competitive Advantage and Growth:	Uncovers new market opportunities and helps dominate niche segments by using specific phrases (long-tail keywords).

4.	Strategic Decisions:	Provides a database for informed decisions about product development, marketing, and overall business strategy.

The question “Why is SEO Keyword Optimization Important for Social Media?” is often asked in marketing. In the context of business organization marketing, SEO keyword optimization on social media is critical especially in 2026, it is even often referred to as Social SEO, as the platforms now function as full-fledged search engines. Users (especially Gen Z and Gen Alpha) are increasingly searching for information on social media like TikTok, Instagram and YouTube, instead of using search engines like Google.

5.2. Social media role in SEO keyword optimization

The main reasons why social media keyword planning is important for business include the following components:

1. Social platforms are the new search engines

Social media is no longer just for entertainment, but for discovering many new and different things. When keywords are used strategically in descriptions, titles and even in the text of the video itself, discoverability increases: content appears when users search for specific solutions or products directly in the search bar of the application.

Algorithmic ranking: Keywords help algorithms understand the topic of content and show it to the right audience in sections like "Explore" or "For You".

2. Google presence through social profiles

Social media profiles and posts (especially LinkedIn, YouTube and Reddit) often rank on the first page of Google for branded searches.

SERP dominance: When someone searches for a specific business name, optimized social profiles ensure that the organization controls the first 5-10 results, building authority and trust.

3. Targeting "Search Intent"

Keywords allow businesses to align with the needs of the user at different stages of the funnel:

Informational targeting: The user is looking for "how to..." (here the so-called educational content is optimized).

Commercial targeting: The user is looking for "the best products for..." (here the direction is towards comparisons and reviews of different products and services).

4. Support for artificial intelligence and voice search

In 2026, AI tools and voice assistants will analyze social content to provide answers. The use of conversational keywords (long phrases that mimic human speech) makes businesses easier for AI models to "understand."

5. Higher engagement and conversions

When content is optimized for keywords that your audience actually uses, it resonates more strongly by Improving CTR (click-through rate) because users see familiar terminology, as well as increasing sales because it attracts people who are actively searching for what the brand has to offer, rather than just random passersby.

6. Digital growth ecosystem

All of the elements represented in paper construct the framework of digital growth ecosystem (Figure 4).

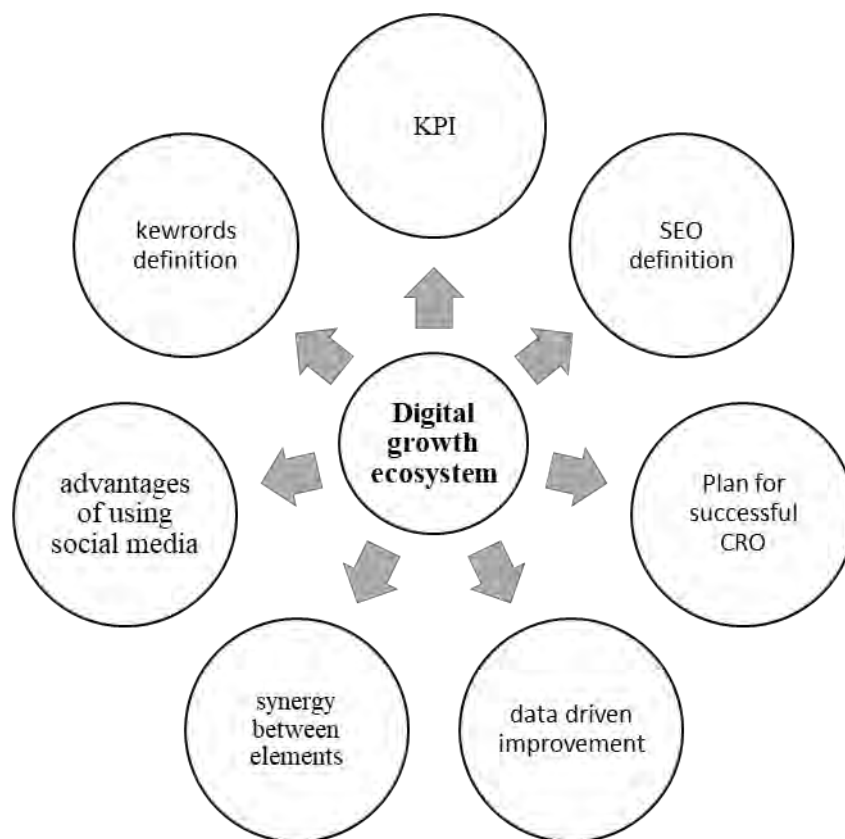


Fig. 4 Digital growth ecosystem

Source: made by the author's in connection with the conducted research

1. The Foundation of digital growth ecosystems are Keywords and SEO Strategies

It all starts with understanding the user behavior and needs.

Keyword Definitions on his part are the "language" of the current audience. They are not just words, but intentions (Intent).

Regarding to SEO Optimization it can be said that words are turned into actions through technical optimization, content and links. The goal is for the web site to be discoverable where users are looking for solutions.

2. The Conversion Engine: Unified CRO Process

After SEO brings traffic, it's time for CRO (Conversion Rate Optimization). This process ensures that business organization don't "waste" the visitors they've attracted.

The Steps including Research -> Hypothesis -> Test -> Analysis, which is the scientific approach. Instead of guessing what users want, marketing researchers have to test and implement only what works at this specific moment and brings value not only for the customers, but also to the brand.

The Connection to SEO is characterized as Good when CRO improves the user experience, which is a direct signal for Google to rank you higher.

3. The Amplifier: SEO for Social Media

Social networks are now functioning like search engines (especially for Gen Z).

When you optimize your content on social networks with the right keywords, you get Synergy and this is the biggest benefit.

Social signals and shares affect in increasing brand authority, which indirectly helps core SEO.

4. The Control Room: Metrics and KPIs

To manage this ecosystem, every marketing specialists need specific measurement.

List of metrics to study represents the “diagnostic” data (as bounce rate, load speed, page time). They show where in the chain there is a “leak”.

Key Performance Indicators (KPIs) are the ultimate business goals – organic traffic, number of queries and overall ROI.

In conclusion, it can be said that to optimize marketing activities in an organization, special attention should be paid to all components of the marketing ecosystem for search engine optimization, which, with the help of the right keywords, lead the user to the most suitable brand and product (including service) for him.

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Marketing Strategies in the Distribution of Medicinal Products Based on the Example of "MediLine Distribution" Ltd

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Abstract

The pharmaceutical industry is one of the most dynamic and strategically important sectors of the global economy. In the context of strict regulatory requirements, technological progress and ever-increasing competition, the effectiveness of marketing strategies, especially in the field of distribution, is becoming crucial for the market sustainability and growth of pharmaceutical companies.

In the context of the Bulgarian market, this need is even more pronounced. On the one hand, the pharmacy sector in the country is highly fragmented, and on the other hand, customers (including pharmacies and medical institutions) expect fast, accurate and reliable delivery. This places distributors at the center of the value chain and requires them to implement well-thought-out marketing approaches that combine logistics, service and communication.

Keywords:

pharmaceutical industry,
distribution channels,
international markets,
marketing techniques

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1. Introduction

The main objective of this report is to analyze marketing strategies in the distribution of pharmaceutical products, with a focus on their effects on logistical efficiency, customer communication and market competitiveness.

To achieve the set goal, the following tasks are formulated:

Tasks:

1. To clarify the concept of marketing mix and the role of distribution and communication in it;
2. To present the features of the pharmaceutical industry and the legal framework related to distribution;
3. To study the distribution channels and participants in the pharmaceutical market;
4. To analyze the communication and marketing strategy of a selected distribution company - "MediLine Distribution";
5. To conduct a survey among pharmacies in order to assess the effectiveness of the strategy;

The object of the study is the marketing strategies used in the pharmaceutical sector.

The subject is specifically the strategies and practices for the distribution of pharmaceutical products, examined through the case study of the company "MediLine Distribution".

The following methods are used in the thesis:

- theoretical analysis of scientific literature;
- case study analysis;
- survey method (quantitative research);

The main objective of this report is to conduct an in-depth analysis of the marketing strategies applied in the distribution of medicinal products, focusing on their impact on logistical efficiency, the quality of communication with business clients (pharmacies and hospitals), as well as on the market positioning of pharmaceutical distributors in conditions of high competition and regulatory strictness.

2. Review of literary sources and development of hypotheses

2.1. Analysis of marketing strategies in the distribution of pharmaceutical products

Pharmaceutical distribution is not just a logistical function — it is a strategic activity in which marketing plays a critical role. The strategies implemented by distribution companies not only facilitate delivery, but also determine the relationship with pharmacies, influence the perception of the brand and the positioning of the company in the B2B environment.

Key components of the strategy (4P analysis)

1. Product strategy

Pharmaceutical distributors do not manufacture, but build a portfolio of drugs and medical devices, which in itself is a form of “product positioning”. A successful product strategy includes:

- A balanced mix of Rx and OTC products;
- Diversity by manufacturer (local and international);
- Inclusion of products with a seasonal or regional focus;
- Products with specific storage conditions (requiring controlled logistics)

2. Price Strategy

In the context of regulations and limited opportunities for markup, the price strategy focuses on:

- Providing volume discounts
- Contract schemes with pharmacy chains
- Bonus products (e.g.: 10+1)
- Flexible payment terms (especially for independent pharmacies)

Price strategies are critical for customer retention and maintaining liquidity. In a competitive environment, they often determine the choice of distributor.

3. Place Strategy

This is the main focus of the analysis - the strategy includes:

- National coverage through regional hubs
- Built-in network of suppliers and couriers
- Track & trace of shipments
- Online ordering platforms

Distribution efficiency is a key criterion for competitiveness. Companies that deliver within 24 hours gain trust and long-term partnerships.

4. Communication Strategy (Promotion)

In the pharmaceutical B2B environment, promotion is mainly aimed at:

- Pharmacy managers
- Pharmacists
- Hospital warehouses

Tools used:

- Field representatives

- Electronic newsletters and CRM campaigns
- New product presentations
- Online customer service platforms

The communication strategy determines not only product awareness, but also the building of trust and long-term relationships. It is especially effective when combined with training and support for pharmacy staff.

Strategic approaches according to company policy

Competitive strategy (Michael Porter):

- Some companies use a differentiation strategy - through fast logistics and quality service
- Others rely on low prices and wide reach (e.g. national networks)
- Others use a niche strategy - aimed at hospitals or rare products

An effective marketing strategy in the distribution of pharmaceutical products must be integrated, adaptable and oriented to the needs of the pharmacy business. Key to success are:

- reliable logistics,
- personalized communication,
- and the implementation of new technologies, including a digital platform, CRM and customer data analysis.

2.2. Pharmaceutical market – regulations and specifics

Specifics of pharmaceutical products

Medicinal products are a special category of goods, characterized by sensitivity to external factors, regulations and significant public interest.

Main specifics:

- Rx (prescription drugs): are dispensed only by prescription from a doctor; their distribution is subject to strict control.
- OTC (over-the-counter drugs): freely sold, but subject to traceability and accountability.

Additional features:

- Storage under controlled conditions: compliance with temperature regimes (e.g. 2–8°C, 15–25°C), protection from light and moisture.
- Expiration dates and withdrawals: require strict accountability and timely withdrawal of products with an expiring date.
- Traceability by batch and serial number: a requirement for increased transparency and security.

Market participants

The pharmaceutical market involves multiple stakeholders, each with a different role in the delivery process to the end user.

- Manufacturers – create, package and market pharmaceutical products. Examples: Teva, Sopharma, Pfizer.
- Distributors – intermediaries between manufacturers and retail outlets. Examples: Phoenix Pharma, Sanita, Mediline Distribution.
- Pharmacies – retail outlets for final sale, organized as:
 - o individual (independent)
 - o pharmacy chains (e.g. Subra, SCS, SOpharmacy)
- Institutions – NHIF (national funding), Ministry of Health (strategic regulation)
- Patients – end users, but often do not have a direct choice, as medications are prescribed by doctors

Distribution models and distribution channels in the pharmaceutical sector

The distribution model describes the way in which products move from the manufacturer to the end user. In the pharmaceutical industry, distribution is not just a physical process, but a strategic tool that influences:

- Availability of pharmaceutical products, ensuring that goods are available exactly when they are needed.*
- Accessibility, by achieving optimal market coverage – from large cities to remote areas.*
- Safety, by adhering to good distribution practices (GDP), temperature control and full traceability of products.*

Key factors in choosing the optimal distribution model are:

1. Product type

o Rx (prescription drugs) – require stricter control and traceability.

o OTC (over-the-counter drugs) – more flexible in distribution, but also need reliable channels.

2. Regulatory requirements

o Legislation (ZLPHM), GDP rules, licensing of warehouses and transport.

o Approvals and audits by BDA and EMA.

3. Nature of customers

o Hospitals and clinics – often require direct, contractual supplies and special conditions.

o Pharmacies – both chains and independent sites, with different volumes and frequency of requests.

o Patients – end users, although indirectly involved through pharmacies.

4. Geographical scope and logistical capabilities

o Availability of regional hubs and distribution centers.

o Fast delivery capabilities (e.g. 24-hour service) and coverage of remote areas.

o Use of own or external logistics operators (3PL).

Distribution channels in Bulgaria

The distribution of medicinal products in Bulgaria follows a clearly structured and regulated chain, consistent with the legislation and the principles of good distribution practices (GDP).

The typical scheme of movement of medicines from production to the end user includes the following units:

Manufacturer → Wholesale distributor → Pharmacy / Hospital → Patient

Main participants in the channels:

Wholesale distributors:

o Phoenix Pharma

o MediLine Distribution

o Sanita

o Pharmahem

They carry out warehousing, transport and supply of pharmacies and medical institutions. Some of them also have their own logistics platforms and CRM solutions.

• Pharmacies:

o Independent pharmacies – usually with a local reach, often prefer flexible partners.

o Chains – e.g. Subra, SOpharmacy, Seiba, 36.6 – apply centralized contracting and delivery, higher requirements for logistics.

- *Hospitals and polyclinics:*

- o *Have hospital pharmacy units that supply the internal distribution network of the healthcare facility.*

- o *Apply a special supply regime, often through public procurement and framework agreements with approved distributors.*

Trends in the development of distribution models

In the rapidly changing pharmaceutical environment, several key trends are emerging that shape future distribution models:

1. Digitalization

Online ordering and electronic platforms: The introduction of B2B ordering systems allows pharmacies and hospitals to place orders 24/7, with automated confirmation and real-time stock review.

Track & Trace Systems: The integration of barcodes and RFID technologies provides full control over the movement and status of batches, which reduces losses and the risk of counterfeiting.

2. Outsourcing of logistics

Partnerships with 3PL providers: Pharmaceutical companies increasingly rely on specialized

3. Marketing strategies in distribution

Distribution in the pharmaceutical sector is not just a logistical process, but a tool for achieving strategic marketing goals. Modern distributors of pharmaceutical products apply targeted strategies, tailored to the specifics of the B2B market, regulations and customer needs (pharmacies, hospitals, clinics).

Strategic framework (4P + B2B)

In pharmaceutical distribution, the marketing strategy follows the classic 4P model (Product, Price, Place, Promotion), but adapts to the specifics of the B2B environment (Business-to-Business), where customers are not end users, but pharmacies, hospitals, clinics and pharmacy chains.

1. Product

Assortment: Balance between Rx (prescription) and OTC (over-the-counter) medications, medical devices and supplements.

Quality: Compliance with regulatory standards and good distribution practices (GDP).

Brand: Presentation of products under its own brand ("private label") or from established international manufacturers.

Packaging: Complies with safety, traceability and convenience requirements for filling and presentation in front of pharmacies.

2. Price

Volume discounts: For orders above a certain threshold (e.g. 500 packages).

Contractual terms: Long-term framework agreements with pharmacy chains and hospitals.

Flexibility: Schemes with deferred payments and bonuses "10+1" or monthly cashback programs.

3. Place

Territorial coverage: Central warehouses with regional hubs for fast service.

Delivery time: Guaranteed deliveries within 24 hours in large cities and within 48–72 hours in remote areas.

Accuracy: Precise forecasting of needs through analysis of historical data and seasonal fluctuations.

4. Promotion

Sales teams: Regional representatives who maintain personal contact with pharmacies.

Newsletters: Electronic and printed catalogs with current promotions and availability.

CRM: Customer relationship management systems, automated campaigns and personalized offers.

Product training: Webinars and seminars for pharmacists and pharmacy staff.

B2B marketing

- Focus on business customers: Sales are not directed to the end patient, but to pharmacies and medical institutions, which form the direct channel.
- Long-term partnerships: Building trust through regular meetings, joint sales analyses and flexible terms.
- Individual approach: Personalized offers according to the specifics of each client - volume, geographical location and type of pharmacy (chain vs. independent).

Unlike the B2C sector, where marketing is oriented towards a mass audience, B2B distribution requires a long-term approach, building trust and personalized communication. Therefore, strategies within the 4P framework focus on:

- building partnerships,
- customer support and training,
- long-term commercial stability,
- high added value through logistics, information and fast service.

Combining the 4P model with B2B specifics allows distribution companies to build sustainable competitive positions, meet the requirements of pharmacy and hospital customers and achieve a high level of loyalty and trust.

Communication tools

1. Email newsletters: Regular information letters with new products, promotions and regulatory changes.
2. Telephone contact: Sales representatives maintain direct contact, accept orders and collect feedback.
3. Online ordering platform: Convenient interface for placing and tracking orders, history and special offers for each customer.
4. Videoconference training: Demonstrations of new products and training with pharmacy staff in real time, especially important for dispersed customers.

Competitive Advantages in Distribution

The success of a pharmaceutical distribution company largely depends on its ability to build sustainable competitive advantages. In the face of intense competition and regulatory constraints, companies strive to offer not only products, but also added value through service, technology and flexibility. Below are the main competitive advantages that play a key role in market positioning.

- Delivery speed (<24 hours): A key factor in choosing a distributor, especially for urgent medical needs.
- Promotional offers: Regular campaigns, package offers and seasonal bonuses that stimulate order volume.
- Digital feedback: Online surveys and a service rating system; automated collection and analysis of customer opinions, which allows for rapid optimization.

Competitive advantages are not limited to product and price – speed of delivery, digital transformation, and active feedback are becoming increasingly crucial factors for partner retention and market share expansion in the pharmaceutical distribution industry.

Case study: MediLine Distribution Ltd

The pharmaceutical sector is a highly regulated and strategically important industry, in which the effective distribution of medicines plays a key role in ensuring access to treatment. Especially for prescription medicines (Rx products), the distribution model directly affects the timeliness of deliveries, patient safety, price control and compliance with the regulatory framework.

This case study examines the different approaches to distributing Rx products – direct, indirect and hybrid

models – by analyzing their advantages, disadvantages and applicability depending on the type of product, target market and regulatory requirements. By comparing these models, the aim is to propose the most effective distribution strategy that will ensure both market sustainability, quality service and regulatory compliance.

General characteristics of MediLine Distribution Ltd

MediLine Distribution Ltd is a fictional Bulgarian distribution company, constructed for the purposes of this study, but derived from real business models typical of the pharmaceutical market in the country. The company specializes in the supply of:

- Pharmaceuticals (Rx and OTC)
- Medical devices and consumables
- Dietary supplements and vitamins

Basic facts about the company

- Year of foundation: 2010
- Head office: Sofia
- Regional warehouses: Varna, Plovdiv, Burgas
- Team members: 70 (logistics, sales representatives, administrative staff)
- Coverage: Over 300 pharmacies and 25 medical facilities across the country
- Online platform: Interactive real-time ordering system with a catalog of over 2,000 items

Key highlights of the model

- Flexible logistics: Centralized inventory management and regional hubs for fast shipping
- Digitalization: Full integration of ERP/CRM system with the ability to automatically track and analyze orders
- B2B focus: Customized solutions for pharmacies and medical facilities, including contractual schemes and volume discounts

This configuration allows "MediLine" Distribution" to provide reliable, timely and high-quality distribution services, building strong and long-lasting partnerships in the pharmaceutical market.

Distribution Business Model

MediLine Distribution Ltd. operates entirely on a Business-to-Business (B2B) model, aimed at serving pharmacy chains, independent pharmacies, as well as hospital and polyclinic pharmacy structures.

The company does not make direct sales to end users, but focuses its activities on effective mediation, logistics and building long-term partnerships within the pharmaceutical market.

The product portfolio includes:

- Rx medications – prescription drugs, mainly from Bulgarian and European manufacturers;
- OTC medications – non-prescription drugs, including popular brands with high recognition;
- Nutritional supplements and vitamins – natural and synthetic products aimed at prevention and health support;
- Medical consumables – sterile products, diagnostic tests, measuring devices and other medical products.

The company's logistics model is hybrid, combining its own distribution capacity with outsourced services from external logistics operators:

- Own transport – daily service to major cities: Sofia, Varna, Plovdiv, Burgas, with fixed routes and schedules.
- 3PL (Third-Party Logistics) – partnerships with specialized external suppliers, certified by GDP (Good Distribution Practice), covering more remote areas in the country.

The warehouse policy of "MediLine" is based on the "just in time" principle, with the aim of:

- Optimization and minimization of storage costs;
- Maintaining high product rotation and freshness of medications;
- Ensuring flexibility in responding to customer requests and seasonal changes in demand.

The entire logistics and distribution system is managed through a centralized ERP platform, providing:

- real-time inventory monitoring,
- order management,
- control over expiration dates,
- automated notification of low stock levels.

Application of the marketing strategy

The marketing strategy of "MediLine Distribution" Ltd. is built on the classic 4P marketing mix model, adapted to the specifics of B2B pharmaceutical distribution. The approach combines operational efficiency, digital tools and personalized sales relationships.

Key communication channels

Sales representatives

Regularly visit customers on site, present new products, accept orders and collect feedback. They are the main bearer of trust and a consulting role for the pharmacy staff.

Digital catalog

Online database with current availability, prices, instructions for use and promotional conditions - available to all registered customers 24/7.

Email and SMS notifications

They are used to inform about current campaigns, new items, expiring expiration dates and important regulatory news that could affect the practice of customers.

This comprehensive strategy positions "MediLine Distribution" as a modern, reliable and adaptable partner in the pharmaceutical market, which skillfully combines operational efficiency with a customer-oriented approach.

Survey among pharmacies

Purpose of the study

The main purpose of the survey is to assess the effectiveness of the marketing and distribution strategy of the company "MediLine Distribution" OOD from the perspective of pharmacy customers. The study aims to identify the strengths and weaknesses of communication, logistics service, commercial conditions and overall satisfaction.

Methodology

Type of study: Quantitative, with elements of qualitative analysis

Method: Online survey

Tool: Google Forms

Scope: 50 respondents from pharmacies in different regions of the country (large and small settlements)

Type of questions:

- Closed questions with a 5-point scale (from "strongly disagree" to "strongly agree")
- Open-ended questions for additional comments

Anonymity: Fully guaranteed; no personal data was collected

Survey questions

For the needs of the study, a questionnaire was created aimed at assessing key aspects of the marketing and distribution strategy of "MediLine Distribution" from the perspective of pharmacy customers. The

questions cover both logistical parameters and elements of communication, service and satisfaction.

4. Research results

Processing and analysis of results

Based on the survey among 50 pharmacy sites, the following summarized indicators were obtained, reflecting the main aspects of the marketing and distribution strategy of "MediLine Distribution":

Category Positive responses (%)

Timeliness of deliveries 82%

Quality of service 74%

Price satisfaction 61%

Awareness of new products 79%

Average overall rating 4.3 / 5

Note: "Positive responses" include a rating of 4 or 5 on a 5-point scale.

Analysis of results

Based on the data collected, the main strengths and weaknesses of the company can be outlined in the context of perception by pharmacy customers:

Strengths:

- Reliability of deliveries - over 80% of respondents confirm that they receive the goods on time.
- Good service - sales representatives are perceived as responsive and informed.
- Respected name among pharmacies – high percentage of overall satisfaction and loyalty to the company.

Weaknesses:

- Limited choice of specialized products – some respondents share a lack of niche or hospital items.
- Pricing policy – perceived as less competitive compared to larger distributors or in off-season campaigns.

The analysis of the results shows that “MediLine Distribution” successfully implements marketing strategies, especially in aspects related to logistical efficiency, communication and service. However, there are opportunities for further improvement through the following strategic directions:

- More flexible pricing – introduction of dynamic discounts or personalized contracts for key customers.
- Digital transformation of the platform – upgrade with real-time tracking functionalities, chat support, mobile version.
- Training of the sales team – development of skills for personalized communication, digital sales and work with CRM.

Main conclusions

Based on the theoretical review, case analysis and the results of the survey, the following key conclusions can be formulated regarding the activities and marketing strategies of "MediLine Distribution" Ltd.:

- Well-established organizational structure and established market position

The company demonstrates a sustainable business model, an effective logistics network and a stable customer base in the field of pharmacy distribution.

- Strengths in logistics and service

Main competitive advantages are timely deliveries, precise service and the personal approach of the sales team to pharmacy partners.

- Potential for digital and strategic development

Opportunities for improvement through technological investments have been identified, including mobile

solutions, advanced CRM and real-time shipment tracking.

- Survey results confirm high customer satisfaction

At the same time, some of the respondents express expectations for a more flexible pricing policy and expanded choice in certain product niches.

5. Conclusions

This report provides an in-depth look at the topic of marketing strategies in the distribution of pharmaceutical products, with a special focus on real business practice through a case study with the company "MediLine Distribution". The study combines theoretical analysis, market diagnostics, strategic planning and empirical survey research, which provides a comprehensive picture of the processes in this specific B2B sector.

Theoretically, the key aspects of the marketing mix (4P), the role of distribution as a strategic tool, and the specific features of the pharmaceutical market – regulated, sensitive to public needs and dependent on logistical precision – were summarized.

The practical part, based on the case study with "MediLine Distribution", showed how a distribution company can build an effective product and pricing strategy, optimize its logistics through regional hubs, and implement modern communication approaches through CRM and digital platforms.

The survey among pharmacy customers revealed high satisfaction (score 4.3/5), but also pointed out important areas for improvement – implementation of integrated digital tools, expansion of coverage and more flexible pricing.

In the context of accelerated digitalization, regulatory changes and increased partner requirements, marketing strategies in distribution cannot be considered separately from logistics, technology and communication. The success of pharmaceutical distributors will depend on their ability to:

- anticipate and respond to customer needs in real time,
- integrate innovation into their daily operations,
- and build trust through transparency, speed and partner engagement.

"MediLine Distribution" has all the prerequisites to be a successful model in the sector, as long as it continues to adapt flexibly to the challenges of the modern pharmaceutical market.

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Application of International Sustainable Practices and Standards in Tourism Enterprises in Bulgaria

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JEL: O14, P24, C41, E13

Abstract

Sustainable practices and standards embedded in European policies represent a key element in Bulgaria's strategic development. This *study aims* to provide a structured overview of these practices and to analyze their application in the tourism sector. The focus is placed on environmental and social recommendations and standards incorporated into legislation, plans, programs, and strategies. *The methodological approach* is primarily based on the examination of secondary sources, which were purposefully selected, systematically organized, and subjected to analytical processing. The sustainable development vision aligns with the proposed standards, while simultaneously presenting a number of challenges for their adoption and implementation. *The findings* aim to draw the attention of tourism enterprises to concrete path that can facilitate the implementation of sustainable standards.

Key words:

sustainability, environmental protection, standards, tourism enterprises.

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1. Introduction

Tourism is far long not any more a special occasion. In year 2023, 65% of EU residents made at least one personal tourism trip (Eurostat, 2025). Main destinations such as Spain, Italy, France, Greece continued to suffer from over tourism and face its negative effects. Main concern is when noise is raised by a concentration of tourists in roads, pedestrian streets and certain types of tourist attractions such as amusement parks or car/motorcycle race tracks and may reach uncomfortable and irritating levels for nearby residents, and other tourists (Sadeghian, M. M., 2019). Further on additional complication might arise in a common interaction between locals everyday life and tourists exploring walks. Rather small towns or places are vulnerable from hosting huge numbers of tourists and may find this to be a particular challenge. Local residents may experience a loss of privacy as a consequence of tourism, as visitors can intrude upon their personal space through photography or other forms of observation. This issue can be particularly problematic in destinations where tourism represents a major economic activity, as the constant presence of visitors may create a sense of being continuously watched or monitored, potentially leading to discomfort and social tension within the local community (Malik, Z. U. et al., 2023).

Stressing on the environmental pillar of sustainable development a recent study indicated that personal norms have the strongest direct influence on support for these interventions, followed by individual attitudes (Ritchie et al., 2022). Furthermore, awareness of the consequences demonstrated a substantial positive effect on personal norms and a comparatively weaker positive influence on attitudes.

One primary reason sustainable standards are important is the increasing global market demand for environmentally responsible tourism products. International tourists increasingly prioritize sustainable practices when choosing accommodation. According to a survey (Trišić, I., et al., 2021) significant majority of international tourists (79.9%) would prefer choosing an eco-hotel over other categories. Following out of the research mentioned, tourists express a willingness to choose hotels that implement key sustainable standards, such as those that recycle waste safely (69.2% of respondents) and those that use renewable energy sources (63.6% of respondents). They also highly value the possession of eco-certificates when selecting hotel.

Tourists demonstrate specific desires aligned with sustainable standards, including choosing hotels that offer organic food, which usually involves sourcing from local producers. The commitment to consume locally sourced products while on holiday is the top preferred sustainable touristic action in the large majority of European countries. Adopting these standards allows Bulgarian tourism businesses to align with these consumer preferences, which translates to a potential increase in business results and profits.

The Southern European hotel industry generally shows deficiencies in the insufficient use of organic products and eco-materials. The region faces problems with waste recycling, sorting of packaging, and the use of alternative energy sources. Although some hotels use renewable energy sources, it is often characteristic of high-category hotels, indicating a need for wider adoption across other categories. Across surveyed southern European capitals, only 40% of the facilities had eco-labels, indicating a broad need to obtain necessary business certificates to ensure and verify sustainable operations (Trišić, I., et al, 2021). Sustainable standards, particularly those relating to the green economy, are important for tourism businesses in Bulgaria due to a combination of market demand from international tourists and the country's need to improve its implementation of environmentally responsible practices.

A study on European citizens' sustainable tourism intentions categorized Bulgaria as one of the countries where citizens were least prepared to assume sustainable tourism behaviour (77% willingness, ranking low among EU countries). In Bulgaria, the action that received the highest percentage of positive responses concerning sustainable habits while on holiday was reducing waste while on holiday. Bulgaria belongs to the group of EU countries that are classified as having the lowest percentage of "green" tourists—those least prepared to change their habits (Bassi, F., & Martín, J. A. M., 2024).

Therefore, adopting robust and verifiable sustainable standards, such as those that form the basis for certification, is crucial for Bulgarian tourism businesses not just for competitive advantage among international destination and travellers, but also to contribute to the broader goal of sustainable tourism development within the country and to meet the environmental postulates demanded by the tourism industry worldwide.

Implementing established standards, such as those related to green procurement, eco-labeling, and a general transition toward the green economy, represents a perspective of hospitality and sustainable tourism development that businesses should prioritize. The trend of improving business operations to obtain certain certificates of the green economy needs to gain popularity among hoteliers in the region, driven by the belief that such business provides a strategic development.

Helping Bulgarian businesses to align with the European sustainable development, this study raised the following research questions:

- Which are the current sustainable standards related to ecology and social responsibility?
- Which are the most popular International sustainable practices and standards in Tourism?
- How are these practices and standards applied in tourism enterprises in Bulgaria?

2. Literature Review

2.1. Key concepts: sustainability, sustainable tourism, standards, certification

A sustainable approach to tourism considers the social, cultural, environmental, and economic effects that tourism creates both now and in the future. Its goal is to achieve a balance by enhancing the positive outcomes while reducing the negative impacts over the long term (Zippelius, E., 2024, October). The idea of sustainability has come from the World Conservation Strategy (1980) and the famous Brundtland Report (1987). Initial definition of sustainable tourism development - "tourism development that meets the needs of the present without compromising the ability of future generations to meet their own needs", later enriched with "guaranteed respect for local environments, societies and cultures" (Brundtland Report, 1987). Sustainability is perceived further in research as strategic management that strives to minimise the direct and

indirect costs of a given activity whilst concurrently maximising the attendant benefits, both locally and globally (Weaver, 2006). Sustainable tourism is defined by the UN Environment Program and UN World Tourism Organization as “tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities.” Additionally, they say that sustainable tourism “refers to the environmental, economic, and socio-cultural aspects of tourism development, and a suitable balance must be established between these three dimensions to guarantee its long-term sustainability” (UNEP & UNWTO, 2005). Latest document “The 2030 Agenda for Sustainable Development” (2015) of the UN outlines 17 strategical Goals highly influencing tourism destination management decisions. Tourism enterprises are considered primary stakeholder on the one side affecting and on the other side affected by overcrowding, nature disruption, air and water pollution, gender inequality, etc.

The conceptual idea needing further clarification and understanding from the members of the United Nations and associated stakeholders invest efforts and will into building guiding and substantial support from the Division for Sustainable Development Goals (DSDG). The DSDG has a central role in assessing how the United Nations system implements the 2030 Agenda and in leading advocacy and outreach efforts related to the Sustainable Development Goals (SDGs). To turn the 2030 Agenda into action, it is essential that the widespread support for the SDGs translates into concrete commitments from all stakeholders. The DSDG works to encourage and support this active participation. In this regard since 2015 there have been reports issued every year (Sustainable development goals report) in service of delivering comprehensive analysis and evaluation of the execution of the suggested strategy and pointing out achievements.

Following voluntary sustainability standards (VSS) outline a set of criteria that producers, traders, manufacturers, retailers, and service providers are encouraged to fulfil. These standards provide us with a broad spectrum of sustainability dimensions, including support to fundamental human rights, assurance of worker health and safety, mitigation of environmental impacts arising from production processes, promotion of positive community relations, responsible land use planning, and other related considerations (UNFSS, 2013). Aiming to assess and track the sustainability of tourism, researchers have introduced a variety of methodological frameworks and tools, including the Sustainable Tourism Index (STI), the Global Sustainable Tourism Council (GSTC) Criteria, the Systematic Indicators System (SIS), as well as analytical models such as the Importance–Performance Analysis (IPA) and the SERVQUAL framework (Council Global Sustainable Tourism, 2013; Fernández & Rivero, 2009; Schianetz & Kavanagh, 2008).

2.2. International application of sustainable practices

With the introduction of the Bruntland report (1986) and International Organisation for standardisation (1996), following by Sustainable development goals in 2015, the concept of being oriented toward the future needs of the coming generations is brought to action and certain standards were introduced. The implementation of sustainability standards in international enterprises primarily emphasizes the development of integrated management systems, the definition of measurable performance benchmarks across operational areas, and the assurance of transparency and reliability through certification and third-party verification — especially within the global tourism sector (Futagami, M., & Kumara, T., 2022). This follows the introduction of sustainable standardisation and certification process, to foster the sustainable development of tourism. According to the World Tourism Organization, there are currently more than 200 sustainable tourism and ecotourism certification programs worldwide (UNWTO, 2005). These programs address various dimensions of tourism’s impact, including economic, socio-cultural, and environmental aspects. The majority focuses on accommodation facilities evaluation, while relatively few extend certification to other sectors and components of the tourism industry. In terms of geographical distribution, Europe accounts for approximately half of all sustainable tourism and ecotourism certification programs globally. In addition, tourism certification audits found that only 34 tourism certification programs out of more than 200 tourism certificates reported worldwide

are currently considered credible or workable (Dragomir, L., Mazilu, M., & Marinescu, R., 2018).

In contrary to the supply side, according to a study conducted by Bassi F. and Martin J. (2024) only a relatively small proportion of European citizens (14.7%) are reluctant to modify their travel behaviours. The countries demonstrating the highest willingness among citizens to engage in environmentally responsible practices while on holiday include Malta (99%), Ireland and Luxembourg (95%), and Austria, Portugal, and Romania (94%). Conversely, the nations where residents are least inclined to adopt sustainable tourism behaviors are Cyprus (72%), Denmark (75%), Lithuania (76%) and Bulgaria (77%). The trend is supported by Bassi and Dias (2019) which outline that a significant number of countries in Eastern Europe demonstrate limited engagement in sustainability practices in relation to circular economy practices among small and medium-sized enterprises in Europe. Following this trend, the European Commission launched in 2013 the "European Tourism Indicators System (ETIS) as an integrated tool for the sustainable development of destinations across Europe. The system is comprised of 27 core indicators and additional 40 optional indicators. The main goal of ETIS was to provide a practical tool for destinations to monitor, manage and improve sustainable tourism at the local level (Gkoumas, A., 2019). According to Global Sustainable Tourism Council sustainable certifications (including eco-labels and eco-certificates) within the tourism industry are predominantly applied to enterprises and facilities, with a particular emphasis on accommodation. The distribution and focus of these certifications highlight both the scope of sustainable practices and the areas where further engagement may be needed. The hotel and accommodation industry represents the primary focus of sustainable certification programs. Studies indicate that eco-labels are most commonly applied in this sector, reflecting a global effort to integrate environmental responsibility into accommodation operations (Trišić, I. et al., 2021). For instance, a survey of 100 hotels across Southern European capitals found that 40 facilities had adopted specific eco-labels (Peng, N., & Chen, A., 2019). The concept of the "green hotel economy" further emphasizes consumer preference for environmentally responsible accommodations that align operations with sustainability principles. It is suggested that establishing sustainable tourism indicators serves as a stepping-stone for local enterprises to put the principles of sustainability into action (Agyeiwaah et al., 2017). The GSTC Industry Criteria for Hotels and Accommodations (2016) provide a structured framework for certification, guiding hotels in implementing sustainable management practices. Additionally, other hospitality and catering facilities, including restaurants, are increasingly considered within sustainability frameworks, although explicit certification adoption data for these subsectors remains limited. Tour operators and attractions are also targeted by sustainability certification programs. The GSTC Industry Criteria for Tour Operators and Attractions Criteria (2016) establish benchmarks for integrating sustainability into service delivery, supplier selection, and operational management. Certification in this domain supports the design of environmentally and socially responsible tour programs and ensures that visitor attractions minimize their ecological footprint while enhancing social and cultural benefits. Sustainable certifications are designed to apply broadly across tourism enterprises rather than at the destination level. They are relevant to organizations of all sizes but are particularly significant for small and medium-sized enterprises (SMEs), which may lack internal capacity to implement sustainability initiatives without external guidance. Certification also extends to specialized segments of the tourism industry, including ecotourism enterprises and marine recreation providers, ensuring compliance with sector-specific environmental and social standards, which are enhanced with the development and implementation of certification programs or ecolabels worldwide (Akama et al., 2011). Overall, sustainable certification programs in tourism primarily target hotels, tour operators, and attractions, reflecting efforts to standardize sustainability practices across the core components of the tourism value chain. The focus on accommodation underscores its centrality in tourism consumption patterns, while inclusion of tour operators, attractions, and niche sectors demonstrates a comprehensive approach to sustainability. The widespread application of these standards, supported by frameworks such as GSTC criteria, contributes to the professionalization of sustainability practices and fosters broader adoption of responsible tourism behaviours globally.

3. Material and Methods

3.1. Methodology

The methodological approach is based on qualitative secondary research design to examine the application of international sustainable practices and standards (social and environmental) within tourism enterprises in Bulgaria. The secondary research approach was selected as it enables the systematic collection, analysis, and synthesis of existing information from credible academic, institutional, and industry sources (Veal, A. J., 2017). The design is primarily descriptive and analytical in nature. It aims to classify international sustainable standards and to evaluate their application in the Bulgarian tourism sector. The study conducted for the purposes of the report is stepping on the following reports and strategic documents ISO (2023), ECEAT, ECOTRANS (2004), UNEP & UNWTO (2005) Foundation for Environmental Education (2023), Foundation for Environmental Education (2023), Carbon Trust (2023), European Commission (2023), PEFC (2023), BRE Global (2022), FSC International (2022), U.S. Green Building Council (2023), GRI (2021), United Nations Global Compact (2024). By familiarizing with the thematic data, thru sorting and classification will be sufficiently analysed and evaluated (Nowell, L. S. et al, 2017). Data for the research were obtained exclusively from secondary sources, including standard and certificates guidebooks, institutional reports, policy documents, and corporate sustainability statements. Institutional and policy-related information was sourced from international organisations, including the United Nations World Tourism Organization (UNWTO), the United Nations Environment Programme (UNEP), the European Commission, and the Global Sustainable Tourism Council (GSTC), International organisation for standardisation (ISO), Forest Stewardship Council. National-level data were collected from the Bulgarian Ministry of Tourism, the National Statistical Institute (NSI), and industry associations such as the Bulgarian Hotel and Restaurant Association. In addition, sustainability and certification reports from selected Bulgarian tourism enterprises were reviewed to provide contextual insights into practical implementation.

3.2. Application of international sustainable standards in Bulgarian tourism enterprises

Main standards and paradigms for standartisation practices are set by the following institutions outlined in Table 1. For the aim of the study the most significant once are presented focusing on social and environmental responsibility. Analysed are 14 standards, 4 of them are non- certifiable voluntary framework (ISO 26000, UN Global Compact Principles, ISO 20400, GRI Standards) and 10 certifiable standards with audits. ISO 26000 - Social Responsibility standards is a guidance standard, that can be used by organisations of all kind for setting social responsible planning and management. Odyseia-In Ltd. is the first Bulgarian travel agency to achieve Travelife certification, which incorporates ISO 26000 guidelines on corporate social responsibility. Across Europe Ltd. complies with over 200 criteria related to office management, product range, international business partners, and customer information, aligning with ISO 26000 themes, and is Travelife certified. Bulgaria's Ministry of Environment and Water (MoEW) and Ministry of Tourism, along with other stakeholders, signed in 2024 the Charter for Sustainable Tourism. This initiative aims to position Bulgaria as a year-round sustainable tourism destination, safeguarding natural and cultural heritage while supporting local communities as part of the National Strategy for Sustainable Development of Tourism in The Republic of Bulgaria. UN Global Compact Principles is a voluntary initiative and reporting structure applied by all kind of organisations that commit to submit annual communication on the progress of social responsibility practices (United Nations Global Compact, 2024). The principles even though in the core value of the sustainable development and planning of tourism organizations and enterprises is not witnessing high popularity in the Bulgarian Tourism industry. The PECB ISO 37101 Lead Auditor training course enables to perform a management system for sustainable development in communities (MSSDC) audit by applying widely recognized audit principles, procedures, and techniques aligning with ISO 37101. Out of the thee analysed standards only ISO 26 000 is applied officially by Bulgarian enterprises. Even though 53 companies

obtained the UN Global Compact principles, none of them are tourism and hospitality once. Sustainable Tourism Education Program (STEP) is another certificate aligning with ISO 26000, not applied in Bulgarian companies (GSTC, 2017). Considering the large discussed issue of staff shortage companies in hospitality and tourism are highly recommended to study and incorporate well developed standards, providing high value for the enterprise and the wellbeing of the employees, resulting in loyalty and favourable corporate image.

Table 1**International sustainable standards**

	Standards	Institution	Key elements	Target level of application	Application in Bulgaria
Social	ISO 26000 - Social Responsibility	International organization for standartisation	Social responsibility Stakeholders integration	Organisational – business/enterprise level Covering all operational processes	Odysseia-In Ltd. Across Europe Ltd.
	UN Global Compact Principles	UN Global Compact	Human rights Labour Environment Anti-corruption	Individual companies Business level	53 enterprises. No tourism and hospitality related
	ISO 37101 - Sustainable Development in Communities	International organization for standartisation	Smart cities Communities	Communities and local government level	Ministry of Environment and Water (MoEW) Ministry of Tourism
Environment	ISO 20400 - Sustainable Procurement	International organization for standartisation	Climate action Net zero emissions Integrating sustainability	Organisational level	No enterprises officially dedicated
	ISO 50001 - Energy Management Systems	International organization for standartisation	More efficient use of energy Fix targets and objectives Continual improvement	Organizational level, Individual organisations and enterprises	BMF Port Burgas
	GRI Standards (Global Reporting Initiative) - Sustainability Reporting	GRI, funded through partners	Anti – corruption Water Biodiversity	Organisational level	No dedicated initiatives
	LEED Certification (Leadership in Energy and Environmental Design)	Canada Green building council	Lower carbon emissions Conserve resources Water savings	Building, facility level	Commercial building companies, indirectly related to business tourism
	BREEAM (Building Research Establishment Environmental Assessment Method)	BRE Group	Reduce carbon emissions Boost circularity; Biodiversity Circularity and resilience Whole life performance	Building, facility level	Garite Park, San Stefano Plaza Sofia Related to business tourism

	FSC (Forest Stewardship Council) Certification	Forest Stewardship Council	Compliance with laws Workers' rights and employment conditions; Indigenous peoples' rights; Community relations; Environmental impact; Maintenance of high conservation value forests;	Organisational level	FSC Bulgaria, 65% of Bulgarian Forest certified
	PEFC (Programme for the Endorsement of Forest Certification) for Sustainable Forest Management	Forest stewardship council	Endorse national forest certification schemes to ensure sustainable forest management	Forest management units certified under national schemes Supply chain organizations (CoC)	Council for Sustainable Forest Management and Certification in Bulgaria (CSFMCB),
	ISO 14001 - Environmental Management Systems	International organization for standartisation	Environmental performance Risk management; Cost savings Operational improvement Stakeholders trust	Organisational – business/enterprise level Covering all operational processes	Sunrise Resort Calypso Hotel
	EcoLabel - Certification for environmentally preferable products	European Union certification scheme	Life cycle environmental impact Minimize environmental impact	Product/service level	Executive Environment Agency (EEA) under the Ministry of Environment and Water acts as the national competent body.
	Carbon Trust Standard - Carbon footprint management	Carbon Trust	Low-carbon strategies and energy efficiency	Individual organizations or enterprises	No enterprises officially dedicated
	Green key	Foundation for Environmental Education (FEE)	Energy and water conservation, waste management, environmental awareness among staff and guests, sustainable purchasing.	Hospitality and tourism establishments	10 hotels and 1 restaurant

Source: Authors' Compilation, 2025.

ISO 20400 is a standard that focuses on net zero emissions and climate actions with no popularity in Bulgaria. RINA is a company that specialises in certification of transport and infrastructure enterprises who are willing to align with the ISO 20 400 standards. According to the register of RINA, there are 3 companies applying the certificate, however none of them related to the tourism industry. The standard ISO 50001 is fully certifiable by accredited bodies, widely used in tourism and industry worldwide

(Hilton, JW Marriott, Intercontinental etc.) and in Bulgaria BMF Port Burgas officially received 2021 the standard recognition. GRI Standards are dedicating to the GSDG framework and leading initiatives toward organisational and community engagement in issues related to Anti-corruption, human rights and biodiversity, not recognized officially in any organisation and company among the Bulgarian tourism industry. LEED Certification is applied by hotels and tourism infrastructure providers including Hilton, Marriott, Accor, InterContinental (in destinations such as USA, UAE, Italy, Cape Town), to demonstrate environmental responsibility, reduce operational costs, and appeal to eco-conscious travellers (US Green Building Council, 2025). In Bulgaria the majority of LEED-certified buildings are commercial office spaces (Sofia Business Park, Sofia Airport Center etc.), which leads us to the idea of business tourism recognition of the standard, rather than leisure one. BREEAM is managed by BRE Global (UK), specialized in design and construction management and certification. These certificates have rating from one- to six-star scale with descriptors from “pass” to “outstanding” and apply to new, existing, or renovated buildings (BRE Global, 2022). In Bulgaria, construction companies increasingly adopt such systems to meet consumer sustainability expectations and improve investment returns. For example, Garitage Park and San Stefano Plaza in Sofia became the first multifunctional complexes in Central and Eastern Europe to receive a BREEAM Communities “Excellent” rating for its social, economic, and environmental performance. FSC is recognised globally, certifies both forest management and chain of custody. The indicators of the new FSC Forest Stewardship Standard, tailored to conditions in Bulgaria, will protect these vital ecosystems and improve management going forward (FSC, 2024). The Revised report stated that 65% of the forests in the country are identified as of High Conservation Value. An alternative for FSC is PEFC, represented through The Council for Sustainable Forest Management and Certification in Bulgaria (CSFMCB) existing from 2019 and replaced the national system with the Balkan Forest certification scheme in July 2025. PEFC Bulgaria’s standard-setting process can be considered of a high standard, with satisfactory public communication, stakeholder participation, process documentation, and general transparency (PEFC Council, 2024). One of the most widely used environmental certification is ISO 14001 - Environmental Management Systems, applicable in the hospitality industry and allowing high level of recognition among the eco-friendly orientated companies and travellers. Two hotels in Bulgaria state ISO 14001 recognising, which helped them gain “Eco hotel” label. The Executive Environment Agency of Bulgaria is responsible for Eco labelling and is currently developing following Projects: “Danube WATER integrated management” – WATER and “Improving Bulgarian Biodiversity Information system” (EEA, 2025). There is no evidence of Bulgarian enterprises standardised, even though there are guidelines dedicated to the Hospitality sector with focus on energy efficiency and water savings (Carbon Trust, 2025). Manchester Airport Group, Marriott International Melia Hotels International are one of the companies Carbon Trust labelled.

4. Conclusion

It has to be noted that according to the National Strategy for Sustainable Development of Tourism in The Republic of Bulgaria (2017) several voluntary systems in Bulgaria for certification of the sustainable development of tourism enterprises already exist. There are international quality assurance/sustainable development certification programmes and/or specialized eco-labels with accent on tourism enterprises. Among them are: "Blue Flag", PAN Parks, "Green House" Certificate, "Authentic Bulgaria", Regional Quality Brand "Stara Planina", Regional Brand "Strandja", Regional Brand "Lomovete", Brand "Nature Park Vrachanski Balkan" as well as other eco-labeling schemes - the EU Ecolabel scheme, the Ecohotel Management System, the Green Globe certification. As it is evident many of them with local level, rather than international and worldwide recognisable once. As some previous research (Bozhinova, M., & Georgieva, K., 2023) on the topic stated the established place in international practices in Bulgaria is rather limited. Despite the wide variety of sustainability programs and brands, the majority of tourism enterprises in the country do

not possess such ratings. The reasoning behind might be in the high cost required, statement justified by the research conducted by Dimitrov I. (2023) and arguments that enterprises will increase the interest in sustainable standardisation implementation in case of governmental administrative support and financial funding.

The application of international sustainability practices and standards in Bulgarian tourism enterprises is steadily advancing, though it remains at an early stage of integration. Most progress is evident in the implementation of environmental management systems such as ISO 14001, EU Ecolabel, Green Key and BREEAM, adopted primarily by larger hotels and resorts seeking to enhance environmental performance and attract eco-conscious tourists. Notable examples include Calypso Hotel, Sunrise Resort. Business entities such as Garitage Park in Sofia suggest that environmental sustainability efforts are done in order to meet the business traveller demand. In contrast, broader frameworks such as ISO 26000, ISO 20400, and the UN Global Compact Principles are less commonly applied, largely due to limited awareness, resources, and the voluntary nature of these initiatives. Expected social responsibility initiatives and standards are not popular among Bulgarian tourism companies, and rather irrelevant to the Balkan context. Nevertheless, the growing alignment with EU sustainability directives and international certification schemes indicates increasing recognition of sustainability as both a strategic and ethical imperative. Efforts toward sustainable future are confirmed by the secondary research sources, however actual planning and execution are still in shortage. Strengthening institutional support and knowledge transfer remains crucial for wider sectoral adoption.

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3. MANAGEMENT, STRATEGY, AND ADMINISTRATION

New Strategic Landmarks for Romania's War Equipment and Materials Production Sector

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Abstract

Background and aim: This paper analyzes Romania's new strategic landmarks in the production of defense equipment and materials, against the backdrop of Russia's war in Ukraine and Romania's positioning on NATO's Eastern flank. The study aims to highlight the dual character of war production, which functions both as a military necessity and as an economic and technological driver. *Scope:* The research is limited by its reliance on strategic documents and secondary literature, without direct empirical data from companies or stakeholders. *Methods:* The authors apply an interdisciplinary approach combining documentary analysis, comparative perspectives, and critical assessment of domestic industrial capacities, framed along economic, technological, and geopolitical dimensions. *Results:* The findings reveal significant vulnerabilities in Romania's defense industry—such as outdated technologies, weak governance, and dependence on imports—while also identifying opportunities in NATO/EU funding, strategic partnerships, and emerging technologies. *Conclusions:* The paper argues that Romania's ability to transform its defense industry into a competitive, resilient, and integrated sector depends on sustained investment, governance reforms, and international cooperation. *Originality:* The paper contributes to the literature by linking war production with economic governance and innovation, framing it as a tool of resilience and convergence with NATO/EU industrial chains. *Practical implications:* The study offers insights for policymakers, suggesting that Romania's defense industry can evolve from vulnerability to strategic strength by aligning military necessity with economic modernization and collective security goals.

Key words:

Romania, defense industry / war production, NATO, European Union, economic governance.

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1. Introduction

The profound transformations that have occurred in the international security environment over the last decade have, undeniably, led to a radical change in the way states define their defense policies and, in particular, how they organize their national defense industries. The war—highly undesirable, at least for EU member states—launched by the Russian Federation against Ukraine has confirmed the necessity for Romania and NATO to prepare for high-intensity conflict scenarios characterized by massive ammunition consumption, complex technological requirements, and extended logistical chains. For Romania, situated on NATO's Eastern flank, this geopolitical reality represents both a strategic vulnerability and an opportunity to strengthen its role as a regional security provider. Under these conditions, the production of defense equipment and materials can no longer be interpreted solely from a military or technical perspective. It has become a fundamental component of state resilience policies, strongly interconnected with economic growth, technological innovation, and the development of critical infrastructures.

In essence, our paper emphasizes that Romania's new strategic landmarks regarding war production must be understood within the broader context of the geopolitical transformations shaping the third decade of the 21st century. Romania cannot build a competitive and sustainable defense industry in isolation but

only through integration into the European and Euro-Atlantic security architecture—benefiting from the support of partners while actively contributing to collective security. This reality derives both from internal structural constraints (limited technological capacities, dependence on imports) and from the geopolitical logic of NATO and EU membership.

Accordingly, we note that the National Strategy for the Defense Industry 2024–2030 (GR, 2023) is framed as both a declaration of intent and a complex action plan designed to reposition Romania within the European and Euro-Atlantic defense architecture. Its major objectives aim at revitalizing production capacity for important military equipment, reducing import dependence, and aligning with NATO and EU standards of interoperability and sustainability.

The concept of war production must therefore be understood in an extended sense: beyond the strictly technical meaning linked to the manufacture of munitions or equipment, it involves an integrated vision encompassing political, economic, technological, institutional, and social dimensions (Duncan & Coyne, 2013). This approach implies interdependent relationships between the public and private sectors, academia and industry, military structures and economic actors—all converging toward the creation of a national industrial and technological base capable of sustaining defense efforts over the long term.

Structurally, the paper is organized as follows: (1) Introduction; (2) Material and Methods; (3) Analysis of the geopolitical context and identification of pressures on Romania; (4) Strategic priorities for the production of defense equipment and materials; (5) A focus on the economic and governance dimension. The final section (6) is dedicated to Conclusions as well as the presentation of research limitations and future directions.

In this way, we argue that modernizing the defense industry is not only a military necessity but also a strategic objective of economic development and a means of strengthening the resilience of the Romanian state, in full convergence with NATO and EU collective security goals.

2. Material and methods

Our study is based on a qualitative and interdisciplinary methodological framework designed to capture the multiple dimensions of the transformation of Romania's defense industry.

The main bibliographic sources include official public policy documents, such as the National Strategy for the Defense Industry 2024–2030 (GR, 2023), the NATO Strategic Concept 2022 (NATO, 2022, 2023), the NATO Defence Production Action Plan (NATO, 2025), and the EU Strategic Compass (European Commission, 2022). These are complemented by syntheses (Clapp, 2025) and reports published by the European Defence Agency (EDA, 2023), the European Parliament (2023), the European Commission (2024), as well as relevant academic literature in the field of defense industrial policy and security studies (Matthews, 2025; Zaborowski, 2022). The research design is illustrated in Figure 1.

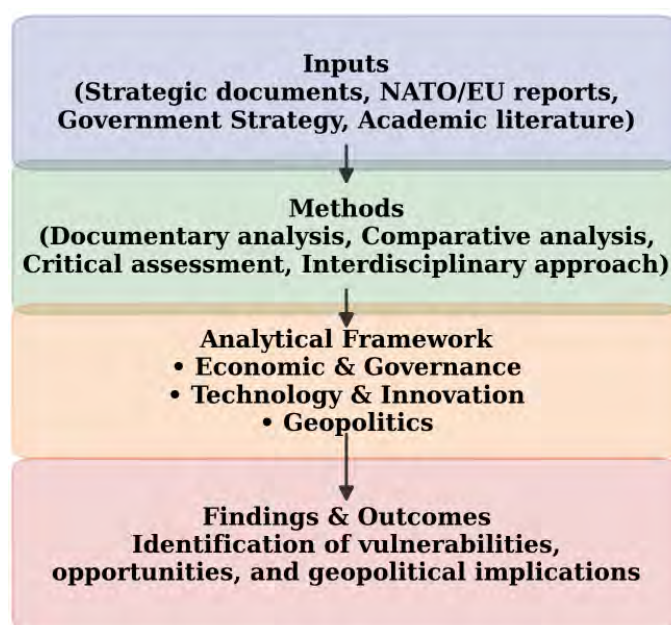


Fig. 1. Research design

[Source: Authors' elaboration](#)

Our methodological approach integrates several levels of analysis. First, a documentary analysis was conducted to extract the main strategic directions formulated at the national, NATO, and EU levels. Second, a comparative analysis was applied, situating Romania's strategic options within the broader context of defense industrial policies adopted by other allied states. Third, a critical assessment of the national industrial base was undertaken, with emphasis on structural vulnerabilities (outdated technologies, fragmented governance, dependence on imports) and on existing opportunities (NATO/EU funding, strategic partnerships, integration into global supply chains).

To guide the interpretation of results, the authors applied an analytical framework structured along three dimensions: (1) the economic and governance dimension, highlighting financial sustainability and corporate governance reforms; (2) the technological and innovation dimension, focusing on the adoption of emerging technologies and knowledge transfer; and (3) the geopolitical dimension, assessing Romania's integration into the NATO and EU defense architecture and the implications for collective security.

3. Analysis of the geopolitical context and identification of pressures on Romania

3.1. The new European security architecture

Following the annexation of Crimea by the Russian Federation (2014) and, above all, the launch of the large-scale invasion of Ukraine (2022), Europe is facing the most severe security climate since the end of the Cold War. The NATO documents we reviewed underline that member states must rapidly rebuild their industrial capacities in order to meet the requirements of a high-intensity conflict (NATO, 2023). At the same time, the European Union, through the Strategic Compass for Security and Defence, stresses the need to reduce external dependencies and strengthen the European Defence Technological and Industrial Base (European Commission, 2022).

In this context, considering also Russia's earlier concerns with the Development of the Military-Industrial Complex (Balashov & Martianova, 2016), Romania is called to redefine its position on NATO's Eastern flank—not only as a beneficiary of the collective defense umbrella but as a security provider.

3.2. Romania's strategic position in the NATO and EU context

Romania's geographic position, at the eastern border of both NATO and the European Union, generates both opportunities and vulnerabilities. Proximity to the conflict zone in Ukraine (Figure 2) makes Romania a key state for regional security, while at the same time exposing it to hybrid, cyber, and military threats (European Defence Agency, 2023).

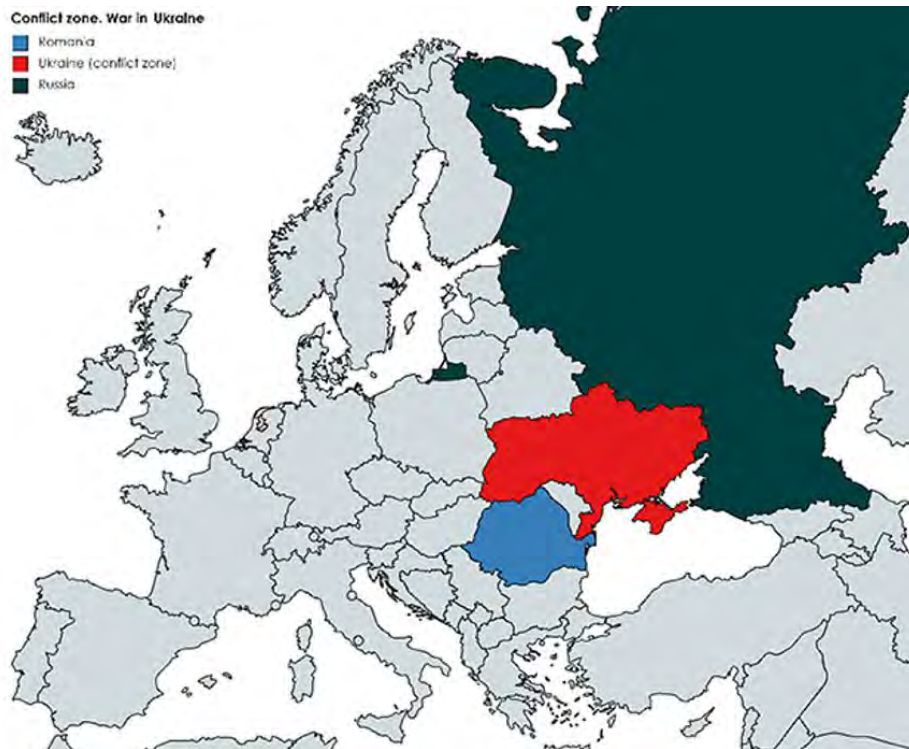


Fig. 2. Romania's geographical position in relation to states engaged in armed conflict—Ukraine and the Russian Federation

Source: European Council on Foreign Relations, 2022

For this reason, the National Strategy for the Defense Industry 2024–2030 provides for a shift from an import-based economic model to one centered on domestic production, technological cooperation, and strategic partnerships.

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3.3. The state of the national defense industry

In terms of ownership, Romania's defense industry includes both state-owned and private operators. However, in both categories, the lack of consistent investment and the degradation of infrastructure have led to major vulnerabilities (Matthews, 2025). The financial analysis for 2021 shows an imbalanced situation (Table 1): state-owned operators recorded losses, while the private sector generated some profits.

Table 1

Comparative financial data (2021) for Romania's defense industry

Indicators (million lei)	State-owned operators	Private operators	Sector total
Capital	1,485.7	3,013.3	4,499.1
Turnover / Revenue	972.5	8,239.2	9,211.8
Net profit	-114.2	356.3	242.0
Losses	165.8	227.1	393.0
Total liabilities	1,988.6	8,055.4	10,044.0
Number of employees	7,077	22,493	29,570

Source: Authors' selection based on GR, 2023

Between 2020 and 2023, the cumulative turnover of state-owned companies in the sector nearly doubled, rising from approximately 841 million lei (2020) to 1.89 billion lei (2023) (Figure 3).

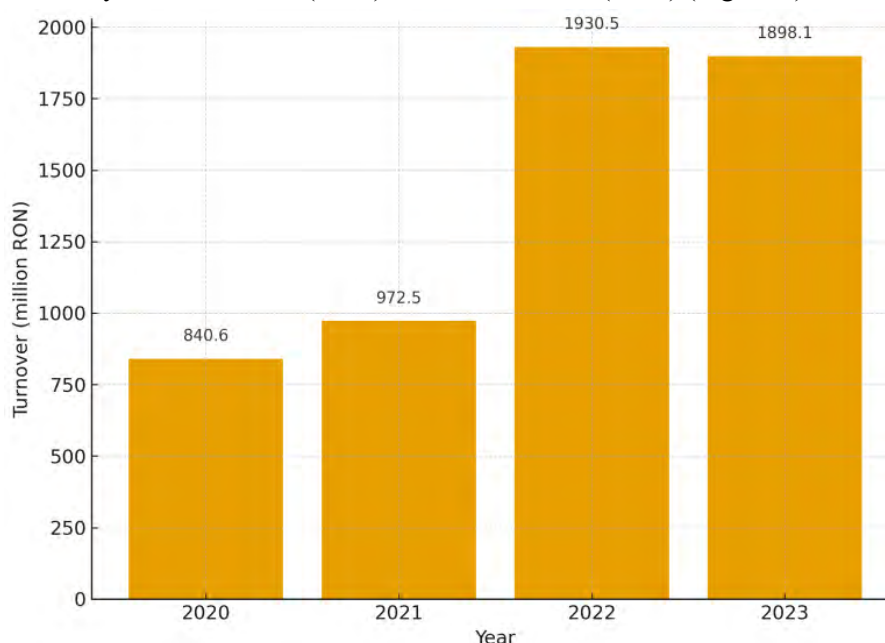


Fig. 3. Turnover of state-owned companies in the defense industry, 2020–2023 (million lei)

Source: Authors' elaboration based on GR, 2023

This positive trend demonstrates not only a revival of state-owned industrial capacities, driven by increased domestic and external demand amid the conflict in Ukraine, but also the beginning of Romania's strategic repositioning. Through investments, partnerships, and integration into NATO and EU supply chains, Romania can transform its defense industry from a structurally vulnerable sector into one capable of contributing actively to collective European security.

A key moment in this regard is the European Commission's 2024 decision to allocate €47 million for the construction of a powder plant in Romania, a project that will enable the production of 2 million shells annually (European Commission, 2022).

3.4. SWOT analysis in the geopolitical context

The SWOT analysis of the Defense Industry highlights a sharp contrast between Romania's potential and the structural difficulties it faces (GR, 2023). Regarding strengths, Romania benefits from significant historical and technical capital: decades of accumulated experience, the presence of skilled specialists with international

recognition, and certain export potential to traditional markets. Its geostrategic position—at the crossroads of trade and military routes between East and West—further strengthens Romania's role as a potential security provider on NATO's Eastern flank, offering a solid basis for industry revitalization.

Conversely, the weaknesses are substantial and structural. Outdated technologies and the lack of significant investment have reduced competitiveness. The fragmentation of state-owned companies, accumulated debts, and dependence on imports for critical raw materials (e.g., powders and explosives) pose serious obstacles. Furthermore, the loss of young, qualified labor, combined with an aging workforce, generates long-term vulnerabilities.

In terms of opportunities, Romania's NATO and EU membership provides significant prospects. Access to European funding programs such as EDF, PESCO, and EDIRPA, as well as the potential for creating strategic industrial partnerships, are favorable factors for retooling and modernization. At the same time, the global increase in demand for munitions and military equipment, following the conflict in Ukraine, offers an ideal context for Romania's reintegration into external markets.

As for threats, these are both external and internal. For years, international competition—especially from low-cost Asian producers—has exerted pressure on Romanian companies' competitiveness. Environmental and ecological constraints could delay modernization efforts. The risk of insolvency among state-owned companies and regional geopolitical instability further increase uncertainty.

The visual representation of the SWOT Matrix (Figure 4) confirms that, while Romania possesses significant advantages such as historical expertise, geostrategic positioning, and a core of skilled specialists, these assets can only be fully leveraged through effective management of structural vulnerabilities and rapid integration into European and Euro-Atlantic industrial chains—especially as competitive and geopolitical pressures intensify.

Strengths • Historical experience • Skilled specialists • Export potential • Geostrategic location	Weaknesses • Outdated technologies • High dependency on imports • Fragmented state-owned companies • Loss of skilled workforce
• EU/NATO funding programs • Growing global demand for munitions • Strategic partnerships • Reclaiming export markets Opportunities	• Strong international competition • Environmental constraints • Risk of insolvency • Geopolitical instability Threats

Fig. 4. SWOT Matrix of Romania's defense industry

Source: Authors' elaboration based on GR, 2023

The SWOT matrix thus becomes not only a descriptive tool but also a starting point for shaping concrete strategic directions, showing that geopolitical pressures on Romania can be transformed into genuine opportunities for industrial development and for strengthening its role on NATO's Eastern flank.

3.5. Strategic implications for Romania

Based on the above context, it is important for Romania to pursue two major objectives: (1) revitalization of domestic production of munitions, weapons, and military equipment, in order to meet FSNA requirements and contribute to collective security (European Commission, 2022); and (2) active integration into NATO and EU industrial chains through technological cooperation, know-how transfer, and partnerships with major international producers (Zaborowski, 2022).

As NATO (2022) emphasizes, only such an approach can transform Romania from a vulnerable actor into a pillar of regional resilience, strengthening its status on NATO's Eastern flank.

4. Strategic priorities for the production of defense equipment and materials

The authors' analysis of the National Strategy for the Defense Industry 2024–2030 finds that it outlines a series of important orientations designed to strengthen Romania's capacity to produce, modernize, and efficiently use the equipment, weapons, and ammunition required for high-intensity military operations. In the context of new geopolitical challenges and NATO/EU standards, these directions—discussed in what follows (GR, 2023)—aim to reduce critical vulnerabilities accumulated after 1990 and integrate Romania into an industrial and military system capable of meeting the current and future demands of collective defense.

4.1. Revitalization of ammunition and explosives production

A strategic priority is the restoration of powder, explosives, and ammunition production capacities, which have experienced severe decline over the last three decades. Without such capacities, Romania has become dependent on imports, a major strategic risk in the event of prolonged war. Through sustained investments—such as the 2024 European Commission-supported project to build a modern powder plant—the aim is to achieve reasonable autonomy, enabling Romania to produce millions of shells annually, in line with NATO standards. This process requires both modernization of technological infrastructure and recruitment of young, well-qualified personnel.

4.2. Development of ground military equipment

Strengthening Romania's ability to manufacture and modernize ground equipment, especially armored vehicles, carriers, artillery, and mobile air-defense systems, is also a strategic necessity. At present, much of this equipment is either imported or produced under offset arrangements with foreign companies, reducing the country's strategic independence. Currently, through cooperation with NATO partners and joint research and development programs, Romania aims to develop competitive production lines capable of meeting both domestic and external needs, including participation in international security missions.

4.3. Defense aeronautics and naval industry

Another strategic pillar is the modernization and diversification of aeronautical and naval production. Romania has a tradition in the manufacture of training aircraft and helicopters (e.g., IAR Braşov), but these capacities have eroded. The Strategy calls for investments in modernizing infrastructure, integrating new technologies (drones, unmanned aircraft, advanced sensors), and establishing partnerships with major international manufacturers.

In parallel, Romania's shipyards are expected to engage in the production of frigates, corvettes, and logistic vessels, considered indispensable for security in the Black Sea.

4.4. Integration of emerging technologies and digitalization of production

An innovative dimension of the strategic directions is the integration of emerging technologies into

defense production: artificial intelligence, robotics, 3D printing of spare parts, smart sensors, and cybersecurity solutions. One of the most important lessons drawn from contemporary conflicts—particularly the war unfolding near Romania—is that victory no longer depends solely on the quantity of equipment or the number of mobilized troops, but on the ability to integrate emerging technologies and transform scientific knowledge into concrete military products.

Certainly, digitalizing manufacturing processes will reduce costs, improve product quality, and enable rapid adaptation to global market demands. At the same time, a stronger focus on research and development will foster cooperation with universities and innovation centers, consolidating ties between the national defense industry and the academic and scientific ecosystem.

To illustrate the systemic approach promoted by the National Defence Industry Strategy 2024–2030, Figure 5 maps the integration of emerging technologies and digital enablers into a centralized framework of digitalized defense production, highlighting both technological inputs and expected operational outcomes.

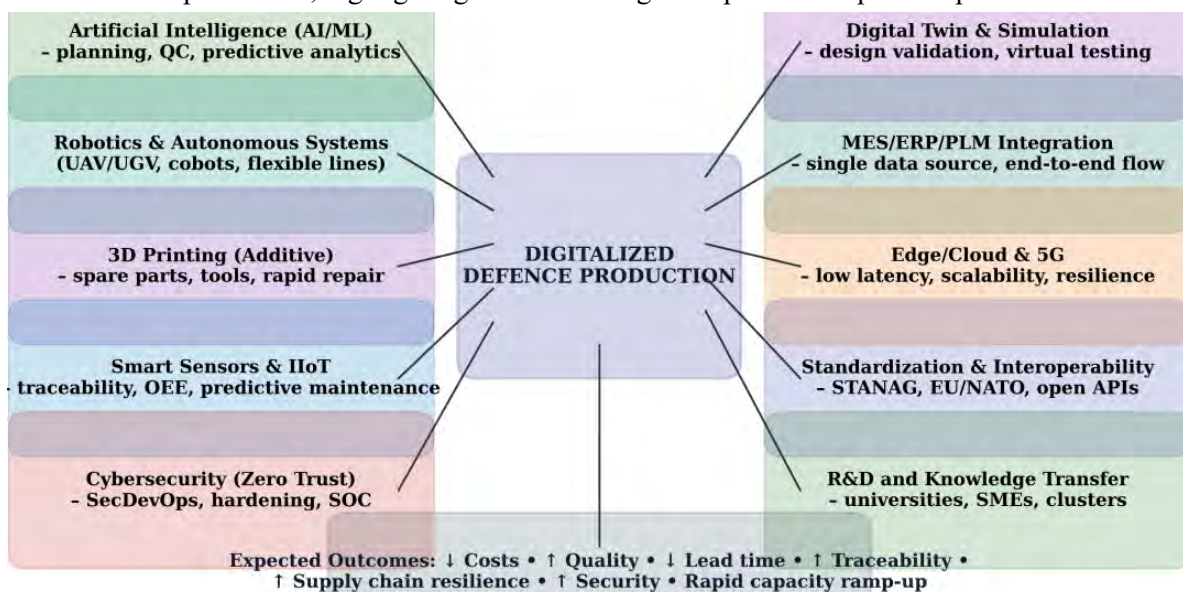


Fig. 5. Integration of emerging technologies and digitalization in Romania's defence industry

Source: Authors' elaboration based on GR, 2023

As illustrated in Figure 5, the convergence of artificial intelligence, robotics, additive manufacturing, IoT, cybersecurity, and digital twin technologies is expected to reshape Romania's defense industry into a flexible, resilient, and innovation-driven ecosystem, capable of meeting NATO/EU standards while ensuring long-term sustainability and strategic autonomy.

4.5. Human resources and knowledge transfer

Recently, the Defense Industry has also faced a shortage of young specialists and a loss of expertise. To address this critical vulnerability, human resources have become a strategic focus. Through training programs, partnerships with technical education institutions, and financial incentives to attract and retain specialists, Romania aims to ensure continuity and professionalism in its workforce (Burciu et al., 2008; GR, 2023). At the same time, know-how transfer through international collaborations is expected to contribute to forming a new generation of experts capable of managing advanced technologies and innovating in the field.

4.6. Strengthening international partnerships and integration into NATO/EU supply chains

Romania's participation in multinational projects, industrial consortia, and European initiatives such as

the European Defence Fund (EDF) or Permanent Structured Cooperation (PESCO) is one of the major transversal strategic objectives (GR, 2023). Integration into NATO and EU production and supply chains facilitates access to advanced technologies and the development of partnerships with global industry leaders.

Thus, the new strategic directions for the production of defense equipment and materials outline a profound transformation of the national defense industry—from a fragmented and import-dependent sector to one integrated into NATO/EU chains, competitive and sustainable. In the authors' view, implementing these objectives will not only guarantee national resilience but also make a significant contribution to European collective security.

5. A focus on the economic and governance dimension

War production cannot be viewed solely as a military or technical process; it must be analyzed in close connection with the economic dimension and governance mechanisms (Dew & Lewis, 2024). The defense industry, through its dual nature (military and economic), is an integral part of the national economy, with the potential to generate stable jobs, stimulate technological innovation, and attract strategic investments with multiplier effects across other industrial sectors.

5.1. The defense industry as a strategic economic sector

In recent approaches, the defense industry is no longer regarded merely as a consumer of budgetary resources but as a driver of economic growth (GR, 2023). Modernizing arms factories, expanding ammunition production capacities, and integrating into European supply chains contribute directly to value creation. Moreover, the defense industry generates positive externalities for related sectors such as metallurgy, chemicals, electronics, and IT&C, acting as a catalyst for modernizing the national economy.

Yet, corporate governance and management of state-owned enterprises—most controlled through C.N. Romarm and its subsidiaries—remain problematic. Economic performance has been relatively weak, explained by poor management, politicization, lack of predictability in orders, and outdated infrastructure. The solution lies in professionalizing management, implementing corporate governance principles, and strengthening accountability and transparency. The creation of integrated industrial consortia capable of competing effectively on the European market should not be overlooked.

The economic dimension of the defense sector also carries significant social implications. Many arms factories are located in mono-industrial areas, where they represent the main source of employment and economic stability. Revitalizing them therefore serves not only a military purpose but also one of regional development, preventing depopulation and stimulating local infrastructure. Furthermore, the defense industry can attract and retain qualified human capital, reducing the outflow of talent abroad.

5.2. Investments and financing

An important strategic dimension is the identification of financing sources and the establishment of a framework for sustainable investment (Bostan, 2021; Bostan & Nicula, 2017; Dinu et al., 2016). National budget allocations can be complemented by European funds, particularly through the European Defence Fund (EDF), the European Peace Facility (EPF), and mechanisms such as EDIRPA (European Defence Industry Reinforcement through Common Procurement Act).

Public–private partnerships also represent a viable option, whereby the state ensures infrastructure and legislation, while private operators contribute capital, know-how, and dynamism. Offset investments, linked to major military procurement contracts, are another important avenue to leverage.

From a governance perspective, Romania's peripheral position, reliant on imports, creates security risks in the event of prolonged conflict. The solution lies in rapid integration into NATO and EU supply chains. Participation in multinational projects and European consortia can ensure both the economic sustainability of

defense companies and a more competitive position in international markets. Only in this way can the defense industry cease being an isolated sector and become an integral part of a common European industrial architecture.

5.3. Transparency, sustainability, and European compliance

Modern governance also entails compliance with EU rules on transparency, public procurement, and sustainability. The new strategic orientations therefore include harmonizing the national legal framework with EU standards, creating effective mechanisms for monitoring company performance, and applying environmental criteria in military production. These measures are intended not only to accelerate integration into the European defense market but also to build greater trust among strategic partners.

To synthesize the analytical dimensions discussed, Table 2 summarizes the main structural challenges currently faced by Romania's defense industry, the strategic measures proposed under the 2024–2030 National Defence Industry Strategy, and the expected impacts in terms of competitiveness, governance, and integration into NATO/EU supply chains.

Table 2

Economic dimension and governance – Comparative overview

Current challenges	Proposed measures (Strategy 2024–2030)	Expected impact
Outdated and underfunded production capacities	Massive investments in modernization and new technologies	Increased competitiveness and reduced external dependency
Deficient management and politicization of state-owned companies	Implementation of corporate governance principles and professionalization of management	Improved economic performance and reduced losses
High dependency on imports of munitions and critical components	Revitalization of domestic production of munitions and explosives	Strategic autonomy in munitions supply
Peripheral position in NATO/EU supply chains	Integration into European consortia and multinational projects (EDF, PESCO, EDIRPA)	Access to markets, technologies and European funding
Brain drain and aging workforce	Programs to attract and train young specialists	Ensured continuity and quality of human resources
Lack of transparency and compliance with EU standards	Alignment of national legislation with EU law and sustainability criteria	Greater trust of partners and faster integration in the European defence market

As highlighted in Table 2, implementing these measures is expected to gradually transform the defense industry from a sector marked by systemic vulnerabilities into a strategic pillar of economic growth, resilience, and collective security, thereby reinforcing Romania's role within the European and Euro-Atlantic defense architecture.

As economists, we must stress that the economic and governance dimensions of the defense industry are central to transforming this sector into a pillar of both national and collective security. Through strategic investment, effective corporate governance, and integration into NATO/EU supply chains, Romania can transform its defense industry from a sector plagued by vulnerabilities into one capable of generating economic growth, jobs, and added value, while simultaneously strengthening state resilience.

6. Conclusions

The analysis developed in this paper demonstrates that the development of Romania's defense industry

is not only a military priority but also an economic and geopolitical one. In our view, given the current context marked by international tensions and armed conflict near Romania's borders, the country cannot afford to remain dependent on imports or to maintain an industry characterized by outdated technologies and poor management. This study allows us to conclude that the National Strategy for the Defense Industry 2024–2030 provides a coherent framework for revitalizing ammunition production, modernizing industrial infrastructure, attracting and training specialists, and integrating Romania into European and Euro-Atlantic security chains.

At the same time, it is clear that the success of this process depends on the effective implementation of corporate governance principles, the mobilization of both domestic and external financial resources, and the full capitalization on opportunities offered by NATO and EU programs. The authors are convinced that Romania has the potential to transform its defense industry into a strategic sector capable of generating not only national security, but also economic growth, employment, and international competitiveness. Most importantly, we argue that war production must be regarded simultaneously as a tool for strengthening state resilience and as a vital contribution to European and Euro-Atlantic collective security.

Limitations

This study acknowledges certain limitations, stemming from the fact that the analysis is based mainly on strategic documents and secondary literature, without including empirical data such as interviews with industry stakeholders or case studies of specific companies.

Future Research Directions

Future research should include case studies of national and private companies, regional comparisons, analysis of the innovation ecosystem, and evaluation of Romania's participation in NATO and EU programs, with particular attention to long-term geopolitical scenarios and industrial resilience in the face of protracted conflicts.

Author Statement on AI Use

The authors declare that AI-based tools (ChatGPT-5) were employed solely for assistance in language editing, style improvement, translation verification, text refinement, and illustration enhancement, under the full supervision of the authors. The entire content has been thoroughly reviewed and finally approved by all authors of the paper.

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Strategic Gaps in Emergency Call Management Research

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Abstract

Background and aim: Emergency call systems (ECS) are vital to public safety infrastructure, enabling rapid communication between citizens and responders in crises. Yet, their academic study has rarely been examined through a long-term strategic lens. This paper provides the first comprehensive bibliometric mapping of global ECS research over 45 years (1981–2025), identifying trends, key contributors, and critical thematic gaps. Particular attention is paid to the absence of accessibility and inclusion—issues essential for equitable emergency communication.

Scope: The analysis focuses on Scopus-indexed literature, excluding non-English and grey literature sources. *Methods:* A dataset of 490 publications was retrieved using a structured Boolean query. Bibliometric analysis was conducted with Biblioshiny, VOSviewer, and JASP to map annual scientific production, collaboration networks, thematic evolution, and co-citation structures. *Results:* Findings reveal rapid publication growth after 2000, driven by mobile telecommunications, GPS integration, and AI adoption. Despite technological advances, terms such as “accessibility,” “disability,” or “inclusion” are absent from indexed keywords, indicating a systemic research blind spot. *Conclusions:* ECS research has shifted from infrastructure-centric to human-centered themes but has yet to embed inclusivity as a strategic priority. *Originality:* This is the first longitudinal bibliometric study of ECS research to highlight accessibility as an overlooked dimension. *Practical implications:* Results offer a roadmap for aligning ECS innovation with governance frameworks and accessibility mandates, supporting more resilient and inclusive public safety systems.

Key words: emergency call systems, bibliometric analysis, accessibility gap, AI in public safety, governance, inclusion

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1. Introduction

Emergency call systems (ECS) serve as the critical link between citizens and emergency responders, enabling life-saving interventions in urgent situations such as medical emergencies, fires, natural disasters, accidents, and security incidents (Møller et al., 2021). Functioning as the “first gateway” to public safety, these systems not only connect individuals in distress to appropriate agencies but also facilitate the coordination and prioritization of emergency resources under time-critical conditions. From sudden cardiac arrests in urban centers to mass-casualty events in remote regions, the effectiveness of ECS directly impacts response times, survivability rates, and public trust in crisis governance (Barnes et al., 2019; Wen et al., 2023).

In an era marked by global uncertainty—driven by pandemics, armed conflicts, climate-related emergencies, and large-scale migration flows—the ability of ECS to remain resilient, adaptive, and inclusive has become a strategic priority for governments and international organizations alike (European Union, 2019; Kuper et al., 2020). Modern societies face increasingly complex risk environments. Emergencies are no longer isolated incidents but unfold against a backdrop of interconnected vulnerabilities, such as aging infrastructure, urban overcrowding, and digital dependency.

Since the 1980s, ECS have undergone a profound transformation. Early systems relied exclusively on analog landline infrastructure, manual call routing, and region-specific numbering schemes, which often resulted in delays and inconsistencies in service provision. Limited interoperability between jurisdictions and the absence of caller location data further hindered operational efficiency, especially in cross-border or rural contexts. The turn of the millennium brought mobile telecommunication, GPS technology, and later, Advanced Mobile Location (AML), enabling far greater accuracy in identifying incident locations and automating the transfer of critical metadata to dispatch centers (Li et al., 2022). These advances have been instrumental in reducing average response times and improving situational awareness for emergency responders.

In the last decade, the integration of artificial intelligence (AI), natural language processing, emotion recognition, and multimodal communication tools has begun to reshape the role of call operators and dispatchers. AI-powered triage systems can filter and prioritize calls, detect signs of distress or urgency from voice patterns, and assist human operators in making faster and more accurate dispatch decisions (Hao et al., 2022; Bokor et al., 2025). In parallel, multimodal access channels such as real-time text, video relay, and app-based communication are expanding the reach of ECS to individuals with hearing, speech, or mobility impairments, although their implementation remains uneven across regions.

Despite these technological advancements, research on ECS remains fragmented and heavily weighted toward performance metrics such as call handling time, accuracy of location data, and technical reliability. While these operational indicators are vital, they overshadow equally important dimensions of accessibility and user experience—particularly for persons with disabilities, non-native speakers, older adults, and other vulnerable groups (Dodds & Palakshappa, 2021; Owen et al., 2023). This imbalance in research focus is increasingly problematic given the binding accessibility requirements set forth by the European Accessibility Act (European Union, 2019) and the obligations under the UN Convention on the Rights of Persons with Disabilities (Kuper et al., 2020; Toquero, 2020). Non-compliance with these frameworks not only risks legal repercussions but also undermines the broader goal of universal emergency preparedness.

This paper addresses these gaps through a 45-year bibliometric analysis of ECS research, examining how the field has evolved, identifying key contributors and thematic trends, and assessing the degree to which inclusivity has been integrated into the scholarly discourse. Specifically, the study pursues two research questions:

1. What trends and patterns can be identified in ECS research over the past 45 years?
2. How have accessibility and inclusion been addressed—or overlooked—in this body of literature?

By linking bibliometric findings to governance frameworks, policy directives, and technological innovation trajectories, this paper provides evidence-based insights that can inform academic debate, shape public policy, and guide the design of more resilient, equitable, and inclusive emergency communication systems for the future.

2. Literature Review and Hypotheses Development

2.1. Emergency Call Systems (ECS)

Emergency call systems (ECS) are specialized telecommunication infrastructures designed to provide citizens with a rapid, reliable, and universally accessible channel to connect with emergency response agencies in critical situations, such as medical incidents, fires, natural disasters, and public security threats (Møller et al., 2021; Barnes et al., 2019). They function as the operational “front door” of public safety services, where every second lost can directly affect survival outcomes.

Historically, ECS relied on analog landline networks, switchboard operators, and manual call routing. These early configurations, while functional, often suffered from long connection times, limited geographic reach, and the absence of standardized procedures across jurisdictions. Coordination between agencies was

frequently constrained by incompatible communication systems, particularly in cross-border or rural scenarios.

Since the early 2000s, ECS have undergone a significant transformation through the integration of mobile telecommunications, GPS-based location services, and automated routing protocols (Li et al., 2022). These upgrades have drastically improved response times, reduced human error in call transfer processes, and enhanced interoperability among emergency agencies. The addition of Enhanced 112 and Enhanced 911 systems in many countries has allowed operators to receive caller location data automatically, even when the caller is unable to speak.

According to Hao et al. (2022), the evolution of ECS reflects a broader trend in public safety management in which speed, accuracy, interoperability, and reliability are central performance indicators. However, while technological efficiency remains the dominant metric, ECS research has gradually expanded to consider governance, inter-agency coordination, and user experience. The European Commission (2019) underscores that ECS are not purely technical tools but also public policy instruments that must reconcile operational performance with equitable access for all users. This includes ensuring that systems meet the needs of vulnerable groups, comply with legal accessibility requirements, and integrate with broader resilience and disaster risk-reduction strategies.

Despite these policy imperatives, as Dodds & Palakshappa (2021) note, human-centered issues such as accessibility, cultural and linguistic inclusion, operator well-being, and the psychological dimension of emergency communication remain substantially underrepresented in the scholarly literature. The lack of comprehensive, cross-disciplinary studies addressing these elements highlights a critical research gap and suggests that the “human factor” in ECS is still overshadowed by technical performance metrics.

2.2. Technological Transformation in ECS

Technological innovation has been the primary driver shaping the trajectory of ECS research over the past two decades. The introduction of Global Positioning System (GPS) technology and, more recently, Advanced Mobile Location (AML) has transformed location accuracy from a margin of several kilometers to within a few meters in optimal conditions (Hao et al., 2022). AML-enabled devices automatically transmit precise location data to the public safety answering point (PSAP) when an emergency call is made, improving incident detection in rural or hard-to-reach areas and aiding faster deployment of resources.

The integration of artificial intelligence (AI) into ECS workflows has introduced new capabilities that extend beyond location detection. AI-powered applications—ranging from emotion recognition algorithms that analyze vocal stress patterns, to speech-to-text systems that transcribe calls in real time—are enhancing the efficiency and quality of operator decision-making (Wen et al., 2023; Bokor et al., 2025). Automated triage systems can prioritize calls based on severity, direct them to specialized operators, and even offer multilingual support for non-native speakers through real-time translation.

Parallel developments in multimodal communication—including real-time text (RTT), video relay services, and dedicated emergency apps—are progressively enabling direct access for people with hearing, speech, or mobility impairments. In many jurisdictions, these technologies are integrated with mobile devices to facilitate rapid transmission of both audio and visual data to emergency responders. However, deployment remains uneven, with disparities in availability between urban and rural areas, and between technologically advanced and resource-limited regions.

Despite these advances, ECS research remains disproportionately focused on technical performance metrics such as call connection time, location accuracy, and network reliability. While these are critical for operational success, they do not capture the full spectrum of system effectiveness, which also depends on user accessibility, trust, and cultural inclusivity. Insights from adjacent fields—such as public health emergency management (Chen et al., 2022; Li et al., 2022) and emergency logistics (Shen et al., 2022)—reinforce the importance of integrating human, organizational, and technological dimensions to build truly resilient and

inclusive ECS. This integration is vital to ensuring that technological innovations translate into equitable, real-world benefits for all users, regardless of demographic or situational barriers.

2.3. Accessibility and Inclusion in ECS

Accessibility in Emergency Call Systems (ECS) refers to the capacity of all individuals—regardless of physical, sensory, cognitive, or linguistic abilities—to initiate and receive emergency communications through channels that are equivalent in effectiveness, reliability, and timeliness (European Union, 2019; Kuper et al., 2020). True accessibility means more than simply enabling alternative modes of contact; it requires designing systems from the outset to meet the diverse needs of all users. This principle, often framed within the concept of *universal design*, ensures that emergency communication is not an afterthought but a built-in feature of public safety infrastructure.

International legal frameworks such as the European Accessibility Act (Directive (EU) 2019/882) and the United Nations Convention on the Rights of Persons with Disabilities (UN CRPD) mandate that by 2025, emergency communication services—including voice calls, real-time text (RTT), video relay services, and other equivalent modalities—must be accessible to persons with disabilities. These obligations are binding for EU member states and carry direct implications for technology providers, network operators, and public authorities. In practice, this means ensuring interoperability between traditional voice systems and alternative communication modes, seamless location sharing regardless of communication type, and operator training to handle calls from individuals with different communication needs.

Despite these mandates, bibliometric mapping of ECS research over the past four decades reveals that terms such as “*accessibility*,” “*disability*,” and “*inclusion*” are largely absent from indexed keywords. This suggests that, while accessibility has gained traction in policy discourse, it has yet to become a mainstream focus within academic research. As Bedini et al. (2017) highlight, dispatcher workload, stress, and resource limitations can disproportionately affect service delivery for vulnerable populations, potentially leading to longer call handling times, misinterpretation of requests, or even failed service provision.

Moreover, inclusion in ECS extends beyond the disability dimension. Linguistic accessibility is critical in multilingual societies or regions affected by migration, where a significant proportion of the population may not speak the national emergency language fluently. Failure to provide translation or interpretation support in such contexts can delay response times and compromise the quality of assistance. Cultural sensitivity in operator training also plays a role, ensuring that responders can interpret cues, emergencies, and priorities within diverse cultural contexts.

Another overlooked dimension is digital inclusion. While app-based emergency communication and multimodal access channels can enhance accessibility, they presuppose smartphone ownership, reliable internet access, and digital literacy—resources not equally available across all demographics. This creates a “*digital divide*” in emergency communication, where technologically advanced solutions risk excluding those without the means or skills to use them effectively (Owen et al., 2023).

Addressing these gaps requires cross-sector collaboration between policymakers, technologists, disability advocates, linguists, and emergency service providers. Such collaboration should aim to embed accessibility-by-design principles into every stage of ECS development, from regulatory compliance and technical architecture to operator training and user feedback mechanisms. Without this holistic approach, innovations risk perpetuating existing inequities rather than dismantling them.

2.4. Hypotheses Development

The review of the literature indicates that the evolution of Emergency Call Systems (ECS) has been strongly shaped by successive waves of technological innovation, ranging from the introduction of mobile telecommunications and GPS to the current integration of artificial intelligence (AI), emotion recognition, and

multimodal communication tools. Each technological leap has expanded the capabilities of ECS in terms of speed, accuracy, and operational efficiency (Hao et al., 2022; Wen et al., 2023). The increasing adoption of Advanced Mobile Location (AML) and AI-powered triage systems also aligns with broader trends in public safety modernization, where the deployment of advanced tools is often correlated with heightened research interest and publication activity. Based on these observations, the first hypothesis is formulated:

H1: Technological advancements (e.g., GPS, AI, automated triage) have driven the expansion of ECS research output over the past 45 years.

Conversely, the literature also highlights a notable thematic imbalance in ECS research. While policy frameworks such as the European Accessibility Act and the UN Convention on the Rights of Persons with Disabilities (CRPD) mandate that emergency communication services be accessible to all users, bibliometric evidence shows that concepts such as “accessibility,” “disability,” and “inclusion” remain largely absent from indexed ECS publications Bedini et al.,(2017). This underrepresentation persists despite growing recognition of the importance of inclusive design and linguistic accessibility in public safety communication (Dodds & Palakshappa, 2021; Owen et al., 2023). The disconnect between policy priorities and research trends suggests a structural oversight within the academic discourse. Therefore, the second hypothesis is stated as:

H2: Accessibility and inclusion remain underrepresented themes in ECS research despite international legal frameworks mandating equal access.

These hypotheses together provide the analytical foundation for the present study, enabling the investigation of both technological drivers and thematic blind spots within the ECS research landscape.

3. Material and Methods

3.1. Research Design

This study adopts a quantitative bibliometric approach to analyze the evolution of Emergency Call Systems (ECS) research from 1981 to 2025. The bibliometric dataset was extracted from the Scopus database (Elsevier, 2025) in August 2025. Bibliometric analysis is widely recognized for its ability to map both the intellectual structure (key authors, institutions, sources) and conceptual structure (themes, topics, and trends) of a research field (Aria & Cuccurullo, 2017). The design was chosen to capture the dual nature of ECS scholarship: the technological dimension, which focuses on system performance and innovation, and the social dimension, which examines governance, accessibility, and inclusion. This dual perspective allows the study to not only quantify research output but also evaluate thematic priorities and neglected areas over time.

3.2. Data Collection

The dataset was retrieved from the Scopus database, selected for its extensive coverage of peer-reviewed literature in technology, public safety, and management domains. The search query was:

“TITLE("emergency call system*" OR "emergency communication" OR "112" OR "911")”

This query was designed to capture research directly referencing ECS or equivalent terminology in global contexts. Filters were applied to:

- Language: English only, to ensure comparability of metadata and to focus on literature with broader international reach.
- Subject areas: Irrelevant fields such as mathematics, chemistry, and energy were excluded to maintain thematic precision.
- Document stage: Only final-stage publications (articles, conference papers, reviews) were retained, ensuring completeness of bibliographic information.

Our initial Scopus search retrieved 2,078 documents published between 1981 and 2025. We applied strict

inclusion criteria: limiting to English-language publications, excluding irrelevant subject areas, and removing duplicates. This process yielded 490 peer-reviewed articles. Metadata—including titles, abstracts, keywords, author affiliations, and reference lists—was exported in CSV format for processing and analysis.

3.3. Data Analysis Tools

Two complementary bibliometric tools were employed:

- Biblioshiny (R-package *Bibliometrix*): Used for descriptive analysis, including annual scientific production, leading authors, top institutions, source productivity, and keyword frequency analysis. Biblioshiny was also utilized to generate thematic evolution diagrams and conceptual structure maps.
- VOSviewer: Used to visualize co-authorship networks, co-citation patterns, and keyword co-occurrence maps. Its strength lies in producing clear, high-quality network visualizations that allow for the identification of clusters, link strengths, and thematic density.

This dual-tool approach ensured that both statistical accuracy (Biblioshiny) and visual interpretability (VOSviewer) were achieved.

3.4. Analytical Procedures

The analytical process was conducted in four main steps:

Descriptive bibliometrics — Calculation of annual publication output, identification of the most productive authors, institutions, and journals.

Citation analysis — Recognition of the most influential publications, authors, and journals based on citation counts.

Keyword analysis — Detection of thematic trends and longitudinal keyword evolution from 1981–2025, enabling the identification of emerging, declining, and motor themes.

Thematic mapping — Grouping of research topics into conceptual clusters using VOSviewer, categorized by centrality (importance) and density (development).

This methodological framework combines quantitative mapping of ECS scholarship with qualitative interpretation of thematic gaps, particularly in relation to accessibility and inclusion. By integrating descriptive statistics, network analysis, and thematic mapping, the study offers a comprehensive overview of how ECS research has developed over nearly half a century and where strategic gaps remain.

4. Findings and Discussion

4.1 Annual Scientific Production

Across the 45-year period from 1981 to 2025, the final dataset comprises **490 peer-reviewed articles**, published in **173 distinct sources**, representing a cumulative **annual growth rate of 6.79%**. Early scholarly attention to Emergency Call Systems (ECS) was sporadic, with fewer than five publications per year prior to 2000. This limited activity likely reflects the then-nascent nature of ECS technology, which in most countries was still dependent on analog landline infrastructure and manual routing, with little integration of advanced location or automation features.

Figure 1 presents the annual scientific production in ECS research, highlighting the slow start before 2000, followed by steady growth through the early 2000s and a pronounced surge in output from 2010 to 2017.

From the early 2000s onward, the field experienced **steady and sustained growth**, coinciding with major technological milestones such as the introduction of mobile telecommunications into emergency networks, the global spread of GPS-based location services, and the standardization of the 112 and 911 numbering systems in many jurisdictions. The period between 2010 and 2017 marked a particularly dynamic phase, driven by the

rollout of Advanced Mobile Location (AML) technology and the increasing adoption of mobile data for emergency communication. The **peak in 2017** (31 articles) aligns with a surge in research on mobile-GPS integration and early discussions on AI applications in call triage. Co-authorship analysis shows **moderate collaboration levels**, with an average of **3.66 authors per paper**. The proportion of **internationally co-authored papers** stands at **14.9%**, indicating a research landscape that remains somewhat nationally oriented despite the inherently global nature of public safety challenges. This suggests potential for greater cross-border collaboration, particularly on topics such as accessibility, standardization, and interoperability of ECS.

The upward trajectory of publication output indicates that ECS has transitioned from a niche technical topic to a multidisciplinary field intersecting with public safety governance, telecommunications, AI research, and accessibility studies. However, the relatively modest level of international collaboration highlights an opportunity for more integrated global research networks, especially as emergencies increasingly transcend national boundaries.

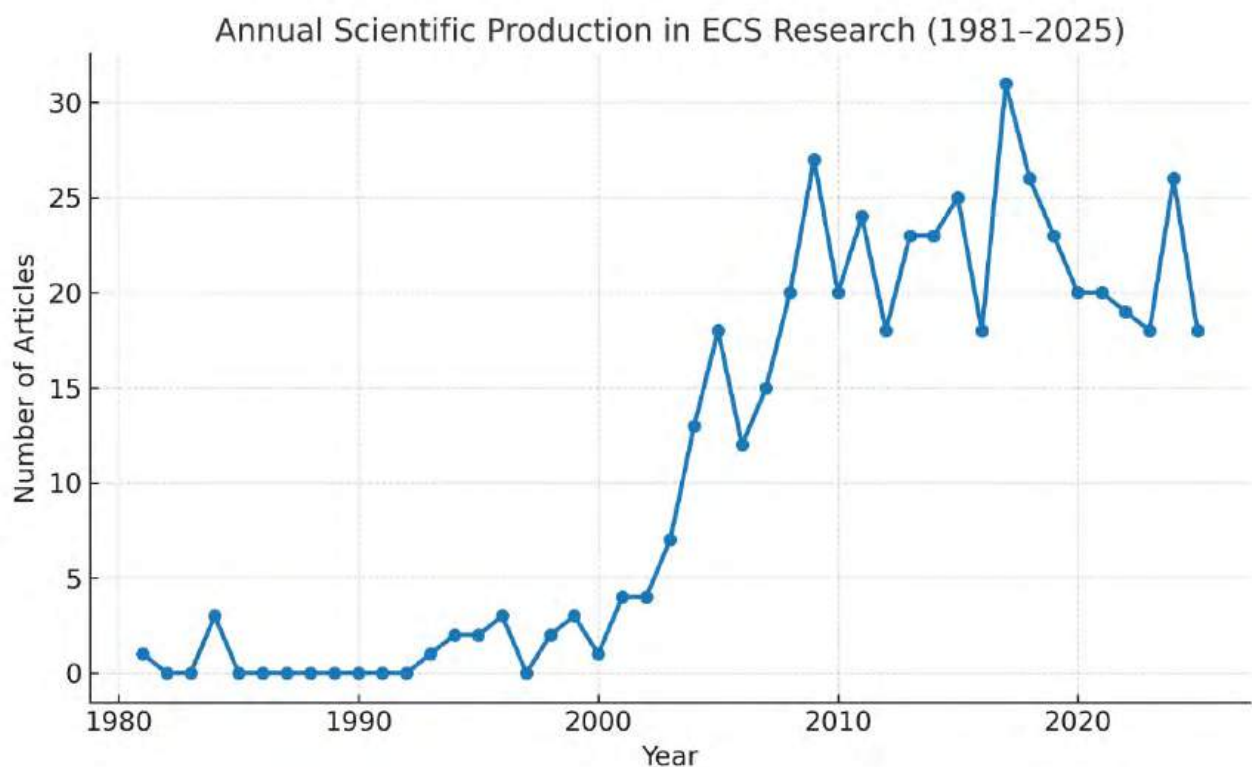


Figure 1 Annual scientific production in Emergency Call Systems (ECS) research (1981–2025).

Source: Author's analysis based on Scopus data processed in Biblioshiny (Elsevier, 2025).

4.2 Most Relevant Authors and Journals

The author productivity landscape in ECS research exhibits a long-tail distribution, where most scholars contribute a single publication, while a relatively small core of highly active authors produces multiple works over the study period. This pattern is consistent with Lotka's Law, which suggests that in most scientific fields, a few prolific authors account for a disproportionate share of publications.

The top five authors by output are: KANG, SHINGAK (8 articles); LIU, QINGCHONG JOHN (5); NADER, MAJEED (5); LEE, IJJIN (5); and HUH, MIYOUNG (4). These authors predominantly publish in technology-focused venues, reflecting the dominant technological orientation of ECS research. Notably, none of the leading authors specialize exclusively in accessibility or inclusion-related aspects of ECS, reinforcing

the thematic gap identified in this study.

Publication venues demonstrate a high degree of concentration, with the ACM International Conference Proceeding Series accounting for 224 articles, far surpassing any other source. This dominance indicates the central role of computing and information technology forums in disseminating ECS research, particularly work focused on system architecture, call routing algorithms, and AI applications. The next most frequent outlets are PLOS ONE (18 articles), CEUR Workshop Proceedings (6), Procedia Computer Science (5), and Intensive and Critical Care Nursing (4). The inclusion of nursing-focused journals among the top venues suggests some cross-disciplinary engagement, particularly in contexts where ECS intersects with pre-hospital emergency care and patient outcomes.

While the concentration of publications in computing-oriented outlets has advanced technical innovation, it may also contribute to the relative underrepresentation of governance, policy, and inclusivity themes, which are more commonly addressed in public administration or social sciences journals. This distribution points to a potential opportunity: encouraging more ECS research in interdisciplinary or policy-focused journals could broaden the field's thematic scope and better align it with international accessibility mandates.

Table 1.

Most Relevant Authors and Journals in ECS Research (1981–2025)

Rank	Author	No. of Articles	Rank	Journal / Source	No. of Articles
1	KANG, SHINGAK	8	1	ACM International Conference Proceeding Series	224
2	LIU, QINGCHONG JOHN	5	2	PLOS ONE	18
3	NADER, MAJEED	5	3	CEUR Workshop Proceedings	6
4	LEE, IJIN	5	4	Procedia Computer Science	5
5	HUH, MIYOUNG	4	5	Intensive and Critical Care Nursing	4

Source: Author's analysis based on Scopus data processed in Biblioshiny (Elsevier, 2025).

4.3 Keyword Co-occurrence Network

The keyword co-occurrence analysis, conducted using VOSviewer, reveals three stable and well-defined thematic clusters in ECS research over the 1981–2025 period:

1. Technological innovation — Keywords in this cluster include *mobile telecommunication systems*, *GPS*, *Advanced Mobile Location*, *AI*, and *automated triage*. This cluster reflects the dominant emphasis on developing and refining technical capabilities to improve emergency communication speed, accuracy, and automation.

2. Operational efficiency — This cluster is characterized by terms such as *response time*, *call routing*, *dispatch decision support*, and *network reliability*. It reflects ongoing efforts to optimize ECS processes, reduce delays, and enhance interoperability between emergency service agencies.

3. Public safety management — Keywords here include *risk management*, *interoperability*, *emergency preparedness*, and *disaster response*. This cluster connects ECS research to broader crisis management and governance frameworks, often with a focus on coordination among multiple stakeholders.

Notably, and of critical importance to this study, terms directly associated with accessibility and inclusivity—such as “accessibility,” “disability,” “inclusion,” “universal design,” or “assistive technology”—are entirely absent from the trend-topics dataset. This absence persists across all decades analyzed, suggesting that such concepts have not yet entered the mainstream vocabulary of ECS research, despite their prominence in European Union legislation (Directive (EU) 2019/882) and the UN CRPD.

The absence of these terms in indexed keywords has several implications:

- Searchability bias — Future researchers may struggle to identify existing accessibility-related ECS work because it is not tagged with appropriate descriptors.
- Policy–research gap — Despite regulatory requirements, academic research output is not reflecting accessibility as a priority theme, potentially slowing its integration into practice.
- Interdisciplinary disconnect — Accessibility in emergency communication often appears in disability studies, human–computer interaction, or social policy literature, but rarely crosses into the ECS technical domain.

These findings directly address Research Question 2 by providing bibliometric evidence of a systemic thematic gap. Bridging this gap will require intentional collaboration between technical ECS researchers and scholars in accessibility, disability advocacy, and policy design.

Figure 2 presents the visual output of the keyword co-occurrence network, showing the three dominant thematic clusters and the absence of accessibility-related terms.

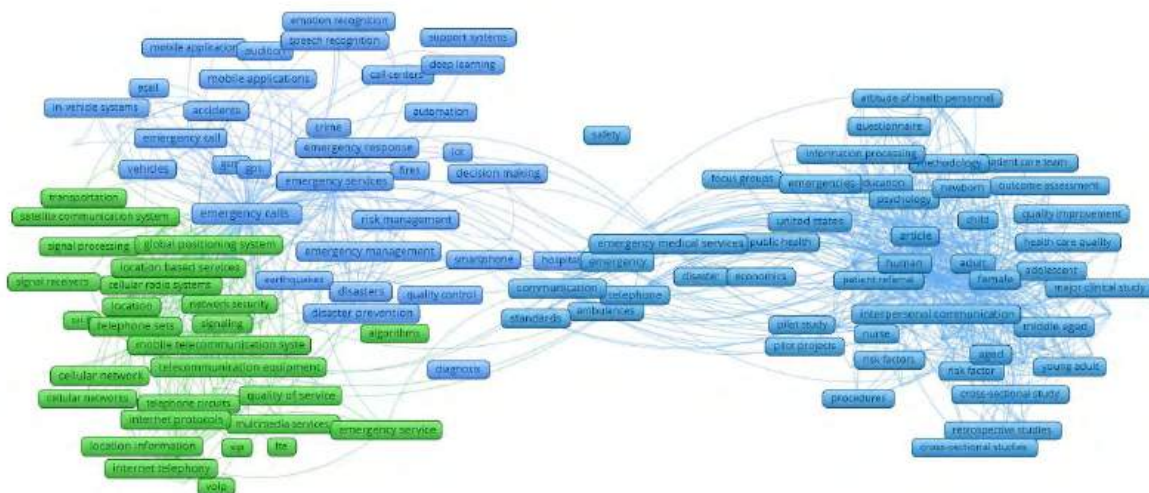


Figure 2. Keyword Co-occurrence Network in ECS Research.

Source: Author's analysis based on Scopus data visualized in VOSviewer (Elsevier, 2025).

4.4 Thematic Mapping

The thematic map generated through Biblioshiny plots research topics according to their centrality (importance in the overall network) and density (level of development). The analysis reveals that human-related concepts—including *human factors*, *user satisfaction*, *training*, and *decision-making*—occupy the motor themes quadrant, indicating that they are both central to the ECS research field and relatively mature in their scholarly treatment. These topics often intersect with operational efficiency studies, particularly in optimizing call-handling procedures and improving dispatcher performance.

In contrast, keywords such as *emergency calls*, *emergency services*, and *emergency response* appear in

the declining themes quadrant. This positioning suggests a reduction in research momentum for these foundational concepts, despite their ongoing practical importance in public safety operations. The decline could reflect a shift of academic attention toward more specialized or technology-driven subtopics, such as AI-enabled triage and advanced location technologies, leaving core operational issues less explored in recent years.

The absence of strong niche themes or emerging themes is notable. In a dynamic and technologically evolving field, one might expect to see developing clusters around *multimodal accessibility*, *real-time translation services*, or *AI ethics in emergency decision-making*. Their absence reinforces the earlier observation—supported by keyword co-occurrence analysis—that accessibility- and inclusion-related research remains marginal within the ECS domain.

This thematic mapping has direct relevance to Research Question 2, as it visually confirms the structural invisibility of accessibility in the conceptual landscape of ECS scholarship. It also suggests that the research community has not yet fully engaged with opportunities to integrate universal design principles, inclusive communication strategies, and AI-supported accessibility features into mainstream ECS research.

From a strategic perspective, the lower density of accessibility-related themes indicates that they are not yet well-developed or connected to other high-centrality topics. This presents an opening for interdisciplinary collaboration between telecommunications engineers, public safety managers, accessibility advocates, and policy experts. Targeted efforts in these areas could not only fill a critical research gap but also align academic work with international legal obligations such as the European Accessibility Act and the UN CRPD.

Figure 3 illustrates the thematic map, highlighting the positioning of human-related concepts, the decline in core operational themes, and the absence of accessibility-oriented clusters.

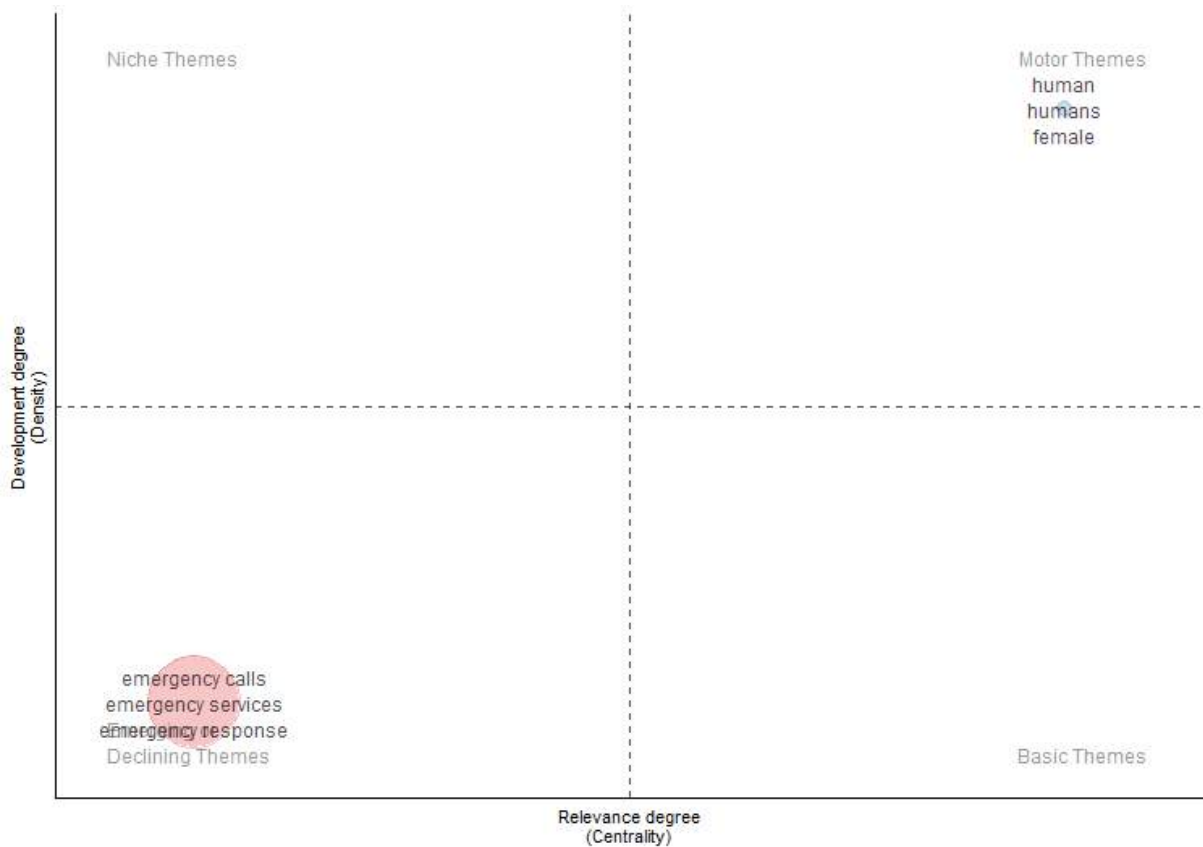


Figure 3. Thematic Map of ECS Research (density vs. centrality).

Source: Author’s analysis based on Scopus data visualized in Biblioshiny (Elsevier, 2025)

4.5. Implications for Research and Policy

The findings of this study portray a research field that is technologically sophisticated yet thematically imbalanced. Innovation-driven topics—such as AI-enabled decision support, advanced location services, and automated call routing—are well-developed and central to the discourse. However, accessibility and inclusivity remain underexplored, despite a clear policy push from both the European Accessibility Act and the UN Convention on the Rights of Persons with Disabilities.

This thematic gap has both scholarly and operational consequences, as it risks perpetuating inequities in emergency communication systems and delaying compliance with international legal frameworks.

To address these shortcomings, the following strategic priorities are recommended:

1. Embed accessibility-by-design into ECS research and development — Accessibility features such as *real-time text (RTT)*, *video relay services*, *multimodal user interfaces*, and *speech-to-text tools* should be considered core components in the design phase, rather than optional add-ons. Research should assess their usability across diverse demographics and operational contexts.
2. Foster cross-disciplinary research collaborations — Stronger integration is needed between telecommunications engineers, AI specialists, human factors researchers, disability studies scholars, and public governance experts. Such collaboration can bridge the current gap between technological innovation and user-centered design.
3. Standardize metadata and keyword taxonomies — Ensuring that ECS-related studies systematically include descriptors such as *accessibility*, *inclusion*, and *universal design* in their keywords will improve discoverability and facilitate more targeted bibliometric tracking in the future.
4. Expand evaluation metrics beyond speed and accuracy — Performance indicators should incorporate measures of equitable access, service quality for marginalized populations, and end-user satisfaction, recognizing that operational efficiency does not guarantee inclusivity.
5. Encourage policy–research integration — Governments, regulatory bodies, and funding agencies should incentivize ECS projects that explicitly address accessibility requirements, ensuring that innovation aligns with legislative mandates and ethical obligations.

By pursuing these priorities, ECS research can evolve from a predominantly technology-driven field to one that equally values human-centered and inclusive design principles. This shift will not only strengthen the scholarly relevance of ECS studies but also enhance real-world resilience, ensuring that in times of crisis, no caller is left behind.

4.6 Limitations and Future Research

This study is subject to several limitations. First, the bibliometric analysis relied exclusively on the Scopus database, which, while comprehensive, may omit relevant publications indexed only in Web of Science, PubMed, or regional repositories. Second, the search strategy restricted results to English-language articles, potentially underrepresenting valuable research published in other languages, particularly in countries with unique emergency call system implementations. Third, while the study captures publication trends and co-occurrence patterns, it does not assess the quality or impact of individual research contributions in depth.

Future research could address these gaps by conducting a multi-database search, integrating non-English sources, and performing qualitative content analyses of highly cited works. Expanding the analysis to include grey literature, policy reports, and technical standards could also enrich understanding, particularly for emerging themes such as AI integration, accessibility for people with disabilities, and cross-border interoperability in emergency communication systems.

5. Conclusion

This 45-year bibliometric analysis of Emergency Call Systems (ECS) research reveals a field that has undergone profound technological transformation—from the analog landline networks of the 1980s to the AI-enabled, location-optimized, and multimodal systems of today. This evolution underscores the sector's capacity for rapid adaptation in response to advances in telecommunications, geolocation, and artificial intelligence. However, the findings also expose a persistent thematic imbalance: while technological innovation is strongly represented, inclusivity and accessibility remain marginal in the academic discourse.

The near absence of accessibility-related terms in longitudinal keyword trends, coupled with their absence from thematic mapping, points to a structural research gap with significant operational and social consequences. This gap directly addresses the second research question of this study, confirming that despite binding obligations under the European Accessibility Act and the UN CRPD, accessibility has yet to achieve mainstream visibility in ECS scholarship.

To close this gap, future research agendas must integrate accessibility-by-design principles, foster cross-disciplinary collaboration that bridges technical and human-centered expertise, and expand evaluation frameworks to measure equity of access alongside traditional performance metrics. Such an agenda will not only improve scholarly relevance but also ensure operational systems meet the needs of all users, including persons with disabilities, non-native speakers, and other vulnerable populations.

Looking ahead, bibliometric monitoring should be expanded to include Web of Science data and leverage advanced text-mining and natural language processing techniques. This will provide deeper insights into thematic evolution, facilitate earlier detection of emerging trends, and help align academic output with pressing policy priorities. By doing so, ECS research can evolve into a more balanced, inclusive, and globally coordinated field—ensuring that in moments of crisis, *no caller is left behind*.

Affiliation

This paper is a result of research conducted within the Doctoral School of Management, Bucharest University of Economic Studies, Bucharest, Romania.

Conflict of Interest

The authors declare no conflict of interest

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Conflict Management in Veterinary Clinics – Strategic Implications**Petya ANGELOVA¹, Taher SARYIA²**¹ University of Economics - Varna, Varna, Bulgaria, p_angelova@ue-varna.bg² University of Applied Sciences, Berlin, Germany, taher.saryia@student.hs-anhalt.de**JEL:****Abstract**

Workplace conflict is a common challenge in high-stress environments such as veterinary clinics, affecting staff morale, collaboration, and organizational performance. This study explores conflict sources and management strategies at United Veterinary Clinic (UVK)-Varna, a leading veterinary facility in Bulgaria. Using semi-structured interviews with 10 employees and thematic analysis, four main themes were identified: managerial inefficiencies, workload and organizational stress, interpersonal and team dynamics, and client-induced stress. Sub-themes included role ambiguity, inconsistent conflict interventions, communication gaps, and difficult client interactions, all of which exacerbate tensions and reduce operational efficiency. Based on these findings, a strategic conflict management framework is proposed, incorporating structured resolution protocols, comprehensive training, clear roles and responsibilities, improved communication, and stress management support. Preventive measures, such as performance reviews, employee assistance programs, positive reinforcement, and team-building activities, are also recommended to reduce future conflicts. The study provides practical insights for veterinary clinics and similar healthcare settings, highlighting the importance of tailored conflict management strategies in enhancing employee satisfaction, teamwork, and service quality.

Key words:

strategic management,
conflicts, workplace conflicts,
organizational conflicts,
reasons for conflicts, types of
conflicts, conflict management,
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1. Introduction

Conflict situations are topical in all types of organizations, but especially in healthcare enterprises, where they can be derived from too many sources, starting with different professional perspectives, staff disagreements, workplace insufficiencies, and ending with clients' dissatisfaction (Borkowski & Meese, 2021). In veterinary clinics, the picture is similar. Conflicts are often seen as a result of preoccupation and a stressful environment (Joyce et al., 2022). Doctors have too many engagements, while the support staff is either insufficient nor qualified enough to assist with all cases. Clients, on the other hand, are highly sensitive and emotional, hence creating another high potential for conflict emergence. Whatever the reasons, in terms of strategic conflict management, all conflicts should be handled and analyzed, for it is crucial to achieve organizational effectiveness, staff satisfaction, and excellent patient outcomes. As a result, appropriate tools to prevent and/or manage conflicts should be offered. If successfully applied, they can lead to more cooperation, better decision-making, and higher quality of provided services (Carsten and Gelfand, 2013).

Our research is based on the case of United Veterinary Clinic (UVK)-Varna. Being one of the best facilities of this type in the city of Varna (Bulgaria), the clinic faces many organizational and conflict management challenges due to its size, clientele type, and the nature of services it provides. Thus, developing a suitable conflict management approach is necessary to facilitate a proper conflict management plan, helping to avoid destructiveness in the future development of the veterinary organization. Therefore, this research focuses on identifying the potential sources of conflict in UVK-Varna and developing an effective strategic solution to address the conflict that is suitable for the organization's operations and culture. The study aims to

provide significant research input to conflict management in the veterinary context, as well as improvements in staff retention and clients' experience.

2. Literature Review

2.1. Definition of Organizational Conflicts

Organizational conflicts allude to discord that emerges when the objectives, interests, or values of people or gatherings within an association are contrary and thwart each other's endeavours to accomplish targets (Fenn & Gameson, 2003). Conflicts in associations are unavoidable because of assorted characters, varying qualities, and the mind-boggling nature of organizational structures and interactions. To comprehend organizational conflicts thoroughly, it is fundamental to investigate insightful definitions and dissect their key parts. One generally acknowledged meaning of organizational conflict is "an intuitive cycle appeared in contradiction, conflict, or discord inside or between social entities like people, gatherings, or associations" (William & Blaustein, 2007). This definition stresses the intelligent idea of contention, featuring that it's anything but a static peculiarity, however a unique cycle including dynamic commitment between clashing groups. The expressions "contradiction," "conflict," and "disharmony" underline the central components that describe struggle: an absence of concordance and arrangement in objectives, interests, or values.

The critical parts of these definitions can be separated into a few components. Firstly, the interactive process suggests that conflict includes correspondence and activities between parties. This collaboration can be plain, like verbal debates, or incognito, like detached opposition. Furthermore, the possibility of inconsistency, conflict, or cacophony features the key idea of contention: a conflict between restricting powers. This conflict can be because of different factors like asset distribution, contrasting needs, or individual qualities. Thirdly, insight assumes a vital part; regardless of whether no genuine incompatibility exists, the conviction that another's activities or goals will adversely influence one's inclinations can set off struggle (Folger et al., 2021).

Understanding conflicts inside organizations is essential since it straightforwardly influences organizational performance, employee satisfaction, and overall workplace dynamics (Jordan, 2020). Conflicts, whenever left unmanaged, can prompt diminished efficiency, as the energy and focal point of representatives are redirected from their undertakings to the actual contention. This redirection can bring about missed cutoff times, lower quality of work, and generally shortcomings within the association (Dunford et al., 2020). Employee satisfaction is one more basic region impacted by organizational conflicts. Persistent, unsettled conflicts establish a distressing workplace, prompting more significant levels of representative dissatisfaction and burnout. This dissatisfaction can increase turnover rates, as workers might decide to leave the association as opposed to manage progressing clashes. Moreover, a working environment overflowing with struggle can discourage likely ability, making it challenging for the association to attract and hold talented representatives. In addition, the general working environment elements are essentially impacted by how conflicts are dealt with (van der Lippe et al., 2020). Positive conflict management can prompt better communication, a more grounded group union, and a culture of common regard and joint effort. Then again, unfortunate refereeing can establish a harmful workplace portrayed by doubt, disdain, and decreased resolve. In this way, understanding and really overseeing hierarchical struggles is fundamental for cultivating a useful, positive, and amicable working environment (Rahim, 2001).

2.2. Types of Organizational Conflicts

Conflicts in organizations are complex, and there are different approaches to their classification. However, the most broadly used among them is the one organized around their level of appearance in the organization (see Table 1):

Table 1**Main Types of Conflicts in Organizations**

Type by Level of Conflict	Subtype	Brief Definition
Personal Conflict	Intrapersonal Conflict	Conflict occurring within an individual due to competing motives or goals.
	Interpersonal Conflict	Disagreement or tension between two or more individuals due to differences in values, personalities, or communication styles.
Group Conflict	Intragroup Conflict	Conflict among members within the same team or department about goals, processes, or relationships.
	Intergroup Conflict	Conflict between different teams, departments, or divisions within the organization.
Organizational Conflict	Vertical Conflict	Conflict between different hierarchical levels, such as managers and subordinates.
	Horizontal Conflict	Conflict between departments or units at the same organizational level.
	Line–Staff Conflict	Disagreement between line managers (who execute core tasks) and staff specialists (who provide advisory support).

Source: Authors' Compilation, 2025

Note: All types of conflict may be either functional (constructive) or dysfunctional (destructive), depending on their impact on individual and organizational performance.

Intra- and interpersonal conflicts refer to conflicts that concern personality issues in and between people inside an organization. These contentions emerge from contrasts in characters, values, correspondence styles, and interests, which can prompt strain and questions (McConnon & McConnon, 2011). Interpersonal conflicts are the most well-known sort of contention in the working environment and can fundamentally affect group elements and overall organizational viability.

Intragroup conflicts happen inside a group or gathering of people cooperating towards shared objectives. These conflicts emerge from conflicts and contrasts among colleagues with respect to task execution, asset portion, and dynamic cycles (Scannell, 2010). Intragroup struggles are unmistakable from relational contentions as they center around questions inside an aggregate instead of between people (Kinnander, 2011).

Intergroup conflicts refer to debates and strains that emerge between various gatherings or offices inside an association (R. Gameson, 2003). These struggles happen when gatherings have contrary objectives, go after restricted assets, or have varying qualities and viewpoints. Understanding the nature and reasons for intergroup clashes is urgent for keeping up with hierarchical agreement and viability. One essential cause of intergroup clashes is rivalry for assets (Zomeren et al., 2023). Differences in objectives and priorities are one more huge reason for intergroup conflicts. Offices frequently have particular goals that may not be completely aligned with each other. These varying needs can prompt contentions over project timetables, asset assignment, and vital heading.

Organizational conflict refers to disagreements and discord that occur at a broader organizational level, involving multiple groups or affecting the entire organization. These conflicts can stem from various sources, including structural changes, policy decisions, and cultural differences, and they can significantly impact the overall functioning and efficiency of the organization. One primary cause of organizational conflict is organizational change. Changes such as restructuring, implementation of new technologies, or shifts in organizational strategy can create uncertainty and resistance among employees (Franke et al., 2013).

2.3. Reasons for Organizational Conflicts

Reasons for workplace clashes are a complex and ubiquitous issue across various industries and organizations. As is evident by now, conflicts can manifest in numerous ways, ranging from interpersonal disagreements to systemic organizational disputes. These conflicts not only disrupt the workflow but also affect employee well-being, productivity, and overall organizational performance. Understanding the underlying causes of workplace conflicts is crucial for designing effective conflict management strategies. Hence, in Table 2 below, we have attempted to give a brief overview of the most common reasons for conflict situations according to their level of occurrence.

Table 2

Most Common Reasons for Conflicts in Organizations

Level of Conflict	Common Reasons for Conflict	Explanation
Personal (Intrapersonal or Interpersonal Conflict)	Role ambiguity or overload	Unclear job expectations or too many responsibilities cause stress and confusion.
	Personality clashes	Differences in attitudes, behaviors, or temperaments lead to tension.
	Value or goal differences	Conflicting beliefs or priorities create disagreements.
	Communication breakdown	Misunderstandings or lack of information lead to conflict.
Group (Intergroup Conflict)	Competition for limited resources	Teams compete for budgets, space, or personnel, causing friction.
	Misaligned goals between teams	Different objectives create obstacles to cooperation.
	Poor coordination or cooperation	Lack of teamwork results in inefficiency and disputes.
	Differences in norms or priorities	Varying work standards or expectations lead to clashes.
Organizational (Structural or Interorganizational Conflict)	Organizational change or restructuring	Adjustments in roles or systems create uncertainty and resistance.
	Unclear authority or reporting lines	Overlapping responsibilities cause confusion over control.
	Policy inconsistencies	Unequal or unclear rules lead to dissatisfaction.
	Power struggles or hierarchy issues	Disputes arise over decision-making authority or influence.

Source: Authors' Compilation, 2025

One of the most prominent reasons for workplace conflicts is personality clashes. Diverse workplaces bring together individuals with varying temperaments, communication styles, and behavioural tendencies. The conflict between introverted and extroverted personalities is a well-documented phenomenon. Introverts may prefer a quiet and structured environment, while extroverts thrive in dynamic and social settings. This divergence can lead to misunderstandings and frustration, particularly in collaborative tasks. Research suggests that personality differences are one of the most common sources of interpersonal conflict in the workplace³⁶.

In addition, conflicts arise when employees have incompatible working styles. Some individuals may prefer working independently and focusing on details, while others may take a more flexible and broad approach to tasks. These differences can create friction, particularly when team members are required to collaborate closely. Studies (Allan et al., 2007), (De Dreu & Gelfand, 2008) highlight that conflicting work

styles often lead to disagreements regarding task execution, timelines, and responsibilities, which can escalate into larger conflicts.

Communication issues are another major cause of conflicts in any organization. Effective communication is the bedrock of successful teamwork and collaboration. However, miscommunication, unclear instructions, or the absence of open dialogue can easily lead to misunderstandings and frustration. When individuals feel that their concerns are not being heard or acknowledged, it leads to feelings of resentment and dissatisfaction, which can manifest as conflicts (Zil-e-huma, 2016).

In particular, non-verbal cues, tone of voice, and written communication can often be misinterpreted, leading to unintended conflicts. Furthermore, cross-cultural communication issues in diverse workplaces can exacerbate these problems, as different cultures have varying norms regarding communication styles and etiquette. De Dreu et al. research (2004) emphasizes that socio-emotional conflicts are more likely to arise in situations where there is poor communication, particularly in culturally diverse teams.

Another significant source of conflict is competition over scarce resources. In many organizations, employees are required to share limited resources such as office space, technology, or personnel support. When resources are constrained, employees may feel compelled to compete for access, leading to interpersonal tensions. Research demonstrates that conflicts over resources are particularly common in hierarchical organizations, where employees may feel that resource distribution is unfairly skewed in favour of those with higher authority or more influence (Schieman & Reid, 2008).

In competitive work environments, individuals may also feel pressured to outperform their colleagues, which can foster unhealthy rivalry. This competitive pressure can lead to conflicts, particularly if employees perceive that others are trying to undermine their efforts or take credit for their work. Research also noted that this form of conflict is particularly prevalent in organizations that emphasize individual performance and recognition over team collaboration (Liddell, 2004).

Leadership also plays a critical role in shaping workplace dynamics, and conflicts often arise from disagreements about leadership approaches or management styles. Ineffective leadership can create an environment of uncertainty and mistrust, which fosters conflict. Poor leadership—characterized by inconsistent decision-making, lack of transparency, and poor communication—can be a major cause of workplace conflict (Jabr, 2024). Leaders who fail to provide clear direction or who exhibit favouritism can create an environment ripe for disputes.

Role ambiguity occurs when employees are uncertain about their responsibilities or the expectations placed upon them. This ambiguity can lead to confusion and frustration, particularly when employees feel that they are being held accountable for tasks that are not clearly defined. Role ambiguity is a significant source of task conflict, as employees may disagree about who is responsible for specific tasks or how they should be performed. Research found that task conflicts often arise from a lack of clarity in roles and responsibilities, leading to disagreements about task priorities and execution (Härtel et al., 2003).

Task conflict can also occur when employees have different ideas about how to approach a particular project or goal. While some degree of task conflict can be productive, encouraging innovation and creative problem-solving, it can quickly become destructive if not managed effectively. It is argued that task conflicts, when left unresolved, often escalate into more personal, emotionally charged disputes that can be detrimental to team cohesion (De Dreu & Gelfand, 2008).

Organizational change is a significant source of conflict, particularly when employees are required to adapt to new structures, processes, or leadership styles. Change often creates uncertainty and anxiety, as employees may fear job loss, reduced responsibilities, or shifts in power dynamics. Research notes that conflicts during organizational change are often exacerbated by poor communication from leadership, as employees may feel that they are not being adequately informed or consulted about the changes affecting their roles (Ramsay, 2001).

Structural conflicts also arise from organizational hierarchies and power imbalances. Employees in lower-level positions may feel that their concerns are not being heard by those in leadership, leading to frustration and resentment. Structural conflicts are particularly pronounced in large, bureaucratic organizations, where decision-making is often centralized, and employees have limited control over their work environments. Research found that employees who felt they had little control over their work conditions were more likely to experience workplace conflicts and report lower levels of well-being (Oxenstierna, 2011).

In today's globalized work environments, cultural diversity is both an asset and a potential source of conflict. Cultural differences in communication styles, values, and work ethics can lead to misunderstandings and disagreements. For example, in some cultures, direct communication is valued, while in others, indirect communication is preferred. These differences can create confusion and frustration, particularly in multinational teams. Research highlights the importance of cultural competence in managing workplace conflicts, as cultural misunderstandings are a common trigger for interpersonal disputes (Lewis, 2022).

Thus, workplace conflicts are an inevitable aspect of organizational life, stemming from a wide range of sources. They are much more common in organizations with constant emergencies, as vet practices, for example, and that is the reason why our research is focused on such an organization. Conflicts and interpersonal conflicts between staff and with clients of the clinic.

3. Research Methodology

3.1. Research Aim and Objectives

UVK-Varna consists of approximately 50 people - veterinarians, technicians, and administrative staff. It forms a complex system in which individuals exhibit diversified attitudes, approaches, and goals, interacting with each other. Currently, the clinic has no conflict management plan and does not apply a specific approach according to the particular organization's requirements. Lack of such a framework negates staff's ability to manage conflicts and organize for constructive resolution, hence the constant reappearance of conflict and long-term dissatisfaction among employees and the clients.

Current research aims to fill this gap by developing an effective conflict management strategy that can improve team collaboration, enhance the organization-client relationship, and ensure high-quality veterinary care by determining the root causes and hitherto unnoticed patterns of conflicts at UVK-Varna.

For that purpose, the following main research objectives have been formulated:

- To recognize the primary sources and patterns of conflict within UVK-Varna.
- To analyze existing conflict resolution practices and their effectiveness in the clinic.
- To propose a custom conflict management strategy that stimulates collaboration and enhances operational efficiency.

3.2. Data Collection Methods

In the conducted research on conflict management strategies at UVK-Varna, the primary data collection method of business research was interviewing selected employees by using semi-structured questionnaires to attain thorough information. This method was chosen because of the flexibility it offers the researcher in gathering the personal and sometimes highly emotionally charged narratives of the participants in organizational conflicts. Semi-structured interviews lie between fixed and flexible kinds of questioning; the study enables the participants to express themselves with a certain degree of latitude while at the same time guaranteeing that the researcher covers all the areas of interest pertinent to conflict management. In this quantitative, cross-sectional study, participants totaled 10 employees from UVK-Varna. This number was considered sufficient in order to perform qualitative analysis, but at the same time, reach an appropriate depth of data collected. The sampling used in this research was purposive. Participants were selected in order to capture the range of employee activity, rank, and division within

the context of the firm. This diversity helped to preserve the richness of the data collected and reflected different viewpoints and expected experiences connected with conflicts and their resolution in UVK-Varna. Credited to purposive sampling, the study involved populist and features that provided close and contextual information on the experience of the participants with workplace conflicts.

The semi-structured interviews were conducted using a pre-designed interview guide, which included open-ended questions to explore participants' experiences with workplace conflicts, their perceptions of existing conflict management strategies, and suggestions for improvement¹¹¹. While the guide ensured consistency across interviews, participants were encouraged to elaborate on their answers, allowing unexpected themes and insights to emerge. This approach enabled the collection of both structured responses for comparability and rich qualitative data for deeper analysis. The interviews were conducted in a setting that ensured confidentiality and encouraged participants to speak candidly. Confidentiality was emphasized to build trust and ensure that participants felt comfortable discussing potentially sensitive topics. The interviews were recorded, with participants' consent, to ensure accuracy in data transcription and analysis. This step was crucial for maintaining the integrity of the data and facilitating a detailed review of the participants' responses.

Purposive sampling and semi-structured interviews were particularly suited to this study because they align with the exploratory nature of qualitative research. These methods allowed the study to uncover nuanced and context-specific insights into conflict dynamics at UVK-Varna, which would not have been possible through quantitative methods or more rigid data collection techniques. The small sample size enabled the researcher to engage deeply with the data, identifying patterns and themes that reflect the lived experiences of employees. Furthermore, the use of purposive sampling ensured that the study focused on participants who were most likely to provide relevant and actionable insights.

3.3. Data Analysis

Employing the method of semi-structured interviews with employees of UVK – Varna, this research worked extensively with thematic analysis as its main approach for data analysis. The approach is very useful for qualitative research because it applies a pattern with the intent of looking continuously at the same idea throughout occurrence, but at the same time does not remove specific settings or words of each participant (Namey, 2012). Thematic analysis involves the initial acquaintance with the materials, the primary way being the repeated reading of the interview transcripts, and then coding the data, searching for the most meaningful phrases, ideas, or observations. These codes are then clustered into potential themes that provide more general trends associated with the study objectives. For purposes of the present analysis, the themes might encompass typical types of conflict in the workplace, current approaches to conflict resolution, and potential enhancements.

Thematic analysis is rich in versatility, which constitutes one of its most obvious benefits in this particular study. It uses an inductive type of analysis, which enables an emergence of themes from the data rather than imposing theoretical frameworks. This is especially valuable for a study focused on defining conflict management approaches in UVK-Varna, as the nature and management of conflicts in this organization may be affected by the organizational culture. In this way, the flow of the study allows the data to shape the conclusions and means that the proposed strategies are derived from the employee experiences.

The approach of thematic analysis has been considered to be the most suitable because it is flexible, rigorous, and capable of capturing rich, detailed, and practical insights from participants' experiences, perceptions, and even emotions about workplace conflicts.

3.4. Limitations

The research has been conducted at only one veterinary clinic, and the results cannot be generalized to have strategic implications for all organizations of the same type.

4. Findings and Strategic Implications

As a result of the conducted thematic analysis, certain workplace tensions and organizational stressors at UVK-Varna have been identified. They had been derived from the following four key themes:

Theme 1: Managerial Inefficiencies in Conflict Resolution

Theme 2: Workload and Organizational Stress

Theme 3: Interpersonal and Team Dynamics

Theme 4: Client-Induced Workplace Stress

All of them contain sub-themes that further explain the actual drawbacks and problems identified by the research participants. Thus, a much fuller picture of the real conflict situation in the clinic is revealed (see Fig. 1).

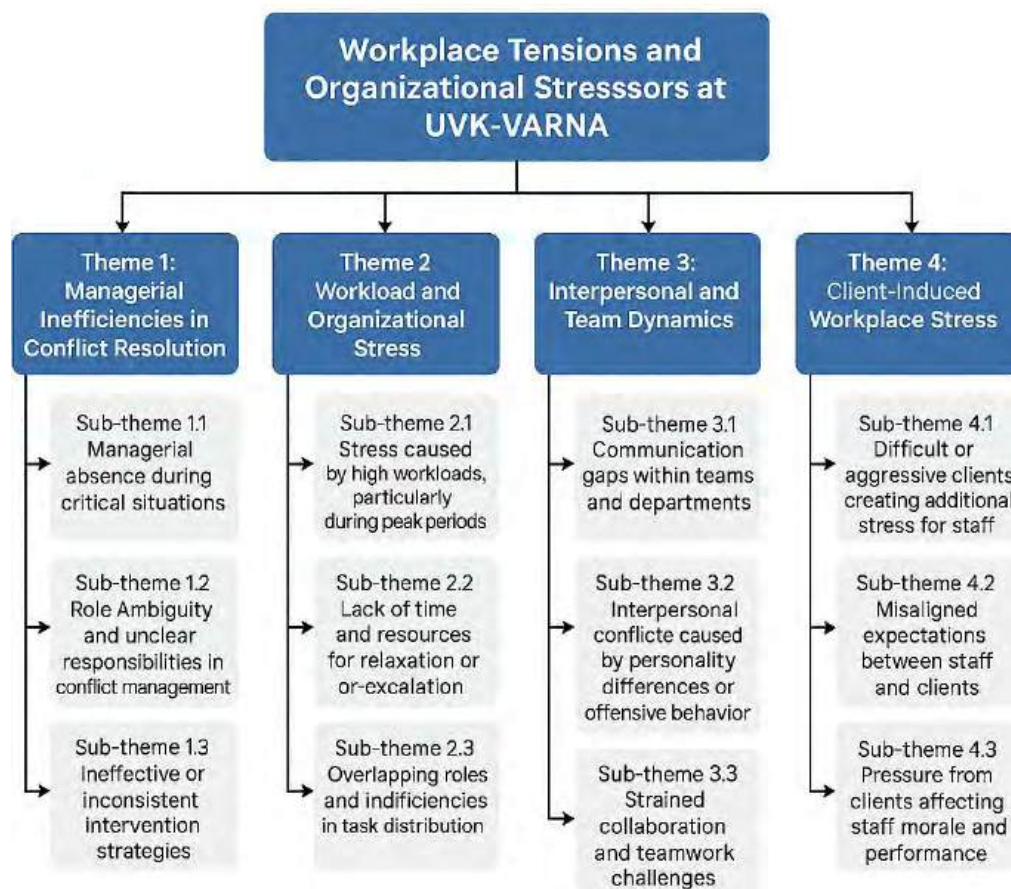


Fig. 1. Most Important Themes and Sub-themes According to the Conducted Research

Source: Authors' compilation, AI-generated

Theme 1: Managerial Inefficiencies in Conflict Resolution

Holding inefficiencies in the manager conflicts is a major issue that needs to be discussed based on the interviews carried out at UVK-VARNA. To be more specific, the participants' responses raise different concerns, such as late managerial response, ineffective conflict management approaches, and limited available leadership during the occurrences of significant events. These inefficiencies create voluntary or forced enemies at work, demotivated workers, and negatively impact the performance of the clinic.

Sub-theme 1.1: Managerial absence during critical situations

One of the major problems identified at UVK-VARNA, according to the interviews conducted, is managerial absence during critical circumstances. Employees in this sub-theme struggle to seek prompt assistance from the managers when in a position to address conflicts in the workplace. Staff are more likely to feel commissioned and morale decreases when their managers are unavailable, interpersonal relationship between workers deteriorates, and productivity at the workplace is interfered with. This paper seeks to elaborate on the effects of managerial absence, this being augmented by participant perceptions of the resultant feelings and organizational impacts, as well as suggesting possible courses of action.

Sub-theme 1.2: Role ambiguity and unclear responsibilities in conflict management

Lack of clarity regarding roles and responsibilities for conflict management was identified as one of the major sub-themes during interviews held in the UVK-VARNA organization. As it will be observed from the participants' contributions, there was a continually raised issue on the aspect of role and task ambiguity arising from uncertainties of who is supposed to assume leadership during conflicts at the workplace. Such an approach creates confusion, prolongs a conflict and tends to make everything achieve seem lethargic. Lack of unclear role also increase anxiety because employee's do not know what they are suppose to do or they do not have the support of their directors. This section further discusses role ambiguity, be embedding the appropriate codes and participants' observations as well as presenting some solution strategies.

Sub-theme 1.3: Ineffective or inconsistent intervention strategies

Ineffective or inconsistent intervention strategies in conflict management emerged as a significant sub- theme during the analysis of interviews at UVK-VARNA. Participants highlighted that while managerial interventions occurred, their effectiveness and consistency were often lacking. Some interventions resolved conflicts effectively, but others exacerbated tensions or left disputes unresolved. This inconsistency created uncertainty among employees and negatively impacted workplace morale and productivity. This section examines the implications of ineffective intervention strategies, supported by codes aligned with this sub-theme, participant quotations, and recommendations for improvement.

Theme 2: Workload and Organizational Stress

Workload and organizational stress emerged as a significant theme in the analysis of workplace tensions at UVK-VARNA. Participants consistently pointed to excessive workloads and inadequate organizational structures as central contributors to interpersonal conflicts and emotional strain. The findings reveal that these issues, particularly during peak periods, disrupt the work environment, diminish employee morale, and negatively affect productivity.

Sub-Theme 2.1: Stress caused by high workloads, particularly during peak periods

The most prominent sub-theme under workload and organizational stress is the heightened pressure employees experience during peak periods. Participants frequently described how increased responsibilities and tight schedules create stress and, in turn, contribute to conflicts among team members. One participant explained, "During busy times, everyone is under so much pressure that even small disagreements turn into big issues." This statement underscores the direct connection between workload stress and workplace tensions, reflecting the code "Workload-Induced Tension." Another participant shared, "When the clinic is full, and we're working nonstop, tempers flare. People don't communicate well because everyone is focused on just getting through the day." This observation aligns with the code "Communication Breakdown," as excessive workloads often hinder effective communication, a key factor in maintaining teamwork and preventing conflicts.

Sub-Theme 2.2: Lack of Time and Resources for Relaxation or De-escalation

The lack of time and resources for relaxation or de-escalation was a key concern expressed by participants in the analysis of workplace tensions at UVK-VARNA. The fast-paced nature of the work, compounded by high workloads and organizational demands, often leaves employees with little opportunity to step back and recover from stressful situations. Without adequate time to relax or de-escalate, tensions build, conflicts escalate, and employees experience burnout.

Sub-Theme 2.3: Overlapping Roles and Inefficiencies in Task Distribution

Overlapping roles and inefficiencies in task distribution were also identified as significant contributors to workplace tensions at UVK-VARNA. Participants described how unclear responsibilities and uneven workloads created confusion, resentment, and operational inefficiencies. These issues not only hinder productivity but also exacerbate interpersonal conflicts among staff.

Theme 3: Interpersonal and Team Dynamics

Interpersonal and team dynamics represent a cornerstone of workplace functionality and productivity. At UVK-VARNA, challenges within this theme emerged prominently in the data, reflecting how poor communication, interpersonal conflicts, and strained teamwork disrupt the work environment. The following sub-themes emerge from the exploration of this analysis:

Sub-theme 3.1: Communication gaps within teams and departments.

Communication is the foundation of effective collaboration, and its absence creates significant disruptions. At UVK-VARNA, communication gaps were frequently identified as a source of tension and conflict within teams and across departments. The key codes aligned with this sub-theme are “Miscommunication,” “Lack of Transparency,” and “Information Silos.”

Sub-theme 3.2: Interpersonal conflicts caused by personality differences or offensive behavior.

Interpersonal conflicts are inevitable in any workplace, but become particularly disruptive when exacerbated by personality clashes or inappropriate behavior. At UVK-VARNA, participants identified such conflicts as a major source of tension, aligning with the codes “Personality Clashes,” “Inappropriate Behavior,” and “Unresolved Disputes.”

Sub-theme 3.3: Strained collaboration and teamwork challenges.

Collaboration and teamwork are critical for achieving organizational goals, yet at UVK-VARNA, participants frequently described strained relationships within teams. This sub-theme aligns with the codes “Lack of Cooperation,” “Blame-Shifting,” and “Team Disconnect.”

Theme 4: Client-Induced Workplace Stress

Client-induced workplace stress emerged as a critical theme from the analysis, highlighting how challenging client behaviors and unrealistic demands significantly impact staff morale and contribute to workplace tensions. This theme underscores the relationship between client interactions and the internal dynamics of the organization, revealing how external pressures can infiltrate the work environment.

Sub-Theme 4.1: Difficult or Aggressive Clients Creating Additional Stress for Staff

Clients with difficult or aggressive behavior were frequently mentioned by participants as a source of significant stress. Such interactions often escalate tensions, disrupt the workflow, and take an emotional toll on staff members.

Sub-Theme 4.2: Misaligned Expectations Between Staff and Clients

Misaligned expectations, particularly regarding services and costs, were another prominent source of workplace stress. Participants noted that these misunderstandings often stem from a lack of clear communication or unrealistic client assumptions.

Sub-Theme 4.3: Pressure from Clients Affecting Staff Morale and Performance

The pressure exerted by clients, whether intentional or unintentional, was another significant

source of workplace stress identified by participants. This pressure often leads to burnout, diminished morale, and reduced performance among staff.

The final result from the current research has been the formulation of strategic implications that have been developed in two directions. First group – recommendations oriented towards the resolution of current conflicts, and the second group – recommendations for conflict prevention:

Recommendations for the resolution of current conflicts

- Implement Structured Conflict Resolution Protocols
- Provide Comprehensive Training Programs
- Establish Clear Roles and Responsibilities
- Enhancing Communication Channels
- Integrating Role Clarity and Communication Improvements
- Create Support Systems for Stress Management

Below, in the following table (see Table 3), it is evident how those recommendations correspond with the outlined problems and can have a positive impact on their solution:

Table 3

Alignment Between the Recommendations for the Resolution of Current Conflicts and Workplace Tensions at UVK-VARNA

Recommendation	Related Theme(s)	Relevant Sub-theme(s)	How the Recommendation Solves the Issues
Implement Structured Conflict Resolution Protocols	• Theme 1: Managerial Inefficiencies in Conflict Resolution • Theme 3: Interpersonal and Team Dynamics	• 1.1 Managerial absence during critical situations • 1.3 Ineffective or inconsistent intervention strategies • 3.2 Interpersonal conflict caused by personality differences • 3.3 Strained collaboration and teamwork challenges	• Provides consistent procedures for managers to handle conflicts promptly. • Reduces interpersonal tension and improves collaboration. • Ensures conflicts are resolved fairly and predictably.
Provide Comprehensive Training Programs	• Theme 1: Managerial Inefficiencies in Conflict Resolution • Theme 2: Workload and Organizational Stress • Theme 3: Interpersonal and Team Dynamics • Theme 4: Client-Induced Workplace Stress	• 1.2 Role ambiguity and unclear responsibilities • 1.3 Ineffective intervention strategies • 2.1 Stress caused by high workloads • 2.2 Lack of time and resources for relaxation • 3.2 Interpersonal conflict • 4.1 Difficult or aggressive clients • 4.3 Pressure from clients affecting morale	• Equips managers and staff with skills for conflict resolution, leadership, and stress management. • Improves teamwork, communication, and ability to handle client pressure. • Provides strategies for time management and resilience.
Establish Clear Roles and Responsibilities	• Theme 1: Managerial Inefficiencies in Conflict Resolution	• 1.1 Managerial absence during critical situations • 1.2 Role ambiguity and	• Clearly defines responsibilities, reducing confusion and duplicated work.

Recommendation	Related Theme(s)	Relevant Sub-theme(s)	How the Recommendation Solves the Issues
	• Theme 2: Workload and Organizational Stress	unclear responsibilities • 2.3 Overlapping roles and inefficiencies	• Empowers staff to act independently when managers are unavailable. • Increases accountability and efficiency.
Enhancing Communication Channels	• Theme 3: Interpersonal and Team Dynamics • Theme 4: Client-Induced Workplace Stress	• 3.1 Communication gaps within teams • 4.2 Misaligned expectations between staff and clients • 4.3 Pressure from clients affecting morale	• Facilitates smooth flow of information internally and with clients. • Reduces misunderstandings and improves teamwork. • Ensures client expectations are clear, lowering stress.
Integrating Role Clarity and Communication Improvements	• Theme 1: Managerial Inefficiencies in Conflict Resolution • Theme 2: Workload and Organizational Stress • Theme 3: Interpersonal and Team Dynamics	• 1.2 Role ambiguity • 2.3 Overlapping roles • 3.1 Communication gaps	• Combines clear roles with improved communication to create structured workflows. • Reduces errors, tension, and bottlenecks. • Promotes teamwork efficiency and clarity in decision-making.
Create Support Systems for Stress Management	• Theme 2: Workload and Organizational Stress • Theme 4: Client-Induced Workplace Stress	• 2.1 Stress caused by high workloads • 2.2 Lack of time and resources for relaxation • 4.1 Difficult or aggressive clients • 4.3 Pressure from clients affecting morale	• Provides Employee Assistance Programs, counseling, and peer support. • Helps staff cope with high workload and challenging clients. • Improves staff well-being and overall morale.

Source: Authors' compilation, AI-generated

Conflict management not only deals with current issues. It is essential for the prevention of serious future problems and clashes in terms of personal relations in the organization. That is why a certain number of recommendations have also been developed in that direction.

Recommendations for the prevention of future conflicts

- Regular Performance Reviews
- Employee Assistance Programs (EAPs)
- Positive Reinforcement
- Fairness and Equity
- Regular Team Building Activities

Each of those prevention strategies is based on the needs of UVK-Varna derived from the essence of the current workplace issues as defined by the research participants (see Table 4).

Table 4**Alignment Between the Recommendations for Prevention of Conflicts in Line with Current Workplace Tensions at UVK-VARNA**

Recommendation	Related Theme(s)	Relevant Sub-theme(s)	How Recommendation Prevents Conflicts
Regular Performance Reviews	Theme 1: Managerial Inefficiencies in Conflict Resolution; Theme 2: Workload and Organizational Stress	1.1 Managerial absence during critical situations; 1.2 Role ambiguity and unclear responsibilities; 2.1 Stress caused by high workloads; 2.3 Overlapping roles and inefficiencies in task distribution	Ensures managers monitor performance and intervene promptly; clarifies expectations and responsibilities; helps identify workload issues early and prevent overload.
Employee Assistance Programs (EAPs)	Theme 1: Managerial Inefficiencies in Conflict Resolution; Theme 2: Workload and Organizational Stress; Theme 3: Interpersonal and Team Dynamics; Theme 4: Client-Induced Workplace Stress	1.3 Ineffective or inconsistent intervention strategies; 2.1 Stress caused by high workloads; 2.2 Lack of time and resources for relaxation; 3.2 Interpersonal conflict caused by personality differences; 4.1 Difficult or aggressive clients; 4.2 Misaligned expectations between staff and clients	Provides counseling and support for staff; reduces stress from workload and client pressure; helps staff manage interpersonal conflicts more effectively.
Positive Reinforcement	Theme 3: Interpersonal and Team Dynamics; Theme 4: Client-Induced Workplace Stress	3.3 Strained collaboration and teamwork challenges; 4.1 Difficult or aggressive clients; 4.3 Pressure from clients affecting staff morale and performance	Motivates staff and improves morale; encourages teamwork and collaboration; mitigates stress caused by client interactions through recognition and positive feedback.
Fairness and Equity	Theme 1: Managerial Inefficiencies in Conflict Resolution; Theme 2: Workload and Organizational Stress; Theme 4: Client-Induced Workplace Stress	1.1 Managerial absence during critical situations; 1.2 Role ambiguity and unclear responsibilities; 2.3 Overlapping roles and inefficiencies in task distribution; 4.2 Misaligned expectations between staff and clients; 4.3 Pressure from clients affecting staff morale and performance	Ensures consistent treatment of all staff; clarifies roles and responsibilities; reduces workload conflicts and unfair pressures from clients.
Regular Team Building Activities	Theme 3: Interpersonal and Team Dynamics	3.1 Communication gaps within teams and departments; 3.2 Interpersonal conflict caused by personality differences; 3.3 Strained collaboration and teamwork challenges	

Source: Authors' compilation, AI-generated

Incorporating these strategies into the managerial practices of UVK-Varna can significantly mitigate conflict risk, improve team morale, and overall productivity. However, if they are not incorporated promptly into the overall organization strategy and if the overall organizational philosophy and culture are not aligned with them, the opposite effect might be expected.

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Relationship Marketing as a Tool for Building Sustainable Business Models

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JEL: O14, P24, C41, E13

Abstract

Relationship marketing is emerging as a contemporary marketing concept that goes beyond the boundaries of classical marketing, which is mainly oriented toward sales and short-term profits. At the core of the relational approach is the building and maintaining of long-term relationships with customers based on trust, commitment, and mutual value. The relevance of the topic stems from the intensifying competition in the tourism and service sectors, where service quality and customer satisfaction are decisive factors for the sustainable development of companies. With the advance of digitalization and changing consumer attitudes, customers no longer seek merely a product or service, but a holistic experience and an emotional connection with the brand. In this context, relationship marketing appears not only as a method for improving customer service, but also as a strategic instrument for building sustainable business models. Sustainable business models require the integration of economic, social, and environmental dimensions into organizational management. They imply a new philosophy of interaction between the company and its stakeholders—customers, employees, suppliers, and partners. Relationship marketing provides the conceptual and instrumental framework for the realization of these interactions by emphasizing trust, loyalty, cooperation, and shared value. The present study seeks to demonstrate that the application of relationship marketing in tourism, and particularly in the field of tourist animation, not only leads to higher customer satisfaction and loyalty, but also supports the development of sustainable business models. The empirical part is based on a study conducted at “BVS Entertainment” Ltd., one of the leading companies in the field of hotel animation in Bulgaria.

Keywords:

relationship marketing,
sustainability, business models,
tourist animation, customer
loyalty

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1. Introduction

Relationship marketing represents a contemporary and strategically significant marketing concept that places the relationships between the company and the customer at the center of business management and organizational culture. Unlike classical marketing, which to a greater extent emphasizes the one-time act of purchase and efforts to attract new customers through mass communication channels, relationship marketing aims at building, maintaining, and developing long-term relationships. These relationships are based on trust, mutual commitment, emotional attachment, and the creation of added value for both parties. Contemporary research emphasizes that sustainable commercial success increasingly depends less solely on price or the quality of the offered product and more on the level of customer engagement and satisfaction, which can transform customers into long-term partners of the company (Grönroos, 2007).

The relevance of the topic stems from the growing dynamism and intensifying competition in the tourism sector—a sector that is extremely sensitive to changes in consumer attitudes and the global environment. It is precisely here that relationship marketing plays a key role, as service quality, the level of customer experience,

and the degree of customer loyalty are decisive factors for the sustainable development of tourism companies. The concept is successfully applied in hospitality, catering, and entertainment services, where the value of the service is often assessed not only through its functional characteristics but through the way the customer feels in interaction with the staff and the organization as a whole.

Under conditions of digitalization and global challenges, relationship marketing gains additional importance. Digital platforms allow more precise personalization of offers, maintenance of constant contact with customers, and collection of information about their preferences and behavior. This provides opportunities for building deeper and more meaningful relationships that strengthen trust and increase the likelihood of repeat purchases. In this sense, relationship marketing can be regarded not only as a set of operational tactics but as a management philosophy aimed at achieving long-term sustainability and competitiveness of the business (Kotler, Kartajaya & Setiawan, 2017).

2. Object, Subject, Aim, Tasks, and Research Methods

The object of the research is the application of relationship marketing in the field of tourism services, with a specific focus on hospitality and animation as added value to the tourism product. Tourism represents a complex system of relationships between service providers and consumers, in which the degree of trust and satisfaction determines the competitiveness of each company (Buhalis & Sinarta, 2023).

The subject of the research is the influence of the relationship marketing approach on the sustainable development of hotel animation companies, with a special focus on “BVS Entertainment” Ltd (Karadzhova & Angelov, 2018). This company represents an illustrative example of the practical application of the concept under Bulgarian conditions, where animation is not merely an entertainment service, but an instrument for building long-term customer relationships (Sustainability Editorial Board, 2025).

The main aim of the research is to demonstrate that the systematic application of relationship marketing in the tourism sector contributes to increased customer satisfaction, stimulates loyalty, and supports sustainable business development through the establishment of stable interaction models between the company and its stakeholders.

To achieve this aim, several main tasks are defined:

- To conduct a critical review of existing theoretical models of relationship marketing and identify its main characteristics;
- To analyze the essence of tourist animation as a specific service and as a strategic instrument for building long-term customer relationships;
- To examine the application of relationship marketing at “BVS Entertainment” Ltd. through the systematization of empirical data from customer and organizational studies;
- To formulate practical recommendations for optimizing the animation product and for the broader application of relationship marketing as a tool for building sustainable business models in tourism.

The research methodology includes a combination of quantitative and qualitative methods. Survey studies were conducted among hotel customers where the company provides animation services, in order to determine levels of satisfaction, expectations, and loyalty. In parallel, surveys were conducted among company employees and managers to examine the effect of the relational approach on internal organizational culture and work process efficiency. Statistical analysis of the collected data is complemented by a comparative method for evaluating the results in relation to other companies in the sector. Additionally, a descriptive method is applied to systematize the theoretical foundations, as well as expert assessments for the formulation of recommendations.

As a result of this methodology, the study integrates both the theoretical framework of relationship marketing and its practical applications in real market conditions, providing a solid basis for conclusions and

guidelines for building sustainable business models (Georgiev, Petrov & Nikolova, 2023).

3. Theoretical Part

Marketing, in its classical form, is viewed as a system of activities aimed at attracting new customers and ensuring short-term sales. According to Kotler, marketing is a social and managerial process through which individuals and groups obtain what they need and want by creating and exchanging value (Kotler, 2002). This definition emphasizes the transaction—the single act of buying and selling—as the main objective of marketing efforts. Under conditions of industrialization and mass production, the transactional approach guaranteed market success, as the satisfaction of basic needs was the leading priority.

The development of marketing theory and practice has passed through several clearly defined stages. Initially, the emphasis was on product-oriented marketing, dominated by the idea that a good product sells itself. Over time, sales-oriented marketing emerged, in which aggressive sales practices were used to impose products on the market. The third stage is market orientation, where companies began to realize that understanding customer needs and market segmentation are key to success. At a later stage, customer orientation emerged, and at the most contemporary stage, the concept of relationship marketing became established, shifting the focus from one-time transactions to long-term cooperation.

Relationship marketing emerged as a response to dynamic changes in the market environment. Under conditions of globalization, digitalization, and increasing competition, customers have become more informed, demanding, and mobile. They no longer seek merely a product or service, but a comprehensive experience that creates added value and an emotional connection with the brand. In this context, relationship marketing represents a strategic approach in which the company builds a network of long-term relationships not only with customers, but also with suppliers, partners, employees, and society as a whole.

A key advantage of relationship marketing is that it is based on trust, satisfaction, and loyalty—elements that ensure repeat purchases and business sustainability. Key instruments include loyalty programs, personalized offers, two-way communication, and post-purchase customer care. In this way, the company does not merely generate sales, but builds long-term relational capital that becomes a competitive advantage.

In recent decades, sustainable development has become a fundamental principle of business strategies. Tourism, as one of the most dynamic industries, is particularly sensitive to the need for sustainable operational models that combine economic success, social responsibility, and environmental care. Relationship marketing contributes to sustainability in several directions:

- it creates a stable customer base that ensures predictable revenues and reduces dependence on external factors;
- it encourages corporate social responsibility by integrating the interests of various stakeholders;
- it supports the development of organizational culture through employee engagement;
- it contributes to building a positive image and public trust, which form the basis for long-term competitiveness.

In this sense, relationship marketing is not merely an instrument for achieving market success, but a key element of strategies for building sustainable business models.

4. Application in Tourism and Tourist Animation

Tourism is one of the sectors in which the application of relationship marketing is particularly significant. Due to the specific characteristics of tourism services—their intangibility, inseparability from the consumption process, and strong dependence on the human factor—the relationships between provider and customer are central to the perception of quality. Unlike tangible products, where value can be assessed through physical characteristics, tourism services are evaluated primarily through emotional connection and the overall

customer experience (Christopher, Payne & Ballantyne, 1991).

Relationship marketing in tourism is expressed through personalized offers, loyalty programs, feedback systems, digital platforms for maintaining constant contact, and—most importantly—through animation as a unique form of interaction with tourists (Peppers & Rogers, 1993). Animation represents a complex of activities that create added value to the core tourism product by providing entertainment, social interaction, and active customer participation. In this way, it not only enriches the experience but also strengthens the emotional bond between the tourist and the brand.

In hotel and resort practice, animation performs the function of a strategic tool for customer retention. Studies conducted by Dr. Alexander Angelov within the framework of his dissertation show that tourists who participate in animation programs demonstrate significantly higher levels of satisfaction and a greater tendency toward repeat visits. According to survey data, more than 70% of respondents state that animation was the factor that turned their stay into a memorable experience. This directly corresponds to the concept of relationship marketing, in which the key to sustainable development lies in building loyal customers through value and emotion (Reichheld, 1996).

Hotel animation also contributes to the creation of a sense of community among tourists. When guests participate together in games, sports activities, cultural and artistic events, they build relationships both with each other and with the hotel staff. This process creates positive brand associations and strengthens emotional engagement, which is difficult to achieve through traditional marketing tools such as advertising or price promotions (UNWTO, 2022).

Another key aspect is that animation becomes a differentiating factor under conditions of intense competition. In destinations where hotel infrastructure is similar, the quality and creativity of animation programs often determine customer choice. Thus, companies investing in innovative and well-organized animation not only retain tourists, but also position themselves as leaders in the sector (Saavedra-Azabache et al., 2024).

At “BVS Entertainment” Ltd., which is the object of the present research, relationship marketing finds concrete application through the development of personalized animation packages tailored to tourists’ age, cultural characteristics, and preferences. The company builds long-term partnerships with hoteliers and tour operators, thereby creating a stable network of relationships. Animator staff are trained not only to perform entertainment functions, but also to act as intermediaries in building trust and satisfaction.

The data show that the introduction of a relational approach in animation leads to tangible results—an increase in average length of stay, growth in repeat visits, and improvement of the image of hotel complexes. In this sense, tourist animation is established as a key component in building a sustainable business model based on relationship marketing.

5. Research Results

“BVS Entertainment” Ltd. is one of the leading companies in Bulgaria specializing in animation services for the tourism sector and is the subject of an in-depth study. The main focus is placed on the application of the relationship marketing concept and its effect on sustainable business development (Baran & Zerres, 2014).

The study was conducted through a combined approach including surveys among tourists and staff, interviews with managers, and analysis of internal company documents. More than 400 respondents—hotel customers served by “BVS Entertainment” Ltd.—participated in the surveys. In addition, over 120 animator employees were surveyed to assess their satisfaction, motivation, and perception of the application of relationship marketing in practice.

The analysis of results shows that 78% of tourists identify animation services as a key factor for satisfaction with their stay (Fig.1). 71% of respondents state that they would choose the same hotel again specifically because of the animation, while 64% indicate that contact with animators contributed to building

trust in the overall tourism product.

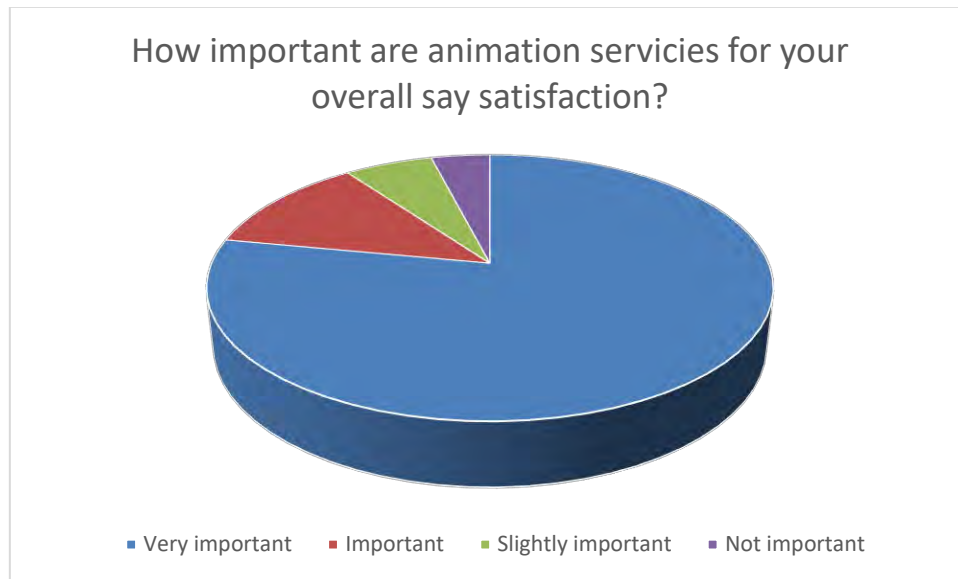


Fig.1. How important are animation services for your overall stay satisfaction?

Particularly noteworthy is the fact that for more than half of the customers (53%), participation in animation programs was decisive in recommending the hotel to relatives and friends. This demonstrates that animation becomes a “brand ambassador” and plays a strategic role in building loyalty and attracting new visitors through recommendations.

Analysis of employee opinions shows that 86% of animators perceive their role not only as entertainment, but also as an instrument for building long-term customer relationships (Fig. 2). At the same time, 67% emphasize that training and internal programs related to relationship marketing have improved their motivation and professional development.

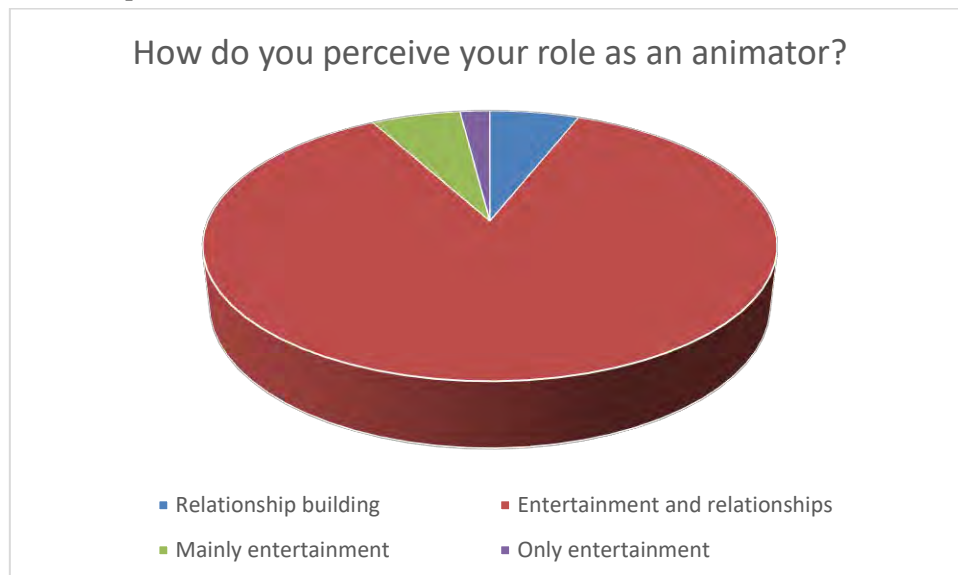


Fig. 2. How do you perceive your role as an animator?

A direct relationship is also observed between employee satisfaction and customer satisfaction. The company applies incentive programs for animators through internal rewards, career development

opportunities, and continuous feedback. This leads to high levels of engagement and reduced staff turnover—key factors for business sustainability.

During the studied period, “BVS Entertainment” Ltd. reports a 15% increase in client contracts with hotel complexes and tour operators, resulting from increased demand for animation services. There is also significant revenue growth, with the introduction of personalized packages and long-term partnerships contributing to the stabilization of the company’s market position.

In addition, the study confirms that investments in relationship marketing and personnel have a long-term effect. Customer repeatability and the development of lasting partnerships with hoteliers create a foundation for a sustainable business model that is less vulnerable to seasonal fluctuations and price competition (Parasuraman et al., 1988).

The empirical data clearly demonstrate that the application of relationship marketing at “BVS Entertainment” Ltd. leads to:

- increased customer satisfaction and loyalty;
- improved staff motivation and engagement;
- expansion of the partnership network and economic growth;
- creation of competitive advantage through a unique customer experience.

6. Discussion

The results of the study at “BVS Entertainment” Ltd. clearly demonstrate the significance of relationship marketing as a strategic instrument for sustainable development in tourism services. The obtained data confirm theoretical assumptions that relationships with customers and partners are a fundamental factor for building competitiveness and long-term business success (Kotler, 2009; Anastassova, 2008).

The high level of customer satisfaction and propensity for repeat consumption indicates that relationship marketing is effective under conditions of strong competition. This corresponds to Reichheld’s concept that loyal customers not only increase company revenues through repeat purchases, but also contribute to expanding the customer base through positive word-of-mouth communication. The application of personalized animation programs and direct customer engagement demonstrates the role of experience as a key added value in tourism.

The results confirm the thesis that a sustainable business model requires parallel investment in both customers and personnel. According to the SERVQUAL model, service quality is perceived as directly dependent on employee attitudes toward customers (Parasuraman et al., 1988). In the case of “BVS Entertainment” Ltd., the high engagement and professional training of animators lead to significantly higher levels of tourist satisfaction, which in turn stimulates repeat consumption and recommendations.

The company’s financial results show that investments in relational practices are justified not only in terms of satisfaction, but also as a concrete economic effect (Christopher, Payne & Ballantyne, 1991). The growth in contracts and revenues recorded during the study period confirms that relationship marketing is sustainably applicable even under conditions of seasonality and high competition in tourism. This corresponds to the idea of Christopher, Payne, and Ballantyne that relationship marketing leads to resource optimization and higher return on investment.

The practical value of the study lies in identifying concrete mechanisms for applying relationship marketing: individualization of animation programs, introduction of customer feedback systems, development of internal staff training programs, and building partnerships with hoteliers. In this context, “BVS Entertainment” Ltd. can be regarded as a model for successful integration of relationship marketing in tourism, adaptable to other companies in the sector.

7. Conclusion

The study of the application of relationship marketing in tourism services, and more specifically in the activities of “BVS Entertainment” Ltd., confirms the strategic importance of this concept for achieving sustainable business development. The synthesis of the theoretical framework, empirical results, and applied aspects clearly outlines the relationship between building lasting relationships and the competitiveness of tourism companies.

Relationship marketing is established as an alternative to the classical transactional model, which views the customer solely as a source of sales. The theoretical foundation developed by Kotler, Christopher, Payne, and Ballantyne, as well as Bulgarian authors Anastassova and Karadzhova, shows that long-term relationships are not only a means of improving customer loyalty, but also an instrument for optimizing business processes and reducing costs. In tourism, these theoretical assumptions acquire particular importance due to the intangible nature of services and their strong dependence on human resources and customer experience.

The survey results at “BVS Entertainment” Ltd. demonstrate several key relationships:

- high customer satisfaction—over 80% of surveyed tourists report being fully satisfied with the quality of animation services;
- loyalty and repeat consumption—nearly 70% of customers express willingness to return to the same hotel due to the quality of the animation program;
- significant role of personnel—the professional training and personal attitude of animators are decisive for the perception of the overall tourism experience;
- economic effect—company revenues have increased, directly linked to growing interest from hotel operators in animation services.

These results confirm that the application of relationship marketing leads to measurable positive effects for both customers and the organization.

The practical significance of the study lies in identifying concrete mechanisms for implementing relationship marketing in tourism companies, including:

- individualization of animation programs according to tourist profiles;
- continuous feedback through surveys and digital channels;
- systematic staff training to develop communication and organizational skills;
- building strategic partnerships with hoteliers and tour operators;
- integration of loyalty programs and digital platforms to maintain contact with customers after their stay.

These practices demonstrate that relationship marketing can become a core element of sustainable business models in tourism.

Despite the clear results, the study has certain limitations. It covers a specific time period, and due to the dynamic nature of the tourism market, further updates are necessary, particularly in light of digitalization and post-COVID-19 changes in consumer behavior. The need for long-term panel studies is also evident, as the present analysis focuses on a limited time horizon.

In summary, relationship marketing is not only a concept, but a practical management philosophy that ensures sustainable competitive advantage. Its application in tourism services, and especially in hotel animation, proves that building trust and emotional connection with customers has strategic importance.

For “BVS Entertainment” Ltd., relationship marketing has become a key factor for expanding market presence, improving economic results, and establishing the company’s image as a reliable partner in the tourism sector.

Based on the analysis, it can be concluded that the future of tourism and related services will inevitably involve broader integration of relationship marketing as a foundation for building sustainable business models in a global context.

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Managing Organizational Commitment of Gen Z in Bulgaria's Fast Fashion Industry during Times of Global Uncertainty

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JEL:M12, M54, M14, J28

Abstract

Gen Z representatives are gradually entering the labor market. One of the characteristics of the environment in which they work is that there are conditions of global uncertainty. The purpose of this study is to analyze the patterns of organizational commitment in the conditions of global uncertainty. The dynamics of organizational commitment (affective, continuance and normative) of Gen Z and Millennial representatives were studied for the period before COVID-19, during lockdown and after loosening the safety measures in leading fast fashion retail companies in Bulgaria. The results show that companies can directly influence affective and normative organizational commitment; as for rational - it increases during uncertainty and decreases in times of good predictability.

Key words:

Gen Z, Millennials, Organizational commitment, Uncertainty, COVID-19.

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1. Introduction

The contemporary world, the impact of digital technology and the global uncertainty are affecting the attitudes of people towards their career and the relationship with their employers. Attracting the best employees, their development, their retention for longer periods of time and building organizational commitment is an important question on which managers and scientists want to find an answer. One of the big impacts on that is the specifics in the behavior and the attitudes towards the work of different generations.

In relation to this, research made by Kingel and Hitner in 2014 shows one specific trend – each next generation doubles the number of employers in their career lifespan (Kingel, 2014). Saying that it is expected that the Millennials (Gen Y) to have 16 different employers for their 30-years career. That means one person changes employer every 24 months¹. If the number of employers doubles for each generation, what business should expect for Gen Z²?

It is necessary to conduct research organizational commitment in times of global uncertainty, particularly the Gen Z cohort, based on which can be given recommendations for human resource managers in business organizations about the labor behavior of that generation in times of global uncertainty.

One of the business spheres that young people choose as a career start, which can allow balance between studying and life, is the fast fashion industry. This term describes a business model, which the apparel, after being shown on the runway, is being produced and delivered to the end user for the shortest period of time. This business model is applied by a lot of retailers. Some of the companies with this model, which operate in the Bulgarian market, are *Inditex (Zara, Pull and Bear, Massimo Dutti, Bershka, Stradivarius, Oysho, Zara Home, Uterque)*, *H&M Group (H&M, COS, Arket, Weekday, & Other stories, Monki, H&M Home, Cheap*

¹ Millennials – there is no consistent information about the line which divide the different generations. In this research it is considered that Millennials are people born between 1980-1995. поколението обхваща хората, родени в периода 1980 – 1996 година

² Generation Z – in this paper it is considered that Gen Z encompass people, born between 1996 and 2012.

Monday) and Tema Textil (LC Waikiki). Their major competitors are Mango, Nike, LPP Group and others.

The average employee in the fast fashion retail business is 32 years old. This includes Gen Y and Z representatives. This sector is attractive to young people, as it offers flexible working hours, higher than average compensation on regional basis and learning and career development opportunities (Gazzola, 2020), (Plank, 2014).

The problem about organizational commitment is being analyzed by many authors, both in Bulgaria and abroad. Nevertheless, there is not sufficient information about the management of organizational commitment of Gen Z representatives in the fast fashion retail companies during times of global uncertainties in Bulgaria. The reason behind this might be the fact that the fast fashion retailers entered in a bulk into the Bulgarian market relevantly recently – in the past 10 years. In addition to that, Gen Z are making their first career steps. There are new on the labour market, and they are interesting research objects, as there is no enough data about their behaviour in the workplace.

In this research it is used the work of Allen and Mayer's work on organizational commitment. Their questionnaire tool is used for measuring organizational commitment levels and subtypes. The subject of this research is Gen Z and Gen Y representatives, specifically during times of global uncertainty. The object of this research is Gen Z, employed in the fast fashion retail companies in Bulgaria. Although they are not dominant segment of the labour market, it is expected to become one in the upcoming years. The research on Gen Z's attitudes towards work during times of global uncertainty is important to be able to manage organizational commitment. In this paper we hypothesized that only one subtype of organizational commitment – the continuance commitment, is influenced by factors in the external environment like global uncertainty.

The research in this paper is quantitative. The raw data is obtained by surveying representative sample of Gen Z and Gen Y, employed in fast fashion retail companies in Bulgaria. The used questionnaire is the developed tool for measuring organizational commitment by Allen and Mayer – Organizational Commitment Questionnaire (OCQ). This tool distinguishes three types of organizational commitment – affective, continuance and normative (Allen, 1990). The data processing is done by using software products such as: Microsoft Excel, Google Sheets, SPSS, PSPP и GPower. The analysis is made by statistical method ANOVA and t-Test.

2. Literature Review

2.1. Characteristics of Gen Y and Gen Z at workplace

Often Gen Y and Gen Z are considered the youngest on the labour market, however we need to make a distinguish between them. One of the reasons for that is the most elderly Gen Y now are 40 plus years old. This means they are in the young adulthood phase in their life. There is not enough data for the behavior of Gen Z in the labor market, as they are soon segmented as a different cohort. Because of that some scientists are studying them in comparison with Gen Y. They have a lot in common with each other, because of the environment in which they have grown, however there are some major differences.

There are different considerations about what the year in which Gen Y stops, and Gen Z starts. In this research it used one of the widely known definitions – that we can consider Gen Y as the people born between 1980 and 1995 (De Cooman, 2012) (Berkup, 2014). This generation has a span of approximately 20 years. Very often this generation is called also “Millennials” (Howe, 2000).

In the labor market, Gen Y are dependent, they need structure, supervision and directions about the work. Apart from that, those requirements need to be aligned with the need for autonomy and flexibility, to perform the work tasks in the most efficient way (Reisenwitz, 2009).

Apart from these specifics, the thing that distinguishes Generation Y representatives is the strong need for feedback about their work (Patterson, 2007). Research among this generation shows that 80% of the

employees are expecting to receive feedback from their line manager. They want and expect constant feedback from their supervisors, which may be a result of the most common parenting style in their childhood (Glass, 2007). Gen Y employees prefer collective actions and tasks. They feel good when they work for companies which have a collective decision-making policy.

Apart from the previous generations, Gen Y often gets in conflict with the authoritative figures at workplace. They don't like orders and don't feel comfortable in strong hierarchy structure. The manager's support is motivating to them. The reason for that is they have grown up in a family environment, which is very supportive. Because of that these are the requirements they have for managerial personnel at work. It is important to note that they don't seek support from people who are on the same hierarchy level as them. They have different requirements to them – to be able to have fun, while working together and to be able to create favorable environment at workplace (Berkup, 2014).

Gen Z representatives, often called “iGeneration” (Tari, 2010) are the youngest working generation. Sometimes they are named “the children of internet” (Levickaite, 2010). There are different years, considered the beginning of this generation. In this research it is used the diapason people born between 1996 – 2012 (Bassiouni, 2014).

According to a study, made by PAW Research Center, attitudes towards social issues do not diverge dramatically from those of Gen Y. However, the attitudes of Gen Z and Gen Y altogether dramatically diverge from those of previous generations. In the same research it is found that they are supporting ethnical diversity and think that this is beneficial for society. Previous generations have more conservative point of view about this topic.

At workplace, the social environment is of major importance for Gen Z. This places organizational culture in one of the top factors, which can influence their attitudes towards work. It is observed that there is the common trait for all young employees, including Gen Y: they are feeling comfortable, when apart from the hierarchy, they are free to interact with all employees (open door policy). For their motivation is crucial to work in flat structures as this gives them the opportunity to have non-formal relationships with their supervisors and managers. They are self-conscious. They know that by working they can achieve their personal goals and that makes them happy. For them happiness matters a lot. In case they can't find it in the organization, they are willing to leave. This generation is individualistic and doesn't like the authorities at workplace (A Study Applied to University Students, 2015).

Workplace Intelligence conducts a survey and finds the similarities and differences between Gen Y and Gen Z representatives (Gen Y and Gen Z Global Workplace Expectations Study, 2020). There are interesting insights into their attitudes. The majority of those surveyed Gen Y and Z prefer to use technology in their work (Y-81%, Z-77%). This trend is becoming more prominent in the contemporary world. As both generations are grown up in technological environments, they understand the advantages of using cutting edge technology. For them technology is part of their life, and they expect using them not only in their private, but also in their professional life.

Gen Y and Z representatives prefer working on projects and do not like routine activities (Y-81%, Z-76%). This format of working allows flexibility, provokes making decisions and variety. This preference shows in general how the work itself and the tasks should be designed for Gen Y and Z.

In Workplace Intelligence research are analyzed the attitudes towards the manager and the supervisors. The surveyed representatives from both cohorts preferred democratic leadership style, which is characterized by participation of subordinate employees in the decision-making process (Y-56%, Z-61%), to work independently (Y-58, Z-46), as this is more valued by Gen Y.

At workplace for both generations the work collective is important, but only when this considers the work-related tasks. Both Gen Y and Gen Z value when their colleagues are involved in the process (Y-69%, Z-65%). Placed in such environments, they feel more motivated and more satisfied.

Generation Z representatives have common traits with Generation Y but are more sensitive to the environment. Indisputably technology is changing the world to a big extent. This creates a new environment that requires adaptation. This on the other hand implies different expectations for society: it changes values, attitudes and the worldview. Previous generations gave a lot – prosperity, security and growth. Gen Y and Z together are different from the previous generations in terms of values. They are more tolerant, self-centered and impatient. Their core is the same as they have common values. The difference is that Gen Z is more – more tolerant, more impatient, more demanding etc. than Gen Y.

2.2 Measuring organizational commitment

In this paper it is hypothesized that one of the most important factors for higher levels of organizational commitment during times of uncertainty is the external environment. In relation to this in the empirical part of the research, a tool that measures the organizational commitment is used – Allen and Mayer's Organizational commitment questionnaire (OCQ) (Allen, 1990). This questionnaire is used often in such types of analysis, and it allows to forecast the staff turnover, the behavior and the absenteeism of employees (Meyer, 2002). It is consisted of 24 questions, each of which describes different type of organizational commitment – Affective commitment (ASC), Continuance commitment (CCS) and Normative commitment (NCS). There is a short version of the questionnaire, that has 18 items – 6 for each type (Meyer J. a., 1997).

In the organizational commitment measuring tool there are questions with positive and negative logical links. When analyzing which is the dominant organizational commitment subtype, this logical link is taken into consideration.

Testing procedure (Weiss, 1967): The form is administered independently. There is no time limit for filling in the questionnaire, however respondents are encouraged to answer fast. Average time for filling the test is 15-20 minutes for the long form and 5-10 minutes for the short form. It is important to build a rapport between the respondents and the examiner. The answers to the questions are on Likert scale – from 1 – 5. The total value of the subscale is calculated by summing the weights of each answer.

The OCQ tool has been chosen because it has proven itself to be reliable. This tool is widely used as it is not culturally sensitive. This means that it can be administered easily in different populations. This is important for this research as the chosen sample is Gen Z employees that work in the fast fashion retailers in Bulgaria.

3. Research methods

3.1. Sample size

To measure the general population, information from the corporate websites of fast fashion companies, that operate in the Bulgarian market, is used. As a result, it is found out that the general population is 23 814 people.

To avoid the risk of irrelevant statistical information, in this research it is chosen method of sample size, which is personalized for the specific project. As a result, it is chosen such sample, that can secure the right functioning of statistical analysis methods. This increases the accuracy of the research and trust in the results. In this research two types of analysis are used:

ANOVA: effect size $f = 0.25$ (average), statistical error $\alpha = 0.05$, power $1 - \beta = 0.95$, analyzed groups – 2 – requires 210 respondents;

t-test: average power of effect $d = 0.5$, statistical error $\alpha = 0.05$, power $1 - \beta = 0.95$ and relevantly equal ratio between the two subgroups. The volume of the sample should be 210 respondents.

To proof the hypothesis a testing of three samples is made – 292, 282 and 276 respondents. The number of respondents in the three samples is more than the minimal requirement. As a result, the sample size satisfies the needs for the research methods and the approbation of the hypothesis.

3.2 Survey administration

In this paper it is hypothesized that one of the most important factors for higher levels of organizational commitment during times of uncertainty is the external environment. External environment can't be controlled by organizations, but it can be examined and monitored as this will be beneficial to predicting employee's behaviour and make efficient management decisions in terms of investing in motivation programs during times of uncertainty and resource scarcity.

This research starts in the moment before COVID-19 crisis in Bulgaria and continues after it.



Fig. 1. Schematic representation of the hypothesis

In order to prove the hypothesis, it is conducted triple research of the same target groups of people – Gen Z and Gen Y representatives, employed in the Fast Fashion retail companies in Bulgaria. The time periods in which the survey is made, are right before COVID-19 crisis, during lockdown and after the easing of the safety epidemiology measures (right after lockdown, when the population is not in alert). The aim of this triple measure is to track how organizational commitment is being changed during times of global uncertainty. In Fig. 2 is shown the graphical representation of the hypothesis and the questions.

To analyze the hypothesis of the research, the OCQ tool is used, together with demographic data in one questionnaire. Those questions encompass the demographic parameters which are needed to identify to which generation the surveyed employee belongs to and the three scales for organizational commitment. To proof the hypothesis, all questions from OCQ tool are used – Affective commitment (1, 2, 3, 4, 5, 6), Continuance commitment (7, 8, 9, 10, 11, 12) and Normative commitment (13, 14, 15, 16, 17, 18).

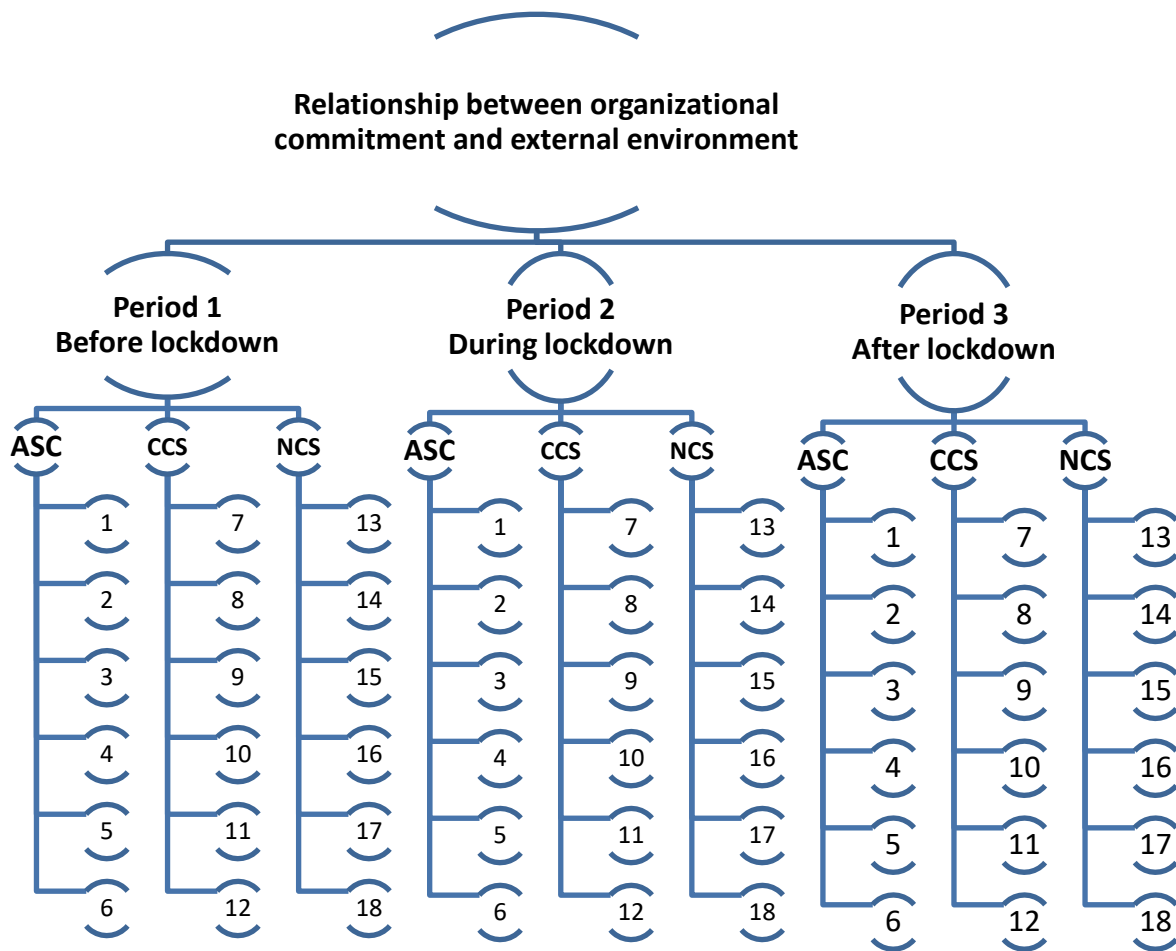


Fig. 2. Schematic representation of the link between organizational commitment and external environment – before, during and after times of global uncertainty

The hypothesis tests the influence of the external environment over organizational commitment. It shows that there are external factors that influence the attitudes and the behaviour of the personnel. It shows that there are factors that are out of organizational control, which gives additional perspective to the management of organizational commitment of Gen Z and Gen Y representatives, employed in the Fast Fashion retail companies in Bulgaria. With this hypothesis the author wants to provide additional point of view and avoid organizational myopia.

To collect enough information the researcher process requires triple sampling of the organizational commitment levels of Gen Z and Gen Y representatives, employed in the Fast Fashion retail companies in Bulgaria. The first sampling is before COVID-19, the second one – during lockdown and the third one – after lockdown.

To analyze the dynamics of the organizational commitment is made ANOVA analysis for each sample, measuring the three types of organizational commitment – ASC, CCS and NCS. The ANOVA analysis helps to identify if there is statistically significant differences in the averages in the levels of each type of organizational commitment for Gen Z and Gen Y representatives, employed in the Fast Fashion retail companies in Bulgaria for the three periods.

Table 1

ANOVA test for ASC, CCS and NCS level analysis for Gen Z representatives, employed in the Fast Fashion retail companies in Bulgaria, triple sample (Before COVID-19, During Lockdown and after Lockdown)

ANOVA Generation Z								
		<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>	η	Imp.
<i>Affective</i>	<i>Between Groups</i>	190,95	2	95,47	4,94	0,008	0,16	< Tip.
	<i>Within Groups</i>	7071,7	366	19,32				
	<i>Total</i>	7262,6	368					
<i>Comotative</i>	<i>Between Groups</i>	1100	2	550	14,71	0	0,27	Tip.
	<i>Within Groups</i>	13688	366	37,4				
	<i>Total</i>	14788	368					
<i>Normative</i>	<i>Between Groups</i>	221,33	2	110,66	2,89	0,057	0,13	< Tip.
	<i>Within Groups</i>	14013	366	38,29				
	<i>Total</i>	14234	368					

Source: Authors' Compilation, 2025

Table 2

ANOVA test for ASC, CCS and NCS level analysis for Gen Y representatives, employed in the Fast Fashion retail companies in Bulgaria, triple sample (Before COVID-19, During Lockdown and after Lockdown)

ANOVA Generation Y								
		<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>	η	Imp.
<i>Affective</i>	<i>Between Groups</i>	446,55	2	223,27	7,82	0	0,19	< Tip.
	<i>Within Groups</i>	13644	478	28,54				
	<i>Total</i>	14090	480					
<i>Comotative</i>	<i>Between Groups</i>	1498	2	748,99	16,33	0	0,25	Tip.
	<i>Within Groups</i>	21922	478	45,86				
	<i>Total</i>	23420	480					
<i>Normative</i>	<i>Between Groups</i>	2597,3	2	1298,7	29,98	0	0,33	Tip.
	<i>Within Groups</i>	20706	478	43,32				
	<i>Total</i>	23303	480					

Source: Authors' Compilation, 2025

In Table 1 and 2 are represented the results of the conducted ANOVA analysis for the level of organizational commitment of Gen Z and Gen Y representatives, employed in the Fast Fashion retail companies in Bulgaria for three periods - before COVID-19, during the lockdown crisis and after the lockdown alert. The data shows that Gen Z have statistically significant average level differences in the values for the

three periods about the affective commitment, (ACS) and Continuance commitment (CCS), where the scale of the effect is typical only about CCS (ASC: $p = 0.008$, $\eta = 0.16$; CCS: $p = 0.000$, $\eta = 0.27$).

The data shows that Gen Z sample shows statistically significant differences in the average levels of the three periods.

There is differences in the values for the organizational commitment levels and for Gen Y representatives. In this sample there is statistically significant differences in the average levels of affective commitment (ASC), continuance commitment (CCS) and normative commitment (NCS). From them with typical significant level are CCS ($p = 0.000$, $\eta = 0.25$) and NCS ($p = 0.000$, $\eta = 0.33$).

Table 3

Average levels of ASC, CCS и NCS before COVID-19, during lockdown and after lockdown of Gen Z representatives, employed in Fast Fashion retail companies in Bulgaria – triplicate study

Report Mean Generation Z				
	Sample	Mean	N	Std. Deviation
Affective	Before	21,1	147	4,7
	During	19,22	72	5,13
	After	20,96	150	3,64
Comotative	Before	15,8	147	5,84
	During	20,56	72	6,66
	After	17,12	150	6,11
Normative	Before	17,82	147	6,09
	During	19,72	72	6,57
	After	19,16	150	6,1

Source: Authors' Compilation, 2025.

Table 4

Average levels of ASC, CCS и NCS before COVID-19, during lockdown and after lockdown of Gen Z representatives, employed in Fast Fashion retail companies in Bulgaria - triplicate study

Report Mean Generation Y				
	Sample	Mean	N	Std. Deviation
Affective	Before	20,01	135	5,46
	During	21,76	220	4,86
	After	19,67	126	5,98
Comotative	Before	17,64	135	7,29
	During	21,71	220	6,5
	After	19,05	126	6,66
Normative	Before	16,67	135	6,7
	During	20,67	220	6,37
	After	15,48	126	6,81

Source: Authors' Compilation, 2025.

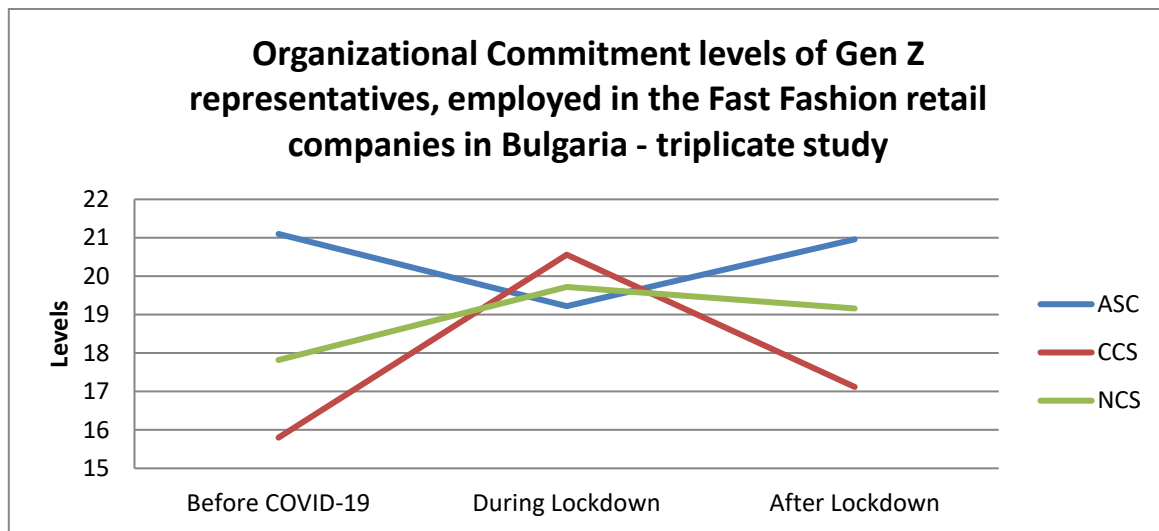


Fig. 3. Organizational Commitment levels of Gen Z representatives, employed in the Fast Fashion retail companies in Bulgaria - triplicate study

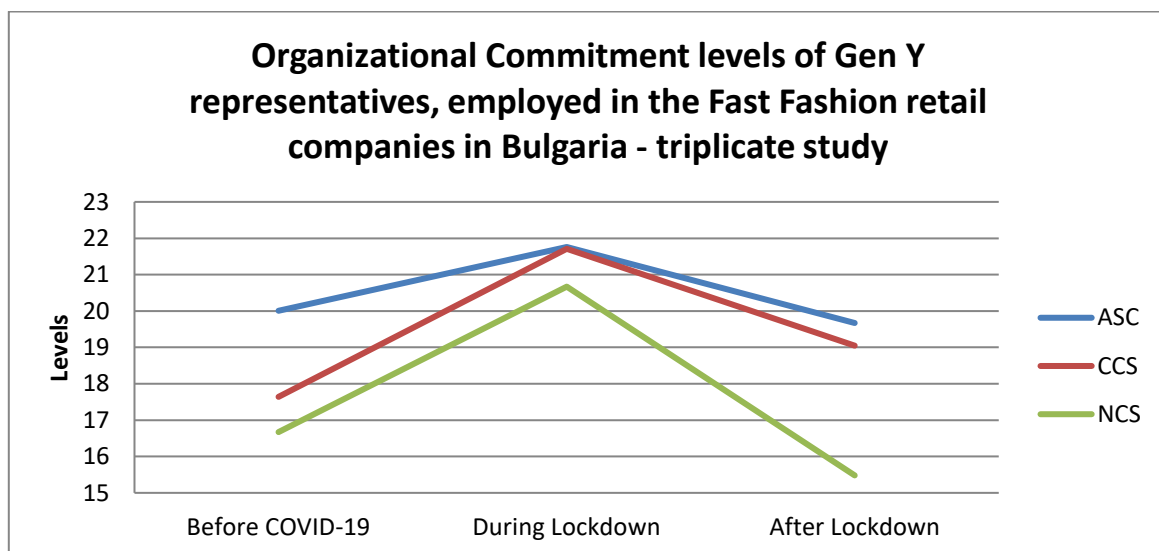


Fig. 4. Organizational Commitment levels of Gen Y representatives, employed in the Fast Fashion retail companies in Bulgaria - triplicate study

In Table 3 and 4 and on Fig. 2 and 3 is presented the information about the average levels of the three components of organizational commitment – ASC, CCS and NCS, before COVID-19, during lockdown and after lockdown about Gen Z and Gen Y representatives, employed in the Fast Fashion retail companies in Bulgaria. The ANOVA analysis shows that there are statistically significant differences in the levels of the organizational commitment components CCS (for both Gen Z and Gen Y) and NCS (only for Gen Y).

The continuance commitment has lower levels during times of stability and higher values during times of global uncertainty for both Gen Z and Gen Y (CCS Z: $\bar{x}_{\text{before}} = 15.8$, $\bar{x}_{\text{during}} = 20.56$, $\bar{x}_{\text{after}} = 17.12$; Y: $\bar{x}_{\text{before}} = 17.64$, $\bar{x}_{\text{during}} = 21.71$, $\bar{x}_{\text{after}} = 19.05$). About then Y the tendency is similar to this one, about the normative commitment (NCS: $\bar{x}_{\text{before}} = 16.67$, $\bar{x}_{\text{during}} = 20.67$, $\bar{x}_{\text{after}} = 15.48$). Based on this research we can conclude there are factors from the external environment, during times of global uncertainty, that affect the continuance commitment of both generations and normative commitment, only for Gen Y.

Continuance commitment has lower levels during times of stability and higher levels when there are times of global uncertainty. The external environment affects the levels of organizational commitment of Gen Z and Gen Y, employed in Fast Fashion retail companies in Bulgaria, during times of global uncertainty. With this hypothesis it is proved that the management of organizations needs to consider the external environmental factors during times of global uncertainty when planning the strategic human resources decisions.

This shows that organizational commitment is multi factor phenomena. In the context of Allen and Mayer's theory it is divided into three subtypes – affective (ASC), continuance (CCS) and normative (NCS). The Fast Fashion retail companies in Bulgaria can influence only the affective (ACS) and Normative (NCS). Those two types of commitment can be influenced by increasing the levels of job satisfaction. The third component – the continuance commitment (CCS) is outside organization's reach and can only be taken in consideration when there are times of global uncertainty.

4. Conclusion

The levels of one type of organizational commitment – the continuance commitment, is influenced by the external environment. That means there are external to the organization factors, that need to be taken in consideration, when analysing and predicting both human resources strategies in terms of retention, and predicting employee behaviour. In order to collect data for proving the hypothesis, triple testing of the organizational commitment levels of Gen Z and Gen Y employees, working in Fast Fashion retail companies in Bulgaria is made – before COVID-19 crisis, during lockdown and after the lockdown.

In order to observe the dynamics of the organizational commitment, ANOVA analysis has been performed for each sample, measuring affective (ASC), continuance (CCS) and normative (NCS) commitment. This allows us to test if there is statistically significant difference between average levels of organizational commitment subtypes for Gen Z and Gen Y representatives during the three periods.

Results show that Gen Z have statistically significant differences in the average levels of affective (ASC) and normative (CCS) commitment, with typical volume of effect only for CCS (ASC: $p = 0.008$, $\eta = 0.16$; CCS: $p = 0.000$, $\eta = 0.27$).

There are differences in the levels of organizational commitment and for Gen Y representatives. There are statistically significant differences in the average levels of organizational commitment subtypes – affective (ASC), continuance (CCS) and normative (NCS), however typical importance level is shown only for CCS ($p = 0.000$, $\eta = 0.25$) and NCS ($p = 0.000$, $\eta = 0.33$).

5. Limitations

This research has some basic limitations. It is focused particularly on Gen Z representatives, as the results for Gen Y are used as a base for comparison. It is important to take in consideration the research is made within the Bulgarian specific cultural environment.

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Quantitative Appraisal of Employee Performance through an Output-Oriented DEA Model

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JEL: J21, C53

Abstract

Employee appraisal can be defined as a procedure for identifying the degree of compliance of their personal qualities, the quantitative and qualitative results of their activities, i.e. their work performance, with certain requirements. It aims to answer two main questions - to what extent the employee performs the assigned work, function or position and what is the degree of compliance between the professional abilities of the employee and the requirements of the job. An objective answer to the first question can be provided by approaches for quantitative performance assessment, such as Data Envelopment Analysis (DEA). Therefore, this report examines the possibilities of the so-called output-oriented DEA model for analyzing the comparative effectiveness of employees in the organization. The presented theoretical statements are demonstrated with a real-data numerical example.

Key words:

Quantitative methods, Human resources, Data Envelopment Analysis, Appraisal.

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1. Introduction

Specialists in the field of human resource management define employee performance appraisal as a procedure for identifying the degree of compliance of their personal qualities, quantitative and qualitative results of this activity, i.e. their work performance, with certain requirements (Kalchev & Atanasova, 2014; Shopov & Atanasova, 2009; Fedotova, Tikhonov & Novikov, 2017; Romanadze & Semina, 2019). Its main goal is to answer two groups of questions:

- to what extent the employee performs the assigned job, function or position;
- what is the degree of compliance between the employee's professional abilities and the requirements of the job (position).

Human resource performance appraisal systems use three categories of indicators:

- quantitative;
- qualitative;
- individual characteristics,

which are represented to varying degrees in different approaches. For this reason, good modern practices recommend the use of human resources appraisal systems that integrate quantitative, qualitative and individual indicators. The choice of specific assessment criteria depends on the categories of employees being assessed and how the assessment results will be used. In any case, they must comply with several basic principles (Shopov & Atanasova, 2009; Magura & Kurbatova, 2005):

- to reflect the most important specific features and requirements of the workplace or position;
- to characterize the employee's achievements;
- to ensure objectivity;
- to include a balanced number of indicators;
- to exclude the possibility of overlapping of the indicators;

- to be universal within the relevant job, function or position.

The theoretical overview of the existing appraisal methods naturally inculcates several basic conclusions:

- The presence of numerous and diverse appraisal methods as a technique of implementation provides, on the one hand, rich opportunities, but on the other hand, makes it difficult for managers to choose the most appropriate one.
- Most of the methods provide a one-sided assessment of the human resources – they assess either their work performance only or their personal qualities, knowledge, skills, competence and their compliance with the requirements of the job position only. This fact limits the possibility of achieving all the goals of the assessment.
- In the methods considered, the quantitative element is relatively poorly represented and it is usually reduced to awarding points and their summation or averaging. This fact increases the possibility of subjectivity in the assessment and dissatisfaction of the assessee with the points assigned or the final grade.
- Due to their specific features and implementation techniques, different methods are suitable for different categories of workers and employees.

Appraisal through quantitative indicators is the most understandable, most objective and perhaps the most direct approach, in which workers and employees are evaluated based on the results achieved (volume of work performed, volume of sales in physical or value terms, etc.). At the same time, the desire to express everything in numbers carries some risks:

- loss of insight into "immeasurable" human qualities, such as motivation, initiative, responsibility, creativity, etc.;
- not to take into account the influence of the factors which affect the result of the work activity.

All this necessitates in many cases the adoption of compromise options or the combination of several methods in order to obtain a complex appraisal, which inevitably complicates the entire procedure. A similar opinion is supported by a number of authors (Zbranek, 2013; Dugelova & Strenitzerova, 2015; Shirouyehzad et al., 2012; Ruiz & Pastor, 2013; Silantyeva & Semina, 2018; Semina & Tikhonov, 2018), who point out the shortcomings of traditional systems for assessing employee performance and highlight the need for new systems that would improve the evaluation process and serve as an advisor to human resource managers. One such opportunity is provided by the method known in the scientific literature as Data Envelopment Analysis (DEA). Although it can be classified as a purely quantitative assessment method, it overcomes some of their main shortcomings by allowing for a certain degree of consideration of both qualitative and individual characteristics in the performance of the assessee.

2. Literature Review

DEA can be successfully employed for assessment across various sectors, including healthcare, education, banking, manufacturing, service provision, police and armed forces, judicial systems, sports, and others.

The initial research in this direction has been primarily focused on the sports domain, where the values of variables involved in assessing athletes (individually or as teams) - such as age, experience, number of matches played or minutes, number of victories won, trophies, goals scored, points, and assists - can be readily measured. Thus, the method has found application in baseball (Anderson & Sharp, 1997; Kim & Cho, 2004; Sueyoshi, Ohnishi & Kinase, 1999; Mazur, 2004), basketball (Cooper, Ruiz & Sirvent, 2009; Bai & Lam, 2009), football (Hirotsu et al., 2012; Kim & Bao, 2006), and tennis (Ruiz & Pastor, 2013).

However, the model is also applicable in cases where the variables involved in the evaluation lack direct quantitative measures, such as motivational factors, working conditions, organizational commitment, and

others. For their quantitative characterization, methods such as expert assessment or the survey approach can be applied (Dragozova & Besarska, 2019).

In this regard, in recent years, efforts have been directed towards the application of DEA in human resource management in the field of manufacturing and services. Studies have been conducted on the appraisal of employees in an intensive care unit (Osman, 2010), a pipe manufacturing company (Shirouyehzad et al., 2010), a company in the motor vehicle sector (Manoharan, Muralidharan & Deshmukh, 2009); IT companies in Slovakia (Dugelova & Strenitzerova, 2015), a distribution company (Lotfi & Shirouyehzad, 2010), and airports in Taiwan (Yu, Chern & Hsiao, 2012). An in-depth study on the application of DEA in human resource appraisal was conducted by Zbranek (2013) in a bakery company. The model used as input variables salary (as stated in the employee questionnaire), working conditions (equipment, occupational safety, workplace temperature, work organization and working hours), rated on a 10-point scale, and benefits. The output variables were work motivation, job satisfaction, and organizational commitment, rated on a 6-point scale ranging from "strongly disagree" to "strongly agree", based on a questionnaire comprising 25 questions. The model identified 12 out of 60 employees as fully efficient, while for the remaining 48, the author recommended that managers implement measures to improve performance through training and qualification plans.

3. Material and Methods

3.1. Theoretical Framework

Data Envelopment Analysis was developed by Charnes, Cooper, and Rhodes (1978) and was originally applied to non-profit organizations and public sector institutions. Its fundamental objective is to identify efficient units—those that generate the maximum output value using the minimum quantity of input resources (Lotfi & Shirouyehzad, 2010).

The fundamental concepts in DEA are:

- Decision-Making Unit (DMU) – the method evaluates the efficiency of a group of performers, termed "Decision Making Units" (DMUs) in DEA. These performers engage in activities that are homogeneous in nature. DMUs may encompass individual workers or employees, as well as teams, departments, branches, divisions, or entire organizations.
- Inputs – the resources that DMUs allocate to their activities, including experience, qualifications, salary level, among others.
- Outputs – the outcomes of the DMUs' activities, such as production volume, number of hours worked within a specified period, and others.
- Efficiency – the central concept of the model, grounded in the principle of Pareto optimality. In synthesized form:

1) A performer's performance is deemed efficient if and only if no input or output can be improved without worsening another input or output.

2) A performer's performance is deemed inefficient when the values of certain inputs or outputs can be improved without adversely affecting the remaining ones.

DEA compares each performer only with the "best" performers, identifying both efficient and inefficient units whose performance can be improved.

The fundamental assumption in DEA is that if a given DMU A is capable of producing Y_A units of output using X_A units of input resources, then other DMUs should also be capable of doing so, provided they are efficient.

- Virtual DMU – the actual performers, that are subject to appraisal, can be combined with certain weights to form a new composite performer, whose inputs and outputs are combinations of the inputs

and outputs of the existing performers. Since this composite DMU does not always exist in reality, it is typically referred to as "virtual". The essence of DEA is to find the "best" virtual DMU for each real one. If the virtual DMU is better than the real one (dominates it) – either by obtaining larger values of the outputs with the same values of the inputs, or by obtaining the same output with smaller values of the inputs, then the real DMU is inefficient.

- Efficient set (efficient frontier) - the set of all real DMUs that are not dominated by any of their virtual variants forms the efficient set (frontier) of DMUs. At the same time, the values associated with the "best" virtual performer for each inefficient actual performer provide target input (output) values toward which the inefficient performer should aspire in order to attain efficiency.

Figures 1, 2, and 3 provide graphical representations of the efficient frontiers and the efficient DMUs situated thereon for the cases of one input and one output, two inputs and one output (input-oriented model), and one input and two outputs (output-oriented model), respectively.

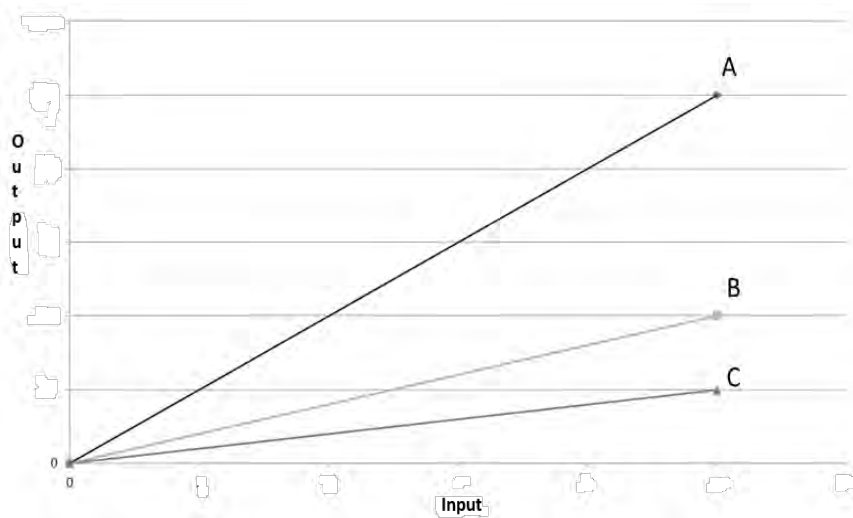


Fig. 1. Efficient frontier in the case of one input and one output

Source: Author, 2025.

In Figure 1, the only efficient DMU is A, for whom the Output/Input ratio has the largest value (the line has the largest slope). Performers B and C are inefficient compared to A and are dominated by it, since they produce a smaller value of output with the available input.

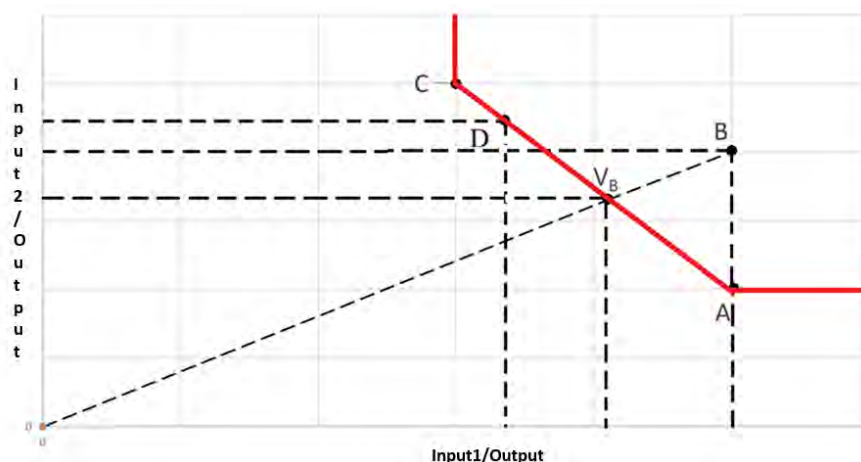


Fig. 2. Efficient frontier in the case of two inputs and one output (input-oriented model)

Source: Author, 2025.

In Figure 2, DMUs A, C, and D are efficient and form the efficient frontier—the southwest piecewise linear boundary. The inefficient performer B lies above this frontier and is dominated by a linear combination of A, C, and D. Its reference virtual DMU is denoted by V_B .

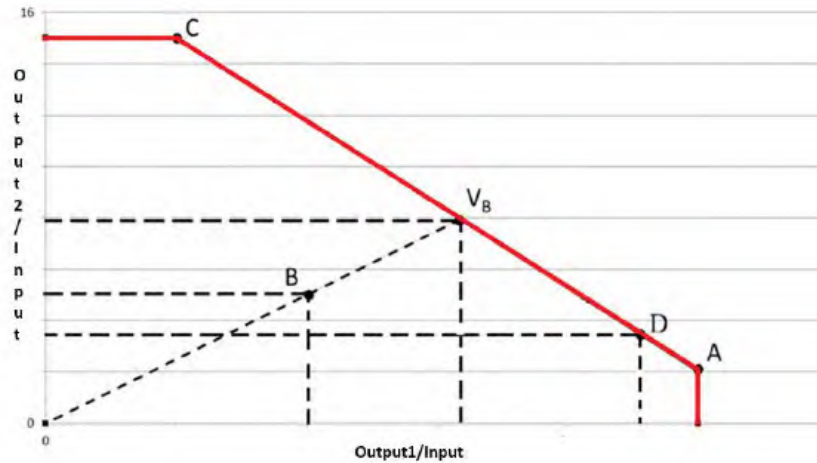


Fig. 3. Efficient frontier in the case of one input and two outputs (output-oriented model)

Source: Author, 2025.

In Figure 3, DMUs A, C, and D are efficient again and form the efficient frontier—the northeast piecewise linear boundary. The inefficient performer B lies below this frontier and is dominated by a linear combination of A, C, and D. Its reference virtual DMU is denoted as V_B .

3.2. Linear form of DEA

In essence, DEA is an optimization mathematical model, the necessary data for which are presented in table 1.

Table 1

Necessary data for DEA

DMU	Input 1	Input 2	...	Input m	Output 1	Output 2	...	Output n
1	a_1^1	a_2^1	...	a_m^1	b_1^1	b_2^1	...	b_n^1
2	a_1^2	a_2^2	...	a_m^2	b_1^2	b_2^2	...	b_n^2
...	...	...	...	...	...	...	...	...
p	a_1^p	a_2^p	...	a_m^p	b_1^p	b_2^p	...	b_n^p

Source: Petkov, Y., (2025).

The most widely used forms of DEA include the linear input-oriented model (1)-(4) and the output-oriented model (5)-(8) (Cooper, Seiford & Tone, 2006).

Input-oriented linear form of DEA:

$$\min: Z = k \quad (1)$$

subject to the constraints:

$$a_i^1 x_1 + a_i^2 x_2 + \dots + a_i^p x_p \leq k a_i^0, i = 1, 2, \dots, m; \quad (2)$$

$$b_j^1 x_1 + b_j^2 x_2 + \dots + b_j^p x_p \geq b_j^0, j = 1, 2, \dots, n; \quad (3)$$

$$x_1 \geq 0, x_2 \geq 0, \dots, x_p, k \geq 0, \quad (4)$$

where x_l is the weight assigned to performer l ($l=1,2,\dots,p$) in the attempt to dominate the performer under assessment and k is the efficiency score.

Output-oriented linear form of DEA:

$$\max: Z = \varphi \quad e \quad (5)$$

subject to the constraints:

$$a_i^1 x_1 + a_i^2 x_2 + \dots + a_i^p x_p \leq a_i^0, i = 1, 2, \dots, m; \quad (6)$$

$$b_j^1 x_1 + b_j^2 x_2 + \dots + b_j^p x_p \geq \varphi b_j^0, j = 1, 2, \dots, n; \quad (7)$$

$$x_1 \geq 0, x_2 \geq 0, \dots, x_p, \varphi \geq 0, \quad (8)$$

where x_l is the weight assigned to performer l ($l=1,2,\dots,p$) in the attempt to dominate the performer under assessment and φ indicates its efficiency level.

There is a direct relationship between the two model forms, with the coefficient $k=1/\varphi$.

In the present study, we will apply model (5) - (8). Its optimal solution provides information about:

- the relative efficiency or inefficiency of the evaluated performer. If the optimal value of φ equals 1, then the performer is efficient; if $\varphi > 1$, then the performer is inefficient;
- the performers that serve as comparators (forming the dominating virtual performer) - those whose weights x_l are different from zero;
- target outputs ($\sum_{l=1}^p x_l b_j^l, j=1,2,\dots,n$) and the magnitude of the required improvement (the difference between $\sum_{l=1}^p x_l b_j^l$ and $b_j^0, j=1,2,\dots,n$);
- or alternatively, if the output values remain constant, the target inputs ($\frac{1}{\varphi} \sum_{l=1}^p a_i^l, i=1,2,\dots,m$).

4. Results

As an application of the output-oriented DEA model (5)–(8) presented above, we assess the efficiency of the monthly performance of four employees - software developers in a banking software development company. To preserve the confidentiality of personal information, we refer to them as employees A, B, C, and D.

As input variables, we consider their average experience in years and actual hours worked during the month. Three output variables are incorporated in the evaluation: the number of completed functionalities, the number of bugs per 1000 lines of code, and execution duration relative to the planned schedule (sprint). The values of the inputs and outputs are presented in Table 2.

Table 2**Input and output values for the model**

Employee	Experience in years (Input 1)	Hours worked (Input 2)	Number of completed functionalities (Output 1)	Number of bugs per 1000 lines of code (Output 2)	Sprint (%) (Output 3)
A	4	160	12	2	95
B	5	152	9	4	100
C	6	155	11	1	90
D	4	146	7	5	120

Source: Author's survey, 2025.

Given that outputs 2 and 3 exhibit negative characteristics and the objective is their minimization, the proper functioning of the model requires their transformation into positively-oriented variables. This transformation may be achieved by converting the indicator "number of bugs per 1000 lines of code" into an indicator such as "quality index" via the formula:

$$\text{Quality index} = \frac{1}{1 + \text{Number of bugs per 1000 lines of code}}, \quad (9)$$

while the indicator "execution duration relative to the planned schedule (%)" is transformed into an indicator "schedule adherence index" via the formula:

$$\text{Schedule adherence index} = \frac{100}{\text{Execution duration relative to the planned schedule (\%)}}. \quad (10)$$

The transformed data for the model are presented in Table 3.

Table 3**Input and transformed output values for the model**

Employee	Experience in years (Input 1)	Hours worked (Input 2)	Number of completed functionalities (Output 1)	Quality index (Output 2)	Schedule adherence index (Output 3)
A	4	160	12	0,33	1,05
B	5	152	9	0,20	1,00
C	6	155	11	0,50	1,11
D	4	146	7	0,17	0,83

Source: Author's calculations, 2025.

The inverse transformations are also valid:

$$\text{Number of bugs per 1000 lines of code} = \frac{1}{\text{Quality index}} - 1; \quad (11)$$

$$\text{Execution duration relative to the planned schedule (\%)} = \frac{100}{\text{Schedule adherence index}}. \quad (12)$$

Based on the data in Table 3, the output-oriented DEA models for assessing the performance of the four

employees take the following form:

For employee A:

$$\max: Z = \varphi$$

subject to the constraints:

$$4x_1 + 5x_2 + 6x_3 + 4x_4 \leq 4;$$

$$160x_1 + 152x_2 + 155x_3 + 146x_4 \leq 160;$$

$$12x_1 + 9x_2 + 11x_3 + 7x_4 \geq 12\varphi;$$

$$0,33x_1 + 0,20x_2 + 0,50x_3 + 0,17x_4 \geq 0,33\varphi;$$

$$1,05x_1 + x_2 + 1,11x_3 + 0,83x_4 \geq 1,05\varphi;$$

$$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0, x_4 \geq 0, \varphi \geq 0.$$

For employee B:

$$\max: Z = \varphi$$

subject to the constraints:

$$4x_1 + 5x_2 + 6x_3 + 4x_4 \leq 5;$$

$$160x_1 + 152x_2 + 155x_3 + 146x_4 \leq 152;$$

$$12x_1 + 9x_2 + 11x_3 + 7x_4 \geq 9\varphi;$$

$$0,33x_1 + 0,20x_2 + 0,50x_3 + 0,17x_4 \geq 0,20\varphi;$$

$$1,05x_1 + x_2 + 1,11x_3 + 0,83x_4 \geq \varphi;$$

$$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0, x_4 \geq 0, \varphi \geq 0.$$

For employee C:

$$\max: Z = \varphi$$

subject to the constraints:

$$4x_1 + 5x_2 + 6x_3 + 4x_4 \leq 6;$$

$$160x_1 + 152x_2 + 155x_3 + 146x_4 \leq 155;$$

$$12x_1 + 9x_2 + 11x_3 + 7x_4 \geq 11\varphi;$$

$$0,33x_1 + 0,20x_2 + 0,50x_3 + 0,17x_4 \geq 0,50\varphi;$$

$$1,05x_1 + x_2 + 1,11x_3 + 0,83x_4 \geq 1,11\varphi;$$

$$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0, x_4 \geq 0, \varphi \geq 0.$$

For employee D:

$$\max: Z = \varphi$$

subject to the constraints:

$$4x_1 + 5x_2 + 6x_3 + 4x_4 \leq 4;$$

$$160x_1 + 152x_2 + 155x_3 + 146x_4 \leq 146;$$

$$\begin{aligned}
12x_1 + 9x_2 + 11x_3 + 7x_4 &\geq 7\varphi; \\
0,33x_1 + 0,20x_2 + 0,50x_3 + 0,17x_4 &\geq 0,17\varphi; \\
1,05x_1 + x_2 + 1,11x_3 + 0,83x_4 &\geq 0,83\varphi; \\
x_1 \geq 0, x_2 \geq 0, x_3 \geq 0, x_4 \geq 0, \varphi &\geq 0.
\end{aligned}$$

Their optimal solutions, obtained using appropriate software for solving linear programming models (Microsoft Excel), are presented in Table 4.

Table 4

Optimal solutions to the models

Employee	x_1	x_2	x_3	x_4	φ	$k=1/\varphi$	Appraisal result
A	1	0	0	0	1	1	efficient
B	0,40	0	0,56	0	1,05	0,95	inefficient
C	0	0	1	0	1	1	efficient
D	0,75	0	0,16	0	1,17	0,85	inefficient

Source: Author's calculations, 2025.

According to the solutions employees A and C are efficient, as the optimal value of their coefficient $\varphi = 1$, and consequently their efficiency coefficient $k = 1/\varphi = 1$. Conversely, employees B and D are inefficient, since the optimal value of their coefficient $\varphi > 1$, and accordingly their efficiency coefficient $k = 1/\varphi < 1$. A significant strength of the DEA method lies not only in obtaining an efficiency - inefficiency assessment, but also in its capacity to derive performance improvement recommendations based on the computed optimal values. This capability will be analyzed in greater detail for employees B and D.

For inefficient employee B, the coefficient $\varphi = 1,05$, which generally indicates that this employee must improve performance by at least 1,05 times to avoid being classified as inefficient - with a target value for output 1: $1,05 \cdot 9 = 9,5$ completed functionalities per month; target value for output 2: $1,05 \cdot 0,20 = 0,21$ quality index; target value for output 3: $1,05 \cdot 1 = 1,05$ schedule adherence index. Applying the inverse transformations according to formulas (11) and (12), the target values for the original outputs 2 and 3 are obtained as follows: Number of bugs per 1000 lines of code = $\frac{1}{0,21} - 1 = 3,76$ per month, and Execution duration = $\frac{100}{1,05} = 95,2\%$. Simultaneously, the optimal non-zero values of the variables $x_1=0,40$ and $x_3=0,56$ provide the weights with which the actual performers A and C are combined to form the reference virtual DMU V_B . This virtual DMU has output values of: $0,40 \cdot 12 + 0,56 \cdot 11 = 11$ completed functionalities per month; $0,40 \cdot 12 + 0,56 \cdot 11 = 11$ quality index, or $\frac{1}{0,41} - 1 = 1,44$ bugs per 1000 lines of code; $0,40 \cdot 1,05 + 0,56 \cdot 1,11 = 1,04$ schedule adherence index, or $\frac{100}{1,04} = 96,2\%$ execution duration.

For inefficient employee D, the coefficient $\varphi = 1,17$, which generally indicates that this employee must improve performance by at least 1,17 times to avoid being classified as inefficient - with a target value for output 1: $1,17 \cdot 7 = 8,19$ completed functionalities per month; target value for output 2: $1,17 \cdot 0,17 = 0,2$ quality index; target value for output 3: $1,17 \cdot 0,83 = 0,97$ schedule adherence index. According to formulas (11) and (12), the target values for the original outputs 2 and 3 are obtained as follows: $\frac{1}{0,2} - 1 = 4$ bugs per 1000 lines of code per month and $\frac{100}{0,97} = 103,1\%$ execution duration. The optimal non-zero values of the variables $x_1=0,75$ and $x_3=0,16$ provide the weights with which the actual performers A and C are combined to form the reference

virtual DMU V_D . This virtual DMU has output values of: $0,75.12+0,16.11=10,76$ completed functionalities per month; $0,75.0,33+0,16.0,50=0,33$ quality index, or $\frac{1}{0,33} - 1 = 2$ bugs per 1000 lines of code; $0,75.1,05+0,16.1,11=0,97$ schedule adherence index, or $\frac{100}{0,97}=103,1\%$ execution duration.

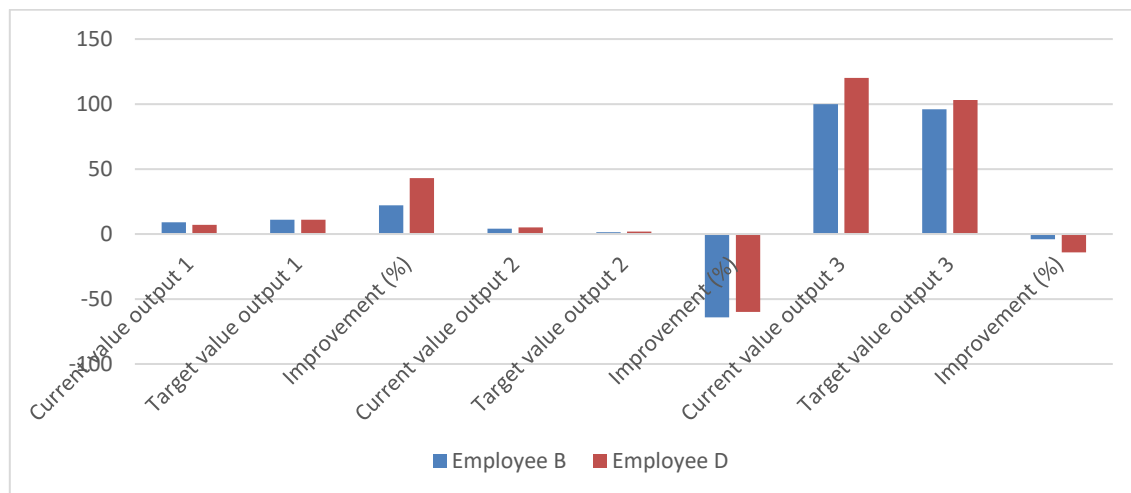


Fig. 4. Target output reference values for employees B and D

Source: Author's calculations, 2025.

The target reference values for the outputs of the inefficient employees B and D, presented in Figure 4, can serve as a guideline for human resource managers in planning performance improvement measures, such as additional training and qualification, enhanced control and testing of program code, more precise schedule planning, and others.

5. Discussion

The method for human resources appraisal presented, like any other approach, has its own advantages and disadvantages, which can be summarized as follows (Petkov, 2025):

Advantages of DEA

- objective assessment and comparison of employees, taking into account not only the results of their performance, but also the resources invested;
- meets employees' expectations for quantifying their qualities and achievements;
- can be used with many inputs and many outputs;
- it is not necessary to know the functional relationships between inputs and outputs;
- input and output variables can be measured in different units of measurement;
- supports the decision-making process for improving human resource performance by indicating the directions and extent to which progress can be achieved;
- provides an opportunity for self-assessment and comparison with other employees, which has a motivating effect;
- allows for the assessment of human resources from different categories and at different levels of integration;
- is easily implemented in human resource management information systems.

Disadvantages of DEA

- efficiency scores are sensitive to the inputs and outputs chosen;

- evaluates "relative" efficiency rather than "absolute" efficiency;
- laborious and time-consuming method;
- qualitative indicators and individual characteristics are more difficult, but not impossible, to incorporate in DEA;
- with a large number of inputs and outputs, the number of effective performers increases, as they become "too specialized".

Some of the weaknesses of DEA can be more easily overcome with the development of AI and its implementation in human resource management systems. Thanks to AI capabilities, it is possible to collect, process and analyze huge data sets, continuously monitor and evaluate performance, prepare forecasts and scenarios for future development, and prepare individual recommendations based on the analysis and evaluation of performance data. (Lynch, 2025; Zielinski, 2023; Kesarska, 2025).

In this sense, although DEA cannot be considered an absolute panacea for the problem of evaluating the performance of workers and employees, it could greatly assist human resource managers in performing this function, especially in combination with traditional qualitative methods and modern IT solutions.

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Relationship Marketing as a Tool for Building Sustainable Business Models

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Abstract

Relationship marketing is emerging as a contemporary marketing concept that goes beyond the boundaries of classical marketing, which is mainly oriented toward sales and short-term profits. At the core of the relational approach is the building and maintaining of long-term relationships with customers based on trust, commitment, and mutual value. The relevance of the topic stems from the intensifying competition in the tourism and service sectors, where service quality and customer satisfaction are decisive factors for the sustainable development of companies. With the advance of digitalization and changing consumer attitudes, customers no longer seek merely a product or service, but a holistic experience and an emotional connection with the brand. In this context, relationship marketing appears not only as a method for improving customer service, but also as a strategic instrument for building sustainable business models.

Sustainable business models require the integration of economic, social, and environmental dimensions into organizational management. They imply a new philosophy of interaction between the company and its stakeholders—customers, employees, suppliers, and partners. Relationship marketing provides the conceptual and instrumental framework for the realization of these interactions by emphasizing trust, loyalty, cooperation, and shared value. The present study seeks to demonstrate that the application of relationship marketing in tourism, and particularly in the field of tourist animation, not only leads to higher customer satisfaction and loyalty, but also supports the development of sustainable business models. The empirical part is based on a study conducted at “BVS Entertainment” Ltd., one of the leading companies in the field of hotel animation in Bulgaria.

Keywords:

relationship marketing,
sustainability, business models,
tourist animation, customer
loyalty

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1. Introduction

Relationship marketing represents a contemporary and strategically significant marketing concept that places the relationships between the company and the customer at the center of business management and organizational culture. Unlike classical marketing, which to a greater extent emphasizes the one-time act of purchase and efforts to attract new customers through mass communication channels, relationship marketing aims at building, maintaining, and developing long-term relationships. These relationships are based on trust, mutual commitment, emotional attachment, and the creation of added value for both parties. Contemporary research emphasizes that sustainable commercial success increasingly depends less solely on price or the quality of the offered product and more on the level of customer engagement and satisfaction, which can transform customers into long-term partners of the company (Grönroos, 2007).

The relevance of the topic stems from the growing dynamism and intensifying competition in the tourism

sector—a sector that is extremely sensitive to changes in consumer attitudes and the global environment. It is precisely here that relationship marketing plays a key role, as service quality, the level of customer experience, and the degree of customer loyalty are decisive factors for the sustainable development of tourism companies. The concept is successfully applied in hospitality, catering, and entertainment services, where the value of the service is often assessed not only through its functional characteristics but through the way the customer feels in interaction with the staff and the organization as a whole.

Under conditions of digitalization and global challenges, relationship marketing gains additional importance. Digital platforms allow more precise personalization of offers, maintenance of constant contact with customers, and collection of information about their preferences and behavior. This provides opportunities for building deeper and more meaningful relationships that strengthen trust and increase the likelihood of repeat purchases. In this sense, relationship marketing can be regarded not only as a set of operational tactics but as a management philosophy aimed at achieving long-term sustainability and competitiveness of the business (Kotler, Kartajaya & Setiawan, 2017).

2. Object, Subject, Aim, Tasks, and Research Methods

The object of the research is the application of relationship marketing in the field of tourism services, with a specific focus on hospitality and animation as added value to the tourism product. Tourism represents a complex system of relationships between service providers and consumers, in which the degree of trust and satisfaction determines the competitiveness of each company (Buhalis & Sinarta, 2023).

The subject of the research is the influence of the relationship marketing approach on the sustainable development of hotel animation companies, with a special focus on “BVS Entertainment” Ltd (Karadzhova & Angelov, 2018). This company represents an illustrative example of the practical application of the concept under Bulgarian conditions, where animation is not merely an entertainment service, but an instrument for building long-term customer relationships (Sustainability Editorial Board, 2025).

The main aim of the research is to demonstrate that the systematic application of relationship marketing in the tourism sector contributes to increased customer satisfaction, stimulates loyalty, and supports sustainable business development through the establishment of stable interaction models between the company and its stakeholders.

To achieve this aim, several main tasks are defined:

- To conduct a critical review of existing theoretical models of relationship marketing and identify its main characteristics;
- To analyze the essence of tourist animation as a specific service and as a strategic instrument for building long-term customer relationships;
- To examine the application of relationship marketing at “BVS Entertainment” Ltd. through the systematization of empirical data from customer and organizational studies;
- To formulate practical recommendations for optimizing the animation product and for the broader application of relationship marketing as a tool for building sustainable business models in tourism.

The research methodology includes a combination of quantitative and qualitative methods. Survey studies were conducted among hotel customers where the company provides animation services, in order to determine levels of satisfaction, expectations, and loyalty. In parallel, surveys were conducted among company employees and managers to examine the effect of the relational approach on internal organizational culture and work process efficiency. Statistical analysis of the collected data is complemented by a comparative method for evaluating the results in relation to other companies in the sector. Additionally, a descriptive method is applied to systematize the theoretical foundations, as well as expert assessments for the formulation of recommendations.

As a result of this methodology, the study integrates both the theoretical framework of relationship marketing and its practical applications in real market conditions, providing a solid basis for conclusions and guidelines for building sustainable business models (Georgiev, Petrov & Nikolova, 2023).

3. Theoretical Part

Marketing, in its classical form, is viewed as a system of activities aimed at attracting new customers and ensuring short-term sales. According to Kotler, marketing is a social and managerial process through which individuals and groups obtain what they need and want by creating and exchanging value (Kotler, 2002). This definition emphasizes the transaction—the single act of buying and selling—as the main objective of marketing efforts. Under conditions of industrialization and mass production, the transactional approach guaranteed market success, as the satisfaction of basic needs was the leading priority.

The development of marketing theory and practice has passed through several clearly defined stages. Initially, the emphasis was on product-oriented marketing, dominated by the idea that a good product sells itself. Over time, sales-oriented marketing emerged, in which aggressive sales practices were used to impose products on the market. The third stage is market orientation, where companies began to realize that understanding customer needs and market segmentation are key to success. At a later stage, customer orientation emerged, and at the most contemporary stage, the concept of relationship marketing became established, shifting the focus from one-time transactions to long-term cooperation.

Relationship marketing emerged as a response to dynamic changes in the market environment. Under conditions of globalization, digitalization, and increasing competition, customers have become more informed, demanding, and mobile. They no longer seek merely a product or service, but a comprehensive experience that creates added value and an emotional connection with the brand. In this context, relationship marketing represents a strategic approach in which the company builds a network of long-term relationships not only with customers, but also with suppliers, partners, employees, and society as a whole.

A key advantage of relationship marketing is that it is based on trust, satisfaction, and loyalty—elements that ensure repeat purchases and business sustainability. Key instruments include loyalty programs, personalized offers, two-way communication, and post-purchase customer care. In this way, the company does not merely generate sales, but builds long-term relational capital that becomes a competitive advantage.

In recent decades, sustainable development has become a fundamental principle of business strategies. Tourism, as one of the most dynamic industries, is particularly sensitive to the need for sustainable operational models that combine economic success, social responsibility, and environmental care. Relationship marketing contributes to sustainability in several directions:

- it creates a stable customer base that ensures predictable revenues and reduces dependence on external factors;
- it encourages corporate social responsibility by integrating the interests of various stakeholders;
- it supports the development of organizational culture through employee engagement;
- it contributes to building a positive image and public trust, which form the basis for long-term competitiveness.
- In this sense, relationship marketing is not merely an instrument for achieving market success, but a key element of strategies for building sustainable business models.

4. Application in Tourism and Tourist Animation

Tourism is one of the sectors in which the application of relationship marketing is particularly significant. Due to the specific characteristics of tourism services—their intangibility, inseparability from the consumption process, and strong dependence on the human factor—the relationships between provider and customer are

central to the perception of quality. Unlike tangible products, where value can be assessed through physical characteristics, tourism services are evaluated primarily through emotional connection and the overall customer experience (Christopher, Payne & Ballantyne, 1991).

Relationship marketing in tourism is expressed through personalized offers, loyalty programs, feedback systems, digital platforms for maintaining constant contact, and—most importantly—through animation as a unique form of interaction with tourists (Peppers & Rogers, 1993). Animation represents a complex of activities that create added value to the core tourism product by providing entertainment, social interaction, and active customer participation. In this way, it not only enriches the experience but also strengthens the emotional bond between the tourist and the brand.

In hotel and resort practice, animation performs the function of a strategic tool for customer retention. Studies conducted by Dr. Alexander Angelov within the framework of his dissertation show that tourists who participate in animation programs demonstrate significantly higher levels of satisfaction and a greater tendency toward repeat visits. According to survey data, more than 70% of respondents state that animation was the factor that turned their stay into a memorable experience. This directly corresponds to the concept of relationship marketing, in which the key to sustainable development lies in building loyal customers through value and emotion (Reichheld, 1996).

Hotel animation also contributes to the creation of a sense of community among tourists. When guests participate together in games, sports activities, cultural and artistic events, they build relationships both with each other and with the hotel staff. This process creates positive brand associations and strengthens emotional engagement, which is difficult to achieve through traditional marketing tools such as advertising or price promotions (UNWTO, 2022).

Another key aspect is that animation becomes a differentiating factor under conditions of intense competition. In destinations where hotel infrastructure is similar, the quality and creativity of animation programs often determine customer choice. Thus, companies investing in innovative and well-organized animation not only retain tourists, but also position themselves as leaders in the sector (Saavedra-Azabache et al., 2024).

At “BVS Entertainment” Ltd., which is the object of the present research, relationship marketing finds concrete application through the development of personalized animation packages tailored to tourists’ age, cultural characteristics, and preferences. The company builds long-term partnerships with hoteliers and tour operators, thereby creating a stable network of relationships. Animator staff are trained not only to perform entertainment functions, but also to act as intermediaries in building trust and satisfaction.

The data show that the introduction of a relational approach in animation leads to tangible results—an increase in average length of stay, growth in repeat visits, and improvement of the image of hotel complexes. In this sense, tourist animation is established as a key component in building a sustainable business model based on relationship marketing.

5. Research Results

“BVS Entertainment” Ltd. is one of the leading companies in Bulgaria specializing in animation services for the tourism sector and is the subject of an in-depth study. The main focus is placed on the application of the relationship marketing concept and its effect on sustainable business development (Baran & Zerres, 2014).

The study was conducted through a combined approach including surveys among tourists and staff, interviews with managers, and analysis of internal company documents. More than 400 respondents—hotel customers served by “BVS Entertainment” Ltd.—participated in the surveys. In addition, over 120 animator employees were surveyed to assess their satisfaction, motivation, and perception of the application of relationship marketing in practice.

The analysis of results shows that 78% of tourists identify animation services as a key factor for

satisfaction with their stay (Fig.1). 71% of respondents state that they would choose the same hotel again specifically because of the animation, while 64% indicate that contact with animators contributed to building trust in the overall tourism product.

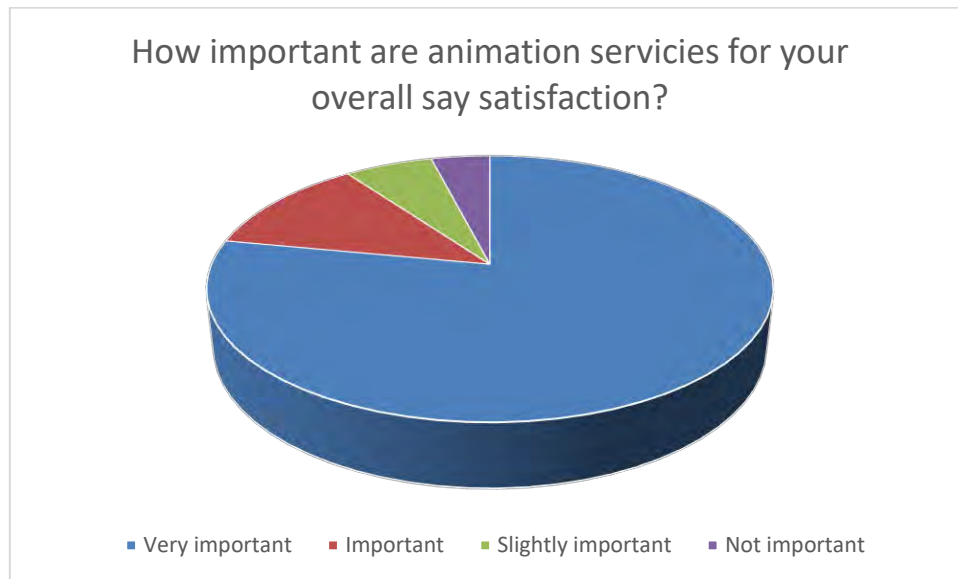


Fig.1. How important are animation services for your overall stay satisfaction?

Particularly noteworthy is the fact that for more than half of the customers (53%), participation in animation programs was decisive in recommending the hotel to relatives and friends. This demonstrates that animation becomes a “brand ambassador” and plays a strategic role in building loyalty and attracting new visitors through recommendations.

Analysis of employee opinions shows that 86% of animators perceive their role not only as entertainment, but also as an instrument for building long-term customer relationships (Fig. 2). At the same time, 67% emphasize that training and internal programs related to relationship marketing have improved their motivation and professional development.

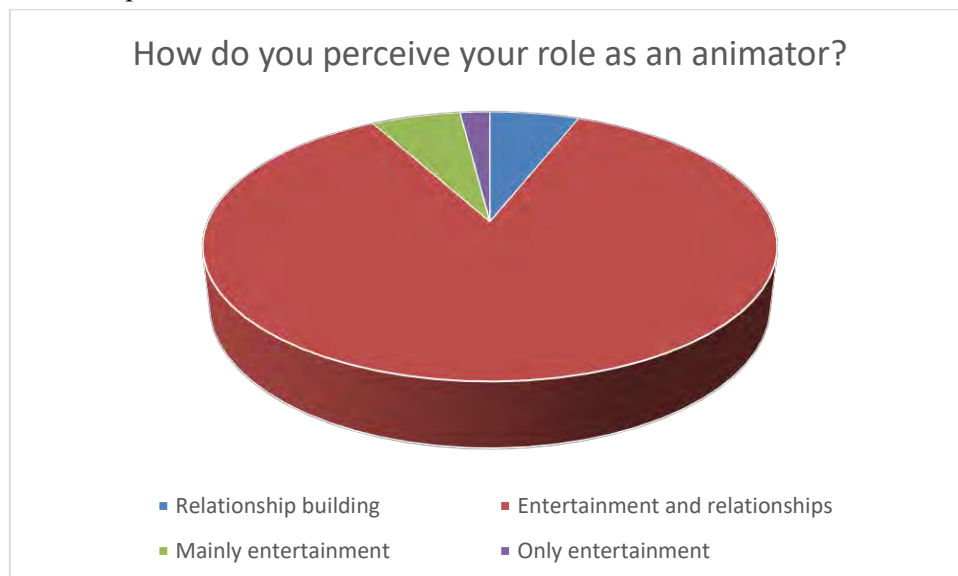


Fig. 2. How do you perceive your role as an animator?

A direct relationship is also observed between employee satisfaction and customer satisfaction. The company applies incentive programs for animators through internal rewards, career development opportunities, and continuous feedback. This leads to high levels of engagement and reduced staff turnover—key factors for business sustainability.

During the studied period, “BVS Entertainment” Ltd. reports a 15% increase in client contracts with hotel complexes and tour operators, resulting from increased demand for animation services. There is also significant revenue growth, with the introduction of personalized packages and long-term partnerships contributing to the stabilization of the company’s market position.

In addition, the study confirms that investments in relationship marketing and personnel have a long-term effect. Customer repeatability and the development of lasting partnerships with hoteliers create a foundation for a sustainable business model that is less vulnerable to seasonal fluctuations and price competition (Parasuraman et al., 1988).

The empirical data clearly demonstrate that the application of relationship marketing at “BVS Entertainment” Ltd. leads to:

- increased customer satisfaction and loyalty;
- improved staff motivation and engagement;
- expansion of the partnership network and economic growth;
- creation of competitive advantage through a unique customer experience.

6. Discussion

The results of the study at “BVS Entertainment” Ltd. clearly demonstrate the significance of relationship marketing as a strategic instrument for sustainable development in tourism services. The obtained data confirm theoretical assumptions that relationships with customers and partners are a fundamental factor for building competitiveness and long-term business success (Kotler, 2009; Anastassova, 2008).

The high level of customer satisfaction and propensity for repeat consumption indicates that relationship marketing is effective under conditions of strong competition. This corresponds to Reichheld’s concept that loyal customers not only increase company revenues through repeat purchases, but also contribute to expanding the customer base through positive word-of-mouth communication. The application of personalized animation programs and direct customer engagement demonstrates the role of experience as a key added value in tourism.

The results confirm the thesis that a sustainable business model requires parallel investment in both customers and personnel. According to the SERVQUAL model, service quality is perceived as directly dependent on employee attitudes toward customers (Parasuraman et al., 1988). In the case of “BVS Entertainment” Ltd., the high engagement and professional training of animators lead to significantly higher levels of tourist satisfaction, which in turn stimulates repeat consumption and recommendations.

The company’s financial results show that investments in relational practices are justified not only in terms of satisfaction, but also as a concrete economic effect (Christopher, Payne & Ballantyne, 1991). The growth in contracts and revenues recorded during the study period confirms that relationship marketing is sustainably applicable even under conditions of seasonality and high competition in tourism. This corresponds to the idea of Christopher, Payne, and Ballantyne that relationship marketing leads to resource optimization and higher return on investment.

The practical value of the study lies in identifying concrete mechanisms for applying relationship marketing: individualization of animation programs, introduction of customer feedback systems, development of internal staff training programs, and building partnerships with hoteliers. In this context, “BVS Entertainment” Ltd. can be regarded as a model for successful integration of relationship marketing in tourism,

adaptable to other companies in the sector.

7. Conclusion

The study of the application of relationship marketing in tourism services, and more specifically in the activities of “BVS Entertainment” Ltd., confirms the strategic importance of this concept for achieving sustainable business development. The synthesis of the theoretical framework, empirical results, and applied aspects clearly outlines the relationship between building lasting relationships and the competitiveness of tourism companies.

Relationship marketing is established as an alternative to the classical transactional model, which views the customer solely as a source of sales. The theoretical foundation developed by Kotler, Christopher, Payne, and Ballantyne, as well as Bulgarian authors Anastassova and Karadzhova, shows that long-term relationships are not only a means of improving customer loyalty, but also an instrument for optimizing business processes and reducing costs. In tourism, these theoretical assumptions acquire particular importance due to the intangible nature of services and their strong dependence on human resources and customer experience.

The survey results at “BVS Entertainment” Ltd. demonstrate several key relationships:

- high customer satisfaction—over 80% of surveyed tourists report being fully satisfied with the quality of animation services;
- loyalty and repeat consumption—nearly 70% of customers express willingness to return to the same hotel due to the quality of the animation program;
- significant role of personnel—the professional training and personal attitude of animators are decisive for the perception of the overall tourism experience;
- economic effect—company revenues have increased, directly linked to growing interest from hotel operators in animation services.

These results confirm that the application of relationship marketing leads to measurable positive effects for both customers and the organization.

The practical significance of the study lies in identifying concrete mechanisms for implementing relationship marketing in tourism companies, including:

- individualization of animation programs according to tourist profiles;
- continuous feedback through surveys and digital channels;
- systematic staff training to develop communication and organizational skills;
- building strategic partnerships with hoteliers and tour operators;
- integration of loyalty programs and digital platforms to maintain contact with customers after their stay.

These practices demonstrate that relationship marketing can become a core element of sustainable business models in tourism.

Despite the clear results, the study has certain limitations. It covers a specific time period, and due to the dynamic nature of the tourism market, further updates are necessary, particularly in light of digitalization and post-COVID-19 changes in consumer behavior. The need for long-term panel studies is also evident, as the present analysis focuses on a limited time horizon.

In summary, relationship marketing is not only a concept, but a practical management philosophy that ensures sustainable competitive advantage. Its application in tourism services, and especially in hotel animation, proves that building trust and emotional connection with customers has strategic importance.

For “BVS Entertainment” Ltd., relationship marketing has become a key factor for expanding market presence, improving economic results, and establishing the company’s image as a reliable partner in the tourism sector.

Based on the analysis, it can be concluded that the future of tourism and related services will inevitably involve broader integration of relationship marketing as a foundation for building sustainable business models in a global context.

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4. INTERNATIONAL & GLOBAL PERSPECTIVES OF BUSINESS AND MANAGEMENT

Pilot Study on the Social Dimension of Corporate Governance in Romanian Listed Companies**Manuel Victoraș Stănilă¹, Edita Carmen Bokor², Constantin Marius Profiroiu³**¹ Bucharest University of Economic Studies, Romania, victor.stanila@amp.ase.ro² Bucharest University of Economic Studies, Romania, bokoredita24@stud.ase.ro³ Bucharest University of Economic Studies, Romania, mprofiroiu@ase.ro**JEL: G34, M14, J78, Q56****Abstract**

Background and aim: In Europe, Environmental, Social, and Governance (ESG) practices are shaped by the Corporate Sustainability Reporting Directive (CSRD) and the European Sustainability Reporting Standards (ESRS) Act (Delegated Regulation (EU) 2023/2772), which require reporting on social issues and accessibility. This pilot study explores how Romanian listed companies address disability inclusion, workplace accessibility. Scope: The study is based on 14 responses from 146 issuers on the Bucharest Stock Exchange. Findings are exploratory only. Methods: A structured questionnaire was conducted in August 2025 and analyzed with descriptive statistics. Results: Some firms reported ESG policies and committees, but adoption is uneven. Accessibility measures are limited, and inclusion is often seen as reputational rather than strategic. Conclusions: Romanian companies are only beginning to align with EU social governance. Originality: Among the first studies on ESG and disability inclusion in Romania. Practical implications: Results can guide companies, policymakers, and investors toward stronger, more inclusive ESG strategies.

Key words:

ESG, CSRD, ESRS, Disability Inclusion, Social Dimension, Corporate Governance.

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1. Introduction

Corporate governance has changed profoundly in recent decades. It has shifted from a narrow focus on shareholder protection, managerial accountability, and transparency (Shleifer & Vishny, 1997) to a broader framework that integrates sustainability, ethics, and social responsibility. This transformation reflects the recognition that firms operate within social and environmental systems and that their impact extends beyond short-term financial results.

In this context, the social dimension of corporate governance has gained importance in debates on Environmental, Social, and Governance (ESG) issues, both in academic literature and in regulatory practice. The adoption of ESG criteria has institutionalized this broader perspective, providing a framework for evaluating how companies contribute to long-term sustainable development while acting responsibly towards stakeholders. In Europe, this process has been accelerated by policy initiatives and regulatory frameworks.

A step forward in this field was the adoption of the Corporate Sustainability Reporting Directive (CSRD, Directive (EU) 2022/2464), which entered into force in January 2023 and will gradually apply to European companies starting with the 2024–2025 reporting cycles. The CSRD expands the scope of sustainability reporting compared to its predecessor, the Non-Financial Reporting Directive (NFRD), by extending the requirements to a larger set of companies and by imposing more detailed information on sustainability practices. A central element of the CSRD is the focus on double materiality, meaning that companies must report both how sustainability issues affect their financial performance and how their operations impact society and the environment. Within this framework, the European Sustainability Reporting Standards (ESRS) provide the methodological basis for the information disclosed, covering specific topics such as workforce diversity,

workplace accessibility, and the inclusion of persons with disabilities.

Even though there has been progress, the social pillar (S) of ESG is still the least developed when compared with the environmental and governance dimensions. Studies show that companies are usually quicker to act on environmental initiatives or governance reforms, while social issues—such as diversity, equity, inclusion, employee well-being, and workplace accessibility—are often pushed aside or treated mainly as matters of reputation (Ioannou & Serafeim, 2017). This imbalance can be seen across many countries and reflects how difficult it is to measure, standardize, and communicate social performance in a way that matters to investors. Still, more researchers now argue that leaving aside the social side of governance puts long-term corporate sustainability at risk. Ignoring these aspects can damage stakeholder trust, lower employee motivation, and make companies less prepared to face social risks and crises (Kotsantonis, Pinney, & Serafeim, 2016).

In Central and Eastern Europe (CEE), research shows that ESG and sustainability reporting are less developed than in Western Europe, with a clear “sustainability reporting gap” linked to historical legacies, weak institutions, corruption, and the limited role of NGOs and governments (Krasodomska, 2025). Evidence from Poland indicates that companies listed on the Warsaw Stock Exchange are still poorly prepared for the CSRD, especially in narrative information and key performance indicators, although larger firms and those with prior reporting experience are better positioned (Godawska & Rymkiewicz, 2025). Previous studies also confirm that corporate characteristics such as company size, industry sensitivity, board composition, and internationalization have a strong influence on disclosure levels in the region (Dyduch & Krasodomska, 2017). At the EU level, national ESG-economic ecosystems play a crucial role, as stronger economies support better adoption while weaker ones need targeted interventions to improve compliance (Avram et al., 2025). In Romania, research on IT companies listed on the Bucharest Stock Exchange shows general compliance with corporate governance codes but also persistent gaps in disclosure and transparency. This suggests that although alignment with the CSRD and ESRS is in progress, the integration of ESG principles into corporate practice remains uneven (Ciurel & Dumitrescu, 2024).

Romania, with a stock market capitalization of EUR 70.38 billion at the end of 2024 and with the Bucharest Stock Exchange ranked among the medium-sized exchanges in Central and South-Eastern Europe, is undergoing continuous reforms in corporate governance (Ciurel, Deselnicu & Botez, 2023). The country is currently in a transition phase toward stronger alignment with ESG standards. Although regulations officially reflect European requirements, the real integration of the social pillar of ESG in Romanian listed companies is still not well understood. Most existing research has focused on environmental reporting or financial governance, leaving a gap in knowledge regarding how companies address workplace accessibility, disability inclusion, and broader social sustainability, both at the board level and at the operational level.

In this context, the study seeks to address a gap in research by carrying out a pilot survey on the social side of corporate governance in Romania. It looks at how companies listed on the Bucharest Stock Exchange (BSE) deal with the inclusion of people with disabilities and workplace accessibility. A structured questionnaire was sent to 146 issuers in August 2025, and 14 complete responses were collected. While the number is modest, the data offers valuable first insights into current practices and helps assess whether the tool can be used in larger studies. The study is guided by two main questions:

- To what extent do Romanian listed companies integrate the social dimension of corporate governance, especially in relation to ESG-related structures, policies, and practices?
- How do these companies address the inclusion of persons with disabilities through employment strategies, workplace accessibility, assistive technologies, and diversity policies?

This research is both new and timely, as it is one of the first studies in Romania to focus directly on the social pillar of ESG. Even though the sample size limits generalisation, the results show early trends and challenges, offering insights for both academics and practitioners. At the same time, the study adds to the

literature on ESG adoption in Eastern Europe and provides useful evidence for policymakers, company boards, and investors on how EU rules are starting to shape national corporate governance.

2. Literature Review

2.1. ESG and Corporate Governance: Global Perspectives

The concept of ESG has become central in evaluating corporate responsibility and sustainability. ESG frameworks expand the scope of traditional corporate governance, which was once focused mainly on shareholder protection, managerial accountability, and transparency (Shleifer & Vishny, 1997). Today, companies are judged not only on financial returns but also on their ability to create long-term value for a wider group of stakeholders, including employees, communities, and future generations. This broader perspective reflects changing societal expectations and the growing influence of institutional investors, who increasingly see ESG compliance as a measure of risk management and resilience (Eccles, Ioannou, & Serafeim, 2014).

In recent years, global debates have placed stronger emphasis on the social pillar of ESG, recognizing that diversity, employee well-being, inclusion, and stakeholder engagement are essential for sustainable growth. Research shows that policy and institutional contexts shape how companies adopt these practices. For example, banks operating under economic policy uncertainty have been found to improve their ESG performance, particularly in social areas, as they increase philanthropic activities and stakeholder relations (Alam, Hassan, & Banna, 2025). Similarly, stronger climate policies can boost ESG scores, especially in the social and environmental dimensions, by promoting awareness and cooperation (Tan, Chen, & Dong, 2025).

A key theme in the literature is the role of board diversity. Cultural and independence diversity are strongly linked to better ESG outcomes, especially in the social dimension (Al-Sarraf, Al-Swidi, & Al-Hakimi, 2025). Board gender equality is also significant: studies in European banks show that the presence of at least three women directors greatly improves ESG performance, supporting critical mass theory (Menicucci & Paolucci, 2024). Similarly, larger boards with higher representation of women and independent members are associated with stronger social and environmental disclosure (Gurol & Lagasio, 2023). Together, these findings highlight that board diversity is a powerful driver of social sustainability.

Human capital is another critical factor. ESG practices have been shown to improve job satisfaction in small and medium-sized enterprises, though demographic factors such as age or marital status influence the strength of this effect (Álvarez-Perez & Fuentes-Bracamontes, 2025). However, investors do not always prioritize the social pillar. In India, social issues rank lower than governance and environmental concerns for equity investors (Sood, Arijit, Pathak, & Purohit, 2023). Similarly, firms in Pakistan show the weakest disclosure in the social dimension, highlighting the need for standardized frameworks (Tauseef & Khurshid, 2025). By contrast, European materiality matrices often show social issues as central to sustainability agendas, though the focus varies across industries and countries (Albuquerque, Gomes, & Rodrigues, 2024).

The connection between social ESG performance and financial outcomes remains mixed. While some evidence suggests that social engagement does not necessarily support dividend stability (Matuszewska-Pierzynka, Mrzygłód, & Pieloch-Babiarz, 2023), other studies indicate that it reduces stock price volatility, making firms more resilient to shocks (Mechrgui & Theiri, 2024). Sectoral evidence shows that economic context also matters: in the cement industry, firms in developed countries are better able to translate social and environmental initiatives into financial gains (Jain & Malhotra, 2025). In contrast, in some markets, social commitments may even create trade-offs, affecting short-term performance (Shaikh, 2022). Moreover, studies on individual investors in India confirm that governance and environmental factors often take precedence over social ones (Sood, Pathak, Jain, & Gupta, 2023).

External actors also shape the role of the social pillar. The loss of analyst coverage has been associated

with improved ESG scores, as companies face less short-term pressure and invest more in long-term sustainability (Fiorillo, Gangi, Meles, Mustilli, & Salerno, 2023). At the same time, the persistence of “greenwashing” remains a challenge, with symbolic ESG actions undermining social value creation, which reinforces the need for stronger regulation and enforcement (Bernini & La Rosa, 2024).

Overall, the literature shows clear progress but also variation in how the social pillar of ESG is integrated into corporate governance across regions. Board diversity and human capital consistently drive positive outcomes, while policy frameworks, investor preferences, and national contexts strongly influence adoption. Yet, disclosure gaps, risks of symbolic compliance, and potential trade-offs with financial performance highlight the complexity of embedding social responsibility into corporate governance worldwide.

2.2. Disability Inclusion under the CSRD and ESRS

CSRD marks a major step in the European Union’s approach to sustainability reporting. By extending disclosure obligations to a wider group of companies and introducing the principle of double materiality, the Directive requires firms to report not only on financial risks but also on their broader social and environmental impacts. Within this framework, disability inclusion is explicitly recognized as a key part of the social pillar.

Delegated Regulation (EU) 2023/2772, which sets out the ESRS, provides detailed rules on how companies must report in this area. ESRS S1 – Own workforce requires firms to present clear policies on the employment and integration of persons with disabilities and to describe concrete actions such as workplace adaptations, assistive technologies, and support mechanisms. Companies must also report quantitative indicators, including the share of employees with disabilities, and establish measurable targets to improve inclusion and reduce inequalities. In addition, they are expected to disclose the resources allocated, implementation plans, and methods used to monitor progress, ensuring that information is transparent and comparable for all stakeholders.

Table 1

Summary of obligations on disability inclusion under ESRS S1

Area	Obligation
Policies	Disclosure of clear policies on employment and integration of persons with disabilities
Measures	Description of accessibility actions (workplace adaptations, assistive technologies, support)
Indicators	Reporting the share of employees with disabilities and inclusion targets
Resources	Disclosure of allocated resources and implementation plans
Evaluation	Explanation of monitoring methods and annual progress
Transparency	Publication of comparable, verifiable, and accessible information for stakeholders

Source: Authors’ compilation based on Directive (EU) 2022/2464 and Delegated Regulation (EU) 2023/2772 (ESRS S1), 2025

The CSRD and ESRS make disability inclusion both a compliance requirement and a strategic priority. For companies, this means embedding accessibility and equal opportunities into policies, operations, and corporate culture. Beyond workplace adjustments, inclusion must also support career development and retention for employees with disabilities. Setting measurable targets and publishing transparent indicators are essential for accountability, while adequate financial and human resources are needed to ensure genuine commitment. At the same time, regulators and policymakers must provide clear guidance and harmonized reporting tools to reduce gaps across sectors and countries.

Integrating disability inclusion into sustainability reporting strengthens social cohesion and enhances the credibility and resilience of European businesses. By aligning governance with equality and accessibility, the CSRD and ESRS reinforce a model of sustainable development where social responsibility and long-term value creation go hand in hand.

2.3. The Social Dimension of the CSRD

CSRD marks an important step in strengthening the social pillar of ESG within the European Union. While environmental and governance aspects have traditionally dominated corporate reporting, the CSRD and the ESRS highlight the importance of workforce well-being, diversity, inclusion, and accessibility. This change reflects the growing recognition that sustainability cannot be achieved without serious attention to social issues.

Scholars underline that the CSRD creates a mandatory framework for reporting social information, placing it on the same level as environmental and governance requirements (Hummel & Jobst, 2024; Farkas & Matolay, 2024). Hummel and Jobst (2024) stress that the directive ensures companies disclose data on employee rights, inclusivity, and social risks. Farkas and Matolay (2024) see the CSRD as an opportunity to embed sustainability into management systems, making social responsibility a strategic priority. The principle of double materiality reinforces this by requiring companies to show how their activities affect stakeholders, not only their financial results. However, studies reveal that many firms, such as Polish listed companies, were not prepared to apply this approach before the CSRD, often neglecting social impacts in their reports (Macuda & Kobiela-Pionnier, 2025). Earlier evidence also shows that mandatory disclosure under Directive 2014/95/EU reduced the gap between commitments and actual practices, including those related to employees (Aboud, Saleh, & Eliwa, 2024).

At the sector level, research shows uneven readiness for social reporting. In the banking sector, Western European institutions score higher on transparency than those in Hungary, where social indicators are less developed (Tözsér, Lakner, Sudibyo, & Boros, 2024). A similar trend appears in Italy, where banks show only moderate alignment with ESRS, particularly on human capital and diversity (Fedele, Principale, Formisano, & Lombardi, 2025). In Slovakia, reporting on diversity, inclusion, and employee well-being varies considerably across banks, exposing challenges in harmonizing human capital disclosure (Serpeninova, Partila, Raboshuk, Krukhmal, & Nezhyd, 2025). Other industries face similar gaps. Automotive companies have started to integrate social aspects such as stakeholder trust and community engagement (Kamińska-Witkowska & Kaźmierczak, 2024), while studies of integrated reports in Europe show that many firms still fall short of ESRS social requirements, with better performance among larger companies and those in sensitive industries (Raimo, L'Abate, Sica, & Vitolla, 2025).

The literature also highlights the political and institutional context. Lobbying played a role in shaping the scope of social reporting obligations, with NGOs supporting stronger requirements and business associations calling for simplification (Pirveli, Ortiz-Martínez, Marín-Hernández, & Thompson, 2025). In public-private partnerships, social economy entities often face barriers to funding despite their natural alignment with community well-being, as they struggle to meet CSRD's formal criteria (Montesinos-Sansaloni, Ribeiro, & Botella-Carrubi, 2025). At the same time, scholars warn that expectations for the CSRD may be too high. Risks such as "green hushing," compliance costs for SMEs, and the complexity of mandatory assurance may limit its effectiveness (Di Tullio, La Torre, & Rea, 2025). Boards are not legally required to act directly on sustainability, but the accuracy of social disclosures places responsibility on them to consider workforce issues in strategy and oversight (Oskarsdottir, Sigurjonsson, & Steinthorsson, 2025).

Finally, the digital transformation of reporting is seen as a key factor for success. Digitization can improve transparency and make it easier to track inclusion and workforce indicators, but challenges remain in regions with lower digital maturity (Jalagonia, Khubua, & Chokhonolidze, 2025).

Taken together, the evidence shows that the CSRD introduces a new level of obligation for reporting on diversity, inclusion, and employee well-being. However, implementation differs across countries, industries, and company sizes. The directive has the potential to place social sustainability at the center of corporate governance, but its success will depend on enforcement, digital adaptation, and the willingness of companies to embed social concerns into their strategies.

3. Methodology

This study adopts an exploratory, survey-based research design to investigate the social dimension of corporate governance among Romanian listed companies. Two central research questions guided the analysis: (1) To what extent do Romanian listed companies integrate the social dimension of corporate governance, particularly in relation to ESG-related structures, policies, and practices? and (2) How do these companies address the inclusion of persons with disabilities through employment practices, workplace accessibility, assistive technologies, and diversity policies?

Data Collection

Data were collected through a structured online questionnaire administered between August 3 and August 21, 2025. The target population comprised 131 companies listed on the Bucharest Stock Exchange (BSE) within the Regular Market and the Multilateral Trading Facility Premium Category, as well as 15 registered bond issuers. In total, 14 organizations provided valid and complete responses. While the relatively low response rate limits the representativeness of the sample, it is consistent with the pilot nature of the study, which aims to generate exploratory insights rather than statistical generalizations.

Survey Instrument and Variables

The questionnaire contained several sections, but only Sections 1–3 was used in the analysis. These covered company profile (size, sector, legal form, listing status), governance structures and ESG practices (dedicated staff, committees, governance documents, internal control mechanisms, implemented ESG actions), and disability inclusion (employment of persons with disabilities, accessibility of workplaces, assistive technologies, diversity and inclusion policies, and Likert-scale perceptions of inclusion as a strategic priority, a factor of retention and organizational climate, and a contributor to company reputation). A detailed mapping of research questions, variables, and survey items is provided in Appendix A.

Data Cleaning and Analysis

The dataset was verified and cleaned using JASP (version 0.18.3; JASP Team, 2023) to ensure consistency in variable labelling and the treatment of missing values. Descriptive analysis was subsequently conducted in RStudio (R version 4.4.0; R Core Team, 2024), including frequency distributions, percentages, cross-tabulations, and graphical outputs. The corresponding R code is presented in Appendix B to support transparency and reproducibility. No inferential statistical tests were performed, as the objective was to highlight descriptive trends and generate preliminary insights. For language refinement of the manuscript, Grammarly (Grammarly Inc., 2025) was employed, with final responsibility for the content resting with the authors.

Ethical and Technical Considerations

The survey was conducted with respect to anonymity and confidentiality of participating companies. Data analysis relied solely on aggregated outputs, without disclosure of company-level identifiers. The text of the manuscript was prepared with the assistance of Grammarly (Grammarly Inc., 2025) for language refinement, while final responsibility for content accuracy remains with the authors.

Limitations

The primary limitation of this methodology is the low response rate ($n = 14$), which restricts the representativeness of findings. Furthermore, the reliance on self-reported data may introduce bias in how companies describe their ESG and inclusion practices. Nevertheless, as a pilot study, the research provides meaningful preliminary insights into the social dimension of corporate governance in Romanian listed companies and lays the groundwork for future empirical research with broader samples and more robust statistical methods.

4. Findings and Discussion

4.1. Organizational and Governance Profile

To address RQ1, we first examined the organizational characteristics and governance structures of the responding companies, as this step also contributes to testing the reliability of the questionnaire as a research tool. Most firms in the sample are headquartered in Bucharest, with others spread across counties such as Bacău, Dolj, Neamț, and Constanța. In terms of activity sectors, companies operate mainly in industry (5 firms), commerce (4 firms), and finance/insurance (2 firms), with IT and services also represented.

Most companies identified themselves as medium-sized enterprises, while smaller and larger firms were also present. All respondents are joint-stock companies (SA), consistent with their listing on the Bucharest Stock Exchange: seven are listed on the AeRo market, five on the regulated market, and two are bond issuers.

The governance structures among the surveyed companies differ. Some organizations report established audit committees, remuneration committees, or independent administrators, whereas others lack formal governance bodies. Corporate governance documents such as internal regulations, policies, and codes of ethics, as well as internal control mechanisms including audit committees, compliance departments, and external consultants, are implemented in several firms but are not consistently adopted across the sample.

These findings not only describe the diversity of governance practices among Romanian listed companies but also underline the importance of aligning with CSRD and ESRS requirements. From a methodological perspective, they confirm that the questionnaire is able to capture relevant variations in organizational and governance structures. From a policy perspective, they point to the uneven implementation of governance mechanisms, which are essential for ensuring accountability and preparing companies for the reporting obligations required at the EU level.

Table 2

Organisational profile of respondent Companies (n=14)

Variable	Most frequent responses
Headquarters	Bucharest (8)
Sector	Industry (5), Commerce (4), Finance/Insurance (2), IT (1), Services (1)
Size	Medium enterprises dominate; also, small and large firms present
Legal form	SA (100%)
Listing status	AeRo (7), Regulated Market (5), Bond Issuers (2)
Governance structures	Audit committees, remuneration committees, independent administrators (varied presence)
Governance documents	Internal regulations, policies, codes of ethics (partial adoption)
Internal control mechanisms	Audit committees, compliance departments, external consultants (varied presence)

Source: Authors' survey, 2025.

The analysis of the organizational profile provides important context for understanding how Romanian listed companies integrate the social dimension of corporate governance. The results show that most respondents are medium-sized enterprises concentrated in Bucharest, which may explain both their relatively higher awareness of governance requirements and the limited resources available for full ESG integration. The predominance of joint-stock companies (SA) reflects their listing status, but the fact that seven operate on the AeRo market suggests possible differences in governance maturity compared to firms on the regulated market.

Governance structures and control mechanisms appear to be unevenly implemented across the sample. While some companies report the existence of audit and remuneration committees, independent administrators,

and compliance departments, others lack such formal structures. This partial adoption indicates variability in organizational capacity and strategic commitment to corporate governance practices. In the context of RQ1, these findings suggest that structural differences at the firm level—such as size, market segment, and governance arrangements—likely influence how companies approach the integration of ESG-related social policies, particularly disability inclusion and workplace accessibility.

Building on this organizational profile, the next step is to examine how these companies translate their structures and resources into concrete ESG practices and policies, with particular attention to the social dimension.

4.2. ESG Practices and Policies

To further address RQ1, we examined the ESG practices and policies reported by the surveyed companies. At the European level, the regulatory framework places growing emphasis on the social and accessibility dimensions of corporate responsibility. The CSRD and the ESRS require companies to provide comprehensive ESG disclosures in their annual reports, which increases the importance of transparent governance and inclusion practices. At the same time, international frameworks such as the World Health Organization's International Classification of Functioning, Disability and Health (ICF) stress that disability covers many areas of functioning and participation, including mobility, sensory limitations, communication, mental health, and social interaction (WHO, 2001).

Our findings show that Romanian listed companies reported employing persons with disabilities mainly in the categories of physical and sensory impairments. While this reflects only part of the broader spectrum recognized by the ICF, it is still a positive step, as organizations are starting to open their doors to persons with disabilities and move towards alignment with European accessibility objectives. Against this background, Table 3 presents the ESG-related structures and practices reported by the respondents.

Table 3

ESG Practices and Policies among Respondent Companies

Variable	Most frequent responses
ESG actions	4 companies reported no ESG policies; others mentioned environmental policies, CSR initiatives, and governance codes
Dedicated persons	In several firms, one person covered multiple functions (ESG, IR, PR), while few had dedicated ESG staff
Committees	3 companies reported no formal committees; others had audit, remuneration, or governance committees
Governance documents	Internal regulations, policies, and codes of ethics were partially adopted, but not universal
Internal control mechanisms	Audit committees, executive management oversight, boards of directors, and external consultants were reported with varied presence

Source: Authors' survey, 2025.

The results suggest that ESG practices are still at an early stage of development. Several companies have begun to adopt policies and committees, which indicates a growing awareness of sustainability and social responsibility, but overall integration remains limited.

These findings provide a first picture of how Romanian listed companies approach ESG structures and governance, but they also raise further questions about how these firms deal with disability inclusion in practice—an issue explored in the next section (RQ2).

4.3. Disability Inclusion and accessibility

Regarding Research Question 2 (RQ2), the analysis focused on how companies address disability

inclusion and workplace accessibility. At the European level, the Corporate Sustainability Reporting Directive (CSRD) requires firms to disclose not only environmental results but also social policies, including diversity and inclusion. Complementing this, the World Health Organization's International Classification of Functioning, Disability and Health (ICF) defines disability across several domains—mobility, sensory, communication, mental health, and social participation—each of which plays a role in equal opportunities and inclusive employment.

Within this framework, the findings from the survey show that Romanian listed companies currently employ persons with disabilities mainly in two categories: physical (mobility) and sensory impairments. Representation is still limited, but these practices mark a first step toward meeting European Union objectives on accessibility and inclusion. Companies also report partial progress in workplace adaptation and in the adoption of diversity policies, though significant gaps remain in staff training and in the use of assistive technologies.

Table 4**Disability Inclusion and Accessibility among Respondent Companies**

Variable	Most frequent responses
Types of disabilities employed	Primarily physical disabilities (mobility impairments); few mentions of sensory disabilities
Reported difficulties	Several firms reported no major difficulties; others cited lack of staff training or complex legislation
Workplace accessibility	Partially adapted (9 firms); fully adapted (3 firms); not adapted (2 firms)
Assistive technologies	Most common: wheelchair access (ramps, lifts) and flexible work programs; other technologies were rarely mentioned
Diversity & inclusion policies	6 firms reported explicit policies (separate documents); 3 firms had none; 3 reported “don’t know”
Training on inclusion	Mixed: some companies provide regular or occasional training; others report no training available

Source: Authors' survey, 2025.

The results suggest that disability inclusion is still in an early stage among Romanian listed companies, with efforts concentrated on physical accessibility and a limited set of disability categories. Nonetheless, the presence of explicit diversity policies in some firms and the adaptation of workplaces in others reflects an encouraging step toward gradual compliance with EU directives and international inclusion frameworks.

These findings provide a factual picture of how Romanian listed companies are beginning to address disability inclusion and workplace accessibility. However, beyond formal policies and reported practices, it is equally important to understand how inclusion is perceived within organizations, which is the focus of the next section.

4.4. Perceptions of Inclusion

To further address RQ2, we examined how companies perceive the role of inclusion in their organizational strategies. Respondents evaluated three statements on a five-point Likert scale: whether inclusion is a strategic priority, whether it contributes to employee retention and workplace climate, and whether it enhances company reputation. The results, summarized in Figure 1, show generally positive perceptions, with the strongest agreement on the reputational benefits of inclusive practices.

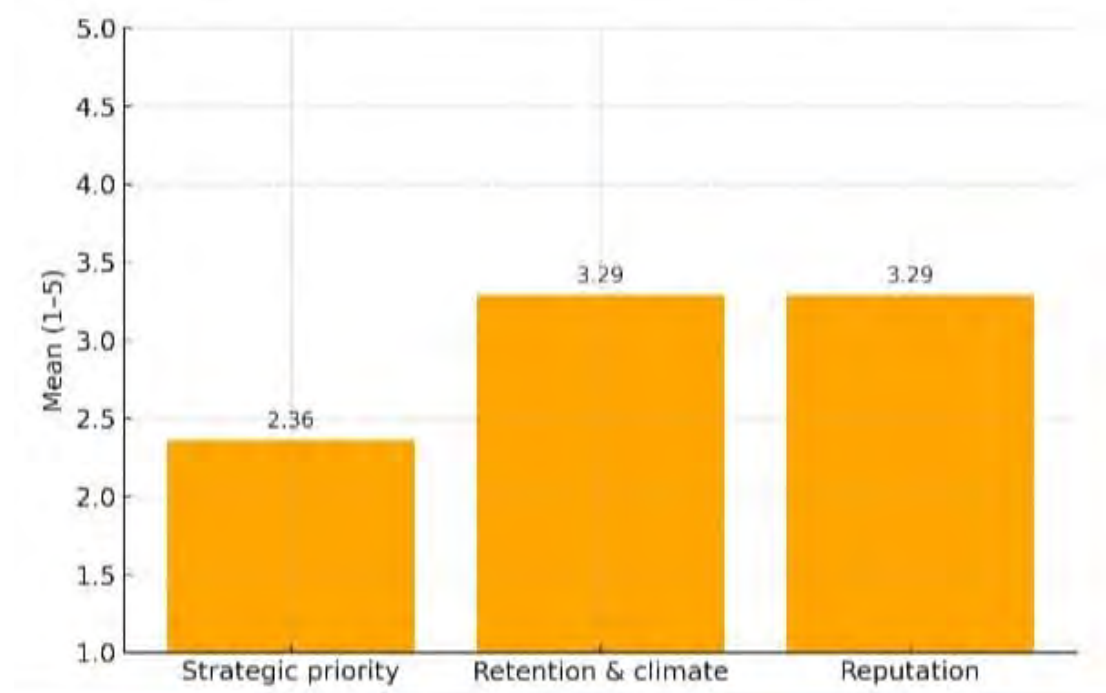


Fig. 1. Perceptions of inclusion among respondent companies (Likert scale means, 1–5).

Source: Authors' survey, generated with R console 2025.

Note: Items reflect (a) inclusion as a strategic priority, (b) inclusion's contribution to employee retention and workplace climate, and (c) inclusion's contribution to company reputation.

As shown in Figure 1, all three aspects received above-average scores, but companies emphasized reputation more strongly than strategic or workplace benefits. This indicates a gradual movement toward European expectations of socially responsible governance. To complement the figure, Table 4 reports descriptive statistics for each item, providing more detail on variability across firms.

Table 4.

Descriptive statistics for inclusion-related items

Item	Mean	SD	Min	Max
Inclusion of persons with disabilities is considered a strategic priority	2.36	1.28	1	5
Inclusion contributes to employee retention and workplace climate	3.29	1.27	1	5
Inclusion contributes to strengthening company reputation	3.29	0.73	2	5

Source: Authors' survey, 2025.

Overall, the findings suggest that while inclusion is not yet widely framed as a core strategic priority, companies increasingly acknowledge its value for workplace climate and reputation. This reflects a gradual but meaningful alignment with European ESG and accessibility standards.

4.5. Perceptions of Inclusion

The survey results show both progress and ongoing challenges in making disability inclusion part of corporate governance and ESG practices. Inclusion is not yet widely seen as a strategic priority, which reflects barriers such as weak internal policies, limited resources, and a narrow focus on only a few disability categories. At the same time, companies acknowledge benefits such as higher employee retention, a better workplace climate, and stronger corporate reputation. These opportunities suggest there is room for further

improvement.

As a pilot study, this research brings two main contributions. First, it provides a partial validation of the questionnaire, showing that the tool can capture differences in policies, workplace accessibility, and company perceptions. Second, the relatively low response rate reflects the level of interest—or in some cases the lack of interest—of Romanian listed companies in the social side of ESG. This finding is consistent with data from the Bucharest Stock Exchange, where only around 20 listed companies currently work to obtain an ESG score, a small part of which also responded to the survey. These outcomes support the refinement of the instrument and its use in larger future studies.

When compared with existing studies, the findings suggest that Romania is still behind several EU countries in adopting systematic inclusion and reporting practices. Western European companies are more advanced in applying diversity policies, board-level initiatives, and sustainability disclosures, while countries in Central and Eastern Europe show gaps similar to those found here (Krasodomska, 2025; Godawska & Rymkiewicz, 2025; Ciurel & Dumitrescu, 2024). This underlines that the social pillar of ESG is unevenly applied across the Union.

Overall, the results indicate that Romania is still in an early stage of aligning with the CSRD and ESRS frameworks, which require transparent reporting on diversity, inclusion, and accessibility. Stronger regulatory support and greater corporate commitment will be needed to make disability inclusion a consistent part of governance and sustainability strategies.

6. Conclusions

This pilot study explored the social dimension of corporate governance among Romanian listed companies, with a particular focus on disability inclusion within ESG practices.

Addressing RQ1 (To what extent do Romanian listed companies integrate the social dimension of corporate governance, especially in relation to ESG-related structures, policies, and practices?): The findings show that while ESG structures and policies remain unevenly adopted, many companies have begun to take steps toward inclusion, especially by employing persons with disabilities in the categories of physical and sensory impairments. This suggests a gradual but still selective alignment with European standards such as the CSRD and ESRS.

Addressing RQ2 (How do these companies address the inclusion of persons with disabilities through employment strategies, workplace accessibility, assistive technologies, and diversity policies?): Survey responses indicate that inclusion is not yet treated as a strategic priority by most firms. However, companies increasingly recognize its value for employee retention, workplace climate, and corporate reputation. These results highlight both barriers, such as limited resources and narrow approaches, and opportunities for building more comprehensive inclusion strategies.

As an exploratory study, the research is constrained by the small number of responses (14 out of 146) and by the reliance on self-reported data. Furthermore, the focus on three sections of the questionnaire restricts the scope of ESG aspects examined. Nevertheless, the study provides an empirical starting point for understanding how Romanian companies approach disability inclusion within ESG frameworks.

The practical implications of these findings are relevant for multiple stakeholders. For companies, the study shows the need to strengthen ESG social strategies by embedding inclusion into long-term governance and reporting practices. For investors, disability inclusion indicators can serve as early signals of compliance with CSRD and ESRS, guiding investment decisions toward socially responsible firms. For policymakers, the results underline the importance of institutional support and clear reporting guidelines to ensure more consistent implementation of ESG standards across sectors.

Looking ahead, future research should broaden the sample of companies to achieve stronger representativeness, while also including comparative analyses between Romania and other emerging markets

in Central and Eastern Europe. Such studies would help clarify regional trends in ESG adoption and provide a richer understanding of convergence with EU standards. In addition, further work could explore the relationship between social ESG practices and financial performance, testing whether inclusion strategies also bring measurable economic benefits.

In sum, despite its limitations, this pilot study contributes to the literature on ESG and corporate governance by offering early evidence of both progress and gaps in disability inclusion among Romanian listed companies. It reinforces the importance of continued alignment with European frameworks, ensuring that accessibility and social responsibility move beyond compliance and become integral parts of corporate strategy.

Affiliation

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Conflict of Interest

The authors declare no conflict of interest

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The Impact of China's Waste Import Ban and Basel Convention Amendments on Global Plastic Waste Trade: A Difference-in-Differences Approach

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Abstract

Global trade in plastic waste was reshaped by the 2018 import ban in China and Hong Kong and the 2021 Basel Convention amendments. This study compares their impacts on HS3915 cross-border flows and the geographic redistribution of exports within a common identification framework, and examines temporal dynamics and heterogeneity linked to enforcement capacity. Using bilateral export data for 2016–2023, we estimate treatment effects via PPML DID/DDD with year and country-pair fixed effects, complemented by event-study designs and pre-trend diagnostics. Exports to China/Hong Kong underwent a one-off yet persistent contraction in 2018, whereas the 2021 amendments exhibits only a limited incremental volume effect. Diverted flows were primarily reallocated to EU gateways and selected ASEAN hubs. The originality of this study lies in the hierarchical identification of the two regulations using PPML within a common econometric context and the counterfactual quantification of the redistribution patterns. Findings indicate that environmental regulation reshapes regional divisions of labor and supply-chain resilience through rule spillovers and trade diversion. Policy implications include harmonizing standards, coordinating enforcement, and jointly developing green recycling capacity within multilateral and regional frameworks to mitigate leakage.

Key words:

global trade in plastic waste, China's import ban, Basel Convention, difference in differences

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1. Introduction

The trade in plastic waste has become a focus of both international and national environmental policy. Governments of developing and developed countries have increasingly begun to take into account not only the positive, but also the negative impacts (Nayanathara Thathsarani Pilapitiya & Ratnayake, 2024) of the international exchange of plastic waste. This, in turn, has been reflected at the international and national levels. Internationally, the desire to reduce and control the quality and quantity of plastic waste has found expression in the amendments to the Basel Convention, the main purpose of which is to reduce trade in plastic waste in order to limit or eliminate their improper disposal and leakage into the environment, illegal trade and protect the interests of developing countries (van der Marel, 2022). Given that the European Union (EU) is one of the main initiators of environmental regulations on the international scene and one of the main plastic waste traders, some of the reforms in the EU legislation over the past decade also deserve attention. These include the EU's plastics strategy from 2018, Directive (EU) 2018/851 (which amended the Waste Framework Directive), the Directive (EU) 2019/904 (the Single-Use Plastic Directive), the Commission Delegated Regulation (EU) 2020/2174 and Regulation (EU) 2024/1157 on shipments of waste. The last two regulations are directly related to the transposition of the Basel Convention amendments.

At a national level, over the past decade we have witnessed a number of changes in state policies, through which governments of countries seek to address social, economic and environmental issues

simultaneously. One of the most impactful measures was the import ban on waste imposed by China in 2018. It was followed by announcements of restrictions by other countries such as India, Vietnam, Thailand, and other countries (Tran, Goto, & Matsuda, 2021) which were also seeking to protect their economies and environment from the enormous quantities of waste redirected to them, especially after China's ban. All the regulatory changes undertaken at national and international level, to one degree or another, have led to changes in the volume and geography of trade in plastic waste. Of course, the magnitude of these changes is expected to vary depending on the scope and the binding nature of the imposed restrictions and regulations.

Taking this into account, the objective of the paper is to examine the influence of China's ban on the imports of plastic waste and the amendments to the Basel Convention on the direction and the value of international transactions in plastic waste. We formulate two research questions: What are the changes in the volume and geography of the trade flows of plastic waste? Do China's import ban and the Basel Convention amendments have the same impact on trends in international plastic waste trade?

To answer these research questions, we employ a methodology designed to capture the impact of the two regulations using the Difference-in-Differences (DID) approach combined with Poisson Pseudo-Maximum Likelihood (PPML) estimation. Our study differs from others in its methodological approach to examining the impact of the Chinese import ban and the amendments to the Basel Convention and estimating their effects on the global plastic waste trade.

2. Literature Review and Hypotheses Development

According to a number of publications, by 2016 China had emerged as a major importer of waste, including plastic, with a share of over 50% of global imports (Brooks, Wang, & Jambeck, 2018; Zhao, Liu, Du, & Gong, 2021; Tran, Goto, & Matsuda, 2021). The introduction of China's import ban in 2018 led to a redirection of plastic waste flows to other countries, raising questions about how trade volumes have changed and in what direction. Some researchers point to developing countries as recipients of plastic waste for various economic and political reasons. Others note that Southeast Asian countries have become the main import hubs, although they lack good infrastructure or a system for environmental waste management (Wang, Zhao, Lim, Chen, & Sutherland, 2020; Zhao, Liu, Du, & Gong, 2021). Tran, Goto and Matsuda (2021), using a descriptive analysis of UN Comtrade data including margin decomposition and statistical tests conclude that the main destinations are mainly low- and middle-income countries in East Asia and the Pacific, along with Europe and Central Asia. Due to lower environmental requirements, lower labor costs and proximity to China, East Asia and the Pacific and South Asia countries are ideal import substitutes after the Chinese ban. However, they cannot absorb all the diverted trade due to a lack of recycling capacity.

The redirection of trade flows from China to other countries is logical and expected, even in the case of plastic waste. Exporters' choice of destination depends on their motivation, which is primarily economic. According to some researchers, the redirection of imports is driven not so much by the demand for plastic waste but rather by exporters' initiative to dispose of waste in other countries, with lower environmental requirements or costs (Chunsuttiwat & Coxhead, 2024; Sommer, 2024), which is the so-called "waste haven" effect. A similar effect has been observed at both global and regional levels of waste trade. Chunsuttiwat and Coxhead (2024) using a standard gravity model confirm the waste haven effect based on GDP per capita and the severity of environmental regulations, with regulations becoming more important after the ban. Sommer (2024) in turn, using a gravity-style difference-in-differences estimating equation, tests for a similar effect within Europe.

The import ban imposed by China drastically reduced imports into the country (Xu, et al., 2024), but did not significantly reduce waste exports, as some countries shifted from net exporters to net importers (Zhao, Liu, Du, & Gong, 2021). In this sense, the solution to pressing social and environmental problems is not truly achieved, but rather relocated to other countries, which is known as the leakage effect. This is

where the role of the amendments to the Basel Convention becomes important. They are intended to provide greater control over the transboundary movement of plastic waste by requiring exporting countries to obtain prior consent from importing countries, thus reducing the volume of illegal dumping of contaminated waste in developing countries. An assessment of how effectively the Basel Convention meets its main objectives is offered by Ishimura, Ichinose and Nomura (Ishimura, Ichinose, & Nomura, 2025). Using bilateral trade data and a difference-in-differences approach, they calculate a 63.7% decrease in the volume of plastic waste trade from developed to developing countries. Moreover, the combination of the two regulations, parallel to tightening the regulations in the EU and non-EU OECD countries has led to increased intra-EU OECD trade and a decline in plastic waste imports by the non-OECD Asian countries (Li, Ward, Lin, & Tukker, 2025).

Consistent with prior research and in the light of the research question posed, we formulate the following hypotheses:

H1: The introduction of China's plastic waste import ban in 2018 has resulted in a sharp reduction in HS3915 exports to China/Hong Kong and a redirection to other destinations.

H2: Displaced HS3915 flows will be reallocated disproportionately toward EU gateways and selected ASEAN hubs, relative to non-hub destinations.

H3: While the 2018 ban resulted in a sharp disruption, the Basel-related effect—if present—emerges more gradually due to compliance and enforcement lags.

H4: The 2021 Basel amendments are manifesting primarily as compositional changes—stronger constraints in higher-enforcement jurisdictions and relatively smaller inflows to non-OECD Asian importers—rather than large additional aggregate volume reductions.

3. Material and Methods

To identify the causal impact of China's (including Hong Kong's) plastic waste import ban and the Basel Convention amendments on international plastic waste trade (HS3915), we employ the Difference-in-Differences (DID) approach, its extended form, the Difference-in-Difference-in-Differences (DDD) and the Poisson Pseudo-Maximum Likelihood (PPML) estimator in a generalized linear model.

DID is a method that has become a benchmark tool for causal identification of the effects of imposing different environmental regulation and trade policies. It compares the changes in time in the "treatment group" and the "control group". It offsets stable inter-group heterogeneity and common shocks by comparing the differences in changes between before and after the policy. In multi-period and asynchronous shock scenarios, we combine the event study form to depict dynamic effects. By comparing the difference between the two groups before and after a policy is implemented, it purifies time-invariant between-group heterogeneity and contemporaneous public shocks. To ensure valid inference, we cluster bilateral country pairs to account for intra-group and serial correlation (Cameron & Miller, 2015). Although both the 2018 China/HK ban and the 2021 Basel amendments take effect uniformly rather than in a staggered fashion, we heed the methodological cautions of Goodman-Bacon (2021) by testing pre-trends and reporting robustness to clustering and coverage thresholds.

Given the frequent occurrence of zero values in trade volume and the variance increasing with the mean, we use the PPML in a generalized linear model to avoid the logarithmic transformation's rejection of zero values while maintaining consistency when the covariance structure is misspecified (Santos Silva & Tenreyro, 2006). Standard errors are clustered at the bilateral country-pair level to be robust to serial and within-pair correlation. To incorporate the Basel Convention Amendments into identification, we also include a joint model with a "Basel Exposure $\times$ Post-2021" interaction term. Furthermore, we use "Basel Exposure" as a third dimension in the DDD to test whether Basel introduces additional relative changes after controlling for common year effects and time-invariant bilateral factors (country-pair fixed effects).

3.1 Lightweight Diagnostics — LITE & SMALL Specs (for quick baselines)

We first adopt a lightweight (LITE) specification. Within PPML, we include only year and importer fixed effects, use China and Hong Kong SAR as the treated destinations, set Post = 2018+, and estimate the DID main effect and event-study coefficients. This setup is computationally light and readable for initial pre-trend and dynamic checks. We cluster by country pair and then move to a stricter pair-FE model as robustness. Intuitively, LITE absorbs global shocks via year FE and time-invariant destination heterogeneity via importer FE but does not absorb time-invariant differences within each reporter-partner pair. Hence, it is a clear starting point; our main conclusions rest on PAIR-FE.

(1) LITE baseline (Year FE + Importer FE, PPML)

$$E[y_{ijt} | X] = \exp(\beta \text{Treated}_j \cdot 1\{t \geq 2018\} + \lambda_t + \alpha_j)$$

where:

y_{ijt} represents the trade value of HS3915 exports in year t from reporter country i to partner country j which is estimated using PPML;

Treated_j denotes whether the importing country is China or Hong Kong SAR. It equals 1 if $j \in \{\text{China, Hong Kong SAR}\}$;

$1\{t \geq 2018\}$ is an indicator for the post-ban period in China;

λ_t is year fixed effects; α_j - importer fixed effects;

β - denotes the DID coefficient on $\text{Treated}_j \cdot 1\{t \geq 2018\}$; the implied percentage change is $(e^\beta - 1) \times 100\%$.

3.2. Core Identification — PAIR-FE (Main Results, Pre-trend, Dynamics)

We tighten identification by moving from LITE to a country-pair fixed-effects (PAIR-FE) design within PPML. This replaces importer FE with pair FE γ_{ij} , absorbing all time-invariant bilateral heterogeneity, so β is identified from within-pair changes around the 2018 China/Hong Kong ban. We keep the same treatment (China & Hong Kong SAR) and post period, cluster standard errors at the country-pair level, and apply modest coverage trimming and the removal of single-year pairs to enhance numerical stability. To probe identification, we add a pre-trend adjustment that allows treated and control groups to have different linear slopes only before the policy and estimate a PAIR-FE event study to check pre-trends and characterize dynamic persistence. PPML is retained to handle zeros and heteroskedasticity and to preserve a proportional-effects interpretation.

(2) PAIR-FE baseline: PPML-DID (year FE + country-pair FE)

$$E[y_{ijt} | X] = \exp(\beta \text{Treated}_j \cdot 1\{t \geq 2018\} + \lambda_t + \gamma_{ij})$$

where:

γ_{ij} - country-pair fixed effects;

(3) Pre-trend adjusted DID (PAIR-FE, PPML)

$$E[y_{ijt} | X] = \exp(\beta \text{Treated}_j \cdot 1\{t \geq 2018\} + \delta \text{Treated}_j \cdot (t - 2017) \cdot 1\{t \leq 2017\} + \lambda_t + \gamma_{ij})$$

Pre-trend term $\delta Treated_j \cdot (t - 2017) \cdot 1\{t \leq 2017\}$ allows the treated and control groups to have different linear slopes only before the policy.

(4) Event study (with 2017 as the base year)

$$E[y_{ijt} | X] = \exp\left(\sum_{k \neq 2017} \beta_k 1\{t = k\} \cdot Treated_j + \lambda_t + \gamma_{ij}\right)$$

β_k are event-time effects: each β_k measures the treated–control differential in year k relative to the base year 2017.

3.3. Basel Amendments Add-ons — Joint, Dynamic, and DDD

(5) Parallel joint model with Basel (PAIR-FE, PPML)

$$E[y_{ijt} | X] = \exp(\beta Treated_j \cdot 1\{t \geq 2018\} + \theta Basel_{ij} \cdot 1\{t \geq 2021\} + \lambda_t + \gamma_{ij})$$

where $Basel_{ij}$ denotes Basel exposure and $1\{t \geq 2021\}$ marks the years after the Basel Amendments entered into force.

(6) Basel dynamic event study

$$E[y_{ijt} | X] = \exp(\theta_{2021} 1\{t = 2021\} \cdot Basel_{ij} + \theta_{2022} 1\{t = 2022\} \cdot Basel_{ij} + \theta_{2023} 1\{t = 2023\} \cdot Basel_{ij} + \lambda_t + \gamma_{ij})$$

(7) DDD

$$E(y_{ijt}|X) = \exp(\beta Treated_j \cdot 1\{t \geq 2018\} + \theta Basel_{ij} \cdot 1\{t \geq 2021\} + \varphi Treated_j \cdot Basel_{ij} \cdot 1\{t \geq 2021\} + \lambda_t + \gamma_{ij})$$

where :

β - DID effect of the China/Hong Kong import ban.

θ - Overall DID effect of the Basel amendments.

φ - DDD incremental effect (additional change for treated vs. control among Basel-exposed pairs after 2021).

3. 4. Main Empirical Results

LITE & SMALL Results

The main results reported in Table 1 show that exports in the post-policy treatment group decreased by approximately 89.5% relative to the control group. Given the significant deviation in event studies in 2016, we introduce a pre-trend term to correct for this; the corrected DID main effect is -87.3% . An alternative estimate with HC3 robust standard errors confirms robustness. In a small-sample regression (SMALL) containing only the top ten exporting countries and pairwise FE, the DID effect is even larger, approximately -95.1% , reflecting a particularly significant contraction in top trade relations after the ban. However, this specification is primarily for robustness and comparison purposes, not for the main results (See Table 1).

Table 1
LITE & SMALL Main Results

Specification	FE Setup	SE Treatment	DID Coefficient (log β)	DID Effect %
LITE + PreTrend	Year FE + Importer (partner) FE	Clustered by country pair	-2.0649	-87.3%
LITE (HC3)	Year FE + Importer (partner) FE	HC3 heteroskedasticity- robust	-2.2520	-89.5%
LITE (cluster = pair)	Year FE + Importer (partner) FE	Clustered by country pair	-2.2520	-89.5%
SMALL (HC3)	Year FE + Country-pair FE (reporter $\times$ partner)	HC3 heteroskedasticity- robust	-3.0118	-95.1%

Source: Authors' calculations, 2025.

The data are from bilateral annual trade records, focusing on HS 3915: "Waste, parings and scrap, of plastics", export flows, and the period 2016–2023. We remove the "statistical aggregation destination," unify the country key (reporter–partner), and convert trade values to numerical values. We remove all-zero country pairs to ensure identifiability consistent with the PPML. The treatment group is defined as China and Hong Kong SAR, with the post-policy period covering 2018 and later, and the base year being 2017. In the main PAIR-FE specification, we further remove country pairs that appear in only one year and estimate within the set of country pairs whose cumulative coverage of base-period trade contributions is $\geq 95\%$ to reduce dimensionality and improve numerical stability. The final sample contains $N = 19,134$ observations, 170 exporting countries, 216 importing countries, and 4,978 country pairs; approximately 346 high-weight country pairs remain after PAIR-FE trimming. The dependent variable is trade volume, and the estimation method is PPML (log link).

Table 2
PAIR-FE (Year FE + Country-pair FE) Main Results with Pre-trend Adjustment

Specification (Spec)	Sample Treatment	Fixed Effects	SE Treatment	DID Coefficient (log β)	DID Effect %	95% CI
PAIR-FE + PreTrend	Coverage $\geq 95\%$, retaining 346 country pairs	Year FE + Country-pair FE (reporter $\times$ partner)	Clustered by country pair	-2.4410	-91.3%	[-95.0, -84.8]
PAIR-FE (baseline)	Same as above	Year FE + Country-pair FE (reporter $\times$ partner)	Clustered by country pair	-2.6745	-93.1%	[-96.1, -87.9]
PAIR-FE (joint, +Basel)	Same as above + includes post- 2021 $\times$ Basel_pair	Year FE + Country-pair FE (reporter $\times$ partner)	Clustered by country pair	-2.6754	-93.1%	[-96.1, -87.9]

Source: Authors' calculations, 2025.

In this sample, the DID main effect without the pre-trend correction is $\log \beta = -2.6745$, which corresponds to a mean decline of approximately 93.1 % in the treated group relative to the control group after 2018 (Table 2).

In the joint PAIR-FE specification that augments the model with Basel exposure, Basel_pair is equal to 1 when both the exporter and the importer are parties to the Basel Convention, and this variable is

interacted with Post2021 to capture any shift associated with the 2021 amendments.

By contrast, the Basel effect is $\log \beta = 0.1397$, corresponding to +15.0% with a wide 95% CI [−14.2%, +54.0%] and $p = 0.349$; statistically it is indistinguishable from zero (See Table 6). Taken together—with year fixed effects already absorbing any global shocks common to all pairs—there is no detectable incremental impact of the 2021 Basel amendments on HS3915 bilateral exports beyond the general time effects, while the China/HK ban remains the dominant, precisely estimated shock.

Table 3

Dynamic Effects of the Basel Amendments (PAIR-FE Event Study)

Year	Interaction (Basel_pair $\times$ 1[year==t])	$\log \beta$	Effect %	95% CI for %	p-value
2021	Basel_pair $\times$ 1[2021]	0.0430	+4.40	[−22.40, +40.46]	0.776
2022	Basel_pair $\times$ 1[2022]	0.2544	+28.96	[−6.63, +78.12]	0.123
2023	Basel_pair $\times$ 1[2023]	0.1076	+11.36	[−21.88, +58.75]	0.552

Source: Authors' calculations, 2025.

In the PAIR-FE framework, we interact Basel_pair (both parties are contracting parties) with year indicators for 2021, 2022, and 2023, respectively, to identify the impact of the 2021 amendment and its potential lagged path. The results show an incremental effect of +4.4% in 2021, +29.0% in 2022, and +11.4% in 2023 (See Table 3). The 95% confidence intervals for all three values cross 0, and the magnitude and direction do not exhibit a monotonic or persistent pattern. Therefore, based on the evidence from HS3915, we do not observe a robust, statistically significant additional decline in trade due to the amendments. In contrast, the main effect of the DID for the China/Hong Kong ban remains highly significant at around −93% in the joint model, indicating that this shock is the dominant factor in the structural shift in international trade in this category.

When we further include a correction term for the “treatment group $\times$ pre-policy linear trend”, the main effect is estimated at $\log \beta = -2.4410$, corresponding to a −91.3% effect. The coefficient on the trend-adjustment term is −35.8%, indicating that, prior to the policy implementation, the treatment group already exhibited a downward relative trend compared to the control group. After explicitly correcting for this difference, the point estimate of the policy effect rebounds slightly, but remains large and highly statistically significant; this suggests that our findings are not artifacts of pre-policy trends but rather reflect policy-related shocks affecting China/Hong Kong after 2018. Combined with the event-study evidence, the estimates point to a large initial shock in 2018 with persistent reductions thereafter. Robustness checks show that the estimated treatment effects are stable across different sample coverage thresholds and clustering schemes (See Table 4 and Table 5).

Table 4

Sensitivity to Coverage Threshold (Sample Trimming) — PAIR-FE Main Effect

Coverage Threshold (Baseline Cumulative Coverage)	DID Effect %	95% Confidence Interval
COVER = 90%	−93.1%	[−96.2, −87.4]
COVER = 95%	−92.9%	[−96.0, −87.4]
COVER = 99%	−93.2%	[−96.1, −88.0]

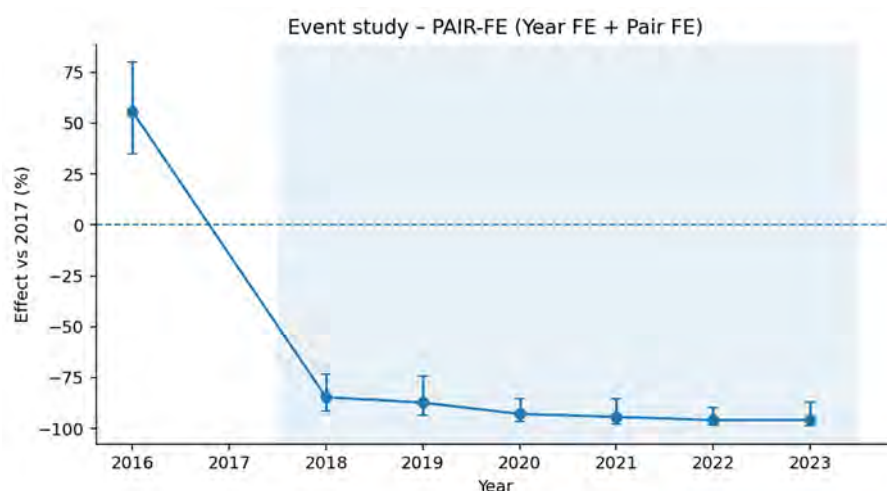
Source: Authors' calculations, 2025.

Table 5
Sensitivity to Clustering Method — PAIR-FE Main Effect (Coverage = 95%)

Clustering Method	$\log(\beta)$	Standard Error (SE)	DID Effect %	95% Confidence Interval
Clustered by country pair	-2.6745	0.2879	-93.1%	[-96.1, -87.9]
Clustered by importer (partner)	-2.6745	0.2157	-93.1%	[-95.5, -89.5]
Clustered by exporter (reporter)	-2.6745	0.2887	-93.1%	[-96.1, -87.9]

Source: Authors' calculations, 2025.

In summary, the PAIR-FE results are very similar after incorporating the pre-trend adjustment, both in sign and magnitude. Even under the most conservative specification, exports to China/Hong Kong fall by about -90% , and the policy impact appears immediate and persistent. These estimates should be interpreted as the causal effect on HS3915 flows to China/Hong Kong relative to other destinations; any post-ban diversion of waste to third countries would likely bias this relative estimate toward zero, making our effect a conservative lower bound.


Fig. 1. Event study (PAIR-FE; percentage effect relative to 2017)

Source: Authors, 2025.

Based on the results of an event study using 2017 as the base year, the one-off policy shock clearly emerges. In 2018, the year the ban took effect, trade plummeted by approximately 84.6% relative to the base year. The negative effect then deepened in 2019 and remained largely stable between -93% and -96% from 2020 to 2023. This suggests that HS3915 flows to China/HK have not experienced a systematic rebound, more consistent with a permanent reallocation than a short-term disturbance. Furthermore, the persistently deep negative trade situation revealed in the event study has led to alternative flows—not an abolition of trade, but rather a significant shift to a few destinations and regions with transshipment and reprocessing capabilities.

Table 6
Basel amendments — Triple-Differences (DDD) under PAIR-FE (PPML)

Exposure definition (Basel)	DDD coefficient ($\log \beta$)	Effect %	95% CI for %	p-value
Basel (pair): both reporter & partner are parties	0.1397	+15.0%	[-14.2%, +54.0%]	0.349
Basel (importer): importer is a party	-0.1751	-16.1%	[-37.7%, +13.1%]	0.250
Basel (exporter): exporter is a party	0.3101	+36.4%	[-9.3%, +104.9%]	0.136

Source: Authors' calculations, 2025.

Within the PPML framework with year and country-pair fixed effects, we add a Basel exposure $\times$ post2021 interaction term after 2021 to construct three DDD specifications to identify the additional marginal impact of the amendments on cross-border trade in HS3915. Because the model includes year fixed effects, any global shocks are absorbed, while the country-pair fixed effects absorb all time-invariant bilateral heterogeneity. Therefore, the DDD coefficient can be interpreted as the additional change in the Basel-exposed group relative to the unexposed group after 2021, net of the effect after controlling for the China/Hong Kong ban and other confounding factors.

The results show that the point estimates for the three Basel exposure measures are not in the same direction (positive for pair-pair and export-only, negative for import-only), and the confidence intervals all cross 0 and are statistically insignificant ($p=0.35/0.25/0.14$). This suggests that in the HS3915 (plastic waste) category, we do not find a robust, identifiable additional decline attributable to the 2021 Basel Convention amendments. In contrast, the DID main effect of the China/Hong Kong ban remains highly significant at approximately -93% in the joint model, and its value is stable across different DDD measures, indicating that the rupture in this category is primarily driven by the China/Hong Kong ban.

From an empirical identification perspective, this finding has two implications: (i) after controlling for global year shocks, there is no systematic difference between Basel-exposed pairs and non-exposed pairs; and (ii) the implementation of Basel may be subject to compliance lags, differences in enforcement intensity, and the applicable boundaries of HS3915, making the true effect difficult to accurately identify in this data structure.

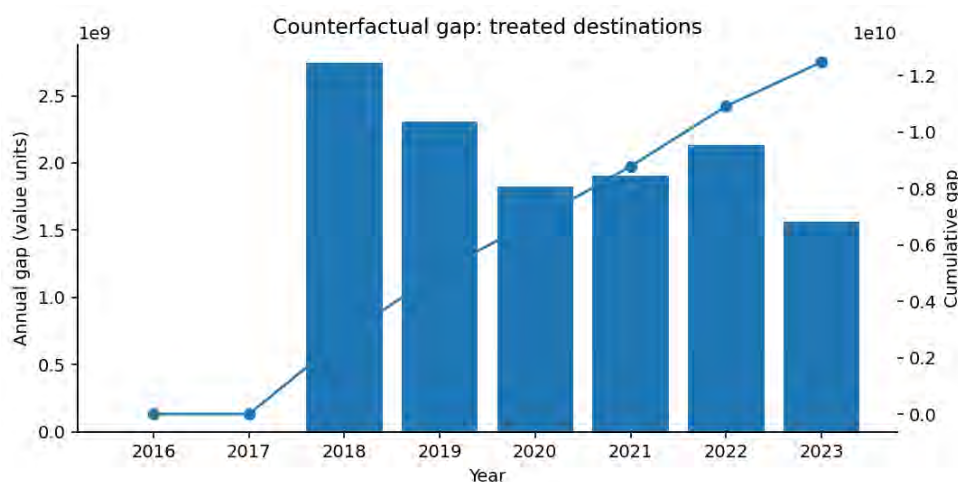


Fig. 2. Counterfactual gap (China/HK as processing destination)

Source: Authors, 2025.

We use the "PAIR-FE + pre-trend" model as the main model. While holding the established independent variables and fixed effects constant, we artificially disable only the "policy shock" factor. Based on this, we use the estimated model to re-forecast the trade level for each observation under the pre-ban scenario. The resulting re-forecast is the counterfactual level; the difference between this and the real-world model prediction is the gap for that observation.

The gaps for all treated units are aggregated by year to produce the annual gap, which is then summed across years to produce the cumulative gap. This cumulative gap is estimated to be approximately \$12.479 billion by the end of 2023. It is important to emphasize that our regression includes both year-fixed effects and reporting country $\times$ destination-fixed effects. The former eliminates common global shocks, while the latter controls for time-invariant structural heterogeneity within each country-pair relationship. Therefore, the gaps mentioned above should be interpreted as the additional reduction in trade with China and Hong Kong

caused by the ban relative to the control group after controlling for these common factors—i.e., a relative gap—rather than a simple projection or accounting of a decline in global plastic waste trade. At the same time, this gap does not equate to a net loss in global welfare or global trade. The EU, ASEAN and other regions have taken on a considerable portion of the squeezed-out traffic, while another portion may be reflected through transit in third places or differences in caliber.

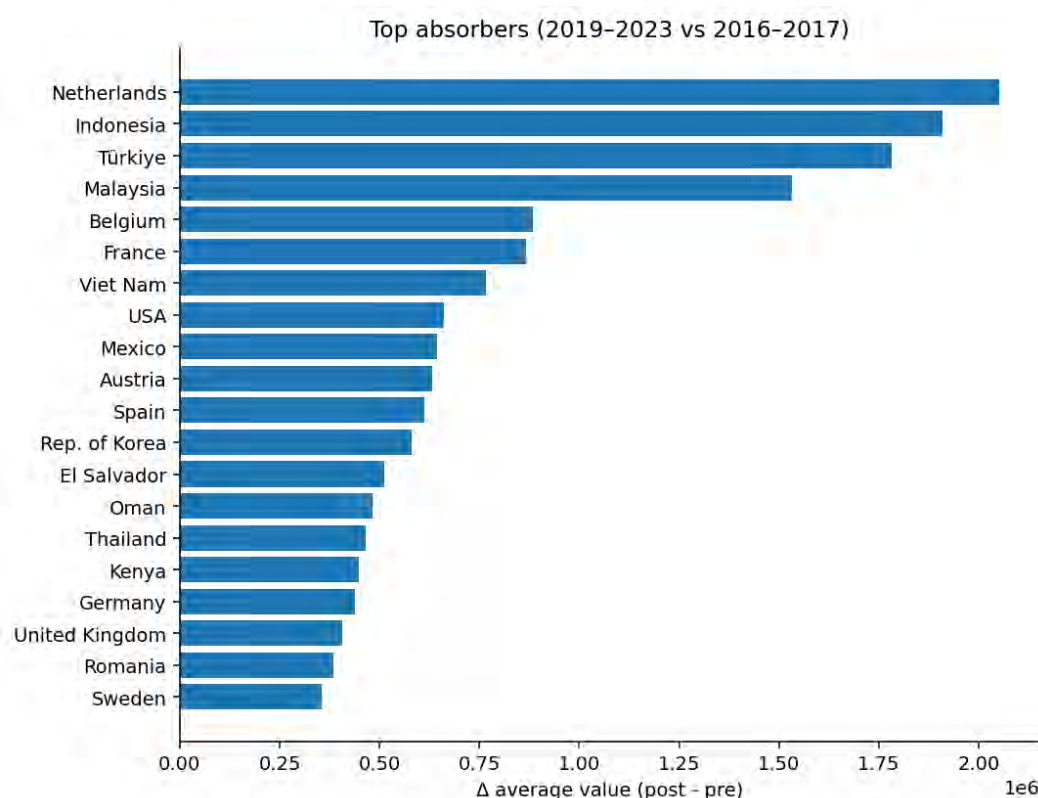


Fig. 3. Top absorbers (2019–2023 vs 2016–2017)

Source: Authors, 2025.

Table 7

Regional summary of destination increments

Region	Sum of Δ	Share of total
EU	7,042,703	38.3%
ASEAN	5,086,183	27.7%
OTHER	2,880,947	15.7%
AMER	1,617,581	8.8%
AFR	633,016	3.4%
ME	567,733	3.1%
EASIA	564,888	3.1%
Total	18,393,051	100%

Source: Authors' calculations, 2025.

The geographical center of gravity has clearly shifted toward Europe and Southeast Asia. Regionally, the EU absorbed approximately 38% of global growth, and ASEAN approximately 28%, totaling over two-thirds. This is consistent with the country rankings in the chart—EU members such as the Netherlands, Belgium, France, Spain, Austria, Sweden, and Romania, as well as Southeast Asian economies such as

Indonesia, Malaysia, Vietnam, and Thailand, are at the top (See Table 7).

The role of "gateway/transshipment-processing-re-export" nodes has become increasingly prominent. The Netherlands ranks first, consistent with its port and transshipment network status; Turkey and Malaysia also saw significant growth, reflecting both capacity expansion and policy facilitation; and growth in the United States and Mexico suggests a redistribution within North America (See Fig. 3).

Third, while the relative growth rates of smaller base countries, such as Kenya and Oman (Kenya +485% and Oman +220%), were impressive, their absolute absorption remained below the primary growth in the EU and Southeast Asia. This suggests that, aside from marginal gains from a few new entrants, the primary growth was still being handled by established nodes. After 2018, direct flows to China/HK plummeted. Accordingly, the global trade chain was restructured through the EU and Southeast Asian hubs, absorbing and reallocating part of the original flows (See Table 8).

Table 8

Identifying "Top New Destinations" by Exporting Country (2019–2023 vs. 2016–2017)

Exporter (reporter)	Drop to China+HK	Top new destination	Increase at top dest	Absorption ratio (%)
Japan	425,863,186	Malaysia	70,691,710	17.0
Germany	193,722,175	Netherlands	33,845,698	17.0
Netherlands	41,894,906	Indonesia	30,280,236	72.0
United Kingdom	84,077,966	Türkiye	24,094,767	29.0
Belgium	25,188,055	Netherlands	20,604,383	82.0
Canada	30,392,897	USA	20,223,784	67.0
Portugal	6,715,385	Spain	14,928,233	222.0
USA	393,536,978	Mexico	14,129,082	4.0
Austria	2,308,768	Germany	11,329,759	491.0
China, Hong Kong SAR	707,903,516	Viet Nam	11,043,975	2.0
Ireland	2,131,978	United Kingdom	8,877,719	416.0
Poland	22,976,600	Germany	8,539,984	37.0
Tunisia	1,239,641	Türkiye	8,343,234	673.0
Spain	50,020,139	Türkiye	7,961,869	16.0
China	447,140	Oman	7,278,139	1,628.0
Other Asia, nes	36,430,719	Malaysia	6,834,537	19.0
France	41,155,182	Spain	6,664,708	16.0
Denmark	671,527	Netherlands	6,552,106	976.0
Italy	7,869,410	Austria	6,474,261	82.0
Philippines	1,014,677	Viet Nam	6,224,668	613.0

Source: Authors' calculations, 2025.

Based on a one-to-one 'preferred new destination' identification framework, the most important export destinations and their respective volume shares at the exporting-country level following the China–Hong Kong ban are identified; overall, two notable reallocation channels emerge. First, rerouting within the EU

and its immediate neighbors: The preferred new destinations for countries like Germany, Belgium, Denmark, and Poland are primarily the Netherlands or Germany, consistent with the distribution, transshipment, and reprocessing functions of ports like Rotterdam and Hamburg. Turkey is the preferred destination for countries like the United Kingdom, Spain, and Tunisia, demonstrating the widespread utilization of processing and transshipment capacity along the Mediterranean-Black Sea coast following the policy shock. Second, the substitution capacity of Southeast Asia and North America has increased. Japan has shifted to Malaysia, the Netherlands to Indonesia, and Hong Kong and the Philippines to Vietnam, reflecting Southeast Asia's role in sorting, recycled pellets, and re-export. Canada and the United States have their preferred destinations in the United States and Mexico, respectively, consistent with the logic of nearshoring and re-export within North America (See Table 8).

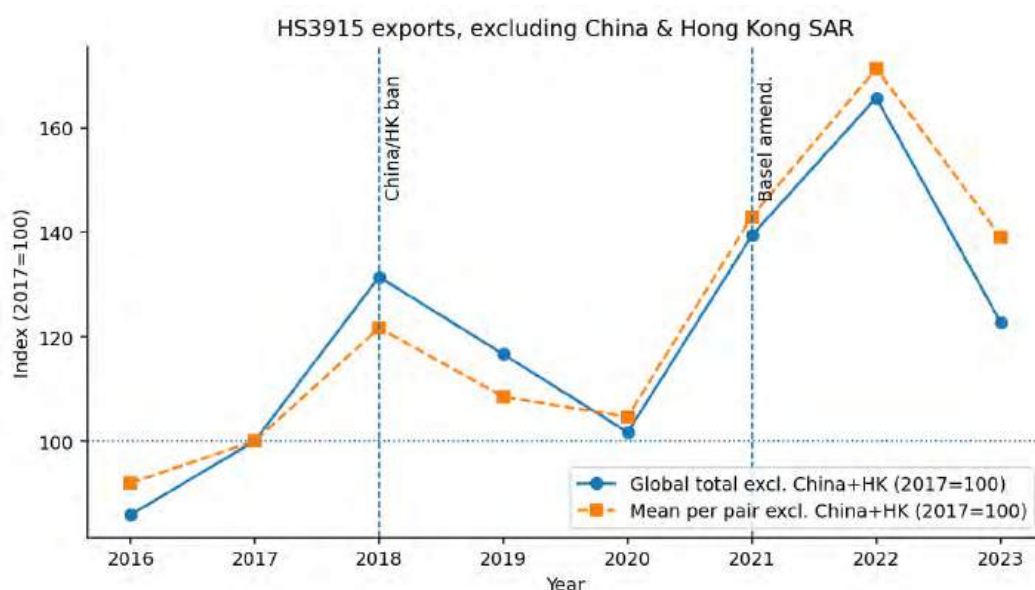


Fig. 4. Exporter-reported shipments of HS3915 to destinations excluding China & Hong Kong SAR (2017=100)

Source: Authors, 2025.

Global HS3915 exports excluding China and Hong Kong (2017=100) are used as an index, alongside a global aggregate index excluding China/Hong Kong and a country-specific mean index excluding China/Hong Kong. Vertical lines indicate the 2018 China/Hong Kong import ban and the 2021 Basel amendments. Both non-China/Hong Kong series jump in 2018, suggesting that flows squeezed out of China/Hong Kong were reallocated to other destinations rather than reflecting a simultaneous global contraction (see Figure 4).

The subsequent decline in 2019–2020 reflects a rebalancing amidst short-term disruptions such as the pandemic and transport. The two curves then rise in parallel again in 2021–2022, reflecting a broad global resonance consistent with the Basel Convention amendments and the post-pandemic recovery in demand. This shows that the 2018 "China-Hong Kong Breakpoint" and the 2021 "Global Step" are distinguishable in terms of timing and nature: the former represents a negative shock specific to China and Hong Kong, with an accompanying transfer to third countries, while the latter represents a common global shift. This descriptive evidence therefore supports the view that the ban effect and the Basel effect are not the same shock and are not confounded in our baseline estimations.

Conclusion

The social and environmental consequences of the use of plastic products confirm the need to both reduce their production and improve recycling, and to regulate the trade in plastic waste. In their attempts to limit the negative social and environmental effects, the international community and individual countries introduce regulations aimed at achieving similar effects. Some of them are the amendments to the Basel Convention and the ban on waste imports into China. The results of our analysis fully confirm hypotheses H1, H2 and H4 and partially the third. At first glance, they show a large difference in the effects of the two studied regulations. The Chinese ban as a national regulation of an imperative nature leads to a sharp decrease in the export of plastic waste to China/Hong Kong and their redirection to other destinations. DID estimates range from –87% to –95%, and the PAIR-FE event study shows a one-off break in 2018 with sustained low levels until 2023. In parallel with the significant decline in imports of plastic waste in the target group, there is a trend of redirection to other destinations and countries. According to the regional accounting and top-destination mapping, the displaced flows of plastic waste were relocated mostly to EU gateways (~38.3%) (primarily to Netherlands and Germany) and selected ASEAN hubs (as Malaysia, Indonesia and Vietnam) (~27.7%) and smaller shares to other regions. Comparing to China's import ban, the Basel Convention amendments does not lead to a drastic reduction or redirection of trade flows of such waste after the implementation, but rather to controlling their quality. The Basel event-time effects for 2021–2023 are small with confidence intervals crossing zero. The Joint/DDD models show no robust additional aggregate reduction, consistent with compositional shifts by enforcement capacity. The results highlight the need for greater international cooperation to implement effective regulations that promote optimal use of plastic waste to simultaneously achieve economic, social and ecological goals.

Acknowledgement

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Development of the Baltic States in the Eurozone: Selected Aspects

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JEL: E42, F45, O52

Abstract

The transformation of a national monetary system is of fundamental importance to any state. Participation in a monetary union entails a specific set of requirements, constraints, and opportunities. Countries acceding to the Eurozone (EZ) find themselves at varying stages of socio-economic development. This necessitates the management of specific requirements and challenges during pre-accession processes, as well as subsequent comprehensive integration into the system. Potential shortcomings at the national level may serve as a catalyst for socio-economic volatility in the short and medium term. The decision to join the EZ may be predicated on either economic or political justifications. The outcomes of such strategic decisions can be monitored in subsequent periods through fluctuations in key macro- and microeconomic indicators.

The object of this publication is three nations that exhibited relatively similar levels of development upon their accession to the EZ. The subject of the study involves several core indicators. The primary objective is to examine the shifts and trends within these key metrics. The research methodology incorporates qualitative analysis and statistical methods, supplemented by comparative evaluations.

Key words:

eurozone, development, indicators

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Introduction

The development of European nations is shaped by a series of significant political decisions that determine socio-economic achievements and societal prosperity. Fundamental strategic decisions include membership in the European Union (EU), inclusion in the Schengen Area, the adoption of the single currency (EZ), participation in collective defense alliances (NATO), and the implementation of Union energy policies, among others. The realization of major strategic national objectives requires prolonged preliminary preparation and the fulfillment of established criteria. Participation in these European unions is evaluated through the achievement of a complex set of primary and secondary indicators.

This publication focuses on analyzing the achievements of Lithuania, Latvia, and Estonia across key performance indicators. The primary goal of the study is to track development within the context of adopting the single European currency and joining the Eurozone. The research utilizes official statistical data and the method of comparative analysis. A comparison is made against the average values achieved within the EU and the EZ. Furthermore, data for Bulgaria is tracked, with the notation that, as of 2024, the country is not a member of the Eurozone.

Baseline information regarding the timeframe for the implementation of strategic decisions by the studied nations is presented in Table 1.

Table 1

Accession dates of Lithuania, Latvia, and Estonia to European structures and population figures.

Country	EU Membership	EZ Membership	Schengen Membership	Population
Lithuania	May 18, 2004	Jan 01, 2015	Dec 21, 2007	2,285,900
Latvia	Sep 01, 2004	Jan 01, 2014	Dec 21, 2007	1,871,900
Estonia	Sep 01, 2004	Jan 01, 2011	Dec 21, 2007	1,374,700

1. Economic Development

Economic development is defined as a sustained improvement in the standard of living of a nation's population. National development is characterized by the achievement of results reflected in key economic indicators, such as Gross Domestic Product (GDP), employment, unemployment, and inflation, among others.

This study adopts the following fundamental definitions for these primary indicators:

- **Public Debt:** Represents the total financial liabilities of the central government and local authorities.
- **Gross Domestic Product (GDP):** An aggregate index measuring the total market value of all goods and services produced within a country.
- **Unemployment:** An index representing individuals of working age who are not currently employed.
- **Inflation Index:** A measure of the general increase in the prices of goods and services within a country.
- **People at Risk of Social Exclusion:** The proportion of the population living below the established national poverty threshold for a given period.

These key economic indicators provide a situational "snapshot" as of 2024 and are statistically monitored over fixed intervals.

Table 2

Key Economic Indicators for 2024 by Country and Region

Indicators	EU	EZ	Estonia	Latvia	Lithuania	Bulgaria
People at risk of social exclusion	20.9%		22.2%	24.3%	25.8%	30.3%
Inflation	2.6%	2.4%	3.7%	1.3%	0.9%	2.6%
Unemployment (ages 15-74)	5.9%	6.4%	7.6%	6.9%	7.1%	4.2%
Youth Unemployment (under 25)	14.9%	14.6%	19.1%	13.6%	16.2%	12.3%
GDP per capita (EUR)	33,550	36,100	21,020	17,510	19,580	11,300
Public Debt	81.0%	84.4%	23.6%	46.8%	38.2%	24.1%
Electricity Price per MWh (EUR)	290.0	309.3	210.7	230.3	223.5	121.5

Source: Author's calculations based on Eurostat data.

Regarding the primary indicator of GDP per capita, a clear divergence is observed between the studied nations and the average values for the EU and the Eurozone (EZ). The lag is tangible compared to EU figures and particularly pronounced relative to the EZ, with notable variations among the three Baltic states

themselves. A proportional correlation is observed (if one seeks a direct link) between GDP levels and the timing of Eurozone accession: Estonia was the first to join and currently maintains the highest GDP. Conversely, the situation regarding inflation is inverted. Lithuania records the lowest values-well below the EU average-while Estonia records the highest, at four times the rate of Lithuania and 1.1 percentage points above the EU average. Latvia also maintains favorable levels, remaining below both EU and EZ averages. As expected, Bulgaria's figures align precisely with the EU average.

In 2024, unemployment rates in Lithuania, Latvia, and Estonia exceed the EU and EZ averages. The relatively high level of total unemployment (7.6%) and particularly youth unemployment in Estonia-exceeding 19%-is noteworthy. For Bulgaria, this indicator remains within a favorable range and significantly below the levels of the studied Baltic states.

The fiscal discipline of national governments can be monitored through public debt levels. The highest public debt has accrued in Eurozone countries, averaging over 84% of GDP. EU values are similar, standing at 81% for 2024. In contrast, the public debts of the Baltic states remain relatively low, staying below 47% (in the case of Latvia). Estonia demonstrates exemplary performance at 23.6% (the best in the EU and EZ), followed closely by Bulgaria at 24.1%.

From a research perspective, two relatively new indicators are of particular interest: the risk of social exclusion and energy prices per MWh. Regarding the former, data has been trackable since 2015. The 2024 EU average stands at nearly 21% (data for the EZ is unavailable). Estonia is closest to this figure (22.2%), while Bulgaria records the highest rate at 30.3%, indicating that nearly one-third of its population faces limited opportunities and prospects.

The indicator for energy access and security has become fundamental due to its impact on quality of life and its decisive role in the competitiveness of European industry. The current snapshot reveals significant disparities. Average EZ prices amount to €310/MWh, with similar rates across EU member states. Among them, the values for Lithuania (€223), Latvia (€230), and Estonia (€210) are relatively the lowest. Bulgaria maintains the lowest prices overall (€121/MWh)-nearly 2.7 times lower than the EZ average. In this context, if a correlation is sought between energy prices and external debt, the countries with the lowest energy costs (Estonia and Bulgaria) have also generated the lowest public debt.

2. Statistics and Analysis

To monitor the developmental stages and trajectories of the economies under review, the following macroeconomic indicators are employed: inflation, GDP per capita, and the proportion of the population at risk of social exclusion.

The initial indicator analyzed in this research is inflation. The statistical dataset spans the period from 2013 to 2024 (Table 3).

Table 3

Inflation Rates (%)

Region/Country	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
EU	1.3	0.4	0.1	0.2	1.6	1.8	1.4	0.7	2.9	9.2	6.4	2.6
EZ	1.4	0.4	0.2	0.2	1.5	1.8	1.2	0.3	2.6	8.4	5.2	2.4
Estonia	3.2	0.5	0.1	0.8	3.7	3.4	2.3	-0.6	4.5	19.4	9.1	2.5
Latvia	0.0	0.7	0.2	0.1	2.9	2.6	2.7	0.1	3.2	17.2	9.1	1.3
Lithuania	1.2	0.2	-0.7	0.7	3.7	2.5	2.2	1.1	4.6	18.9	8.7	0.9
Bulgaria	0.4	-1.6	-1.1	-1.3	1.2	2.6	2.5	1.2	2.8	13.0	8.6	2.6

Source: Author's calculations based on Eurostat data.

Cumulative inflation over the ten-year period from 2015 to 2024 (expressed as a percentage) is as follows: EU - 129.67; EZ - 126.07; Estonia - 155.1; Latvia - 145.3; Lithuania - 150.79; Croatia - 132; and Bulgaria - 137.63. Estonia recorded the most significant growth during this period, with inflation exceeding 55%-nearly double the rates observed in the EU and the Eurozone. To some extent, this does not align with the exceptionally low levels of public debt generated during the same timeframe relative to the other countries under review. This discrepancy lacks a purely economic justification and may instead be attributed to specific socio-cultural factors. By way of comparison, cumulative inflation in Croatia reached 32% during the same period. This figure is closely aligned with EU and Eurozone levels, despite Croatia's higher public debt. A potential driver for this stability is the stringent fiscal discipline mandated by Croatia's preparations for Eurozone accession in 2023.

The trajectory of the inflation index varies across the studied nations. However, the general trend indicates that since 2013, all three Baltic states have consistently recorded higher inflation rates than the EU and Eurozone averages. Exceptions include Estonia in 2020 and Latvia in 2013, 2020, and 2024. While Lithuania exhibited more favorable figures during certain intervals, a distinct trend emerges when comparing the periods before and after its adoption of the single currency. Prior to 2015, the inflation index remained low; subsequently, it experienced significant increases across all analyzed periods, with the exception of 2024. The analysis reveals substantial deviations between 2021 and 2023, during which recorded inflation was nearly double the Eurozone average. In 2022, inflation exceeded 19% in Estonia, with Lithuania reaching similar levels. In summary, for the majority of the period under review, the inflation index in these countries remained significantly higher than the EU and, more notably, the Eurozone averages.

A comparison with Bulgaria yields interesting results. For seven of the years analyzed, Bulgaria maintained lower inflation rates than the EU and Eurozone averages, as well as the Baltic states. However, the disproportionately high inflation spike in 2022 and 2023 warrants attention, as these figures appear excessive within the context of the country's Eurozone accession preparations.

The subsequent primary indicator included in this analysis is GDP per capita. The dataset covers a significant 24-year period (Table 4).

Table 4

GDP per capita (in EUR)

Region/Country	2000	2004	2007	2011	2014	2015	2019	2022	2024
EU	25660	27100	29190	29030	29160	29780	32200	33290	33550
EZ	30330	31600	33700	33140	33060	33660	35950	36910	37040
Estonia	10480	13980	18400	16590	18280	18650	21650	22430	21020
Latvia	6540	9240	13220	11380	13140	13750	15820	16870	17510
Lithuania	6550	9940	12190	12140	14100	14630	17870	19360	19580
Bulgaria	4160	5380	6660	7390	7760	8130	9670	10740	11300

Source: Author's calculations based on Eurostat data.

Predictably, the GDP per capita indicator exhibits a consistent upward trend. This is evident in both the average values for the EU and the Eurozone (EZ), as well as on an individual country basis. For the purposes of this study, the dynamics following the adoption of the single currency will be examined.

From 2011 to 2024, the EU's GDP increased by 15.5%, while the Eurozone countries saw a growth of 11.7%. During the same period, Estonia recorded a growth rate of 26.7%. Between 2014 and 2024, GDP growth in the EU was 15% and in the EZ 12%, while Latvia achieved a growth of 33.2%. For the 2015-2024 period, the average GDP growth was 12.6% for the EU and 10% for the EZ, whereas Lithuania recorded a growth of 33.8%.

Several generalizations can be drawn from these figures. Estonia shows the lowest relative growth compared to the EU and EZ averages, as well as compared to the results achieved by Lithuania and Latvia. It is important to note the specific context: Estonia began from a significantly higher baseline than the other two nations (with a GDP of €16,590 in 2011) and was the first to join the Eurozone. A significant factor in this comparison is also the exceptionally high level of inflation experienced after its accession to the EZ.

Latvia registered a GDP growth of 33.2%, which is double the EU growth rate and 2.8 times higher than that of the Eurozone. The relationship with inflation levels appears to be inversely proportional. During the period under review, Lithuania recorded the lowest inflation levels compared to the other countries. This correlation is distinct both in the years leading up to its Eurozone accession and following its formal membership.

Lithuania was the last of the "Baltic trio" to adopt the single currency. It achieved a GDP growth of 33.8% within the shortest timeframe. During the same period, the average growth for Eurozone countries was 10%.

Since 2011, Bulgaria has recorded a GDP growth of 52.9%. Comparisons with Estonia, for example, reveal a significant disparity in the baseline: Estonia's GDP was 2.2 times higher than Bulgaria's in 2011. Over the course of 13 years, despite not being a member of the Eurozone, Bulgaria has managed to reduce this gap to 1.8 times. It should be noted, however, that comparisons with Bulgaria are not entirely equivalent, given that the country is not yet a member of the Eurozone.

Table 5**Public Debt as a Percentage of GDP (%)**

Region/Country	2000	2004	2007	2011	2014	2015	2019	2022	2024
EU	66.6	67.1	62.4	81.7	86.9	85.1	77.4	82.5	81.0
EZ	69.2	69.7	65.9	87.3	92.9	91.0	83.6	89.5	87.4
Estonia	5.1	5.2	3.9	7.6	11.6	10.8	9.0	19.1	23.6
Latvia	12.4	15.2	8.9	46.4	43.1	38.3	37.9	44.4	46.8
Lithuania	23.5	18.6	15.9	37.4	40.7	42.4	35.6	38.1	38.2
Bulgaria	70.7	35.7	16.3	15.2	27.0	25.9	20.1	22.5	24.1

Source: Author's calculations based on Eurostat data.

Public debt, expressed as a percentage of GDP, serves as a primary metric for assessing a nation's current economic standing and its prospects for future development. A review of the data spanning from 2000 to the end of 2024 reveals significant disparities and a trend of sustained growth, with only minor periodic exceptions. Even during the baseline period, debt levels exceeded the established 60% threshold for both the EU (66.6%) and the Eurozone (69.2%).

Among the three nations under review, an initial reduction in public debt relative to the baseline period is observed. This downward trend persisted until 2007, coinciding with the countries' accession to the European Union and the Schengen Area. Estonia demonstrated the strongest performance, with debt reducing to 3.9%, while Lithuania recorded the highest level among the three at 15.9%. Comparisons with the EU (62.4%) and Eurozone (65.9%) averages are particularly striking; at that time, Estonia's public debt was sixteen times lower than the Union average, while Lithuania's was nearly four times lower. Membership in these unions did not appear to exert a positive influence on this metric, as public debt levels subsequently began to rise. By 2011, the year of its Eurozone accession, Estonia recorded a public debt of 7.6%—more than tenfold lower than the EU average. For Lithuania (which joined the Eurozone in 2015), the debt level remained twice as low as the average. During its inaugural year of Eurozone membership, Lithuania recorded its highest debt-to-GDP ratio at 42.4%, prompting subsequent fiscal consolidation efforts. Debt levels subsequently declined to 35.6% by 2019, before the trend reversed and began to climb once more.

The fiscal dynamics in Latvia have proven even more cyclical. During the baseline period, the country recorded relatively low public debt levels (12.4%). By 2007, it had successfully reduced this figure to 8.9%, only for it to experience a sharp surge to 46.4% by 2011. In its first year as a Eurozone member, Latvia's public debt stood at 43.1%, followed by a gradual reduction and a subsequent rise to 46.2% by the end of 2024.

Comparisons with Bulgaria reveal even more significant volatility. During the baseline period, Bulgaria's public debt (70.7%) was substantially higher than that of Lithuania, Latvia, and Estonia; it exceeded the EU average (66.6%) and was equivalent to the Eurozone average. Subsequent periods were marked by significant debt reduction; by the year of its EU accession, Bulgaria's debt had fallen to 16.3%. This downward trend persisted until 2011, when public debt reached a low of 15.2%. In the ensuing periods, the trend reversed, with public debt climbing to 24.1% by the end of 2024.

3. Discussion

The selection of countries for this study was predicated on the assumption of their relative proximity regarding socio-economic indicators and a comparable level of economic development. However, the data analysis failed to validate this hypothesis. At the time of EU accession (with all three nations joining the Union in 2004), their initial positions concerning GDP per capita exhibited substantial disparities. Estonia recorded the highest figure at €13,980, followed by Lithuania at €9,940 (29% lower) and Latvia at €9,240 (34% lower). A comparison with EU averages reveals a 52% lag even for the top-performing nation, Estonia. From this baseline, Bulgaria's position upon its EU accession in 2007 showed a 77% deficit, placing it significantly behind even Latvia's initial standing.

By the time of its Eurozone (EZ) accession in 2011, Estonia had succeeded in narrowing the GDP gap to 43% relative to the EU average (€16,580 compared to the EU's €29,030). The figures relative to the Eurozone were less favorable, with Estonia's €16,580 representing a 50% lag behind the EZ average of €33,140.

The data for Lithuania, which adopted the single currency in 2015, are even more unfavorable; its GDP per capita stood at 49% of the EU average. In relation to the Eurozone, Lithuania's €14,640 constituted approximately 44% of the EZ average of €33,660.

A similar situation is observed in Latvia, which joined the Eurozone in 2014. The country's economic output lagged by 55% compared to the EU average and by 60% compared to the Eurozone average (€13,140 for Latvia versus €33,060 for the EZ).

The dynamics of the inflation index following Eurozone accession are of particular scholarly interest. The results indicate an upward inflationary trend in all three nations (notably in Lithuania following its first year of membership). This increase has been substantial, with figures consistently exceeding Eurozone averages—a trend also observable in Croatia, the Eurozone's newest member.

The comparison with Bulgaria yields negative results. Based on the country's anticipated Eurozone accession in 2026, projections are as follows: a GDP per capita of approximately €12,000 against an EU average of €33,600 (representing only 36% of the average, or a 64% deficit). Relative to the Eurozone, the gap is even wider at 68% (€12,000 compared to €37,100).

Conclusion

The baseline information analyzed across the indicators of the studied nations does not permit a comprehensive assessment of the achievements and challenges resulting from accession to the single currency. Despite the relatively concurrent adoption of the Euro, varying dynamics are observed across indicators when compared to EU and Eurozone (EZ) averages, as well as in direct comparisons between the countries themselves.

Regarding GDP, Lithuania achieved the highest growth over the shortest period at 33.8% (compared to a 10% growth rate for the EZ). Conversely, Estonia recorded the lowest GDP growth over the longest duration

at 26.7% (compared to 11.7% for the EZ), though it should be noted that this growth was realized from a significantly higher initial baseline (€16,590).

The figures achieved regarding public debt as a percentage of GDP also preclude definitive conclusions. All three nations exhibit significantly stronger metrics than the Eurozone average (87.4%). Estonia maintains the lowest public debt at 23.6%, although this is measured from the lowest starting point (7.6% in 2011). Lithuania's debt stands at 38.2%, reflecting a net reduction during its membership period (from a 2015 baseline of 42.4%).

The findings for Bulgaria in the period preceding Eurozone accession are as follows:

- The country has achieved intermediate values regarding public debt levels relative to the other nations studied.
- There remains a significant lag in GDP per capita compared to the studied countries, and an even more substantial deficit relative to the Eurozone average.
- Accession to the Eurozone at this stage suggests potential socio-economic challenges and impediments in the short term.

In summary, the fragmented approach adopted in this study limits the objective interpretation of the results. It is both necessary and feasible to conduct further research into indicators such as "people at risk of social exclusion," "youth unemployment," and the increasingly critical metric of "energy prices per MWh."

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5. MARKETING, COMMUNICATIONS, AND BRANDING

Competitive Landscape and Marketing Strategies in China's Imported Olive Oil Market: An Analysis Based on Packaging Information

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JEL: O14, P24, C41, E13

Abstract

Since 2008, the Chinese market for imported olive oil has experienced steady growth in both consumption and imports, reaching a market value of over 5 billion RMB. Spain, Italy, and Greece are the main exporting countries, jointly accounting for more than 80% of Chinese imports. An analysis of 34 olive oil brands available in the Chinese market shows that while basic information (such as origin, production volume, and acidity level) is generally provided, more detailed elements are often missing. These include the specific olive varieties used, explicit health benefits, and consumer education content. Spanish brands dominate in terms of production volume and primarily target the mid-range market segment, whereas Italian brands position themselves in the premium segment, emphasizing tradition and health-related values. Domestic Chinese brands, on the other hand, compete mainly in terms of price and localization. Looking ahead, organic certification and consumer education on olive oil emerge as key areas with strong potential for future market development. This study aims to understand brand packaging information for olive oil brand suppliers. Provide packaging strategies for olive oil companies to enter the Chinese market.

Key words:

International olive oil trade
Chinese market, International
olive oil trade, Packaging
information, Consumer education,
Organic certification

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1. Introduction

With the rise of global health consciousness, the Mediterranean diet has gained widespread recognition for its significant health benefits. Extensive research confirms that the Mediterranean diet, centered around olive oil, plays a positive role in preventing cardiovascular diseases and specific cancers (La Verde et al., 2018; Menotti & Puddu, 2015). This trend has also influenced China's consumer market and dietary policies. The "Dietary Guidelines for Chinese Residents" published in 2022 explicitly recommends that residents can learn from the Mediterranean dietary pattern, signaling that olive oil is transitioning from a Western cooking ingredient into the mainstream health consumption of the Chinese public.

Against this backdrop, China's olive oil market demonstrates huge growth potential and unique structural characteristics. According to data from the International Olive Council (IOC), between 2008 and 2024, Olive oil consumption has increased from 12,000 tons in 2008 to 53,000 tons in 2024 (Figure 1), the production has increased from 2,500 tons to 9,000 tons (Figure 2). The import volume of olive oil in China saw several-fold growth, with the market size exceeding 600 million euros (Figure 3). It is noteworthy that despite the rapid increase in domestic Chinese olive oil production, imported olive oil still holds half of the market share, and the main countries of origin are highly concentrated in Mediterranean regions like Spain, Italy, and Greece. This indicates that imported olive oil still dominates the Chinese market, and the competitive landscape is distinct. This logic is also consistent with the IOC's statistical analysis of the world's major olive oil exporting countries. (Figure 4, Figure 5).

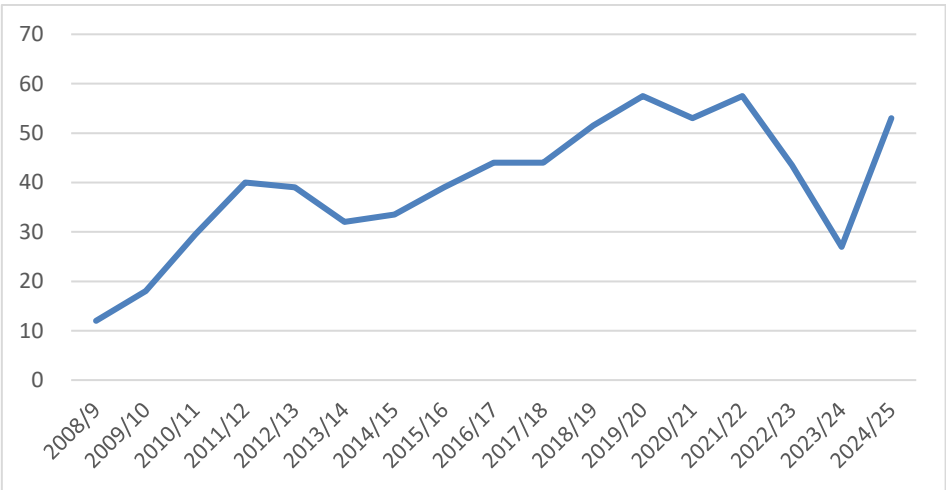


Figure 1. Olive Oil Consumption in China (unit: 1,000 tons)

source: IOC

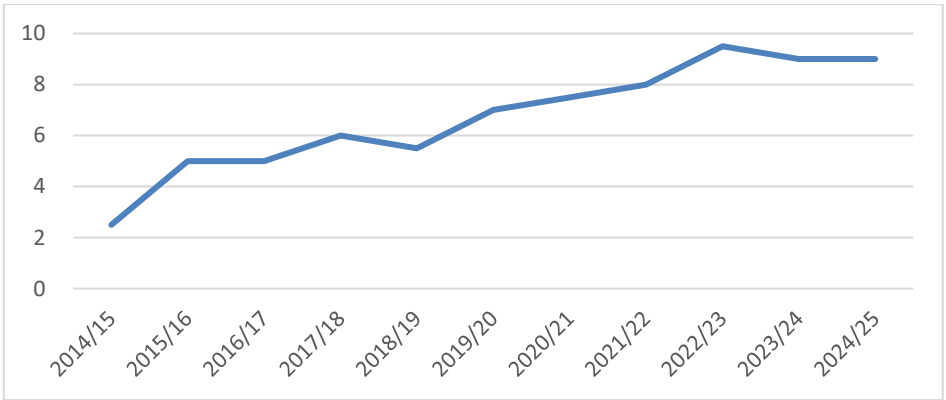


Figure 2. Olive Oil Production in China (unit: 1,000 tons)

source: IOC

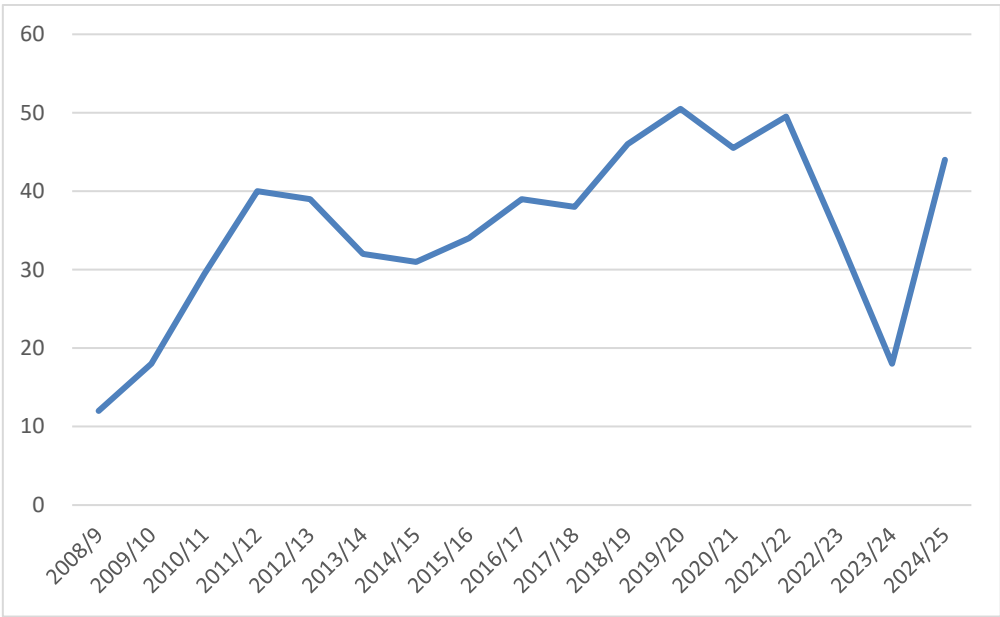


Figure 3. Olive Oil Imports in China (unit: 1,000 tons)

source: IOC

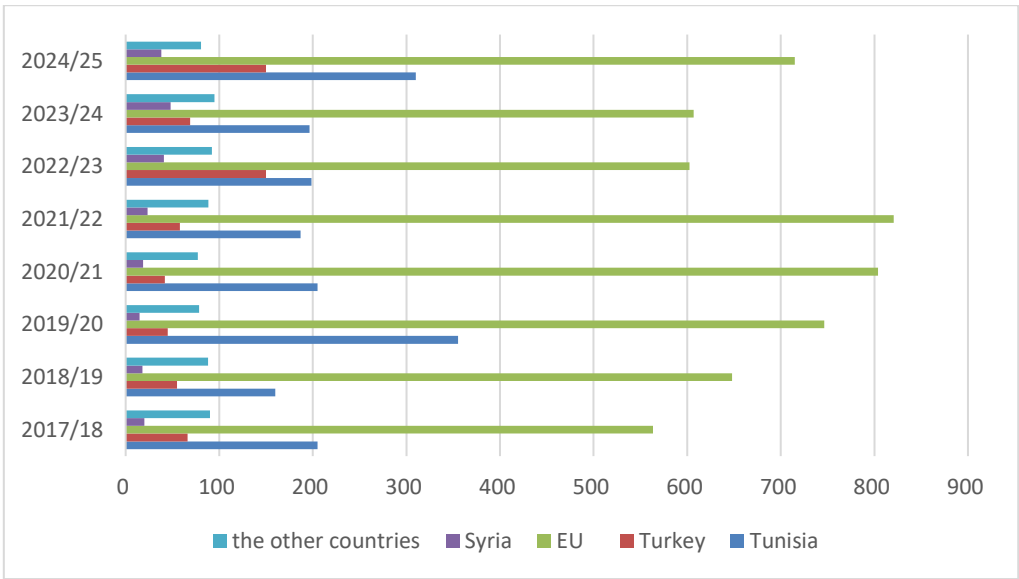


Figure 4. Global Olive Oil Exports (Main Exporting Countries, unit: 1,000 tons)

source: IOC

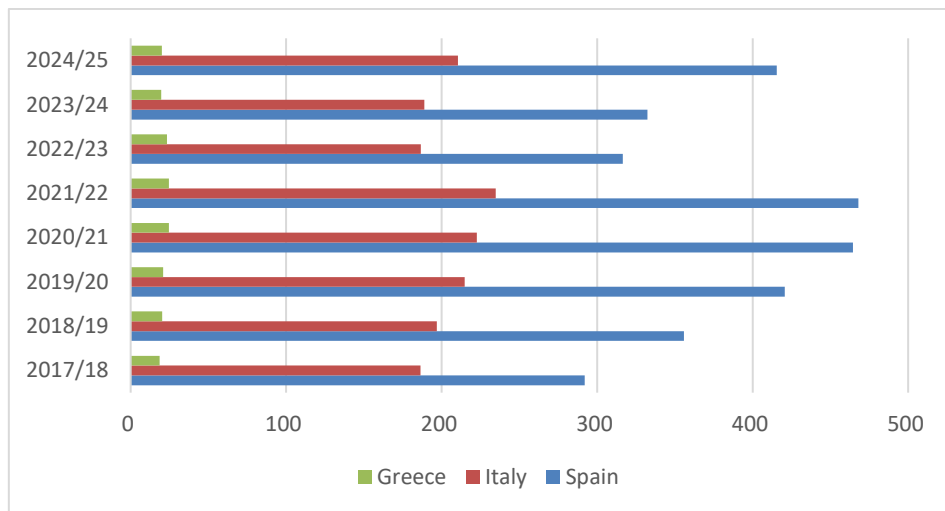


Figure 5. Olive Oil Exports in the European Union
(Main Exporting Countries, unit: 1,000 tons)

source: IOC

However, existing research on the Chinese olive oil market mostly focuses on macro trade data analysis or consumer questionnaire surveys, lacking a micro-level perspective starting from the product itself. Packaging, as the direct carrier of product information, is a key interface for brands to convey value propositions, build trust, and achieve differentiated competition. What information does the current market convey through packaging? What are the similarities and differences in strategies among brands from different countries of origin? Is this information sufficient to support consumption decisions in a mature market?

To answer these questions, this study aims to systematically analyze the packaging information of 34 major olive oil brands in the Chinese market using content analysis. It seeks to decode the current competitive landscape and marketing strategies of the imported olive oil market from multiple dimensions such as country of origin distribution, quality indicators, health claims, marketing appeals, and pricing strategies. The goal is to provide empirical evidence for brands to formulate precise market entry and positioning strategies and to fill the gap in existing research regarding micro-level product information.

2. Conceptual framework

When consumers face high-value, experience-based foods like olive oil where quality information is opaque, their purchase decisions are significantly challenged by “information asymmetry”. According to consumer behavior theory, to reduce perceived risk, consumers rely on external cues—such as country of origin, certifications, brand stories, and price—as key signals to infer intrinsic quality and complete value judgment (Akerlof, 1970; Ge, 2022; Bravo, 2024; McLeod, 2024). This constitutes the psychological basis of market demand decision-making.

To address this challenge, brands have developed systematic signal transmission strategies in their internationalization process. Among them, the “country-of-origin effect” and “brand storytelling” have been proven to be core tools for building trust and achieving differentiation. A strong “category-country” association (e.g., Italy and olive oil) makes the country-of-origin label a shorthand for “authenticity” and “quality,” while profound brand stories can establish emotional connections, collectively supporting brand premium (Peterson, 1995; Kotler & Gertner, 2002; Woodside et al., 2008; Phau et al., 2000; Tijani, 2024; Tarabashkina, 2024).

Systematic review of evidence shows that Front-of-Pack (FOP) labels (Nutri-Score, warning labels, etc.) have a significant impact on consumer choice, especially among younger groups—suggesting that label-based

packaging information directly changes purchasing decisions (Guo,2024).

Looking at global olive oil market research, the application of these strategies shows distinct characteristics of market maturity evolution. In mature markets (e.g., EU, North America), competition has deepened to emphasize specific olive varieties, small-region certifications, and specific health components; whereas in emerging markets, marketing focuses more on building a basic country-of-origin image and culinary localization to achieve category (Vecchio, 2015; Carlucci, 2023; Polenzani, 2020).

However, existing research still lacks systematic decoding of marketing “signals at the product level” in China, a key emerging market. Based on the above theoretical framework, this study aims to use content analysis to deeply explore the following question: How do imported olive oil brands utilize the key interface of packaging information to combine quality signals and brand narratives to address the specific challenges of the Chinese market, and what kind of competitive landscape is shaped in this process? By placing the Chinese market within the global evolution map, this study aims to connect macro theory with micro practice and fill the gap in empirical research on product information strategies.

3. Research Framework

This study employs content analysis to conduct a systematic, objective, and quantitative analysis of the information on brand packaging and official online descriptions. The research sample consists of 34 major olive oil brands with high sales and search rankings on mainstream Chinese B2C e-commerce platforms such as Tmall Global and JD Worldwide as of July 2024. The sample covers major countries of origin (Spain, Italy, Greece, etc.) and Chinese domestic brands, ensuring representativeness.

Based on the literature review, we constructed a coding scheme containing 5 dimensions and 20 specific variables:

- Basic Information: Country of origin, volume, packaging material.
- Quality Information: Acidity, olive cultivar(s), organic certification.
- Marketing Information: Health claims, awards, brand history, cooking suggestions, official endorsements.
- Channel Information: Mention of purchase channels.
- Price Information: Price per liter (converted to Euros for comparison).

Descriptive statistical analysis (frequencies, percentages) was used to present the data, and cross-analysis was conducted to compare strategy differences among brands from different countries of origin.

4. Results and Discussion

4.1. Results

Geographical origin: Origin information is standard. Spain holds an absolutely dominant position in terms of origin with 16 brands, followed by Italy (9 brands). Other sources include Greece (1 brand), the United States (1 brand), and Australia (1 brand). Interestingly, 6 Chinese brands clearly indicate that they use olives imported from Spain for production (Figure 6).

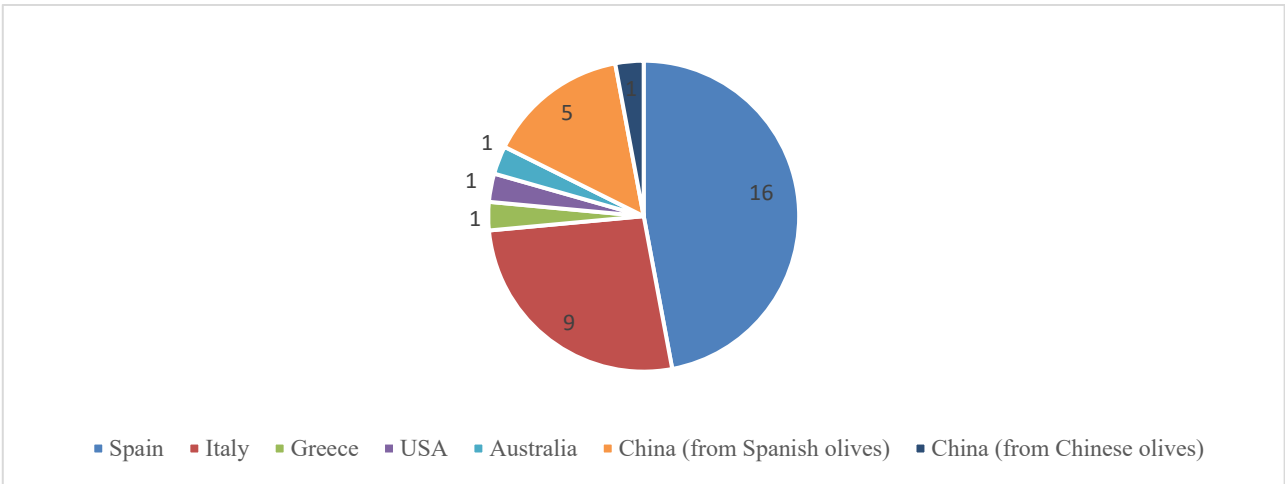


Figure 6. Geographical Origin

Source: our elaboration

Container used: Glass bottles are the most widespread packaging, accounting for 79% (27 brands), with dark glass generally used to protect from light and preserve freshness, demonstrating attention to quality. Other packaging, such as cans (4 brands) and plastic containers (3 brands), represents a small percentage (Figure 7).

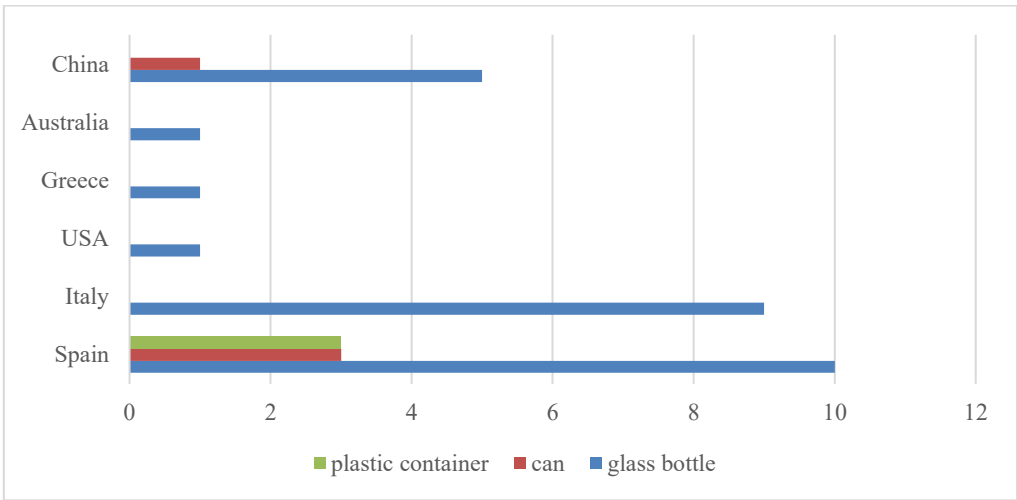


Figure 7. Container used

source: our elaboration

Container Capacity: Bottle capacity ranges from 200 ml to 5000 ml, with the main specifications being: 250 ml (8 brands), 500 ml (6 brands), 1 L / 1000 ml (8 brands), 3 L (4 brands), 5 L (2 brands) (Figure 8).

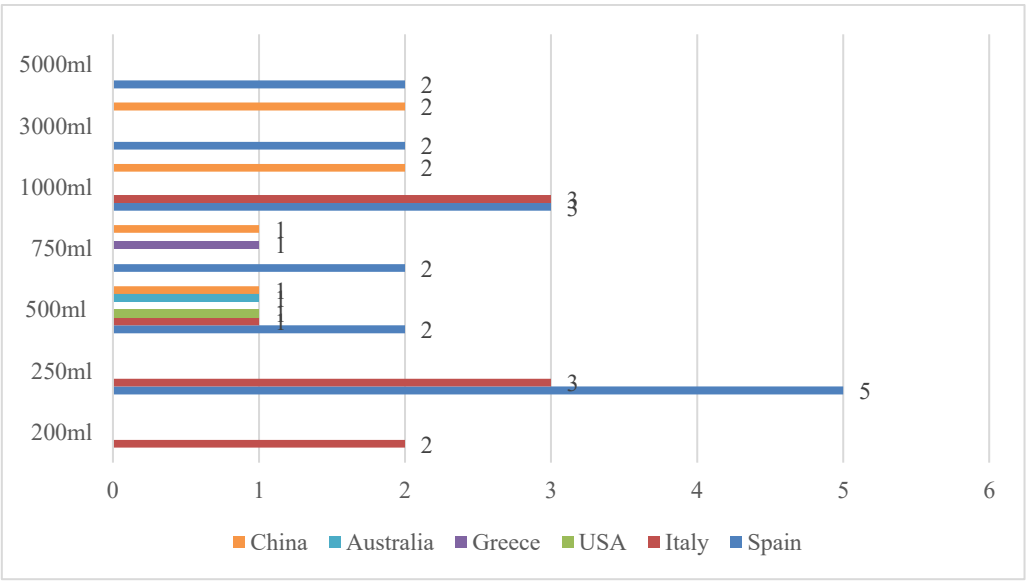


Figure 8. Container Capacity
Source: our elaboration

Acidity: Fundamental Quality Indicator: $\leq 0.5\%$ is the prevailing standard: 22 brands clearly indicated acidity as $\leq 0.5\%$ (or $\leq 0.3\%$, $\leq 0.4\%$, etc.), highlighting the high quality of extra virgin olive oil. Minor differences: 2 brands indicated $\leq 0.6\%$ or $\leq 0.8\%$, 1 brand used the KOH standard ≤ 1 mg/g (corresponding to an acidity of approximately $\leq 0.5\%$), and 9 brands did not clearly specify the exact acidity value (Figure 9).

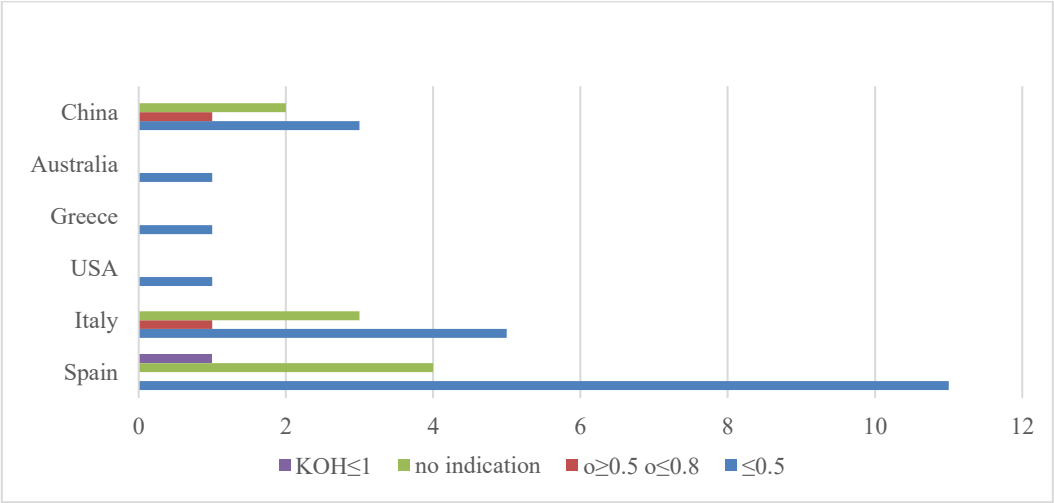


Figure 9. Acidity
Source: our elaboration

Nutritional Information: All 34 brands mentioned nutritional information in their product descriptions, meeting basic regulatory requirements.

Olive Cultivar: Information on olive cultivars is generally lacking. Only three brands (one Italian, one Spanish, and one Greek) clearly indicate the olive cultivars used. This reflects the fact that market demand for information tracing the organoleptic characteristics of olive oil has not been fully met, due to poor knowledge of olive cultivars among the Chinese population and product information not paying much attention to these

varieties (Figure 10).

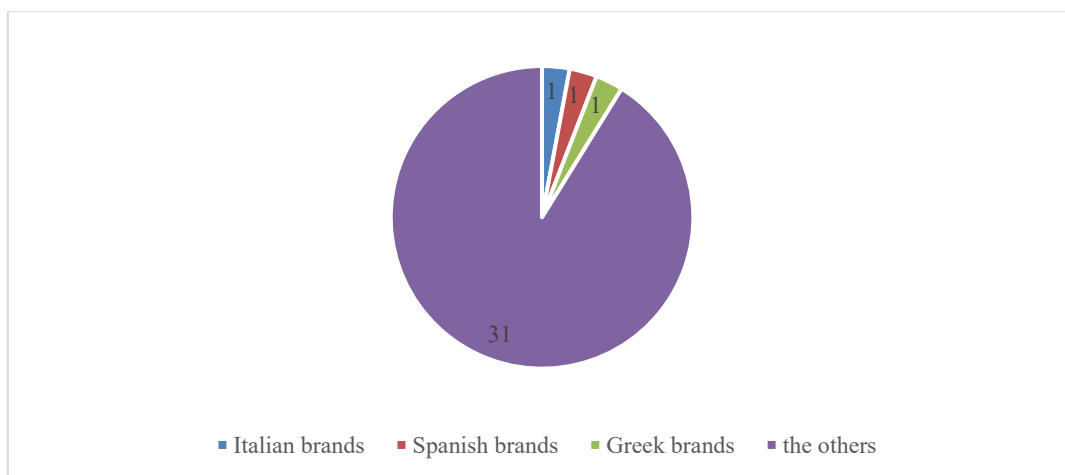


Figure 10. Olive Cultivar

source: our elaboration

Health Information: Less than half of the brands provide information on health claims, with only 18 brands providing information on healthy ingredients such as monounsaturated fatty acids and polyphenols. Seven Italian brands are the most active in health claims, followed by four Spanish brands and four Chinese brands. All other 16 brands lack this information (Figure 11).

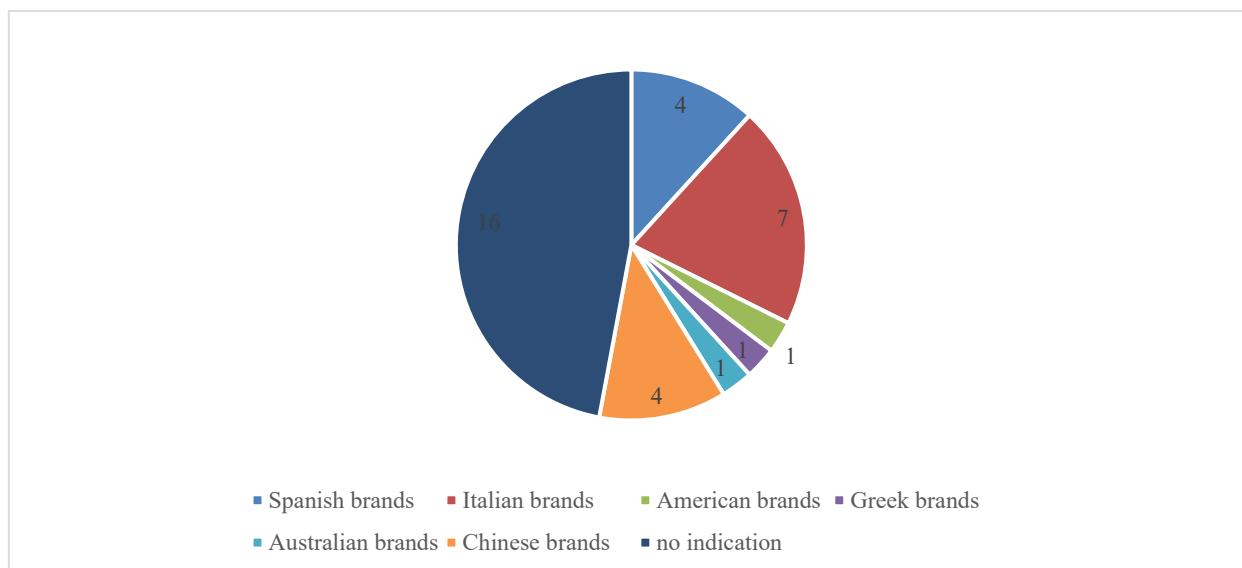


Figure 11. Health Information

Source: our elaboration

Organic Certification: Organic certification is not a widespread selling point, also because Chinese consumers have little knowledge of olive oil certification standards. Only 4 brands have obtained organic certification, including 2 Italian brands, 1 American brand, and 1 Chinese brand. The other 30 brands do not report such information, indicating that organic olive oil is still a high-end niche in the Chinese market (Figure 12).

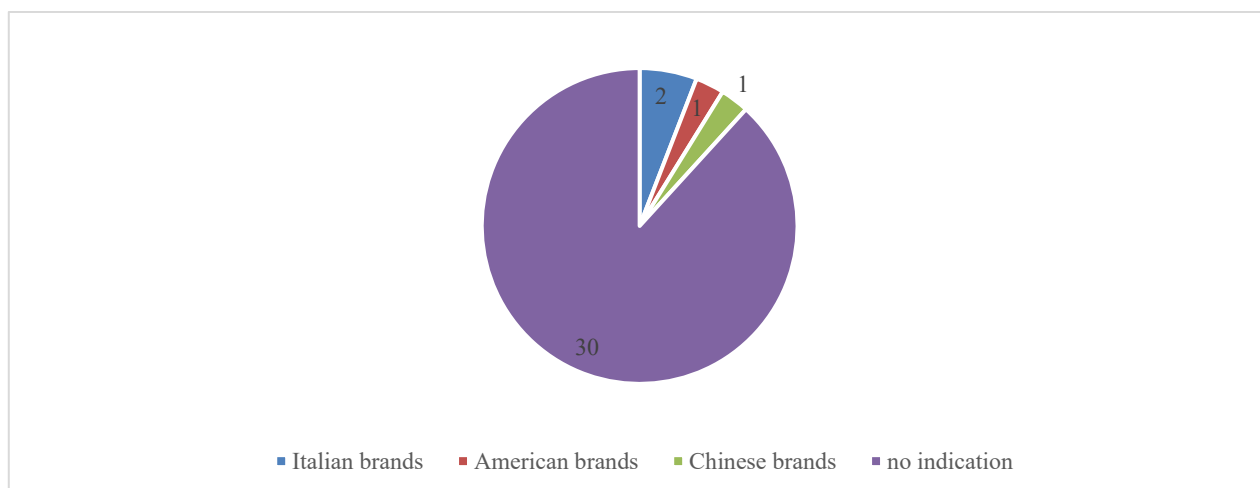


Figure 12. Organic Certification

source: our elaboration

Culinary uses and recipes: 23 brands provided cooking suggestions or recipes. All Chinese brands are labeled as "suitable for Chinese cuisine," precisely meeting local consumer needs and focusing on localization. 8 Italian brands and 8 Spanish brands pay more attention to this aspect. Furthermore, 1 Australian brand, 1 American brand, and 1 Greek brand provide cooking suggestions and recipes in their product sales information (Figure 13).

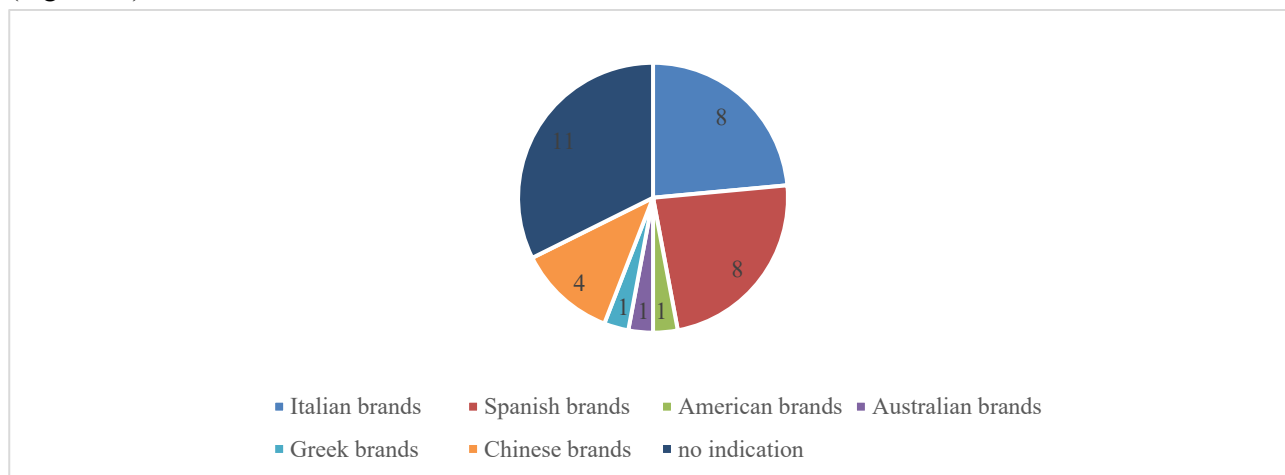


Figure 13. Culinary uses and recipes

source: our elaboration

Certifications: 19 brands displayed various certifications (such as DOP, CAEE, IFS, ISO, etc.). 11 Spanish brands were the most prominent, followed by 5 Italian brands. 15 brands did not emphasize certification (Figure 14).

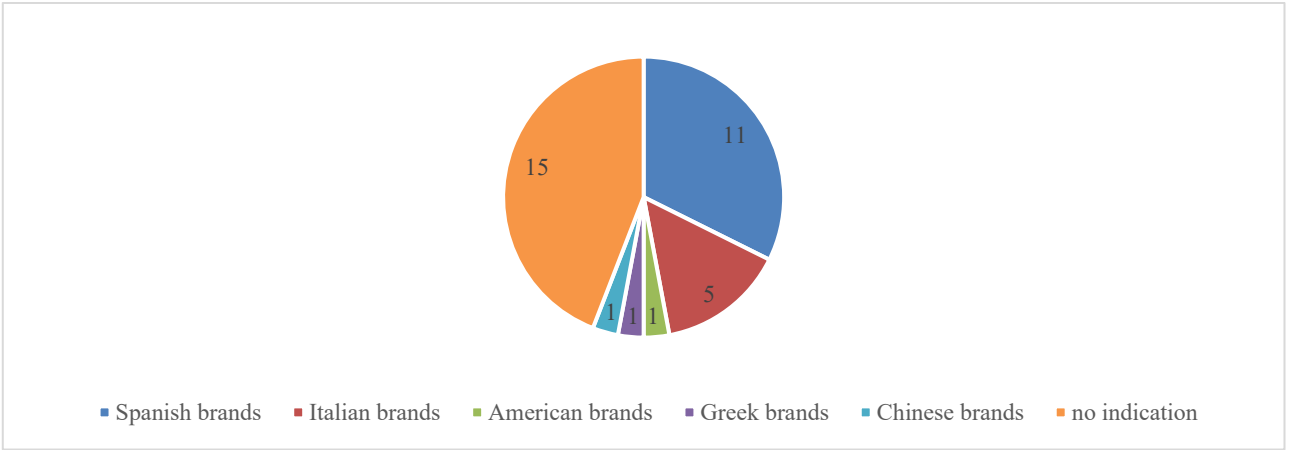


Figure 14. Certifications

source: our elaboration

Awards: 14 brands mentioned awards won, with 6 Spanish and 5 Italian brands leading in award marketing. 20 brands did not mention awards (Figure 15).

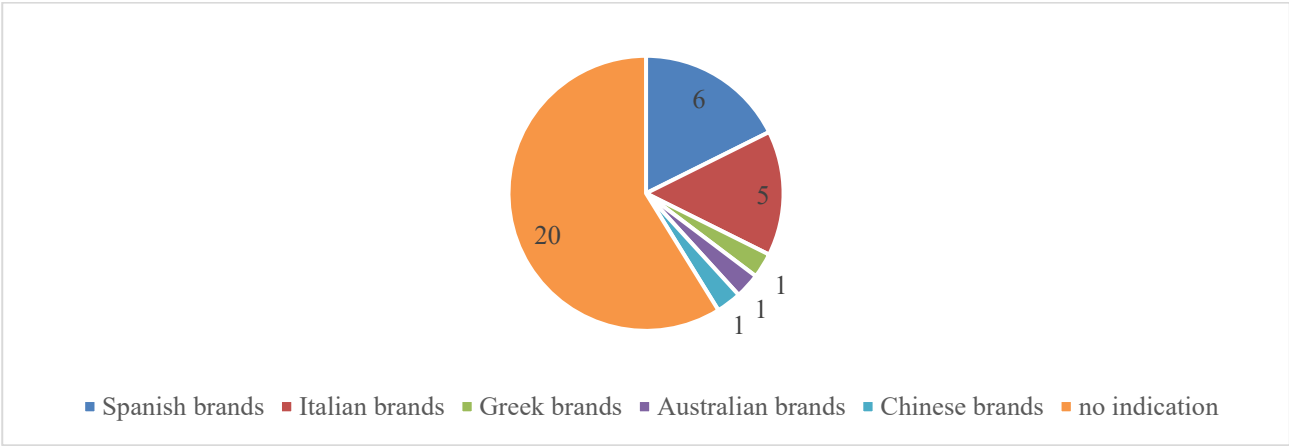
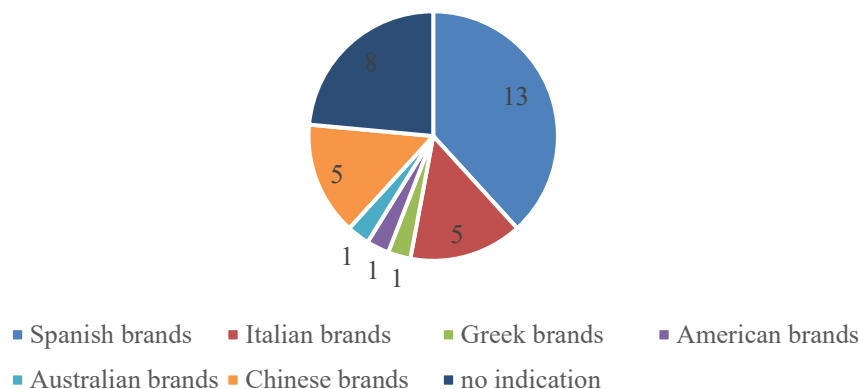


Figure 15. Awards

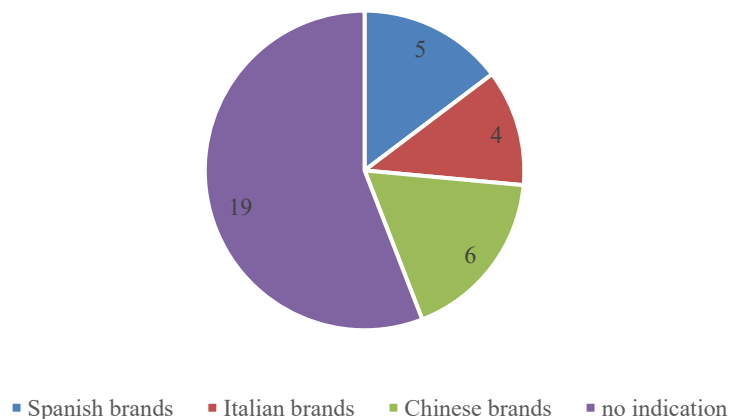
source: our elaboration

Harvesting and Production: 26 brands declared the type of harvesting, pressing, or production process used. Notably, the 13 Spanish brands, the five Chinese brands, and the five Italian brands paid more attention to conveying information related to this aspect (Figure 16).

**Figure 16. Harvesting and Production***source: our elaboration*

"Limited Production": Only one Italian brand uses this as a selling point, and scarcity marketing is rarely used.

Suitable for Chinese cuisine: 6 Chinese brands all emphasized that their products conform to the characteristics of Chinese cuisine, 5 Spanish brands and four Italian brands also emphasized that their products conform to the characteristics of Chinese cuisine, and the remaining 19 brands were not mentioned (Figure 17).

**Figure 17. Suitable for Chinese cuisine***Source: our elaboration*

Brand History: 16 brands tell their brand's story or tradition, with 8 Italian and 6 Spanish brands having deep roots in this area. American and Australian brands also address this aspect. The other 18 brands do not emphasize their history (Figure 18).

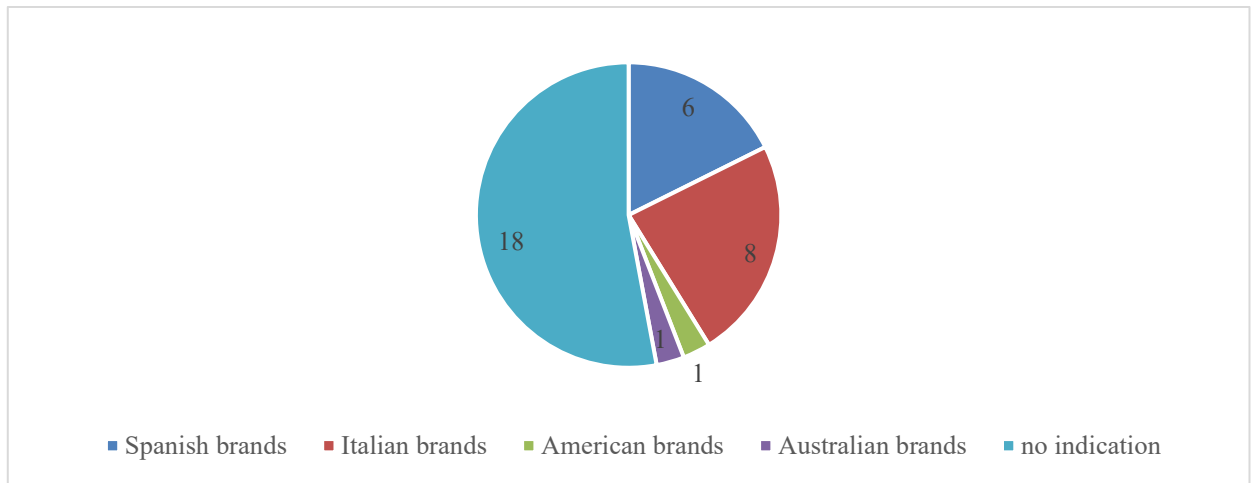


Figure 18. Brand History
source: our elaboration

Dissemination of knowledge is severely insufficient. Only 7 brands (4 Spanish and 3 Italian) provided educational content, such as the classification and categories of olive oil, indicating that there is broad scope for consumer education in the market (Figure 19).

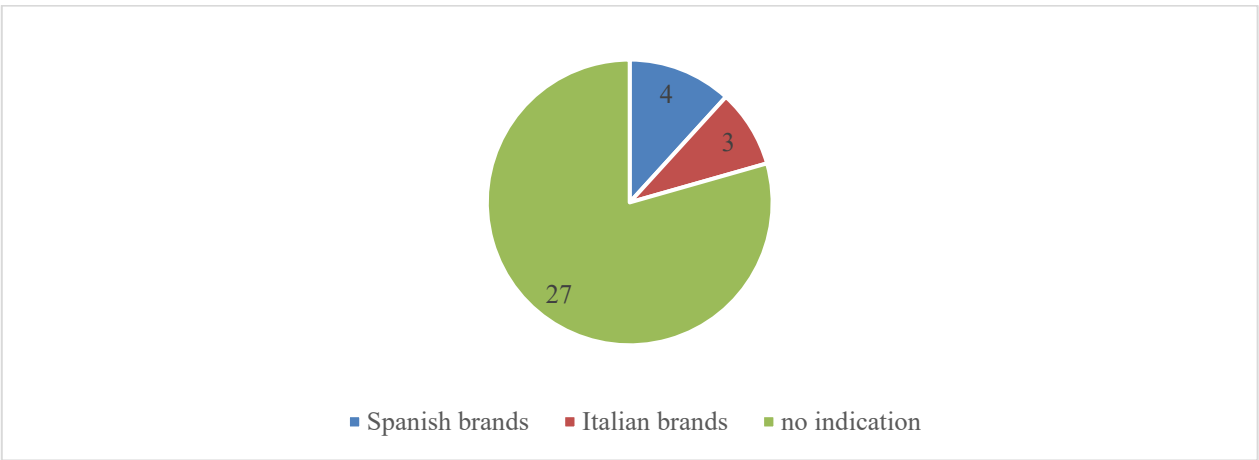
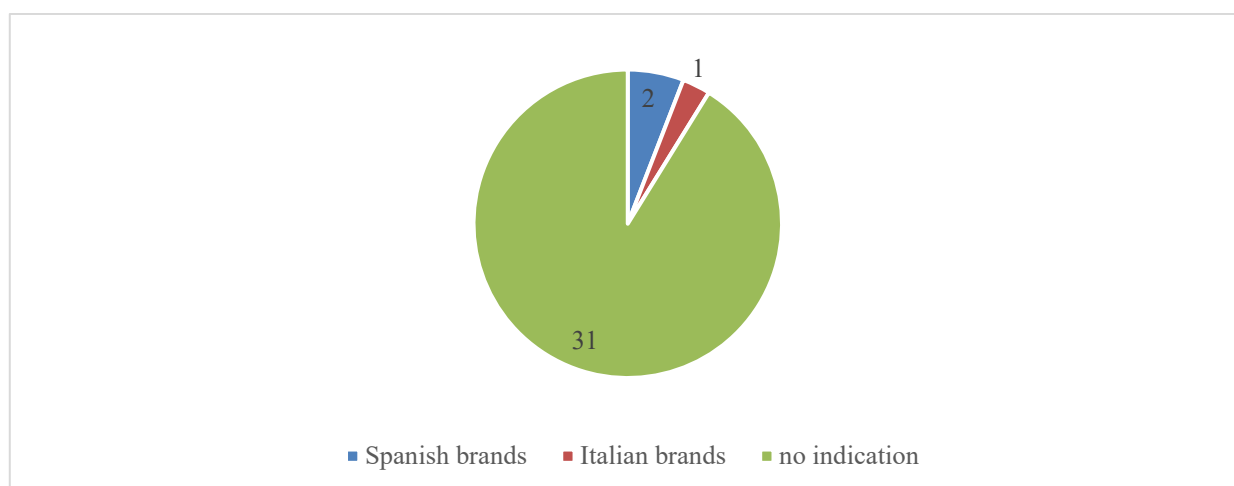
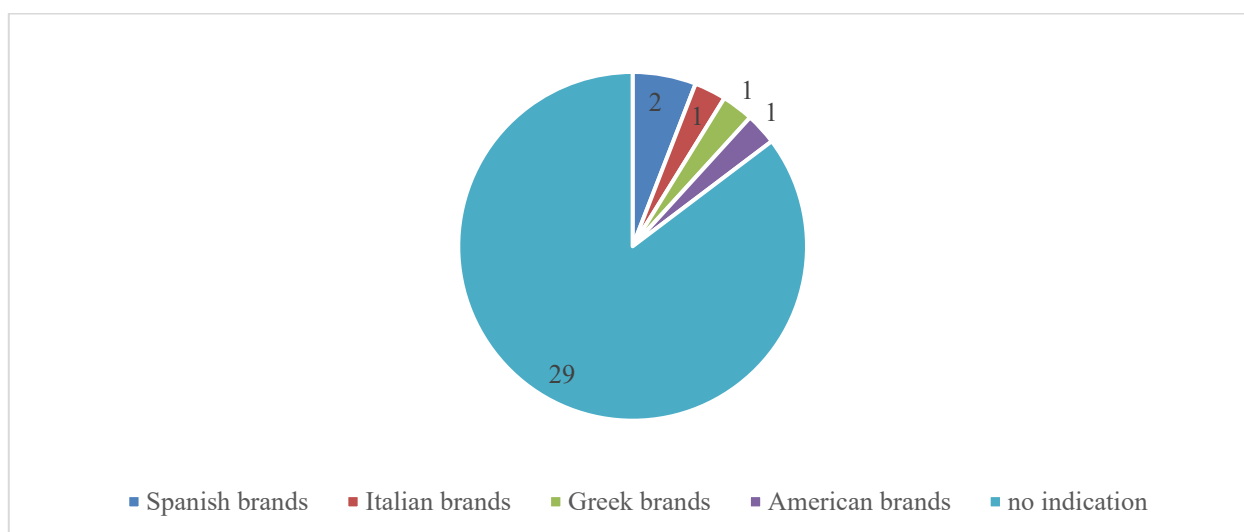


Figure 19. Dissemination of knowledge in classification systems
source: our elaboration

Presented by the embassy: A rarely used resource. Only three brands are marked as recommended by their country's embassy to ensure a high degree of credibility (Figure 20).

**Figure 20. Presented by the embassy***source: our elaboration*

Sales Channels: Very little information. One Chinese brand provided a link to Taobao, and a few other brands (e.g., OLIVOILA) mentioned "distribution via channel" (Figure 21).

**Figure 21. Sales Channels***source: our elaboration*

Analysis of consumer price analysis (Price per liter - Euro):

The price range is characterized by an enormous price span (from € 5 /liter up to € 127.1/liter).

Regional Price Range:

Spanish brands are mainly concentrated in the €9–15/L price range (7 brands), followed by the €16–25/L range (5 brands). Three brands fall into the low-price range (<€8/L), while one brand is positioned in the high-price range (≥€26/L).

Italian brands, on the other hand, are more widely distributed and positioned in the mid-to-high-end

segment. There are three brands priced between €9 and €15/L, and two brands between €16 and €25/L. The remaining three brands are priced at €26/L or above, among which one Italian brand is the most expensive overall. Only one brand is priced below €8/L.

Chinese brands are polarized. There are 4 brands priced <8 €/L (very competitive), 1 brand priced between 16-25 €/L, and 1 brand priced ≥26€/L (attempting to reach the high-end market).

Other Origins: Greek brand is ≥26€/L; American brand is 9-15€/L; Australian brand costs 16-25 €/L (Figure 22).

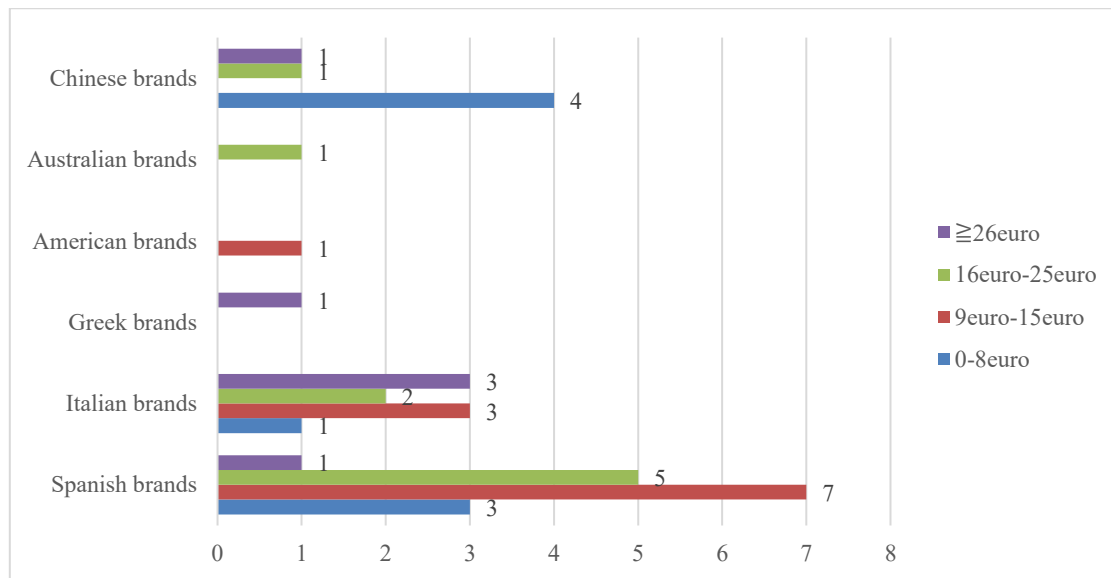


Figure 22. Price

source: our elaboration

4.2 Discussion

The study's findings not only depict the current market situation but also engage in a profound dialogue with existing consumer behavior theories and international branding strategies.

Firstly, the results suggest about the power of the "country-of-origin effect" as a core asset in brand internationalization, but its mechanisms of action show significant differences among brands from different countries. Data show that Spanish brands dominate the mid-market (main price range 9-15 €/L) by virtue of their economies of scale and supply chain advantages, reflecting the cognitive dimension of country of origin as a "basic quality guarantee." In contrast, Italian brands successfully activate the "emotional and prestige" dimension of the country-of-origin effect, anchoring their brands in the high-end market (having the highest number of brands priced ≥26 €/L) by emphasizing brand history, traditional craftsmanship, and health claims. This finding aligns with Phau & Prendergast's (2000) argument that the country-of-origin image relates not only to manufacturing capability but also to cultural connotation and emotional connection, with the latter being key to supporting brand premium.

Secondly, this study reveals a clear contradiction in the quality signals transmitted by brands in the Chinese emerging market: "redundancy of basic information" versus "lack of in-depth information." Although almost all brands provide standardized information such as origin, volume, and basic nutritional composition, in-depth information crucial to product character and true value—such as olive cultivars and specific health component content like polyphenols—is severely lacking. This phenomenon profoundly reflects the current maturity level of the market. According to Violino (2019), in mature markets, this in-depth information is core

to brand differentiation. Its general absence in China indicates that the market is still in its early stages, relying on macro country image for category education, and consumers have not yet developed a widespread demand for finer quality signals. This points the direction for future competition: whoever can first provide and educate the market about this in-depth information will occupy the future market in future differentiated competition.

Thirdly, the marketing strategies of brands from different source countries highlight their different paths for coping with information asymmetry. Italian brands tend to construct a brand narrative about "tradition, health, and art" as their core quality signal. Spanish brands focus more on displaying various official and industry "certifications" (e.g., DOP, IFS), building objective credibility through third-party endorsement. Chinese domestic brands, however, skillfully adopt a hybrid strategy of "imported raw materials" and "localized application": on one hand, using Spanish raw materials as a quality signal, and on the other hand, greatly lowering consumers' usage barriers and perceived risk by emphasizing "adaptation to Chinese cuisine." This strategy accurately aligns with the risk reduction theory (Talyor, 1974), suggesting that emphasizing ease of use and applicability is an effective market entry strategy when consumers are unfamiliar with a product.

Finally, the study's findings point to a key market opportunity: a huge vacuum in consumer education. The vast majority of brands fail to provide educational content on olive oil classification, tasting, etc., and organic certified products remain a niche market. This indicates that current market competition is still focused on dividing the existing "pie." For brands determined to build a professional image and leadership position, proactively assuming the role of market educator and investing in consumer knowledge dissemination is not only a social responsibility but also a forward-looking brand investment. This can cultivate more brand-loyal future consumers and open up high-end market segments for themselves.

5. Conclusions and Implications

This study, through content analysis of the packaging information of products in China's imported olive oil market, arrives at the following core conclusions:

First, the market exhibits a clear "duopolistic structure" characterized by "Spain dominating volume, Italy leading premium". Spain occupies the mid-range market relying on supply chain efficiency, while Italy successfully anchors itself in the high-end through storytelling and health claims. This confirms the different operational mechanisms of the "cognitive" versus "emotional" dimensions within the country-of-origin effect.

Second, there is a significant disconnect in the current market information structure: basic information (e.g., origin, acidity) has become standardized, but the in-depth information that determines brand differentiation (e.g., cultivar, polyphenols) is severely lacking. This indicates that China's olive oil market is still in the early stage of transitioning from "category awareness" to "quality understanding," and consumers' information search needs are not fully met.

Third, the competitive tactics of local and international brands are diverse. International brands (especially Italian and Spanish) focus on displaying heritage and certification "assets", whereas Chinese brands apply a hybrid approach of "imported raw material", "recognized by official organization" and "local adaptation" demonstrating unique advantages in price competitiveness and meeting localized needs.

This study attempts to test the "country-of-origin effect" and "signaling theory" within a rapidly growing emerging market, revealing the hierarchy of their mechanisms. The findings suggest that at the early market stage, macro country image is the dominant quality signal; whereas as the market matures, specific, verifiable product attribute signals (e.g., cultivar, health components) will become increasingly important. This provides new insights for the development of brand internationalization theory in the context of emerging markets.

Implication for European Brands (Italy, Spain):

Leading brands should strive to specify and quantify existing abstract appeals like "health" and "tradition" (e.g., by disclosing polyphenol content) to build an insurmountable technical barrier. The formers shall actively play the role of "market educator," disseminating knowledge about olive oil tasting and classification through

packaging and marketing activities to cultivate future customers. They may also actively pursue certifications to capture emerging niches.

Implications for Domestic Brands:

While maintaining the advantages of “adaptation to Chinese cuisine” and “price competitiveness,” they could explore launching high-end sub-brands emphasizing “single cultivar” or “single estate” to break the stereotype that “local brands equal mid-to-low end”. They should more transparently disclose the specific sources and processing standards of their “Spanish raw materials,” transforming the supply chain advantage into a credible quality promise.

The limitations of this study indicate future research directions: (1) the paper is concentrated on online channels. Future research could include offline high-end supermarkets and specialty stores for cross-channel comparative analysis; (2) while this study identifies the supply of packaging information, it does not verify the actual impact of this information on decision-making. Therefore, future research could employ experimental methods to directly investigate Chinese consumers' willingness-to-pay and trust in different quality signals (e.g., cultivar, polyphenol content), thereby providing more precise guidance for brand strategies.

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Online Grocery Shopping in European Union Countries: Studying the Influence of Economic Factors

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Abstract

Background and Objective: Rising consumer expectations, digital advancements and the rise of e-commerce are evolutionary transforming and shaping grocery shopping in Europe. The main goal of this study is to examine the influence of economic factors on online grocery shopping by consumers in the European Union countries, focusing on the size of GDP per capita, and on this basis to draw the relevant conclusions and generalizations. *Scope:* The object of the study is individuals from the 27 Member States of the European Union who shop online for groceries. The collected and processed empirical data refer to the ten-year period 2014-2024. *Methods:* In methodological terms, the data analysis is based on the application of the linear regression and correlation method. For analytical purposes, the IBM software product is used SPSS and the program Excel. *Results:* The results obtained from the study present the strength of the relationship between online grocery purchases and the size of GDP per capita. The emerging similarities and differences in online grocery shopping behavior are identified. *Conclusions:* As an economic determinant, the GDP per capita is a significant factor influencing online purchases of European consumers. *Originality:* The contribution of economic factors to the development of online grocery shopping in a European context is shown. *Practical implications:* The formulated conclusions are useful for characterizing more significant economic factors determining the behavior of European consumers when shopping online for groceries.

Keywords:

Online grocery shopping,
European consumers, economic
factors determining online
shopping.

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1. Introduction

Rising consumer expectations, digital advancements and the rise of e-commerce are revolutionising grocery shopping in Europe. In the digital economy, online shopping is on a continuous rise. Internet usage is increasing. Consumers are changing their behavior patterns. Grocery retailers are improving the channels they have designed to reach consumers and integrating offline and online assortment offerings.

By its nature, online grocery shopping is one of the main features of consumer behavior. In the specialized literature, researchers on this issue strive to shed light on the factors that influence consumer behavior when shopping online. Special focus is placed on studying the economic determinants at the household or individual level. The emerging changes have an impact on the strategies and tactics of grocery retailers.

European consumers are transforming their way of life. In socio-economic and cultural terms, consumer behavior is transforming, becoming more complex and advanced. Consumer activity is supported by new applications of digital technologies. A significant part of consumers in the 27 Member States of the European Union are adopting and moving towards shopping models that combine offline with online purchases. In this direction, a determining force of influence of various groups of factors is manifested. Among them, demographic, economic, psychological, technical, technological, social, cultural and others stand out. The following presentation presents research understandings and judgments that emphasize one or another group of factors. Priority research interest is placed on factors of an economic nature.

In their scientific works, a number of researchers adhere to the conceptual views that online grocery retailers should create appropriate shopping conditions. These conditions help generate a positive experience for consumers, aiming to ensure repeat purchases and increase the level of loyalty. In this direction, it is important to highlight the influencing factors. According to the statements of a group of theorists, among the determining factors influencing the consumer experience when shopping online are the digital platforms offered by grocery retailers (Jaiswal & Singh, 2020). It is also necessary to assess the consumer experience, as well as psychographic specifics and interests (Fiore & Kim, 2007).

In accordance with the research goal set in this paper, it is of particular importance to outline a theoretical and methodological framework that focuses on the economic characteristics of consumers, such as: the amount of disposable income; the amount of consumer spending; the average consumer spending at the household or individual level; the size of GDP per capita, etc. (Bigne, Ruiz, & Sanz, 2005) The research view is that the indicators highlighted in this way largely determine changes in the behavior of food consumers. For this reason, their influence is defined as dominant over other groups of determinants.

The main objective of this study is to examine the influence of economic factors on online shopping of consumers in the countries of the European Union, focusing on the size of GDP per capita, and on this basis to draw corresponding conclusions and generalizations. Achieving the goal presupposes the formulation of the following related tasks: systematization and interpretation of theoretical statements on online shopping of food products; outlining a methodological framework of the study; analyzing empirical data on online shopping of food products by consumers of the 27 Member States of the European Union; drawing more significant conclusions and generalizations.

Within the framework of the study, the analysis and evaluation of online grocery shopping by European consumers requires the acceptance of certain limitations: introduction of a temporal and territorial scope - the study covers the period 2014-2024; it is aimed at consumers from the 27 Member States of the European Union; the exposition of the study is dominated by the clarification of the impact of economic factors on online grocery shopping in the Community.

2. Literature review

In Europe, the process of online grocery shopping is developing at an increasing pace. In the context of the application of digital technologies in the retail business, this process is characterized by increasing potential and economic significance. By its very nature, online grocery shopping is defined as a form of shopping that is facilitated by e-commerce websites or mobile applications.

Studies of online grocery shopping began in the 1990s. They are associated with the advancement of the high-tech generation, which is moving towards online shopping. This form of shopping creates a number of conveniences and simplifies the lifestyle (Driediger & Bhatiasevi, 2019).

A number of research statements published in the specialized literature prove that the development of the process of online grocery shopping is influenced by various factors of a socio-economic and other nature. For example, according to the statements of a group of theorists, headed by M. Meuter, younger consumers have better developed information and communication skills. This age group of consumers seeks innovative and differentiated consumption, perceives greater benefits from online grocery shopping: saving time; shopping at any time of the day; comparing prices of purchased goods; taking into account promotional conditions of merchants, etc. (Meuter, Bitner, Ostrom, & Brown, 2005).

Another group of authors also reached similar research results. They indicated the role of social connectedness, demographic characteristics, and accumulated digital experience in online grocery shopping (Naseri & Elliott, 2011). The studied dependencies often link gender to the influence of respondents' age on online shopping decisions (Hou & Elliott, 2021).

On the other hand, there is a group of researchers who point out the existence of certain advantages to

online grocery shopping, to which they attribute: *the comfort of home, convenience, saved time and energy, big discounts and promotions, the availability of current offers, etc.* (supermag, 2023)

The adopted principle formulation of this study allows in the following part to present a number of factors and advantages that influence online grocery shopping. As part of the imposed mise-en-scene and following the studied economic literature, the premise is created for examining the factors that influence online grocery shopping as two groups, namely: *external* and *internal*. Within the scope of this study, *the level of gross domestic product, the level of inflation, the level of unemployment* are attributed to *external factors* and *digital technologies*.

Gross domestic product as part of the *external factors influencing online grocery shopping* represents the total value of goods and services produced in a country in a year. This factor is used to assess the economy of a country and its impact on the world economy. In the work of P. Baines the argument is made that *gross domestic product* is most often measured by summing the expenditure on new consumer goods, new investment expenditure, government expenditure and the value of net exports. (Baines, 2008). The cited research team notes that in most of the world this factor, of individual countries, fluctuates depending on the phases of different economic cycles and long-term economic growth over time. On the other hand, the reviewed author team notes that *gross domestic product* is also calculated on a *per capita basis*. According to P. Baines This is the nominal *gross domestic product* divided by the country's population. This factor measures how much a country's economy produces per person, rather than in total. It also serves as a measure of the income, or standard of living, of the people living in a country.

As another *external factor influencing online grocery shopping*, the economic literature considers *the level of inflation*. In the theoretical analysis of O. Issing, the emphasis is on the finding that *inflation* is an important economic phenomenon with negative consequences for the economy (Issing, 2007). Based on the observation of these conclusions, the cited theorist notes that *inflation* is defined as a general or widespread increase in the prices of goods offered over a long period of time, which leads to a decrease in the value of money and, accordingly, their purchasing power. On the other hand, in the considered work, special attention is paid to *deflation* as another economic phenomenon with negative consequences for the economy. In this regard, O. Issing notes that it is defined as the opposite of inflation, i. e. as a phenomenon in which the general price level falls over a long period of time. The considered expert shows that when both phenomena, *inflation* and *deflation*, are absent, this is defined as *price stability*. O. Issing notes that this phenomenon represents a lack of increase or decrease in average prices that remain stable over time. Eurostat data show that weak growth is observed in 2023, indicating that the EU economy has entered 2024 on a weaker footing than expected. The *European Commission's winter interim forecast* revises growth in both the EU and the euro area to 0.5% in 2023 from 0.6% projected in the autumn forecast; and to 0.9% in the EU (compared to 1.3%) and 0.8% in the euro area (compared to 1.2%) in 2024. (europa.eu, 2025) In this regard, *the European Commission* maintains its expectation that the economy will grow by 1.7% in the EU and 1.5% in the euro area in 2025. Within the scope of the study carried out, it was found that the expected forecast for Bulgaria, according to *the European Commission*, fluctuates in the following parameters: real GDP - growth by 1.9% in 2024 and by 2.5% in 2025; annual inflation is expected to slow significantly to 3.4% in 2024 and to 2.9% in 2025.

After *inflation*, the economic literature considers *the unemployment rate* as one of the main *external factors influencing online grocery shopping*. In the economic literature, this factor is defined as a state of the economy in which the supply of labor is greater than the demand. In the research of Drago Matović the axiom is derived that *unemployment* is measured as the percentage of workers in the total labor force who are actively looking for work but cannot find it, or as the author notes, the number of unemployed is divided by the total number of people in the labor force (Матович, 2025). According to the quoted economist, *unemployment* is considered one of the most important indicators of the overall state of a country's economy. If new jobs are added, it means that production and consumption are increasing. In confirmation of his thesis, Matovic presents *Okun's Law*, according to which for every 1% decrease in the unemployment rate, a country's GDP increases

by about 2%. As a conclusion to his studies, the cited researcher points out that providing jobs and increasing activity are extremely important, since each new worker contributes to increasing production, with their new salaries the purchasing power of the population increases, and state revenues increase through taxation. The study shows that in the fourth quarter of 2023 the EU registered a record high level of employment, namely 75.5% (europa.eu, 2025). While in 2022 4.5 million people over the age of 25 in the EU were registered as permanently unemployed. According to NSI data, in the last quarter of 2023 the unemployment rate in Bulgaria was 4.2%, which is 0.5 percentage points more than in the fourth quarter of 2022. (nsi.bg, 2025)

Within the framework of this study, it is required to present the last *external factor influencing online grocery shopping*, namely: *digital technologies*. Iskra Beleva's studies emphasize the thesis that *digitalization* is such a part of modern technological changes that affect all spheres of human existence (Белева, 2022). In her studies, the cited researcher emphasizes the thesis that, like any other technological change, it is seen as a means of accelerating progress in the technological development of the economy, which leads to an increase in productivity and, in particular, labor productivity. As confirmation of her thesis, Beleva indicates that through *digitalization* a given good is produced with fewer resources or that with a certain amount of resources new goods of higher quality are produced, new innovative processes are accelerated and as a final result the efficiency of production is increased. From the point of view of *the European Commission*, *digitalization* hides certain risks, for this reason in 2022 *a Digital Services Act was created*, which aims to create a safer, more transparent and competitive online environment for consumers and businesses, users of digital technologies and to build the protection of fundamental rights in the online space (europa.eu, 2025). As a member of *the European family*, Bulgaria is ranked 26th out of 27 EU Member States in *the European Commission's* Digital Economy and Society Index (DESI) for 2022. Analyses and studies carried out by *the European Commission* show that in recent years the DESI score in Bulgaria has increased by 9%. Experts note that given Bulgaria's position, this growth rate is not sufficient for the country to catch up with the other member states (europa.eu, 2025).

Within the framework of this study, it is imperative to present the *internal factors influencing online grocery shopping*, including: *gender, age, income, and education*.

Introducing *the internal factors influencing online grocery shopping* starts with *the gender of the user*, which has an impact on his behavior in two directions. *First*, men and women as carriers of separate genders have different orientations regarding the use of products such as food, clothing, shoes, valuable products, etc. (Kotler, 2006) *Second*, they participate in different ways in making decisions to purchase goods of a personal or family nature.

The second factor from the group of *internal factors influencing online grocery shopping* is specified as *the user's age*, which has no less impact on his purchasing behavior, again in a two-way influence. First of all, it affects the type of needs and secondly, the places or quantity of these needs (Kotler, 2006). In the case of food products, the following consumption orientations are imposed during the individual stages of age:

- During the first three years – baby and children's food;
- During the growing years – high-calorie and saturated foods;
- During adulthood – food items depending on employment;
- In old age – low-calorie and diet foods in small quantities.

Income as part of *the internal factors influencing online grocery shopping* largely determines not only what a consumer buys, but also what society expects him to buy. This principle is important because different socio-economic groups respond to different types of marketing strategies (Kotler, 2006). Many companies sell goods aimed at wealthy consumers by making special offers to them. Serving low-income consumers also proves profitable for the company. Large retail chains in the low-price range have a great influence on this market by developing offers for the low-income consumer segment. Socio-economic differentiation in marketing strategies is becoming increasingly visible with the development of differentiated brands by large

multifunctional companies.

The consideration of *education* as part of *the internal factors influencing online grocery shopping* are examined from the perspective of the opportunities provided through it. The issues of ensuring the full, intellectual, social, spiritual-moral and physical development of everyone are extremely relevant. Educational institutions are the place for everyone's training and socialization (Kotler, 2006). In them, everyone learns a system of knowledge, norms and values that they need to fulfill their future social roles. The global development and digitalization of the 21st century pose new challenges to *education* in terms of upbringing and training. This implies the need for teachers to also adopt new approaches to upbringing and training, on the one hand, to find and apply modern ways to motivate their students to acquire knowledge and skills, on the other hand, and subsequently, for students to be practically prepared to apply what they have learned in public life, on the third hand.

The information presented on *the European Commission website* shows that in 2023, young people and middle-aged people in the EU made extensive use of online grocery shopping. 87% of internet users aged between 25 and 34 years old have shopped for groceries online, followed by nearly 85% aged between 35 and 44 years old (europa.eu, 2025). *Eurostat* notes that in 2023, 89% of people with a high level of education have shopped online, compared to 57% of people with low or low formal education. The surveys conducted show that 53.8% of Bulgarian consumers have resorted to online grocery shopping, which places Bulgaria in last place among the member states in the community, Ireland and the Netherlands are the leaders, with 93.2% and 93.1% respectively.

Supermag conducted an in-depth analysis of the benefits of shopping for groceries online (supermag.bg, 2025). In this regard, they noted the following advantages:

- *Home comfort* as the first advantage plays a major role in the decision to make a certain purchase. According to Supermag Consumers feel tired of the sterile environment in retail outlets and of the salespeople who try to sell them a product at any cost. This leads to consumers having an unpleasant feeling from the experience. On the other hand, Supermag notes that the new type of experience that makes them feel at home and creates comfort is provided by the online store.
- *Convenience*, as another advantage, is associated with the ability of every consumer, regardless of their location, to proceed with grocery shopping, which makes online shopping so popular.
- *Saving time and energy* is the next advantage presented by Supermag. In addition to the fact that the consumer can shop at a convenient time and place for him, he can easily and conveniently view the prices, weight, type and content of each food product. On the other hand, the “search engine” option provides exceptional convenience, with which the desired product can be checked in seconds and the necessary choice made in minutes.
- *Big discounts and promotions* are classified as another advantage considered by Supermag. The information provided on the cited site shows that online stores provide bigger discounts than physical stores. This is considered normal, since physical stores form more expenses for premises, advertising, and employee salaries.
- The next advantage of online stores is *the impossibility of missing out on current offers*. Shopping in an online store requires registration. This provides the opportunity for sites to send their current information about current offers, especially to users' e-mails.
- Another advantage of online stores is *the choice of a convenient payment method*. According to Supermag, online stores provide the following payment options – in cash upon delivery; with a debit or credit card via a portable POS device; online payment via a virtual POS terminal (debit or credit card); by bank transfer.
- In addition to the payment methods, *delivery* provides certain *conveniences*. The user chooses whether to receive their order at the office of a courier company or directly to their home or office, which

depends on the requested order. Within the framework of its research by Supermag come to the conclusion that usually the amount for the courier service does not exceed the amount for transportation if the consumer uses a physical store. On the other hand, online stores make large discounts on delivery when ordering a certain amount of goods, and others have the option of free delivery. The possibility of delivery to take place at a convenient time and place is also considered an advantage.

- Supermag presents as another advantage *easy and fast comparison*. The Internet provides the opportunity to quickly and easily check not only the price of the product, but also its characteristics, content, importer, etc.
- *Adequate and quick answers to questions* is the next advantage of online grocery shopping. Online stores have a huge database and more time to provide adequate and comprehensive answers to consumers, which physical stores do not have.
- Another advantage that online grocery stores have is *the lack of working hours*. The time for shopping in the online store does not matter, it does not matter whether it is a weekday or a holiday. At any time, the consumer has the opportunity to browse, compare, choose and fill his "shopping cart".
- As part of the benefits of online grocery shopping Supermag present *the huge variety*. The information provided by the cited site shows that the variety of the online store cannot be compared to that of the physical store, due to their limited retail space.
- The last advantage of online grocery stores is *the right to return the ordered goods*. This advantage is based on a regulation included in the Consumer Protection Act, which states that when concluding a "distance contract", the consumer has the right to cancel the purchase. Practice on the Internet shows that there is an option for a courier "Open before paying" or "View before paying", which does not cancel the obligation of the online store to accept the goods within 14 days after purchase. This, in turn, is associated with the payment of the costs of returning the goods at the expense of the consumer.

3. Materials and methods

The presented study focuses on analyzing and assessing the correlation between quantitative variables of online grocery shopping and the size of the Gross Domestic Product per capita at the level of the 27 Member States of the European Union. In turn, the indicator - Gross Domestic Product per capita, is defined as a significant indicator of the economic well-being of European consumers.

The methodological framework includes assessing the highlighted dependence by applying the method of single linear regression and correlation. The analytical goals set require the use of statistical software for computer processing - IBM SPSS Statistics, as well as the capabilities of the Excel program. The main information source is the data on online grocery shopping by consumers of the 27 Member States of the European Union, published by the European Statistical Office - Eurostat. The time scope of the study is 2014-2024.

The research results obtained take into account the variations of the two measured quantitative quantities – the dependent variable of online grocery shopping and the independent variable, as a factor, of the size of GDP per capita, within the European Union. The usefulness of the formulated conclusions finds expression in characterizing the influence of a significant economic factor determining the behavior of European consumers when shopping for groceries online.

4. Research results

The dynamic changes in the online environment and the capabilities of digital technologies form a new added value in the level of satisfaction of the requirements of European consumers. Research results, published in the specialized theory, show that modern European consumers, along with shopping for groceries in physical stores, strive to improve their experience through the capabilities of digital technologies and platforms. For

example, according to data from a report by the Global Retail Association, over 80.00% of online consumers have expectations and attitudes that augmented reality - AR, has the potential to improve shopping at all levels, including in physical stores (Shop. Association, 2023).

The sought-after time savings and convenience created by online shopping are changing the behavioral patterns of European consumers. The visualization of the empirical data for the two quantitative variables measured in this study is achieved using Figure 1.

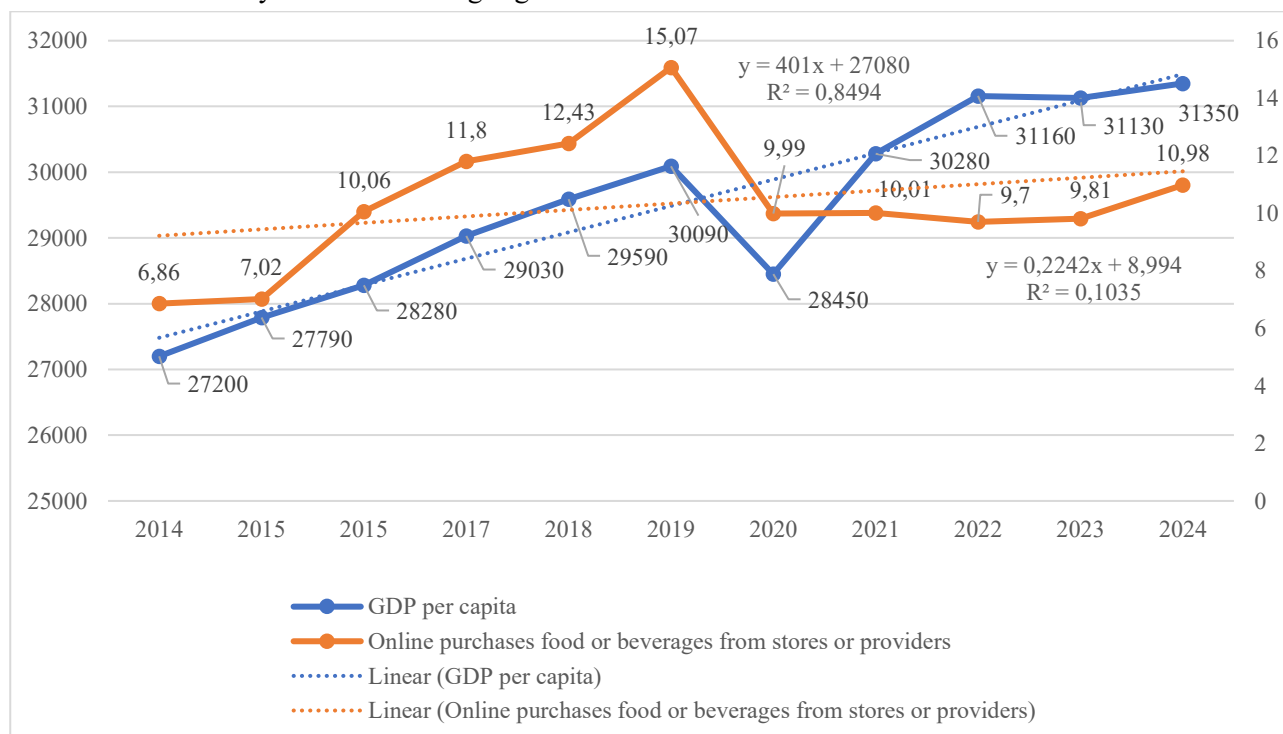


Fig. 1. Dynamics of online purchases of food and beverages from stores and other suppliers and GDP per capita in the 27 Member States of the European Union, 2014-2024.

Source: developed by the authors based on Eurostat data

The Figure 1 thus presented visualizes the dynamics and trends of change of the two measured indicators – the amount of online purchases of food and beverages by European consumers and the amount of GDP per capita. This figure contains two axes, with the right axis illustrating the analyzed type of online purchases, and the left axis – the amount of Gross Domestic Product per capita. At the beginning of the analyzed period – 2014, it is reported that 6.86% of European consumers shop online for groceries, while at the end of the period – 2024, this percentage increases by 4.12%, reaching the value of 10.98%. The other measured variable – the amount of GDP per capita at market prices, also shows an increase – in the last year of the analyzed period this value amounted to 31350.00 euros, which means an increase of about 15.26%.

During the analyzed period 2014-2024, the dynamics of online purchases of food and beverages by consumers from the 27 Member States of the European Union followed a relatively increasing trend. This is also confirmed by the coefficient of determination – R^2 , taking the value 0.8494. The reported coefficient measures the strength of the dependence and shows what part of the variation in the size of the studied online purchases – more than three quarters, is explained by the change in the other determinant – GDP per capita in the Community, measured at market prices. In essence, this is the so-called explained variance. The implementation of a regression analysis aims to establish the presence of an emerging trend.

When considering the section of the regression line, it is established that the increase in the value of GDP per capita in the 27 Member States of the European Union for each of the analyzed years is 0.2242 euros, and

that of online purchases of food and beverages – 401.00 euros. Therefore, it can be summarized that the growth of the two compared indicators is at very different rates and speed of change. In addition, in accordance with the reported dynamics of GDP per capita, it is concluded that the coefficient of determination amounts to 0.1035. For this reason, it is summarized that a relatively low part of the variation of this indicator – about one tenth is explained by the change in the other variable.

The implementation of a single linear regression and correlation using the statistical software product SPSS allows for the analysis of the emerging correlation between online food and beverage purchases made by consumers in the European Union during the period 2014-2024 and the size of GDP per capita in euros at market prices. The following Table 1, Table 2, Table 3 and Figure 2 illustrate the research results obtained from the regression and correlation analysis.

With the help of Table 1, visualization of the values of the correlation and determination coefficients is achieved.

Table 1**Model Summary**

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.470	0.221	0.135	2,150
The independent variable is GDP per capita - euro.			

Source: Developed by the authors based on data from Eurostat

As can be seen from the data in Table 1, the correlation coefficient is 0.470. The indicated coefficient measures the tightness of the single linear correlation between the two dependent quantitative variables. Under the condition $0.300 < R = 0.470 < 0.700$, a medium-strength relationship, or moderate degree of correlation, is established between the size of GDP per capita in the European Union and the size of online purchases of food and beverages.

The value of the coefficient of determination amounts to 0.221 and constitutes grounds for concluding that the regression model explains nearly a quarter of the variation in the studied online grocery purchases by consumers from the 27 Member States of the European Union. Therefore, nearly 22.10% of the differences between European consumers in online grocery purchases can be explained or are due to the influence of the factor - GDP per capita. According to the data in the same table, it is established that the value of the specified coefficient of determination takes the favorable value of 0.135.

Table 2 illustrates data that allow us to estimate the value of the dispersion indicator. The value of the F-criterion is established from the tabular data. The comparison of the two estimates of the variable quantitative values is of certain empirical significance.

Table 2**Anova**

	Sum of Squares	df	Mean Square	F	Sig.
Regression	11,812	1	11,812	2.5 55	0.04 4
Residual	41,604	9	4,623		
Total	53,415	10			
The independent variable is GDP per capita - euro.					

Source: Developed by the authors based on data from Eurostat

As shown in Table 2, the test method or F-criterion has a value of 2.555. Assuming that the risk of a first-order error is 5% ($\alpha = 0.05$), it can be concluded that the explained variance of the quantitative variable is nearly 3 times higher than the error variance. Since the significance level $\text{Significance } F = 0.044 < 0.050 = \alpha$, it can be concluded that there is a natural dependence of online grocery purchases on the size of GDP per capita

in Europe.

The analysis of the measured regression and correlation coefficients is aided by the data in the following Table 3.

Table 3

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
GDP per capita - euro	0.001	0.000	0.470	1,598	0.044
(Constant)	-11,868	13,908		-0.853	0.416

Source: Developed by the authors based on data from Eurostat

Interpreting the value of the private regression coefficient of the quantitative variable – the amount of online grocery purchases by European consumers, provides grounds for making certain findings. The empirical value of the analyzed indicator is 0.001. Therefore, an increase in this type of purchases by 1 euro leads to an increase in GDP per capita by an average of 0.001 euro.

The available data for the 27 Member States of the European Union allow us to illustrate the manifestation of the positive correlation between the two analyzed variables: see Figure 2.

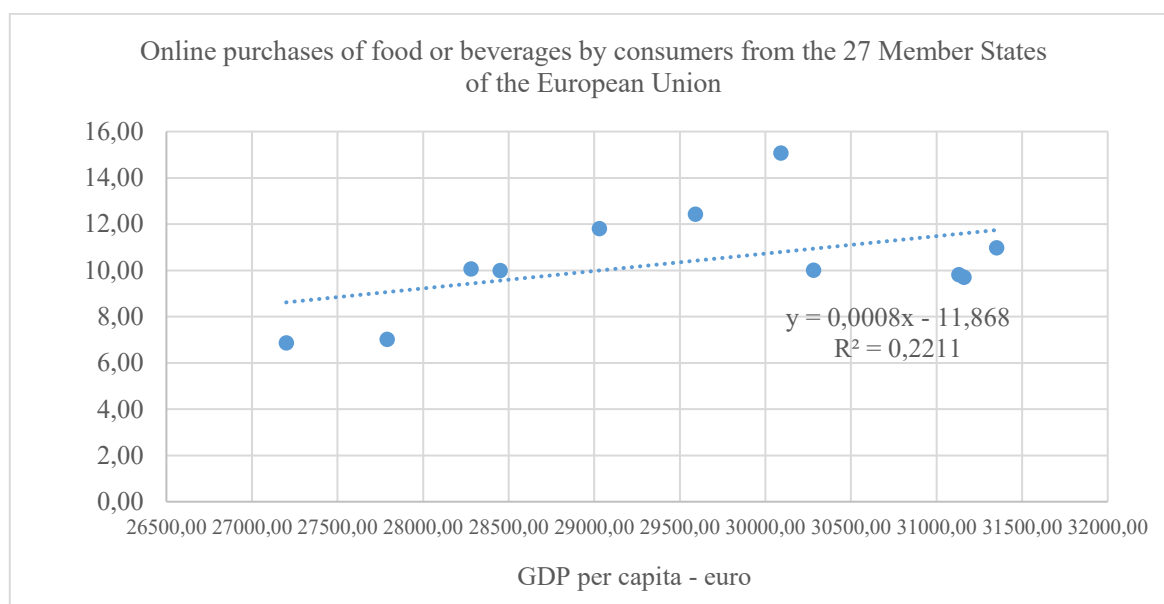


Fig. 2. Correlation between the amount of online food and beverage purchases and the amount of GDP per capita in the 27 Member States of the European Union, 2014-2024.

Source: Developed by the authors based on data from Eurostat

Fig. 2 provides a visualization of the trend model. The quantitative variable, which is a result of this study, is illustrated. During the period 2014-2024, an upward trend in the increase in the size of GDP per capita in Europe, measured at market prices, is outlined. Within the period under assessment, its values vary between 26,500 euros and 32,000 euros. Analytical utility is provided by comparing the results achieved by individual European countries. In this way, certain similarities and differences are highlighted. For example, in 2024, according to the values of the size of GDP per capita, the comparison shows the following: in Luxembourg, a

2.98-fold higher value of the analyzed indicator is reported compared to the value for the European Union; in Ireland, the excess is 2.72 times, followed by Denmark – 1.75 times and Sweden – 1.55 times, while in Bulgaria and Romania, relatively lowest values are reported.

A positive upward trend is emerging for the other variable measuring online grocery purchases by European consumers. The Netherlands – 24.45%, followed by Malta – 23.84%, Czech Republic – 21.43%, Denmark – 18.23%, achieve the highest values compared to the European Union figure of 10.98%. Comparatively lower values characterize the considered form of shopping in Romania, Bulgaria, Slovenia, etc.

The linear and regression analysis of online grocery shopping activity by consumers in Europe and its dependence on the factor - GDP per capita, allows for a discussion of the results obtained, as well as the formulation of more significant conclusions and generalizations.

5. Discussion

The results obtained from this study are grounds for reporting a moderate or medium-strength relationship between the two analyzed quantitative variables of online grocery purchases by consumers in the 27 Member States of the European Union and the size of GDP per capita. Conducting a linear regression analysis allows interpreting the changes occurring in the studied online activity of European consumers.

It is found that variations among European consumers in online grocery purchases are explained or due to emerging disparities and differences in the size of GDP per capita, measured at market prices.

In this regard, it is practically useful to compare with the results of other researchers published in the specialized literature. For example, there is a conceptual view according to which omnichannel shopping, including both online and offline shopping, for groceries is explained by the ever-growing digital capabilities and skills of consumers. The challenges facing the development and use of merchant websites, digital applications, and online grocery shopping platforms are highlighted (Singh & Soderlund, 2020). A large number of researchers adhere to prioritizing the influence of certain groups of demographic, economic, psychological, technological, and other factors. The proposed work prioritizes and assesses the impact of factors of an economic nature.

6. Conclusions

The presented study of the dynamics of online grocery shopping by consumers in the 27 Member States of the European Union provides grounds for formulating more significant conclusions and generalizations. The obtained research results allow us to synthesize that Nearly a quarter of the variation in online grocery purchases by European consumers is explained by differences in reported GDP per capita. At the same time, a relatively small part of the variation in GDP per capita – around one tenth – is due to changes in the online activity of the surveyed consumers when shopping for groceries.

The study shares the view that the size of GDP per capita largely determines the behavior of consumers when shopping for groceries online. In addition, it is perceived that the form of shopping under consideration is determined primarily by the impact of factors of an economic nature. Therefore, it is necessary to seek a modeling effect of economic factors on the size of online shopping for groceries by European consumers, as well as to analyze and evaluate the existing causal relationships. From this point of view, it is important that future business decisions of grocery retailers take into account the influence of a wide range of factors. Among them, as confirmed by economic science, one of the main determinants are those of an economic nature.

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Theoretical Foundations and Evolution of Relationship Marketing

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JEL: O14, P24, C41, E13

Abstract

The article examines the theoretical foundations and the evolutionary development of relationship marketing as a contemporary and strategically significant marketing concept within the context of modern business environments. Particular attention is paid to the gradual transition from traditional product-oriented and sales-oriented marketing approaches toward customer-centered and relationship-oriented strategies, which emphasize long-term interaction, trust, and value creation. In this regard, the study highlights the importance of Total Quality Management as a managerial philosophy aimed at continuous improvement, as well as the role of integrated marketing communications in ensuring consistency and coherence in interactions with customers. Additionally, the SERVQUAL model is discussed as a key analytical framework for measuring service quality and identifying gaps between customer expectations and perceived performance.

The empirical part of the research focuses on the practical application of relationship marketing in the activities of “BVS Entertainment” Ltd., a company specializing in hotel animation services within the tourism sector. Through the analysis of customer perceptions and organizational practices, the study explores how relationship-oriented strategies are implemented in a service environment characterized by high levels of personal interaction and emotional engagement. The findings demonstrate that the consistent application of relationship marketing principles leads to increased customer satisfaction, stronger emotional connections, and higher levels of trust between the company and its clients.

The results further indicate that relationship marketing contributes significantly to enhanced customer loyalty, a higher likelihood of repeat visits, and the development of a positive corporate image. These outcomes support sustainable business growth by strengthening competitive positions and fostering long-term relationships with customers and partners. Overall, the study confirms that relationship marketing is not merely an operational tool but a comprehensive managerial approach that plays a crucial role in achieving sustainable development and long-term competitiveness in the tourism and service industries.

Keywords:

relationship marketing,
services, tourism, hotel
animation, BVS Entertainment

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1. Introduction

Relationship marketing represents a contemporary and strategically significant marketing concept that places the relationships between the company and the customer at the center of business management and organizational culture. Unlike classical marketing, which to a greater extent emphasizes the one-time act of purchase and efforts to attract new customers through mass communication channels, relationship marketing aims at building, maintaining, and developing long-term relationships. These relationships are based on trust, mutual commitment, emotional attachment, and the creation of added value for both parties. Contemporary research emphasizes that sustainable commercial success increasingly depends less solely on price or the

quality of the offered product and more on the level of customer engagement and satisfaction, which can transform customers into long-term partners of the company (Grönroos, 2007).

The relevance of the topic stems from the growing dynamism and intensifying competition in the tourism sector—a sector that is extremely sensitive to changes in consumer attitudes and the global environment. It is precisely here that relationship marketing plays a key role, as service quality, the level of customer experience, and the degree of customer loyalty are decisive factors for the sustainable development of tourism companies. The concept is successfully applied in hospitality, catering, and entertainment services, where the value of the service is often assessed not only through its functional characteristics but through the way the customer feels in interaction with the staff and the organization as a whole.

Under conditions of digitalization and global challenges, relationship marketing gains additional importance. Digital platforms allow more precise personalization of offers, maintenance of constant contact with customers, and collection of information about their preferences and behavior. This provides opportunities for building deeper and more meaningful relationships that strengthen trust and increase the likelihood of repeat purchases. In this sense, relationship marketing can be regarded not only as a set of operational tactics but as a management philosophy aimed at achieving long-term sustainability and competitiveness of the business (Kotler, Kartajaya & Setiawan, 2017).

2. Object, Subject, Aim, Tasks, and Research Methods

The object of the research is the application of relationship marketing in the field of tourism services, with emphasis placed on the specific activity of tourist animation. Tourism is a service with a strongly expressed social and emotional dimension, in which interaction between the customer and staff plays a significant role in the perception of the quality and value of the product. Precisely for this reason, the application of relationship marketing in this sector has the potential to lead to significant competitive advantages. At the center of attention is the idea that the sustainable development of tourism companies can be achieved not only through improvement of the material base or pricing strategies, but above all through building lasting relationships with customers based on trust, satisfaction, and loyalty (Atanasova, 2017).

The subject of the research is the influence of the relationship marketing approach on the sustainable development of companies offering hotel animation as a specific type of tourism service. Animation is a particularly interesting field for research because it combines entertainment, cultural, and social elements that exert a strong influence on the overall tourist experience. On the one hand, it contributes to customer satisfaction and engagement, and on the other, it creates opportunities for building an emotional connection between the tourist and the tourism product. In this way, animation becomes a natural field for the application of relationship marketing, where the quality of relationships is equal in importance to the quality of the service.

The main aim of the research is to demonstrate that the application of relationship marketing in the tourism sector, and in particular in the field of hotel animation, contributes to increased customer satisfaction, the building of long-term loyalty, and sustainable business development. Achieving this aim requires examining both the theoretical foundations and international experience, as well as specific practical aspects in the activities of Bulgarian companies. By integrating the conceptual framework of relationship marketing with real data from practice, a well-grounded assessment can be made of the effectiveness of this approach under the conditions of a dynamic tourism market (Ivanov, 2024).

The research tasks are structured so as to ensure comprehensive and systematic achievement of the stated aim. First, it is necessary to examine and analyze the theoretical framework of the concept of “relationship marketing,” tracing its evolution, key characteristics, and main instruments. Second, the research should focus on the specifics of tourist animation by analyzing its essence, structure, and role in the contemporary tourism product. Third, an important task is the conduct of an empirical study at “BVS Entertainment” Ltd.—one of the leading companies in Bulgaria in the field of animation—in order to assess how relationship marketing is

applied in practice and what results it yields for the sustainable development of the company. Fourth, based on the analysis, practical recommendations should be formulated for improving marketing policy and increasing the competitiveness of tourism organizations.

The research methodology is multifaceted and includes a combination of qualitative and quantitative approaches. At its core is a survey conducted among customers and employees of the company, which makes it possible to measure the level of satisfaction, loyalty, and perception of the offered services. In addition, statistical analysis is applied to process the collected data, through which patterns and relationships between individual indicators are identified. To provide a more in-depth view of the problem, a comparative method is used—through which the research results are compared with available data from international practice—and a descriptive method, allowing the outlining of key characteristics of company policy and customer attitudes. In addition, elements of SWOT analysis are applied to assess the strengths and weaknesses of the company, as well as opportunities and threats from the environment. This methodological combination guarantees the comprehensiveness and objectivity of the results, which can serve as a reliable basis for conclusions and recommendations (Baran & Zerres, 2014).

3. Theoretical Foundations and Evolution of Relationship Marketing

The evolution of marketing has gone through several main stages—from product-oriented marketing, through sales marketing and market orientation, to contemporary relationship marketing (Kotler, 2002). Philip Kotler defines marketing as a process of creating, offering, and exchanging value for the customer, while contemporary authors such as Atanasova and Karadzhova emphasize the necessity of building trust and loyalty. In the field of services, and especially in tourism, relationship marketing emerges as key to the formation of competitive advantages. It presupposes not merely the satisfaction of the customer's immediate needs, but the building of a lasting relationship supported by personalized service, loyalty programs, and high service quality.

4. Application in Tourism and Tourist Animation

In the field of tourism, relationship marketing finds particularly fertile ground for development, since tourism services are by their nature highly personalized and oriented toward building an emotional connection between the customer and the provider. Unlike tangible products, tourism services are characterized by intangibility, inseparability from the process of provision, and subjectivity in the assessment of quality. For this reason, the customer does not perceive the tourism product merely as a package of services, but as a holistic experience, within which relationships with staff and the atmosphere of hospitality play a leading role. In this context, relationship marketing goes beyond the boundaries of traditional marketing techniques by emphasizing long-term trust, individualized approach, and sustainable cooperation with the customer (Buhalis & Sinarta, 2023).

The specific application of relationship marketing in tourism is realized through the development of personalized offers adapted to the needs and preferences of individual customers, the creation of loyalty programs that stimulate repeat visits and form lasting relationships, and the application of innovative digital tools for maintaining constant contact with customers. In addition, a key role is played by the implementation of animation services in hotel complexes, which not only add value to the core tourism product but also transform the stay into a unique experience.

Animation, considered as a specific form of tourism service, represents a complex of activities aimed at entertainment, cultural enrichment, and social activity of tourists. It contributes to increasing their satisfaction while simultaneously forming an emotional bond between the customer and the tourism organization. Under conditions of intense competition, in which hotels offer similar types and quality of services, animation emerges as a factor for product differentiation and a tool for building competitive advantages. Through diverse programs—sports, cultural, artistic, or family-oriented—tourism enterprises create an environment in which

the guest does not merely consume a service but actively participates in events and experiences (Karadzhova & Angelov, 2018).

Relationship marketing in the field of animation is expressed in building trust and attachment between the customer and the animation team. Animation staff have direct and daily interaction with tourists, which allows for rapid establishment of personal relationships, adaptation to individual needs, and creation of a sense of belonging to a particular community. Through consistent application of this approach, hotels succeed in transforming the guest from a one-time consumer into a loyal customer who not only returns but also recommends the destination and services to relatives and acquaintances.

Practice shows that through high-quality animation services, tourism organizations achieve a number of strategic benefits. First, the level of customer satisfaction increases, which is directly linked to building loyalty and increasing repeat visits. Second, animation helps extend the length of tourists' stays by offering additional reasons to remain longer at the hotel or to return in the future. Third, through diverse animation programs, a competitive advantage is secured in the market that is difficult for competitors to replicate, as it results from specific organizational experience, creativity, and emotional connection between staff and guests.

In this sense, animation can be regarded as the core of the application of relationship marketing in tourism. It not only enriches the core tourism product but also plays a key role in the strategic management of customer relationships. Transforming animation services into a platform for building long-term relationships and trust is one of the most effective mechanisms for the sustainable development of tourism enterprises. As a result, companies that successfully integrate relationship marketing into their animation practices manage to achieve sustainable market presence, higher levels of customer satisfaction, and long-term competitiveness.

5. Research Results

The empirical study conducted at "BVS Entertainment" Ltd. aims to assess the effect of the application of relationship marketing in the company's activities and to identify the relationships between marketing practices, customer satisfaction, and sustainable business development (Georgiev, Petrov & Nikolova, 2023). The company is a leading provider of animation services for hotel complexes in Bulgaria and works with a wide range of partners in the tourism sector.

Survey research was conducted among tourists who used hotel animation services, as well as among the company's animation staff. The sample includes over 300 respondents, and the research instrument covers questions related to the level of satisfaction, loyalty factors, preferences for animation programs, and perceptions of service quality. The data were processed through comparative and statistical analysis, and descriptive methods were applied for interpretation of the results.

The analysis shows that over 80% of the surveyed tourists identify animation as a significant factor for the overall quality of their stay. A high level of satisfaction with the personalized approach of animators, their communicative skills, and their ability to create a positive atmosphere was established. Approximately 70% of respondents state a willingness to return to the same hotel precisely because of the high level of animation service, which is a direct indicator of the effectiveness of relationship marketing (Fig. 1).

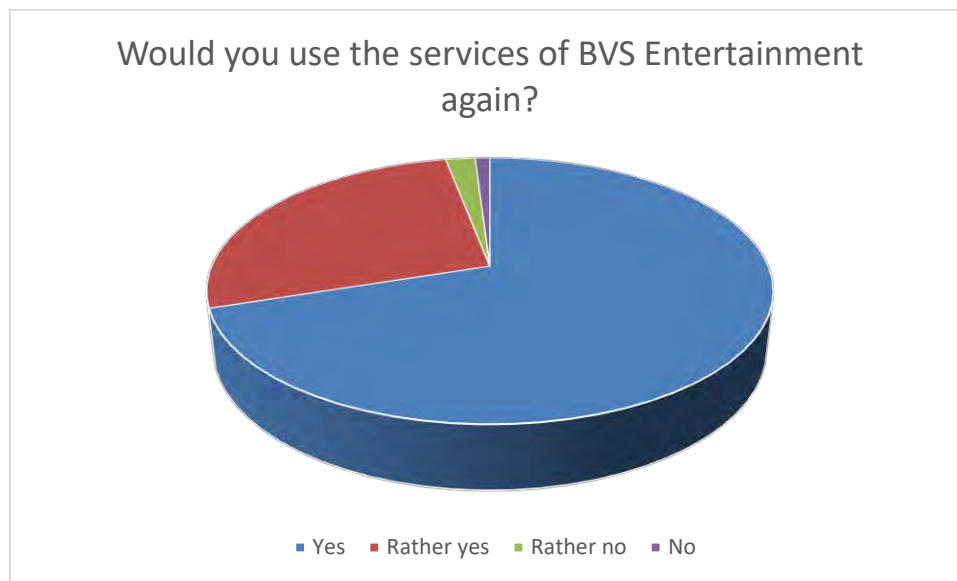


Fig. 1. Would you use the services of BVS Entertainment again?

The results of the staff survey show that the application of the relationship approach has a positive influence on internal organizational culture as well. Animators emphasize the importance of teamwork, continuous feedback from customers, and flexibility in service provision. These factors lead to higher motivation and professional satisfaction, which in turn affects service quality.

The company reports a significant increase in the volume of contracts with hotel complexes and an expansion of its product portfolio during the analyzed period. The implementation of relationship marketing leads to stabilization of the market positions of “BVS Entertainment” and to sustainable growth in revenues. The customer base becomes more loyal, and recommendations from satisfied guests turn into a key channel for attracting new partners and tourists.

The research clearly demonstrates that the application of relationship marketing at “BVS Entertainment” Ltd. is directly related to increased tourist satisfaction, the building of long-term customer relationships, and the strengthening of the company’s competitiveness. Animation is established as a strategic instrument for the realization of relationship marketing, with its effects manifested both at the micro level—through individual customer experience—and at the macro level—through the sustainable development of the organization.

6. Discussion

The results of the study at “BVS Entertainment” Ltd. confirm the importance of relationship marketing as a key management concept for the tourism sector. The analysis shows that the application of the relationship approach not only increases customer satisfaction but also creates prerequisites for sustainable development by strengthening relationships with customers, partners, and employees (Peppers & Rogers, 1993).

In the context of international practice, these results correspond to the conclusions of Kotler et al., according to whom digitalization and personalization in services lead to deeper customer engagement and higher levels of loyalty. Similar conclusions are drawn by Peppers and Rogers, who emphasize that relationship marketing is oriented not so much toward short-term sales as toward building trust and long-term relationships. In the case of “BVS Entertainment,” this trust is achieved through animation—a service that carries emotional value and adds uniqueness to the hotel product.

An important observation is also the impact on internal organizational culture. Company staff perceive the relationship approach as a means of better communication and motivation, which corresponds with the views of Atanasova, according to whom the success of relationship marketing depends on the integration

between external and internal relationships within the organization. Therefore, the effect is twofold: on the one hand, customer experience improves, and on the other, internal team relationships are strengthened.

A debatable issue is the extent to which these results can be sustainable over time. The tourism industry is highly dependent on seasonality and external factors such as economic crises or health pandemics. In this sense, to maintain sustainability, “BVS Entertainment” should further develop relationship marketing through digital platforms, hybrid forms of animation, and expansion of the portfolio with innovative services.

In summary, the research results are in harmony with established international theory and practice, while at the same time highlighting the specifics of the Bulgarian tourism market, where animation emerges as a particularly strong instrument for building an emotional connection with the customer.

7. Conclusion

The study of the application of relationship marketing in the field of tourism services shows that the relationship approach has a direct and multifaceted impact on the sustainable development of companies in the sector. Based on the analysis of “BVS Entertainment” Ltd., several main conclusions can be formulated:

1. Relationship marketing is an effective tool for achieving high customer satisfaction, which in turn leads to increased loyalty and repeat visits.

2. Animation as an element of the tourism product is established as a strategic carrier of relationship marketing, as it creates added value and differentiates the hotel from competitors.

3. The application of the relationship approach has a positive impact on internal organizational culture by motivating employees and encouraging teamwork.

4. The economic results of the company confirm that relationship marketing can be a factor for sustainable business development under the conditions of a dynamic tourism market.

In conclusion, it can be stated that relationship marketing is not merely an additional tool, but a comprehensive management philosophy that combines theoretical principles and practical applicability. Based on the experience of “BVS Entertainment” Ltd., it can be recommended that other tourism companies integrate the relationship approach as part of their strategic framework in order to achieve competitive advantages and sustainable development.

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7 Plus 7: New Dimensions in Value Communication and Creation Process. Expanding the Marketing Mix in the Banking Industry

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JEL: M31

Abstract

In the context of the contemporary market challenges there is a strong need of reconsidering the Value creation and communication process. In order to keep customers satisfied and establish a long-lasting and reliable relationship with them companies need to add additional Value to the classical marketing offering. In a highly competitive industry like the banking one this need is even more evident. Acknowledging the importance of the traditional marketing mix elements for the service industry, the authors of the report suggest theoretically and empirically grounded extension of the marketing mix by adding seven additional elements. Prediction, Personalization, Perception, Partnership, Proximity, Presence and Participation are proposed to be the new dimensions in Value Creation and Communication Process, particularly in the Banking Industry.

Key words:

marketing mix,
communication, value, banking
industry

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1. Introduction

The changed market paradigm results into a revision of the way companies develop and communicate Value to their customers. Nowadays, Value as a Value itself has new dimensions—beyond the classical perception of what customers define as important in their relationship with companies. Building an authentically value-oriented marketing proposition requires incorporating the basic elements which determine the level of customer satisfaction. But at the same time, it demands that businesses take into account the dynamically changing market environment where customers have higher expectation in order to give more (the E+ / “Expectations Plus” concept is very popular, especially in the service sector) (Tay Guan Meng & Sidin, 2021).

In the light of the “95/5 rule” (applicable to both B2B and B2C markets) (Dawes, 2021), only 5% of company’s prospective customers are “on the market” and have readiness to make a purchase. The remaining, predominant 95% of potential customers show no interest in transactional exchanges or immediate purchase; being unaffected by advertising, promotional incentives, and other short-term impact tools typical for Performance marketing. These 95% are searching for a foundation for building long-term relationships with companies. They are customers searching for new dimensions of Value propositions—worth their payment. Companies have the task of identifying, generating, and effectively communicating these new aspects of Value. (Value).

Recognizing these characteristics, the report's authors aim to propose a theoretically and empirically grounded expansion of the marketing mix through the addition of seven supplementary elements while recognizing the significance of traditional marketing elements in the service industry. The report's authors introduce Prediction, Personalization, Perception, Partnership, Proximity, Presence, and Participation as new dimensions in the Value Creation and Communication Process. It is important to specify that the formula of

7 Plus 7 proposed by the authors is focused on the service sector - particularly banking- where these seven elements are characterized by relevance. Such expansion of the classical service sector marketing mix can be adapted to other business spheres, provided that market specificities and consumer understanding of Value are considered.

2. Concept Development

Kotler (2018) defines marketing as the process of "creating, communicating, and delivering Value to a target market at a profit." McCarthy (1960) first developed the concept of the marketing mix in its classical four-element structure (Product, Price, Place, Promotion). However, it was Kotler who established its true understanding as an instrument for companies to create, communicate, and deliver Value. He identifies these four elements as the cornerstone of the Value creation process. Later, Booms and Bitner (1981) expanded the four-dimensional version of the mix with three additional elements (People, Process, Physical evidence), highlighting that in the service sector, creating and communicating Value is impossible without recognizing their importance

These seven elements together are widely recognized as the classical framework (the report's authors hold the same view) for understanding the marketing offering's substantive content. However, market changes and strong impact from the broader marketing environment result in developing of new, expanded versions of the mix that reflect market dynamics and their impact on Value perceptions. Value now emerges as a function of various elements functioning together. For example, Kotler (2017) emphasizes the importance of Partnerships, Personalization, and Packaging in Marketing 4.0. Taking into account the Covid-19 impact, Georgieva (2023) proposes re-conceptualizing the marketing mix by adding Protection as a key element for Value generation given the specific market circumstances of that period.

AI dominance in various spheres of social and economic life in recent years, along with the growing importance of the concept of the "Experience Economy" (Pine & Gilmore, 1998), combined with empirical evidence¹, motivates the report authors' to propose their own extended version of the classical 7-element marketing mix model in the service sector, in particular tailoring their concept with a focus on the banking industry. The banking sector is deeply influenced by technology; customer experience is equally crucial in this market, where developing long-term relationships with customers and maintaining strong satisfaction and loyalty is a valuable asset in an intensively competitive environment. As of this study's writing, 17 commercial banks and 6 branches of foreign banks operate on Bulgaria's relatively small market, highlighting the issue of long-term bank-client relationships. Although this clients- bank relationship differs from the classical interpretation of the clients-company relationship, in both scenarios, building customer satisfaction and loyalty relies on their perception of Value in the ratio of expenses incurred to benefits received. This Value can have different dimensions. It can be both functional—for example, easy access to banking services, favourable pricing conditions, or fast service—or emotional, including sense of care, security, and trust in the CB.

The authors' principal thesis is that Prediction, Personalization, Perception, Partnership, Proximity, Presence, and Participation are the seven new core elements that CBs need to integrate into their classic marketing offer (Product, Price, Place, Promotion, People, Process, Physical evidence) to succeed in creating and communicating Value in client relationships and build the loyalty they pursue. The authors refer to this concept as 7 Plus 7 (Figure 1).

¹ Petar Kirov has over 15 years of practical experience in the banking sector in Bulgaria. He holds various expert and management positions, and for the last 6 years he has been the director of bank locations in various settlements. During this period he has been directly or indirectly responsible for communication with nearly 4,000 companies in Northeastern Bulgaria. The above serves as a basis and reference for some of the observations and subsequent conclusions in this report.

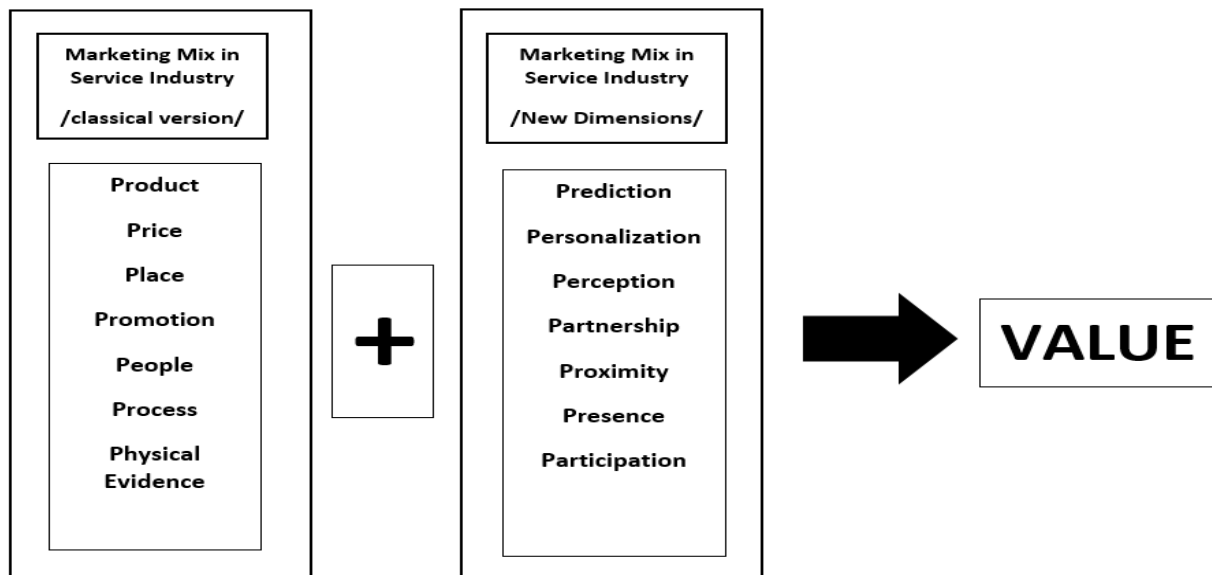


Fig. 1. 7 Plus 7 Marketing Mix Concept in Banking industry

Source: Developed by the authors

In the authors' opinion, integrating these seven new elements with the already existing seven represents the necessary and logical response by CBs to the fundamental transformation in consumer behaviour that is discussed in details in Deloitte's most recent report - "The Value-Seeking Consumer: Competitors Could Lose Out to Brands Offering More than Low Prices" (2025). Although the report is based on a research involving 9,000 U.S. consumers (analysing 900,000 consumer reviews across 290 brands, 5,000,000 credit card transactions, and 300+ corporate reports), some of its findings can be readily applied to the Bulgarian when considering its specificity. Most significantly, the report's data outlines a new consumer profile: "Value seekers"—well-informed, demanding, pragmatic clients who cannot be attracted only by low prices. These consumers want to feel "that the purchase is worth it, regardless of its price" (Deloitte, 2025). Another key point in the report is introducing the "MVP" concept for brands—"More Value for the Price." According to Deloitte (2025), price remains a key element of the marketing mix in forming perceptions of brand Value and the overall marketing offering, but to a great extent this perception (according to the report up to 40%) —(Deloitte, 2025) comes from the added Value that factors beyond the classical 7. These factors differ across industries. In HORECA, it's the quality of the product or service; in automotive, Value depends primarily on reliability; in fashion, fast delivery is a priority. For banking, the authors propose 7 additional components that contribute to the MVP („More Value for the price“) concept, on the one hand, while also providing a foundation for building long-term relationships with "Value seekers," given that this consumer profile is relevant to our market.

These seven components, illustrated in Figure 1, are discussed in more detail below.

Prediction and Personalization

Small and medium-sized enterprises (SMEs), by their nature, represent heterogeneous economic client groups that according to their business specificities use different combinations of banking products and services. For the most part, CBs offer products and services for SMEs with parameters and functionalities relatively similar. The difference lies in how they combine them for a specific company and how this combination addresses its particular needs. It can be said that we find ourselves in conditions of rapidly

accelerating market dynamics driven by factors such as market globalization, digital transformation, and geopolitical disruptions. Therefore, clear communication with business representatives is essential for CBs to orient themselves and understand a company's specific needs promptly. This, therefore, is an important prerequisite for providing adequate financial solutions. In this sector, the key word is "quickly." Thanks to their experience working with numerous SMEs, CBs succeed in creating behavioural models using different criteria to help predict the behaviour of a given business client. This, in turn, saves considerable time and effort in the communication process for both parties. In this context, Prediction and Personalization are identified by the authors as important new elements of the expanded marketing mix tailored for CBs. Through them, not only is the Value proposition improved, but a foundation is also created for building long-term relationships between CBs and SMEs.

Predicting the behaviour of business clients focuses on the predictability of their actions as an asset. This means a commercial bank's (CB's) ability to use available internal information and external data to anticipate a specific client's future behaviour, needs, and potential risks associated with collaboration. For example, based on a CB's experience working with agricultural producers, combined with its active communication with the State Fund for Agriculture and expected agro-economic forecasts for yields in the current agricultural year, the bank can predict the need, volume, and risk of providing working capital loans. In the scenario where a CB has no internal information on a client's transactional and credit behaviour, it can use external data such as references from commercial or credit registers, financial statements, or bank account statements from other banks. These data are systematically organized and analysed afterwards. The internal information the CB holds often relates to its experience with other a like companies that share similar characteristics, such as sector, regulations, business scale, region, available long-term assets, and potential collateral. Similarly, CBs can forecast and compare the added Value of investing time and effort in attracting and retaining any business. For example, it may be more advantageous to focus on a company engaged in heavy international road transport rather than one organizing maritime transport. The bank can predict the expected volume of transactions, the number and type of the used banking products, the potential for attracting employees as clients, credit appetite, risk characteristics, expected revenue, and potential challenges in working with a specific company. Generally, both business clients should be targeted, but when resources are limited, prioritization is essential.

Personalization affords the use of information analysed through the prediction process to modify and adapt the banking offer according to the profile of a specific business client. In personalization, customer experience is the starting point. A strong customer experience is a key indicator of long-term business client retention. In conditions of digitalized processes and almost equalized pricing offers, it prevails over the location of bank branches and the price of banking products and services. The tools used by CBs to support personalized offers and sped up the finalization of the entire process include machine learning-based product recommendations, individual comprehensive offers, personal business banker services provided by someone familiar with the client's profile, customer relationship management (CRM) systems, and electronic signature systems (Evrotrust and Bulbank Mobile).

In summary, both elements—Prediction and Personalization—can be reviewed as applications of AI in the banking sector, each contributing individually to creation of Value, but their combined interaction accelerates the effect. This happens because AI enables real-time prediction of behaviour and risk, making the process faster, more efficient, less costly for the bank, and in some cases even more reliable. In this case, AI is used to process big data, such as transactions, payment cycles, main business partners, licensing regimes, ups and downs in payments, seasonal patterns, market behaviour changes, and information about the business available online. This automation enables faster and more accurate data gathering with lower costs, with the focus on analysis and drawing conclusions. The primary objective is to answer the question of a specific business's potential to generate higher revenues for the CB at minimal costs and potential risk.

Reviewing and adding Prediction and Personalization as additional elements of the banking marketing mix provides a new understanding of how CBs communicate their Value proposition to SME clients. They build upon the effective offering of banking products and services to establish a personalized, sustainable client relationship whose dynamics are supported by AI capabilities.

Perception

The report's authors view perception as a projection of the customer experience. In the spirit of the "Experience Economy" concept (Pine, Gilmore, 1998) — the way consumers feel before, during, and after interacting with a particular company is of essential significance in forming their assessment of Value and deciding whether to continue, terminate, or reactivate relationships with that company. In the Bulgarian banking sector, certain negatively layered image effects exist, resulting from consumers' negative experiences with certain banking institutions over the years (the mass bank bankrupts in 1997, as well as the insolvency of CCB in 2014), which reflect upon clients' initial predisposition even before formal relationship between SMEs and CBs begins. This makes consumers much more sensitive throughout their Customer Journey, increases the likelihood of more Pain Points appearing, which in turn necessitates very good integration of this component with two classical ones — Process and People. Good customer service, a sufficiently high level of information provision, timely assistance, maximum simplification and transformation of processes into customer-friendly operations is essential for the perception of customer experience in CBs to be viewed as a value-generating process. For this reason, CBs that succeed in generating and, more importantly, communicating this aspect of Value should register higher levels of satisfaction in consumer behaviour and, respectively, better financial results.

Although representatives of small and medium-sized enterprises (SMEs) adopt a pragmatic approach when choosing a servicing bank, their personal perception of understanding, respect, and commitment toward the business they manage are of great significance. This perception is formed during the first contact with a particular CB, whether this contact occurs through a physical visit to a branch, the use of an online platform, or access to information from another source. Given its nature, this aspect resists quantitative measurement; in contrast, it is influenced by factors which have specific quantitative parameters. This means that targeted actions affecting these factors also influence the indicator itself. Some of these factors are the response speed to inquiries, service efficiency during branch visits, and instant customer feedback after service (such as the Customer Satisfaction Index (CSI), Net Promoter Score (NPS), Customer Effort Score (CES), or publicly available feedback via Google reviews. The sense of fairness and transparency is critically important for business clients' perception. Clear and transparent communication of all applicable fees, changes in credit policies, and potential risks associated with the use of different banking products is a subject of extensive discussion in Bulgaria in recent years. It can be said that the perception of communication quality is one of the key factors guiding business clients in their choice of servicing CB. Research in this area (BCSG, 2021; IGI Global, 2023) shows that the absence of regular and meaningful communication between CBs and SMEs reduces client engagement and significantly increases the likelihood of switching to a competitor bank. Therefore, perception should be understood not only as a personal experience, but also as an expectation formed by both experience and by reputation and recommendations. Perception is strongly influenced by people and processes (two essential components of the extended marketing mix). For this reason, communication with relationship bank managers plays a key role, since their job isn't just to pass on information but to build trust through professionalism and genuine human understanding. At the same time, the speed and intuitiveness of integrated banking processes and systems play vital role in supporting that communication. The balance lies in reducing bureaucracy and risk while maintaining potential risks low, and achieving high automation without losing the human touch. In conclusion, perception can be viewed as an active component in creating Value for SMEs at CB. Its measuring reveals how much clients trust and engage with a particular CB — and, more broadly, with

banking services as a whole.

Partnership

Trust is also at the fundamental of the next component of the “7 Plus 7” concept. It is a key building block for establishing long-term partnerships, which is of significant importance in the banking sector. The report “Bridging the Trust Gap” (Institute of Practitioners in Advertising & Financial Times, 2025) ranks trust as the second most powerful driver of business success, right behind product or service quality. In today’s turbulent market environment, marked by global uncertainty, digital misinformation, and legitimate concerns about data security arising from AI-driven process automation, trust naturally becomes a strategic intangible asset. It is the foundation for building long-term and sustainable partnerships. It is no coincidence that many communication campaigns of different bank institutions are not merely focused on promoting their product portfolios, but also on building a positive image — which serves as a foundation for trust, collaboration, and partnership.

Partnership illustrates the extent to which SMEs are seeking a strategic partner rather than merely a lending institution, and how the servicing CB is perceived as such a partner. The level of trust in the bank plays an important role in this assessment, along with ratings from reputational agencies. Tools that enable these measurements include the Net Trust Score (NTS), ESG ratings, and Reputation Score. In this way, building trust is no longer seen as an abstract concept related to long-term partnership. It has a measurable quantity, expressed through various indicators. Table 1 summarizes the main indicators used to measure the level of trust that SMEs have in their CB.

Table 1

Trust Measurement Indicators for Banks and Their Relevance in Bulgaria

Indicator	Purpose	Importance for SME Clients	Data Used	Source data	Relevance for CB in Bulgaria
Net Trust Score (NTS)	Measures trust in a given commercial bank through direct customer surveys.	Allows assessment of overall trust in the commercial bank	Primary	Subjective trust	Yes (internal use, not published)
Reputation Score	Measures trust in a given commercial bank by combining qualitative and quantitative data	Influences perception of the bank as a stable partner by providing insights across various indicators—products, ethics, innovation, sustainability, communication, and image	Combined	Overall perception and image	Yes (internal use, not published)
ESG Rating	Evaluates the bank's policies regarding environmental, social, and governance practices.	An important indicator for SMEs operating in sustainable industries and those seeking support for sustainable investments	Secondary	Specific ESG-focused measures	Partially (less public data available)
Customer Relationship Index (CRI)	Assesses the depth and quality of relationships between the CB and its business clients.	Helps assess the bank's commitment to business clients beyond just offering and selling products and services. Measures SME satisfaction, loyalty, engagement, and trust	Combined	Loyalty and recommendations	Yes (widely used internally in practice)

Brand Sentiment Score	Automated analysis of emotional attitudes toward the brand.	Offers indicators of current market perception and reputational risk.	Secondary	Assessment of customer experience and processes	Yes (widely used internally in practice)

Source: Developed by the authors

Measuring this indicator, by combining primary and secondary data, allows CB to develop more precise strategies for attracting, retaining, and developing their business clients. Building long-term partnerships requires a high level of trust. Trust, in turn, is built through transparent communication, high-level expertise, and a human-cantered approach.

Proximity

Proximity is an important component in creating Value and can be understood as humanity, closeness, and accessibility in the communication between a bank and its clients. This component is closely linked to the People component in the classic interpretation of the marketing mix. In banking, services are still predominantly delivered by people to people. Professionalism and expertise in service are crucial, but they do not exclude the purely human element. Empathy can often be what clearly differentiates a CB from its competitors in the market, particularly when clients are selecting a banking partner or whether to continue their Customer Journey with a given bank. During the journey itself, Proximity can serve as a tool to more quickly and effectively resolve situations of client dissatisfaction. Minimizing client dissatisfaction has a direct impact on the bank's financial success and market standing.

It is also important not to overlook the internal organizational dimension of Proximity for CBs. It can be said that branches whose managers demonstrate humanity and respect toward their employees have built a more positive work environment, which increase internal staff satisfaction. Higher employee satisfaction reduces the likelihood of losing valuable personnel. A Gallup study (2022) illustrates a correlation between employee satisfaction and subsequent client satisfaction, which, as noted earlier, has a direct impact on key business indicators for the CB.

In recent years, digitalization has meant that proximity is no longer limited to physical presence. Digital platforms for communication between clients and their relationship bank managers, mobile applications, and the implementation of chatbots result in a new understanding of the Proximity concept. Communication remains person-to-person, but to a large extent, it now takes place in a digital environment. Table 2 summarizes some of the key indicators regarding the quality of communication between CBs and SMEs in the digital context.

Table 2

Indicators for Measuring Communication between SMEs and CB in a Digital Environment

Indicator	Purpose of measurement	Measurement Method	Data Used
Customer Effort Score (CES)	Effort SMEs expend to obtain a service	Survey after contact/transaction	Primary
First Contact Resolution Rate (FCR)	Success in resolving an SME issue from the first inquiry	Internal information systems for number of requests and resolved customer issues, as well as inquiries	Combined
Average Response Time (Digital)	Response time via digital channels (Chat, Email)	Internal information systems	Secondary

Employee Satisfaction Index (ESI)	Employee satisfaction with the work environment	Customer surveys, internal studies, and employee turnover data	Combined
Internal Net Promoter Score (eNPS)	Employee likelihood to recommend the bank as a good employer	Anonymous internal surveys and measurement through financial incentive systems for recommendations	Combined
Churn Rate	Percentage of lost customers	Analysis of quantitative changes in the customer base	Secondary
Chatbot Satisfaction Score	ME rating of interaction with Chatbot	Survey after contact/transaction	Primary
CSAT in Digital Service	SME Satisfaction with the Use of Digital Channels	Survey after contact/transaction	Primary

Source: Developed by the authors

The table shows that measuring Proximity requires both primary data from clients and secondary data from the CB's internal information sources. This, in turn, allows for a simultaneous consideration of both external client and internal employee sentiments and attitudes. The next step in this process is platforms, which gradually replace face-to-face contact. They tend to become not just a communication channel between the CB and SMEs, but an active participant in the communication process. The success of this evolutionary step heavily depends on the integrated digital interface— language, tone, intuitiveness, and the possibility of escalation to a human when needed. This process is delicate as it involves communicating sensitive and often complex and not easily understood matters for clients, such as banking products and services.

Based on the above, Proximity can be considered a manageable marketing component with measurable impact. This impact has both internal and external projections for the CB. It can be said that the focus of Proximity is on human closeness and empathy in interactions. However, achieving closeness also requires assessing the intensity of the bank's contacts, which, in turn, influences recognition, accessibility, and ultimately, how the bank is seen as a partner. The intensity of these interactions represents the next component in the '7 Plus 7' framework.

Presence

Presence is a strategic component in the extended marketing mix proposed by the authors. It enables CBs to communicate their Value proposition. Presence is becoming increasingly important in the context of digitalization and shifting consumer expectations. A CB's presence is no longer viewed solely in physical aspects—through branches, offices, and ATMs—but as a holistic presence in the clients' lives, including digital, social, and even mental aspects. Digital presence means implementation of user-friendly online and mobile platforms, as well as the growing adoption of digital advisors. Social presence goes beyond interaction on social media; it also includes a bank's participation in various social initiatives that provide tangible Value to society and local communities—such as creating eco-paths, funding educational projects, or donating for social causes. All the above stimulates the bank to be established as a trusted partner in the eyes of clients, not merely as a part of the business world but a participant in a wider community. It is reasonable to suggest that Presence is strongly correlated with the previous two components, as targeted and intensive presence creates conditions for building Proximity, respectively Trust, leading to long-term Partnerships with clients. The measurement of this component can be done using indicators such as physical

accessibility (Physical Network Index) or digital presence (Digital Engagement Score). It can also include measuring the bank's online search presence (SERP Presence) or its social recognisability (Brand Recall). Purposeful and cyclical asserting of presence through various channels and the use of different tools is a factor with a clearly strong influence on upon choosing a servicing bank by an organizational client. Although rational factors should primarily guide this choice, the role of social and emotional factors should not be overlooked. For this reason, systematic assertion of the bank's presence is important to reinforce its position in the minds of clients. This does not refer merely to promotional activities, but to efforts focused on the bank's recognisability that go beyond its commercial role. It can be said that a Value proposition has a more favourable foundation for perception by SMEs when its source is more recognizable. At present, this communication process is predominantly one-way — from the bank to the clients. However, it should be noted that in recent years there has been a steady shift from one-way to two-way communication. The client already actively participates in shaping the Value proposition. Expectations are that the effects of this process will accelerate in the future, which supports the establishment of Participation as the next independent and significant component in the “7 Plus 7” formula.

Participation

As already noted, this component reflects the active role of the client in the process of creating, communicating, and delivering Value. The client is not merely a passive recipient of the product or service, but an active participant in their design and communication. This process leads to a blurring of the boundaries between the service providers — in this case, the CB — and the consumer, represented by the SMEs. It is a win-win situation in which both parties jointly participate in developing a product or service that benefits the SME and is profitable for the CB. This participation can be viewed from several perspectives — for example, the involvement of SMEs in the personalization of the services they use. Such cases include online and mobile payment platforms, which offer a high degree of autonomy. Also, they include sharing personal experiences, stories, and suggestions by SMEs through social networks, forums, or various events. Such sharing creates Value that influences the CB's image.

Another important direction in which SMEs actively contribute to Value creation is through feedback, provided via various channels (physical offices, email, mobile banking, and websites) and tools (letters, emails, surveys, and conversations).

The engagement of SMEs in co-creating Value is also evident in their participation in the bank's educational and advisory initiatives. Examples include informational meetings on cyber fraud prevention and webinars discussing the key aspects of the euro introduction as the official currency in the country from January 2026. In addition, there are specific business examples already implemented in the market. One such example is UniCredit Bulbank's introduction of a service allowing new business clients to open a corporate account online and later submit the required documents to the bank. Another example from the same bank is a joint project with Microsoft and Crayon to support 6,000 SMEs through free consultations on digitalization and cybersecurity. A third example is the option provided to SMEs to compare their financial performance with competitors in the same sector. In all three cases, it can be summarized that SMEs are active participants in the processes — not merely service users, but partners in creation - they organize the completion of the necessary forms and submission of documents, take part in joint training sessions, and analyse their market position within their operating sectors themselves. All of this generates Value — in this case, it is a projection - by the client, for the client.

Conclusion

It is important to emphasize that the seven newly formulated components should be viewed as a whole; each of them generates Value individually, but their cumulative effect — when integrated into the marketing

offering alongside the classical seven components — represents the combination that, according to the authors, contributes most effectively to the building and communication of Value in the banking context. In other words, the “7 Plus 7” formula can serve as a reliable foundation for building long-term partnerships between SMEs and banking institutions. The classical seven components of the marketing offering provide the necessary base for generating customer satisfaction; the authors’ seven additional new components enables banks to exceed minimum expectations and create truly loyal customers in a highly competitive environment such as banking. However, it is important for banks to play an active role not only in generating these new dimensions of Value, but also in their communication. The successful implementation of the “7 Plus 7” concept requires the bank to demonstrate persistence and consistency, to create an organizational culture focused on both customers and employees, and to actively use technological innovations to build trust, proximity, and sustainable relationships with clients.

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Marketing the Home Aesthetic: Vibe Communication Across Short-Form Platforms**Plamena PALAMAROVA-KOSTOVA¹**¹ University of Economics - Varna, Bulgaria, p.palamarova@ue-varna.bg

JEL: M31, M37, L82**Abstract**

Short-form video has become central to digital branding, particularly in lifestyle and interior-focused industries, where aesthetic presentation shapes consumer choice and engagement. This paper examines how Home & Living brands communicate the “home aesthetic” and convey brand vibe across TikTok and Instagram, comparing the strategies of global players with local competitors. A systematic content analysis of short-form videos explores content type, aesthetic positioning, and engagement metrics. Results show that global brands more often integrate storytelling and lifestyle contexts, while local brands rely on functional, product-centered approaches. The findings highlight how platform culture influences content strategies and reveal key competitive differences between global and local brands. The study’s originality lies in its cross-platform and international-local comparison within the Home & Living sector and its focus on vibe-driven communication as an emerging form of digital brand expression, offering guidance for local brands to strengthen their online presence.

Key words:

short-form video, digital
branding, home & living
industry, consumer
engagement, aesthetic
marketing, vibe communication

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1. Introduction

Over the past few years short-form video has emerged as one of the most powerful formats in digital communication, transforming how brands present themselves and engage with audiences. Platforms such as TikTok and Instagram Reels have redefined the logic of visibility, favoring immediacy, rhythm, and emotional impact over storytelling. This transformation has not only altered the dynamics of consumer attention, but has also reshaped the aesthetics of brand communication. In this new environment how content feels often becomes more important than what it says. Brands are increasingly challenged to create emotionally resonant and visually coherent content that connects through atmosphere, tone, and mood rather than traditional narrative persuasion.

These developments are particularly evident in the Home & Living sector, where consumption is closely tied to visual aesthetics, lifestyle aspirations and emotional well-being. The post-pandemic focus on the home as a space of identity and comfort has intensified the role of design and atmosphere in consumer decision-making. Home & Living brands now compete not only through products, but through the sensory experiences and emotional impressions they evoke online.

Despite this shift, academic research has paid limited attention to how aesthetic and emotional strategies operate in short-form contexts. Addressing this gap, the present study examines how Home & Living brands communicate the home aesthetic through short-form videos on TikTok and Instagram. By comparing global and local brands, the analysis explores the relationship between content type, aesthetic, emotional dimensions and engagement performance. The goal is to contribute to a better understanding of how short-form communication translates design and emotion into measurable digital interaction.

2. Literature Review

In order to frame the theoretical background of this research, the following literature review explores how

digital communication practices have evolved in the short-form era. It considers how video formats transform brand-audience interaction, discusses the aesthetic and emotional mechanisms summarized through the concept of *vibe* and offers sector-specific insights into Home & Living brand communication.

2.1. Short-form Video Marketing and Communication Platforms

Short-form video content has rapidly become one of the most influential formats in contemporary digital marketing, reshaping how brands communicate, capture attention, and stimulate audience engagement. The rise of platforms like TikTok, Instagram Reels, Facebook and YouTube Shorts is transforming the visual culture of social media, encouraging brands to adopt shorter, more emotionally expressive forms of content, that is specifically designed for high-speed consumption (Manic, 2024; Wahyudi, et al., 2025). Short-form videos combine sound, movement, and aesthetic design into compact narratives that can be viewed in seconds but evoke immediate emotional resonance. Their effectiveness lies in the high impact for a very short interaction time: they mostly deliver a sensory experience, not a detailed message, which is in line with the tendency for scrolling and fragmented attention. According to statistics, 73% of consumers prefer short-form videos when searching for products or services (Macready, 2023) and prefer fast, visually dynamic content (Nielsen, 2023). In line with these trends, brands are adapting their communication strategies, experimenting with tone, rhythm, and mood cues to drive engagement. Within this context, the ability to tailor content to the logic of individual platforms has become a key for the success of digital communication (Jenkins, et al., 2022).

Each short-form platform operates through different algorithm and user context, which affects how brands construct and distribute their messages. For example, TikTok functions as a trend-driven environment in which users, creators, and brands co-produce content through remixes, challenges, and sound reuse (Vizcaíno-Verdú & Abidin, 2021; Guinaudeau, et al., 2022). Its algorithm pushes original and spontaneous content, rewarding formats that appear authentic rather than overly curated. In contrast, Instagram remains grounded in the aesthetics of aspiration and lifestyle storytelling, where visual polish, harmony, and coherence continue to signal brand value (Djafarova & Trofimenko, 2019). While both platforms support short-form video, their interface design, sound integration, editing tools and internal social norms produce distinct content (Highfield & Leaver, 2016) that provokes different emotional reaction. These specifics require brands to interpret not only what to communicate, but also how to stage the aesthetic and emotional experience of their content within the rhythm and atmosphere of each platform.

While many brands maintain a presence across several short-form platforms, their communication strategies often differ in tone, pacing and aesthetic emphasis. Creative concepts are frequently adapted rather than replicated, adjusted to suit the distinct logic and user expectations of TikTok and Instagram. On TikTok brands rely on trend participation, sound alignment and spontaneous interactions to appear native within the platform's environment, whereas on Instagram, the same campaigns are reframed through curated visuals and lifestyle narratives that signal consistency and refinement (Nieborg & Poell, 2018; Arriagada & Ibáñez, 2020). These cross-platform differences demonstrate that success depends not only on technical optimization, but also on the capacity to express brand identity within each platform's context. Short-form marketing effectiveness rests on how brands translate visual design, mood, and tone into affective experiences that resonate with the audiences.

2.2. Visual Aesthetics, Emotional Communication, and the emergence of “Vibe”

Visual aesthetics and emotional resonance have long been essential to how lifestyle brands construct meaning and build attachment with consumers. In industries such as fashion, travel, wellness and home decor, design and mood serve not only to present products, but to also communicate identity, aspiration, and emotional value. Aesthetic presentation acts as a form of persuasion, shaping perceptions of quality, taste, and belonging (Schmitt, 2012; Hagtvedt & Patrick, 2008). At the same time, the emotional dimension of design,

expressed through tone, music, color harmony and composition, plays a decisive role in how audiences interpret branded messages (Kim, et al., 2021; Yang, et al., 2021). In the context of short-form video, these expressive qualities are intensified: sound, movement, and pacing transform visual communication into a multi-sensory experience that engages both cognition and feeling. As social media becomes increasingly visual, branding success depends on the capacity to create content that not only shows but also feels, turning aesthetic form and emotional tone into a unified sensory experience.

In the fast-paced environment of short-form platforms, communication increasingly shifts to *vibe* rather than storytelling, preferring atmosphere over story and emotion over information. A *vibe* can be understood as the overall sensory and emotional impression created when visuals, sound, and rhythm align into a coherent atmosphere (Preece, et al., 2022; Jenkins, et al., 2022). Unlike traditional storytelling, which unfolds through sequence and meaning, *vibe*-based communication relies on immediate affective recognition - how content feels rather than what it says. As a result, audience engagement often comes from the sense of immersion and emotion, that the video evokes, not from its specific message (Anderson, 2009; Manovich, 2017).

A *vibe* emerges from the interaction of multiple expressive elements that collectively shape how audiences perceive and feel a piece of short-form content. These elements, when aligned effectively, produce an overall sense of coherence. Figure 1 shows three core dimensions, that together explain what a *vibe* is: aesthetic cues, mood and atmosphere, and emotional resonance.

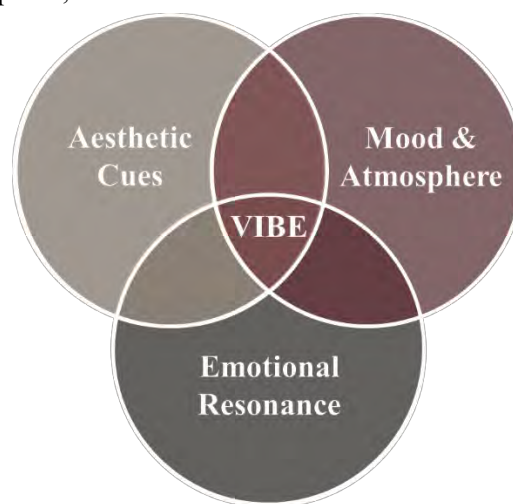


Fig. 1. Elements of a coherent vibe in short-form video content

Source: the author

Aesthetic cues include visual composition, lighting, and color palette - features that define the sensory structure of a video and signal its stylistic identity (Yang, et al., 2021; Hagtvedt & Patrick, 2008). Mood and atmosphere are created through sound design, pacing, and environmental tone, shaping the immersive quality of the viewing experience (Preece, et al., 2022). Emotional resonance refers to the affective connection achieved through gestures, expressions and symbolic associations, that allow viewers to feel with the brand (Schmitt, 2012; Joy & Sherry, 2003). When these dimensions converge, they generate a coherent *vibe* - a unified sensory and emotional impression, that communicates brand identity without explicit narration. In short-form marketing, this alignment of visuals, mood and emotion becomes the invisible architecture behind memorable and shareable content.

For lifestyle brands the ability to craft a coherent *vibe* has become a defining aspect of digital competitiveness. In short-form video environments, where messages are absorbed in seconds, atmosphere often communicates brand identity more effectively than explicit narration. A consistent *vibe* translates values such as warmth, sophistication, or calm into sensory form, allowing audiences to recognize the brand through

feeling rather than logo or slogan. This aligns with recent observations that lifestyle branding increasingly depends on atmospheric communication - the creation of mood and ambiance that evokes desired lifestyles and emotions (Preece & Kerrigan, 2023).

2.3. The Home & Living Sector: Trends, Transformation, and Brand Communication Dynamics

In recent years the Home & Living sector has undergone significant transformation, becoming one of the most dynamic lifestyle industries in the post-pandemic marketplace. As people spent more time at home, domestic spaces gained new emotional and symbolic importance, functioning as extensions of identity, comfort, and personal well-being (Deloitte, 2021; McKinsey & Company, 2022). This shift encouraged consumers to invest in interior design, furniture, and decorative objects not only for functional purposes but as expressions of taste and individuality. The home has evolved from a private space into a visible and shareable lifestyle setting, frequently featured across social media platforms and influencer content (WGSN, 2023). Within this context, Home & Living brands increasingly rely on digital storytelling and short-form video to translate visual aesthetics into aspirational experiences that resonate with the emotional and aesthetic values of modern consumers (Preece & Kerrigan, 2023).

The digitalization of the Home & Living sector has transformed how consumers discover, evaluate, and emotionally connect with interior products. Visual digital media - especially Instagram and TikTok - play a central role in shaping consumer taste, aesthetic aspirations and DIY inspiration. The dominance of image- and video-based platforms has encouraged brands to communicate through atmosphere and lifestyle cues rather than product features. Trends such as “calm design,” “biophilic interiors,” and “new comfort minimalism” reflect a consumer desire for spaces that embody psychological balance and emotional well-being (WGSN, 2023). As a result, Home & Living brands increasingly use digital storytelling to transform aesthetic styling into immersive experiences that invite viewers not only to observe interiors but to imagine living within them.

Within the Home & Living sector communication strategies differ significantly between global and local brands, reflecting variations in resources, visual identity and cultural positioning. Global brands such as Zara Home, H&M Home, and McGee & Co. rely on standardized aesthetics, professional production, and consistent visual storytelling that emphasize certain style, harmony, and aspirational lifestyles. The global players tend to take advantage of the vibe trends in communications by creating a strong visual and emotionally influential content, building an atmosphere of refinement and calm. Local brands operating on the Bulgarian market, including Videnov, Bonami, and Aiko XXXL, tend to adopt more relatable communication styles, focusing on affordability, practical inspiration and new products and product lines. These specifics in the communications approach can be traced to different scale and market expectations: global players communicate aspiration through polish, whereas local brands build audience through realism. While the approaches differ, all of the mentioned brands strive to create certain mood and atmosphere and to connect emotionally with audiences. The contrast between standardized global aesthetics and locally adapted visuals highlights the importance of analyzing how aesthetic and emotional strategies vary across brand scope and platform culture.

Although the Home & Living sector has become one of the most visually active and emotionally charged categories in digital marketing, systematic research on its short-form communication strategies remains limited. Existing studies tend to focus on retail or fashion contexts, leaving the aesthetic and emotional dynamics of home-related content underexplored. Addressing this gap, the present study examines short-form video communication among Home & Living brands, focusing on the connection between aesthetic cues, mood, and emotional resonance as key elements of audience response.

3. Methodology

In continuation of the theoretical discussion, the following section applies these conceptual foundations to the research design of the study, focusing on how Home & Living brands express aesthetic and emotional coherence across short-form platforms.

3.1. Research design

The study uses a quantitative content analysis methodology to examine the communication strategies of Home & Living brands through short-form video content on TikTok and Instagram. Content analysis is chosen because it allows for systematic, replicable examination of visual and emotional elements within brand communication. The analytical process follows a structured, multi-step framework, where each stage is guided by predefined criteria to ensure consistency and comparability between global and local brands. Figure 2 shows the conceptual flow of the research process, which includes platform and brand selection, sampling and coding procedures, analysis of content type, aesthetic-mood dimensions and engagement metrics used to evaluate short-form video communication among Home & Living brands.

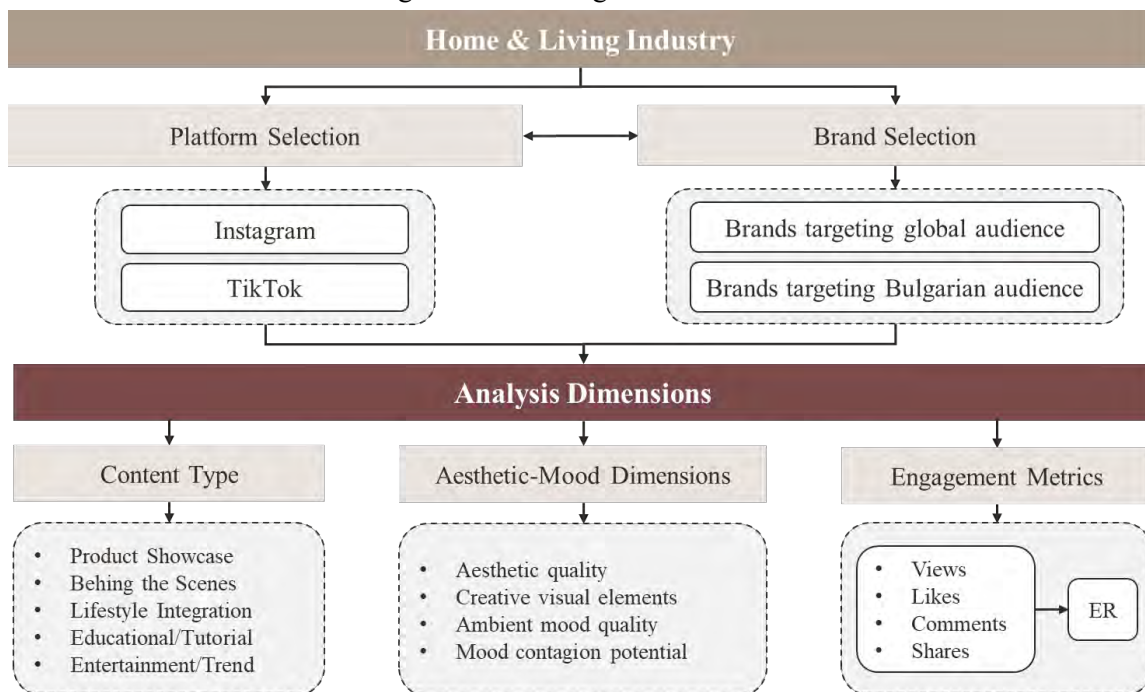


Fig. 2. Overview of research design and analytical process

Source: the author

3.2 Sampling and Data Collection

The dataset consists of 60 short-form videos published between October 2024 - August 2025 by six Home & Living brands. To avoid the influence of seasonal engagement spikes, the sample excludes holiday-related videos, which typically drive above-average interaction levels. Videos were selected from comparable timeframes (within the same months across brands and platforms) to ensure consistency and reduce the effect of seasonality on engagement performance.

The author selected three global brands: Zara Home, H&M Home, and McGee & Co., and three local brands: Videnov, Bonami, and Aiko XXXL. For each brand, five videos per platform are selected from TikTok and Instagram, resulting in an equal representation across brand scope and platform type.

Brand selection was guided by the following criteria:

- **Category relevance:** all brands operate primarily within the Home & Living and interior furnishing segment;
- **Digital activity:** each brand maintains active and regularly updates both TikTok and Instagram profiles with sufficient organic content to enable comparative analysis;
- **Market scope:** the sample includes both global and local brands to capture differences in communication strategy and platform adaptation.

While Aiko XXXL operates in several European markets, for the purposes of this study it is treated as a local competitor because it operates separate social media channels, that specifically target Bulgarian consumers. In contrast, Zara Home, H&M Home, and McGee & Co. are classified as global brands due to their international positioning, standardized content strategies, and cross-market brand identity.

All analyzed videos are organic posts - not sponsored or paid advertising content. This ensures that engagement metrics reflect authentic audience interaction rather than paid amplification. Videos are sourced directly from the official social media accounts to guarantee authenticity and to maintain consistency of brand identity and message tone. The inclusion of both TikTok and Instagram allows for a cross-platform comparison of communication styles in environments with distinct user cultures and algorithm logic.

3.3 Coding Procedure and Variables

Each video is coded manually using a structured codebook developed for this study. The codebook operationalizes both content-level variables (type, platform, brand scope) and aesthetic-emotional dimensions that reflect the growing trend toward vibe-centered communication on social media. The following dimensions are evaluated on five-point scale (1 = very low, 5 = very high):

- **Aesthetic Quality** - the visual polish, composition, and overall design appeal of the video;
- **Creative Visual Elements** - originality and diversity of visual techniques (angles, transitions, editing style);
- **Ambient Mood Quality** - the atmospheric coherence and immersive quality of the setting, music, and lighting;
- **Mood Contagion Potential** - the extent to which the video's emotional tone transfers to the viewer.

Brand scope (global vs. local), platform (TikTok vs. Instagram) and content type are treated as categorical variables. For each video the author records total views, number of likes, comments and shares as displayed on the platform at the time of data collection.

To ensure consistency, the coding procedure follows predefined definitions for each variable. The resulting dataset provides the basis for descriptive and correlational analysis of engagement patterns across aesthetic and emotional dimensions.

3.4 Engagement Metrics and Analytical Procedures

Engagement performance is assessed using the publicly available indicators: views, likes, comments, and shares. The engagement rate (ER) is calculated as follows:

$$ER = \frac{Likes + Comments + Shares}{Views} \times 100$$

This relative measure standardizes interaction across brands of different sizes and audiences. Average engagement rates are calculated at both platform and brand levels to compare performance patterns.

After finalizing the dataset, descriptive statistics are computed for all variables, followed by Pearson correlation analysis to explore relationships between video attributes and engagement rate. Data are analyzed using Microsoft Excel for quantitative measures, with addition of qualitative notes to contextualize aesthetic and emotional observations.

4. Results

The following section presents the findings of the content analysis, focusing on cross-platform and cross-brand comparisons of short-form video performance. Descriptive results are first summarized to outline general engagement patterns, followed by an examination of aesthetic and emotional variables that help explain these trends.

The comparison of average video performance across platforms and brand scope (Table 1) highlights a clear divide between global and local players. Global brands such as McGee & Co., Zara Home, and H&M Home achieve significantly higher reach on both Instagram and TikTok, with average views per video exceeding 10,000 on Instagram and 3,600 on TikTok. In contrast, local brands like Videnov, Bonami, and Aiko XXXL generate only a fraction of this reach, averaging fewer than 200 views per video on Instagram and just over 25 views on TikTok.

Table 1.

Average video performance by platform and brand scope (N = 60 videos)

Platform	Brand scope	Avg. Views	Avg. Likes	Avg. Comments	Avg. Shares	Engagement Rate (%)
Instagram	Global	10 163.13	33.13	34.27	34.27	2.72
Instagram	Local	172.73	5.07	0.13	0.13	0.45
TikTok	Global	3 606	22.60	435.87	435.87	1.90
TikTok	Local	26.07	1.13	2.20	2.20	2.51

Although the calculated engagement rate for local brands on TikTok appears high (2.51%), this figure should be interpreted with caution. The result is largely driven by the very low view counts of some videos, where even a single like or comment disproportionately increases the engagement rate. In practical terms, local brands on TikTok do not achieve stronger performance than global brands, but rather reflect the statistical sensitivity of engagement rate when based on minimal exposure. This reinforces that global players dominate the visibility landscape, while local brands face structural limitations that cannot be offset simply by engagement ratios, underscoring the need for differentiated content strategies aligned with their scale and resources.

To further examine differences within each brand scope, a brand-level analysis was conducted. A brand-level analysis (Table 2) reveals further nuances in performance across the six Home & Living brands

Zara Home stands out as a clear outlier, with an average reach exceeding 4.9 million views per video and the highest overall visibility across both platforms. Despite this exceptional exposure, its engagement rate remains comparable to smaller brands, indicating that scale alone does not guarantee proportionally higher interaction. McGee&Co. achieves the highest average share activity and a balanced engagement rate, suggesting that its content style, characterized by storytelling and lifestyle immersion, encourages users to circulate videos organically. H&M Home, although operating on a large scale, records more modest

engagement relative to its reach, which may reflect the more polished and commercially neutral tone typical of multinational retailers.

Table 2.

Average Video Performance by Brand (N = 60 videos)

Brand	Average Views	Average Likes	Average Comments	Average Shares	Average Engagement Rate (%)
McGee & Co.	95 662.50	3 614.90	26.90	363.20	2.69
Zara Home	4 938 200	15 183.00	22.50	290.60	2.78
H&M Home	1 177 097	1 856.20	34.20	51.40	1.45
Videnov	121 534	223.40	8.90	2.30	1.27
Bonami	26 791	50.00	0.40	0.20	2.13
Aiko XXXL	6 109.50	24.80	0.00	1.00	1.04

Among local players, Videnov demonstrates the strongest performance, with an average of over 120 000 views per video and a solid engagement rate, positioning it as the most competitive Bulgarian brand in the short-form environment. Bonami maintains lower visibility but relatively strong proportional engagement, implying that its audience, though smaller, is more responsive to its content strategy. Aiko XXXL, by contrast, remains marginal in both reach and interaction, with negligible comments and shares, suggesting limited resonance or platform adaptation, despite being one of the largest local players.

Overall, the data confirm that not all global brands perform equally, and that local brands vary widely in their capacity to mobilize audiences. The results underscore that visibility and engagement are shaped not only by brand scope, but also by the tone, atmosphere, and creative coherence of each brand's short-form content.

The next step examines whether these differences extend to the types of content used on different platforms.

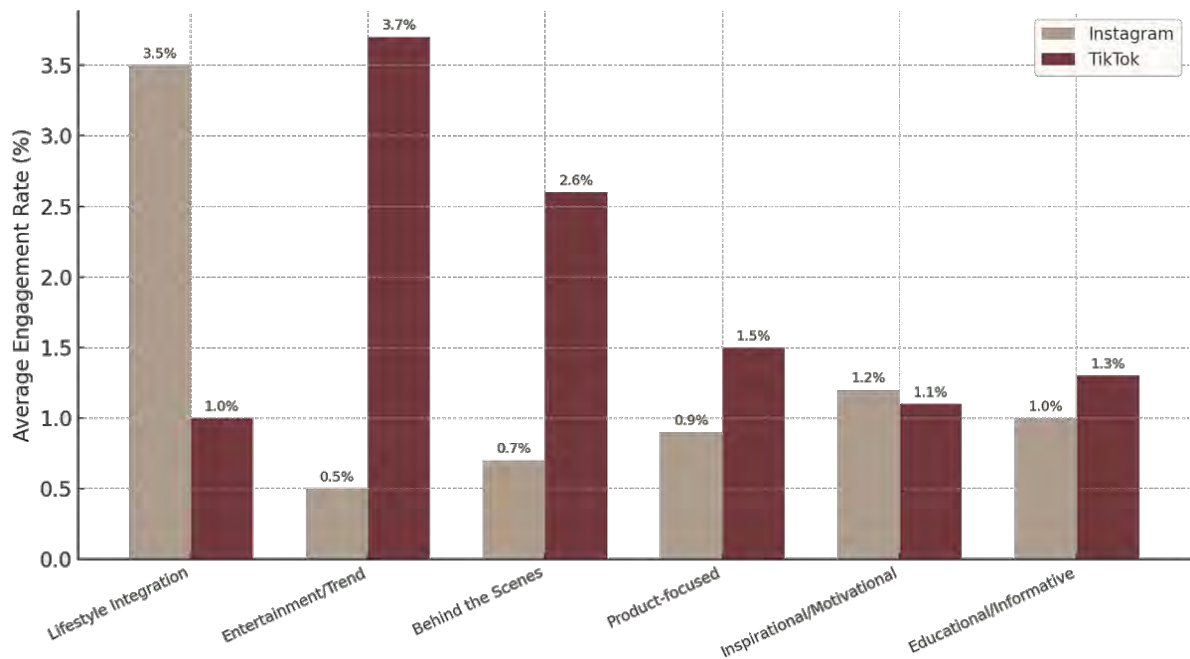


Fig. 3. Average Engagement Rate by Content Type and Platform

The comparison of engagement rates by content type and platform reveals distinct platform dynamics (Fig. 3). On Instagram, “lifestyle integration” is the only content type achieving notable engagement, with an average rate above 3.5%, suggesting that content aligned with aspirational and everyday contexts resonates most strongly with users. By contrast, “entertainment/trend” and “behind the scenes” formats deliver minimal engagement on Instagram, highlighting the platform’s weaker alignment with playful or informal content styles. TikTok shows the opposite pattern: “entertainment/trend“ content achieves the highest engagement rate (3.7%), underscoring the platform’s strong affinity for short, playful, and vibe-driven formats. „Behind the scenes“ also performs better on TikTok (2.6%) than on Instagram (0.7%), reflecting users expectations for more spontaneous and less polished content on this platform.

Table 3.

Average Engagement Rate (%) by Brand Scope, Platform, and Content Type

Brand Scope	Platform	Behind the Scenes	Educational / Tutorial	Entertainment / Trend	Lifestyle Integration	Product Showcase	Average ER (%)
Global	Instagram	—	1.01	—	5.31	0.98	2.43
	TikTok	3.21	0.04	4.50	1.39	1.52	2.13
Local	Instagram	0.73	0.52	0.12	0.26	0.50	0.43
	TikTok	2.04	7.14	3.35	—	1.67	3.55

The cross-tab analysis (Table 3) provides a detailed view of engagement patterns across brand scope, platform, and content type. Global brands show more consistent performance across content categories, particularly on TikTok, where “entertainment” and “behind-the-scenes” formats yield the highest average engagement (4.5% and 3.2%, respectively). Instagram performance among global players is dominated by “lifestyle integration” posts, suggesting that visually polished, atmospheric content aligns well with its aspirational aesthetic.

Local brands record generally lower engagement on Instagram but achieve competitive results on TikTok,

particularly within “educational/tutorial” and “trend-based” formats. The unusually high ER for educational content among local brands reflects isolated viral posts rather than consistent performance. Overall, global brands maintain steadier engagement across content types, while local brands show sporadic peaks, reinforcing the conclusion that content coherence and platform adaptation remain stronger among global players, while local brands remain constrained by limited use of platform-specific, trend-oriented strategies.

To assess whether specific content formats influence engagement outcomes, a correlation test was conducted between content type and engagement rate. The results indicate only weak associations, suggesting that content type alone is not a meaningful predictor of engagement performance. While lifestyle integration and trend-based videos show slight positive correlations with engagement, the strength of these relationships remains limited. This finding reinforces the idea that short-form success depends less on formal content categories and more on the aesthetic and emotional coherence within each video—how visual, tonal, and atmospheric elements align to create a compelling “vibe”. In other words, format provides the frame, but it is the mood and creative execution that drive audience response.

Table 4.

Descriptive Statistics for video attributes by brand scope

Dimension	Global Mean	Local Mean	Global Min-Max	Local Min-Max	Global Mode	Local Mode
Aesthetic	4.90	4.53	4.0-5.0	3.0-5.0	5	5
Creative Visual Elements	3.47	3.70	2.0-5.0	2.0-5.0	4	4
Ambient Mood Quality	4.17	3.70	2.0-5.0	2.0-5.0	4	3
Mood Contagion Potential	3.50	3.27	2.0-5.0	2.0-4.0	4	3

To test this concept further, video attributes were analyzed to assess how visual and emotional qualities differed between brand scopes. The descriptive statistics for the video attributes (Table 4) show that both global and local brands score highly on aesthetic quality, with means above 4.5 and mode values at the maximum of 5. Global brands, however, achieve slightly higher averages in “Aesthetic” (4.9) and “Ambient Mood Quality” (4.2), reinforcing their emphasis on polished and emotionally resonant visual production. Local brands score marginally higher on “Creative Visual Elements” (3.7 vs. 3.5), suggesting greater variation or experimentation in visual styling, though often at the expense of consistent mood quality. “Mood Contagion Potential” is stronger among global brands (mean 3.5 vs. 3.3), indicating their content is more effective at transmitting emotions to viewers.

Finally, the analysis examined which of these attributes are most strongly related to engagement outcomes.

Table 5.

Correlation of video attributes with Engagement Rate (N = 60 videos)

Dimension	Correlation with Engagement Rate
Aesthetic	0.08
Creative Visual Elements	0.08
Ambient Mood Quality	0.36

Mood Contagion Potential	0.07
Brand Identity Alignment	0.07

The correlation analysis between the different video attributes and engagement rate (Table 5) suggests that “ambient mood quality” is the most relevant predictor of audience interaction ($r = 0.36$). This finding indicates that content which creates a stronger immersive atmosphere is more likely to resonate with viewers and prompt engagement. By contrast, dimensions such as “aesthetic quality” and “creative visual elements” show only weak positive relationships ($r = 0.08$ each), suggesting that polish and creativity alone are not sufficient to drive audience action. Similarly, “mood contagion potential” and “brand identity alignment” exhibit almost no correlation with engagement rates, implying that while these qualities may contribute to brand consistency and emotional coherence, they do not directly translate into measurable interaction. These results underscore the importance of mood-driven content strategies in the home and living sector, where the evocation of atmosphere appears more critical for engagement than purely visual or brand-based cues.

Collectively, these results highlight that engagement in short-form Home & Living content depends less on format or production scale and more on the affective tone and atmospheric coherence of the videos - a theme further developed in the following discussion.

5. Discussion

The findings of this study highlight several important dynamics in the way Home & Living brands leverage short-form video platforms. First, the comparison of global and local players confirms the structural visibility gap that shapes digital competition in this sector. Global brands benefit from large established audiences, strong brand recognition, and professional content production capabilities, which translate into consistently higher reach on both Instagram and TikTok. Local brands in contrast operate within much smaller communities and generate minimal visibility, particularly on TikTok, where average view counts remain negligible. This divide reflects broader patterns observed in international marketing, where global players dominate algorithm-driven platforms due to scale advantages and cross-market recognition (Kotler & Keller, 2016). The results underscore the need to interpret engagement ratios with caution: higher engagement rates among local brands on TikTok are largely statistical deviations of extremely low view counts. In practical terms, visibility remains the central challenge for local brands and engagement efficiencies cannot compensate for the lack of audience reach.

At the same time, the brand-level analysis reveals that global players are not homogenous in their digital performance. Zara Home emerges as a clear outlier in terms of reach, while McGee & Co. achieves remarkable shareability, suggesting content that audiences perceive as worth spreading beyond passive viewing. H&M Home, by contrast, reaches large audiences but converted visibility into engagement less effectively, highlighting a gap between exposure and resonance. These differences illustrate that global scale does not automatically guarantee high-quality interaction; rather, brands must align their creative strategies with platform-specific dynamics. For local brands, the variation is more modest but still noteworthy. Videnov achieves relatively higher visibility compared to Bonami and Aiko XXXL, pointing to the potential of certain local players to mobilize audiences when content is consistently distributed. This variation within both global and local categories indicates that competitive advantage on short-form platforms derives not only from scale, but also from strategic content decisions.

The analysis of content type further clarifies these strategic patterns. TikTok emerges as a platform where entertainment-driven and spontaneous formats thrive. Entertainment/trend content produced by global brands generates the highest engagement rates, aligning with prior research on TikTok’s algorithmic preference for short, playful, and vibe-oriented content (Guinaudeau et al., 2022). Behind the scenes formats also perform

better on TikTok than Instagram, suggesting that audiences on TikTok expect less polished, more authentic glimpses of brand activity. Instagram, by contrast, proves far less effective for trend or behind the scenes content, reinforcing its positioning as a platform where aspirational and lifestyle-focused communication dominates (Djafarova & Trofimenko, 2019). The strong performance of lifestyle integration on Instagram demonstrates that aspirational, mood-driven content continues to resonate with audiences in the home and living category, particularly when aligned with everyday contexts such as interior design inspiration or home styling. This platform differentiation highlights the importance of channel-specific strategies: while TikTok rewards trend alignment and spontaneous expression, Instagram continues to serve as the stage for curated, lifestyle-based storytelling.

A particularly significant insight emerges from the analysis of video attributes. While both global and local brands score highly on aesthetic quality and brand alignment, these attributes are only weakly correlated with actual engagement outcomes. This finding suggests that visual polish and consistency, while important for reinforcing brand image, are not sufficient drivers of audience interaction. Instead, ambient mood quality stands out as the strongest predictor of engagement. In practice this means that content which successfully creates an immersive atmosphere - through lighting, music, pacing, or emotional tone - is more likely to generate audience response. This resonates with the growing shift from storytelling to “vibe communication”, where the affective atmosphere of content matters as much, if not more, than narrative structure. In the context of home and living, where brands market not only products but entire lifestyle aesthetics, the ability to evoke a strong mood becomes a key determinant of effectiveness.

This emphasis on atmosphere over production quality has strategic implications for both global and local brands. For global players, the challenge is not simply to sustain polished visuals, but to ensure that their content also communicates affective resonance. For instance, Zara Home’s extraordinary reach provides visibility, but long-term brand impact will depend on whether its content evokes moods that align with its brand positioning. For local brands, limited reach restricts their ability to compete at scale, but opportunities exist to differentiate through mood-driven, niche positioning. By crafting content that emphasizes cultural resonance, everyday relatability, or locally grounded aesthetics, local brands may be able to carve out distinctive spaces even within globalized platforms. In this sense, while engagement ratios alone may not reflect true competitive advantage, focusing on atmosphere and emotional connection may help local players achieve stronger resonance within their smaller audiences.

Finally, these findings carry methodological and theoretical contributions. Methodologically, the study demonstrates the importance of combining engagement metrics with content attribute coding to understand what drives performance on short-form platforms. Purely quantitative indicators such as views or likes provide only a partial picture; without accounting for the qualitative qualities of content, important explanatory factors remain hidden. Theoretically the results contribute to emerging scholarship on vibe marketing and mood-based communication, showing empirically that atmosphere - not only aesthetic quality or brand consistency - predicts audience engagement. This underscores the need for marketing research to move beyond traditional storytelling frameworks and acknowledge the role of affective immersion in shaping consumer-brand interactions in digital environments.

6. Conclusion

This study examines the performance of short-form video content in the home and living sector, comparing global and local brands across Instagram and TikTok. The results confirm a strong structural divide: global brands consistently achieve higher reach and visibility, while local players remain constrained by small audiences and limited exposure. Although local brands occasionally record higher engagement rates, these results are largely inflated by low view counts and do not reflect a genuine competitive advantage. A brand-level analysis further reveals variation within categories, with Zara Home benefiting from extraordinary reach,

McGee & Co. excelling in shareability, and H&M Home translating visibility into engagement less effectively. Among local players, Videnov demonstrates relatively stronger performance, while Bonami and Aiko XXXL remain marginal.

Regarding the specific platforms, TikTok emerges as the more favorable environment for entertainment and trend-driven content, while Instagram rewarded lifestyle integration formats aligned with aspirational home aesthetics. This finding underscores the need for platform-specific strategies that take into account the affordances and user expectations of each channel. Most importantly, the analysis of video attributes showed that engagement outcomes are not explained by aesthetic polish or brand alignment alone. Instead, content that succeeds in creating an immersive mood and atmosphere is more likely to generate audience response. This highlights a shift in digital communication for lifestyle brands: from a focus on narrative storytelling and visual professionalism toward mood-driven, affective strategies.

7. Limitations and Implications for Future Research

While the study provides initial insights into the aesthetic and emotional dynamics of short-form brand communication, it is limited by the relatively small sample size and single-coder design. The focus on organic posts published within a specific timeframe narrows the scope, as engagement levels on short-form platforms fluctuate rapidly in response to trends and algorithmic changes. In addition, the study examines only two platforms and one industry segment, which restricts the generalizability of findings across other sectors and media contexts.

The findings of this study offer several directions for further research. First, the sample was limited to a small set of brands and videos, suggesting the need for larger, cross-industry analyses to test whether the observed patterns extend beyond the home and living sector. Second, future studies could expand the coding framework by integrating “lifestyle aspiration cues” and “brand identity alignment” as analytical dimensions. These variables would provide better understanding of how aesthetic, mood, and emotional interact with brand meaning in short-form communication. Third, there is a need to refine the conceptualization of the attributes that drive audience response in short-form content. The present study employed broad categories of visual and emotional qualities, but further research should examine these dimensions more systematically and develop a theoretical framework for understanding how aesthetic, mood, and emotional cues interact in digital branding. Such an approach would allow marketing scholarship to move beyond platform metrics and toward a deeper understanding of the affective mechanisms that underlie consumer engagement with short-form video content.

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In the Realm of Artificial Intelligence (AI): The Impact of AI on Brand Management in a Digital Era**Steliana VASILEVA¹**¹ D. A. Tsenov Academy of Economics, Svishtov, Bulgaria, s.vasileva@uni-svishtov.bg**JEL: M30, M31****Abstract**

In the current digital environment, AI serves as a central force driving innovation across various sectors, including brand management. The selection of the topic for the paper is based on its relevance and the opportunity to examine different aspects of AI in the context of branding. In relation to the abovementioned, the current paper seeks to emphasize its importance in branding. The *purpose* of the paper is to explore the intersection of AI and branding by conducting a *case study analysis*, highlighting the ways in which leading brands, such as Netflix and Starbucks, utilize AI technologies in digital brand management to boost consumer engagement, and establish stronger connections with their customers thus securing a leading position in the market. The results of the study highlight the importance of AI in influencing the future of brand management, providing essential insights for marketers and companies aiming to leverage the complete capabilities of AI. Nevertheless, using AI in business introduces significant concerns related to privacy, transparency, and social responsibility, which are essential for sustaining consumer trust.

Key words:

Artificial Intelligence (AI),
Brand Management, Customer-
Brand Engagement, Brand
(Strategies), Personalization.

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1. Introduction

It is quite possible that no industry remains unaffected by AI, as each one contemplates how this innovative tool will reshape the operational frameworks of companies. Across all sectors, businesses have increasingly embraced sophisticated AI technologies and digitalization, which have significantly influenced consumer behavior and expectations. This shift has complicated the competitive landscape for brands in terms of competition and sustainability, necessitating a continuous adaptation to contextual change. In the current landscape, companies must elevate their efforts, refine their strategies, and cultivate a deeper comprehension of their customers' needs and preferences, thereby delivering comprehensive and satisfactory solutions to ensure their survival (Kumar et al., 2021).

The integration of AI in brand management signifies a transformation in the manner in which brands comprehend and interact with their target audience. By leveraging AI's capabilities, brand managers can surpass conventional limits, providing tailored experiences that align with customer preferences and requirements. Among AI's most notable contributions to brand management is its ongoing ability to generate highly personalized and relevant communications, which sharply contrasts with the generic approach of mass branding strategies that prevailed during the twentieth and early twenty-first centuries. While the older strategies remain useful, digitalization has transformed brand management by incorporating more personalized, interactive, and data-driven strategies. Through tools such as predictive analytics and recommendation engines, AI-driven solutions allow brands to predict consumer behavior, customize messaging, and present content across multiple touchpoints. Ultimately, AI enables brands to humanize their engagements by crafting genuine, personalized experiences that cultivate trust and loyalty.

As businesses, and the brands that they offer, seek to capture attention in a market that is becoming ever more saturated, the skillful application of AI in developing tailored and captivating consumer experiences has evolved from being a competitive edge to an essential requirement. Furthermore, AI's capability to process

and analyze data instantaneously facilitates dynamic modifications to brand strategies. Duan et al. (2019) and Kaplan & Haenlein (2019) emphasize the significance of AI in enhancing decision-making processes and forecasting trends in consumer behavior, thus enabling businesses to formulate brand management strategies based on data insights. This real-time flexibility guarantees that brand communications stay impactful, even as consumer behaviors and market conditions evolve. For instance, AI can evaluate social media trends and consumer feedback to modify marketing and branding campaigns promptly, ensuring that the content resonates with prevailing consumer interests (Kaplan & Haenlein, 2019).

However, integrating AI into brand management involves navigating several challenges. Considerations regarding data privacy and security, along with the ethical consequences of employing AI to shape consumer behavior, require thorough examination. Furthermore, despite the significant potential of AI, its effectiveness depends on deliberate implementation and ongoing adjustments to maintain consistency with brand values and consumer expectations.

A significant amount of research has been conducted in the domains of AI (McLay, 2018) and brand management (Veloutsou & Guzmán, 2017) independently over the years. Nevertheless, the connection between these two areas and the potential for their integration appears to be insufficiently explored, as can be confirmed by multiple arguments. Some studies focus on the application of AI, but they do so within the broader context of marketing rather than specifically within brand management (Davenport et al., 2020). Despite the widespread application of AI globally, there is still a significant lack of research investigating its influence on brand management (Ho & Chow, 2024). Cheng and Jiang (2022) highlight the urgent need for further studies on how AI affects brand management as the specialized literature suggests that AI has a substantial impact on brand management, enhancing its effectiveness and offering businesses a strategic benefit (Chen et al., 2023). Therefore, it is important to recognize the significance of examining the connection that exists between AI and brand management. While AI is crucial in influencing consumer-brand dynamics, there remain considerable gaps in detailed and integrated research regarding its impact on brand management (Ho & Chow, 2024). Addressing these gaps, the paper asks the following questions:

- In what ways do companies incorporate AI into their branding strategies?
- In what manner does the utilization of AI in brand management improve customer engagement and personalization?
- What insights can be drawn from effective AI applications in branding?

The **purpose** of the paper is to conduct a case study analysis, highlighting the ways in which leading brands utilize AI in their digital brand strategies. Specifically, the research aims to explore the application, obstacles, and results related to AI-driven brand management approaches across two industries. By exploring successful AI implementations across different sectors, the paper intends to clarify the strategies and to gain accurate understanding from these initiatives. Through the analysis of actual case studies, this research aims to offer insights into how AI can boost customer engagement, establish personal experiences, thus securing a leading position in the market for the brand(s). By doing so, the research offers meaningful guidance for brand managers and businesses eager to initiate their AI ventures, steering them towards maximizing the capabilities of AI to enhance their branding approaches and cultivate stronger relationships with their customers.

However, it cannot be definitively stated that brands that implement AI will prevail, while those that do not will fail, and this study does not assert such a position. This research contributes to understanding by shedding light on how AI may influence brands and their management through case studies and a review of existing literature, and seeks to explore the influence of AI on brand management.

In the subsequent sections, the paper will explore two case studies that illustrate the transformative impact of AI on brand management. Through personalized recommendations and predictive analytics, these case studies provide a detailed insight into how AI is altering the branding landscape and generating measurable outcomes for companies. By means of critical and comparative analysis and discourse, this paper seeks to

clarify the opportunities, challenges, and future possibilities of utilizing AI to enhance brand strategies in an ever-evolving digital environment.

2. Literature Review

2.1. About AI

AI represents a collective notion of technology that can demonstrate and replicate human intelligence (Kumar et al., 2021). It can be characterized as a system's capacity to accurately interpret external data, learn from it, and apply those insights to accomplish specific objectives and tasks through adaptable methods (Kaplan & Haenlein, 2019). AI is recognized for its intelligent behavior, demonstrating the ability to respond to different situations (Huang & Rust, 2021). According to Kumar et al. (2021), AI's intelligence is cultivated through its capacity for self-learning and enhancement based on previous experiences, continually increasing its efficiency and intelligence with each task performed, thereby expanding its collection of insights and knowledge. Currently, AI is revolutionizing various sectors, notably in branding, marketing, advertising, and business, in profound ways (Conick, 2017). In addition, AI supports customized interactions between brands and consumers, introducing new types of interactivities that meet the unique needs of the customers.

2.2. The Development of Brand Management

The concept of a brand is fundamental to both the theory and practice of marketing, representing a crucial part of the belief systems of contemporary managers and consumers. In modern society, brands have become distinguished leaders, with a presence across various aspects of our lives, including economic, social, cultural, and sporting spheres. This omnipresence has prompted an increased level of investigation (Klein, 1999). The literature available indicates that a brand's success is primarily based on their ability to differentiate (De Chernatony, 2010). The majority of existing research supports the notion that the most effective source of brand differentiation lies in the non-functional benefits it offers (Kapferer, 1992) – rather than the functional ones that are easy to replicate or copy.

Brand management entails the processes of building, maintaining, and improving a brand to ensure its continued importance, competitiveness, and value in the marketplace. The objective of brand management is to cultivate brands that generate market value (Chernev, 2001). In the context of the rapidly evolving landscape of contemporary business, brand management serves as the essential link that conveys a company's values to the market through strategies for customer engagement and innovative capabilities (Deryl, Verma, & Srivastava, 2023). The impulse for change primarily stems from shifting trends, driven by digital transformation and technological disruption, which requires flexibility and future-oriented ways of thinking in companies to maintain relevance. Amidst these changes, AI emerges as a groundbreaking drive that reshapes brand management approaches and amplifies their influence on consumer perception, brand loyalty, and positioning. AI introduces a significant shift by incorporating AI into brand management, enabling the technology to comprehend consumer behavior in ways previously unattainable for businesses.

In the past, branding has been predominantly based on handmade materials, fixed client segmentation, and excessively generalized campaigns. As noted by Cui Hailang et al. (2023), modern branding operates within an extensive social framework, defined by its historical and practical significance, and engaging multiple stakeholders.

A significant transformation in brand management involves a shift from a product-focused strategy to one that prioritizes the market and the customer. This transformation highlights the necessity of comprehending and addressing the needs and aspirations of consumers. In the current experience-oriented economy, brands must transcend the simple provision of goods and services and instead – deliver customized experiences to connect with customers on a more profound level. In relation to this, Godin (2001) famously expresses the

idea that customers ultimately purchase relationships, stories, and magic, rather than mere products and services, indicating that consumers are frequently more affected by brand communication and emotional relationships than by the particular attributes of a branded product. Consequently, it is essential to develop engaging brand stories and experiences to establish profound emotional connections with consumers. Looking forward, the evolution of brand management is centered on the creation of engaging brand experiences, as noted by Ong et al. (2018).

Specifically, contemporary brands must provide comprehensive experiences to their customers, consisting of various touchpoints that can impart significance to consumers' lives. According to Veloutsou and Guzmán (2017), advancements in technologies have shaped consumers' expectations for a seamless brand experience across all touchpoints, thus heightening the pressure placed on brands. As a result, they suggest that brands must consistently evolve and integrate new technologies to deliver a unified brand experience to customers. Kornberger (2010) additionally emphasizes the necessity for brands to remain consistent with their brand management strategy at all times.

Technological progress has transformed the manner in which customers interact with and perceive brands (Vernuccio et al., 2015). The evolving market landscape, coupled with technological innovations and heightened consumer expectations, has posed significant challenges for businesses in managing their brands, as they have partially failed to control their brand image, brand communications, relationships, and reputations (Veloutsou & Guzmán, 2017). These shifts in brand management have resulted in brands operating within a complicated environment, where businesses have to thoroughly understand how to attract customers' attention and deliver genuine value to their target audience to build a powerful brand (Davenport et al., 2020).

Furthermore, alongside the technological advancements that have taken place, there has also been a transformation in brand management (Kornberger, 2010). In the current digital era, AI is fundamentally changing branding by generating personalized, data-driven experiences that enhance customer engagement significantly. AI tools are profoundly altering brand strategies, allowing companies to process data in real-time and deliver highly customized content to consumers. This evolution in brand management highlights the transition from conventional, intuition-based methods to data-driven strategies that foresee customer requirements.

In relation to the above mentioned, Yahelska and Vasylyshyna (2024) examined the concept of branding and offer a good generalization by deviding it into three stages. Branding 1.0, which is related to the establishment of a brand platform, brand identity, and advertising, emphasizing statistical identifiers. Branding 2.0 signifies a shift towards the digital technology era, leveraging digital platforms, improving online visibility, and engaging with consumers within the digital environment. Branding 3.0 merges human creativity and strategic thought with the analytical capabilities and efficiency provided by AI in the realms of brand development and positioning. This stage of branding illustrates the competition of intellects: who can more skillfully analyze data sets, predict consumer behavior with enhanced precision, create uniquely tailored experiences, and formulate more flexible and effective strategies, among other skills. The integration of AI into brand management is fundamentally reshaping every aspect of branding and refining its architecture.

According to Liu, Cui, & Nie (2023), effective brand management, which is rooted in the current state of business development and enriched by real-world experience, results in the important insight that the progress of businesses is closely connected to effective brand management. The paper examines brand management from this viewpoint. Yahelska and Vasylyshyna (2024) state that in the realm of brand management, intelligence plays a crucial role in formulating unique brand strategies through thorough analysis of consumer behavior, forecasting market trends, and improving the effectiveness of marketing campaigns. The intelligence aspect of brand management is characterized as the process of increasing the intelligence quotient in brand management by incorporating advanced cognitive and analytical methods for the creation, assistance, and growth of a brand. This approach merges insights from marketing, economics, psychology, sociology, and

cultural studies, and in this sense goes beyond traditional brand management. It requires a simultaneous improvement of cognitive effort and AI in analytical, generative, and managerial activities, enabling the brand to adapt to complex dynamics of the market. Consequently, brand management is increasingly utilizing AI to improve activities, with branding serving as a core component used to nurture and grow a brand.

The development of brand management in the digital age has profoundly changed the manner in which businesses engage with customers. Digitalization has modified the way consumers view companies and their interactions, as well as the strategies businesses use for self-promotion (Rachinger et al., 2019). Previously, brands required communication and repetitive messaging to achieve growth. In contrast, brands are now supported by digital platforms that facilitate the creation of experiences that are driven by data, personalized, and captivating. Companies are leveraging emerging technologies to improve their brand visibility, encourage customer loyalty, and maintain a competitive advantage in a swiftly changing market and there remains a considerable amount to discover regarding the application of new technologies, such as AI, in the realm of brand management (Patel, & Kaur, 2024).

2.3. Examining AI's Revolutionary Influence in Brand Management

Contemporary branding methodologies are currently being tested with cutting-edge technologies, including AI, which are being integrated into standard practices to promote overall achievement. The approach is increasingly becoming data-centric, automated, and intelligent. The exceptional capabilities of AI are particularly apparent in the fields of marketing and branding, leading many businesses to adopt AI technologies within their branding strategies (Chui et al., 2018). In practical applications, AI has already shown substantial effects through accurate predictions, enhanced marketing insights, improved product quality, real-time personalized campaigns, increased operational efficiency, and refined customer experiences.

AI's influence on brand management is largely fueled by its ability to improve customer engagement. By leveraging AI to forecast consumer behavior, brands can develop personalized marketing communications that build consumer trust and improve brand loyalty. The predictive capabilities of AI enable brands to detect vulnerable customers early in their journey, facilitating proactive retention strategies like individualized discounts or tailored promotional activities. This approach not only lowers client churn rates but also strengthens the bond between the brand and its consumers. The ability of AI to predict consumer behavior and provide customized messages to the consumers is crucial for enhancing their retention. By promptly recognizing customers that are at risk, brands can execute focused retention strategies, such as customized promotional activities, to decrease customer loss and amplify customer relationships.

Thus, AI possesses significant potential to improve branding potential, particularly in strengthening a company's brand management efforts. The incorporation of AI into branding strategies is undergoing persistent and anticipated expansion. Additionally, there has been a rise in venture capital funding for AI in the last years, leading to an abundance of data. This data can be leveraged to generate insights and recommend actionable strategies, facilitated by increasingly accessible technology, such as advanced computational power and open-source algorithms.

2.4. Data, AI and Brand management

The comprehensive perspective on brand management emphasizes the importance of integrating various data sources to develop targeted strategies that appeal to consumers. In the pre-digital age, these initiatives were primarily driven by market research, consumer insights, and competitive assessments, frequently depending on low speed, manual procedures. Thorough quantitative and qualitative analysis have been essential to assess possible marketing actions and their consequences (Wierenga, Dalebout, & Dutta, 1992). Nevertheless, the evolution of digital technologies, especially AI, has significantly altered the domain of brand management. Through the utilization of big data technologies, AI facilitates the collection and examination of

extensive data sets derived from social media, customer transactions, and market dynamics and trends (Pawełoszek & Korczak, 2023). A holistic perspective on customer engagement reveals fresh insights into data collection and analysis. The scale of data require the application of machine learning methodologies to efficiently manage and interpret this knowledge. This allows brands to predict market changes and and adeptly customize their brand strategies to meet the evolving preferences of consumers.

AI has now become central to brand management operations within the context of digital transformation. Digital tools facilitate more efficient methods for engaging consumers, which in turn drives significant business growth. Data analytics provide examples of how transformation enables companies to examine consumer data for insights that lead to more accurate, data-driven decision-making (Usman et al., 2024). This is due to the fact that data analytics offers actionable insights regarding consumer preferences, behaviors, and trends, which allows businesses to formulate targeted marketing and branding strategies while sustaining a competitive edge in a data-rich context.

2.4. AI Recommendation Systems

AI can assist brand managers in generating valuable insights about what to suggest to their consumers by analyzing data related to consumers' search behaviors, interests, and preferences. Kietzmann et al. (2018) argue that AI systems can deliver relevant and personalized recommendations to customers, aiding them in discovering branded products and services that are more likely to meet their preferences and yield satisfaction. Recommendation systems can be employed to enhance filtered search results and suggest additional branded products within an online retail environment. Additionally, the recommendations may be shaped by external elements such as the current season. By offering customized recommendations, brands can significantly improve convenience and smoothness for consumers by minimizing search expenses. The potential for personalization to elevate customer satisfaction is substantial, as AI allows brands to surpass existing initiatives in personalizing their offerings without the limitations associated with managing extensive data sets (Kumar et al., 2021).

A challenge with recommendation systems is the complexity of forecasting shifts in customer preferences and consumer behavior, as algorithms rely on consumers' historical and current actions to generate insights (Davenport et al., 2020). However, algorithms merely reflect consumers' existing tastes and personalities, failing to account for the ways in which personality and preferences can evolve over time. As a result, this limitation may complicate progress in brand development, potentially resulting in a brand that falls behind. This may also steer a brand's positioning strategy off course. Furthermore, the historical behaviors and preferences of consumers do not always align with their aspirational preferences and the ideal self-image. In this context, recommendation systems could negatively influence consumers' autonomy by overlooking their freedom of choice, which raises ethical concerns.

2.5. The Impact of AI on Personalized Branding

The continuous advancement of AI envisions enhanced cognitive abilities, thereby increasing its capacity to improve human cognition. This advancement, however, also heightens security concerns. The current debate surrounding privacy in relation to personalization is likely to include more intricate marketing features. AI's fundamental capacity to incessantly learn and interpret or predict consumer purchasing behaviors and emotional reactions is set to play a crucial role in shaping and focusing future branding strategies, enabling higher degrees of automation and personalization. Predictions indicate a notable and rapid growth in the field of AI research. Furthermore, the sustainability aspect of AI is expected to expand, allowing for the gradual creation of research contributions that are enriched with more comprehensive and actionable insights (Chintalapati et al., 2022).

Personalization represents one of the most significant advancements that AI has contributed to brand

management. These technologies are altering the branding environment by enabling more customized, predictive, and engaging brand interactions. Marvi et al. (2024) investigate how AI-powered personalization systems assess user data to suggest customized content, thus improving the applicability of marketing communications and boosting conversion rates. In contrast to mass marketing and branding that fail to focus on the unique needs or interests of individual consumers, AI facilitates hyper-personalization by utilizing data derived from browsing history, purchasing behavior, and social media interactions. Brands can leverage this information to provide personalized content and recommendations that meet the specific requirements of consumers.

Personalization refers to the recommendation of tailored products (Riabchykov, Mytsa, & Ryabchykova, 2024), modifying prices in response to demand fluctuations, interacting with automated systems, and employing predictive analytics to foresee customer requirements. For example, the recommendation engine of Netflix, powered by AI, ensures that each user receives content suggestions based on their viewing preferences. This establishes a sense of recognition and relevance, enhancing customer personalization, which in turn leads to increased customer satisfaction and strengthens brand loyalty.

AI-powered marketing automation tools are capable of delivering tailored content and offers to consumers at the most effective times, thereby maximizing engagement. These tools can streamline various components of a branding campaign, ranging from email marketing to social media advertising, and enhance both efficiency and effectiveness. A further notable benefit of AI in personalized branding and marketing is its capacity to generate insights through natural language processing (NLP). NLP allows AI to comprehend and interpret human language, facilitating more individualized communication. Chatbots and virtual assistants, driven by AI, can interact with consumers in real time, delivering customized replies and suggestions. This degree of engagement improves customer satisfaction and collects valuable data that can be utilized to further enhance brand management strategies (Rafieian & Yoganarasimhan, 2023).

According to Yahelska & Vasylyshyna (2024), hyper-personalization involves customizing brand interactions to the individual level by leveraging AI technology. This includes personalized marketing communications, product recommendations, and customer interactions specifically crafted for distinct consumer profiles. The ability of AI to modify brand messages and experiences instantaneously based on data ensures their applicability. Yet, the application of AI influences how consumers perceive brand authenticity. According to Marvi et al. (2024), there is a growing skepticism among consumers towards too polished brand messages. They prefer brands that convey transparency and originality in their messaging. In contrast, the scheming utilization of data or invasive advertising practices can weaken consumer trust. Therefore, transparency in data management and the ethical implementation of AI are essential for sustaining favorable brand-consumer relationships (Krishen et al., 2021). AI introduces duties, especially in terms of protecting consumer data and ensuring ethical standards are upheld. Consequently, the necessity for businesses and their brands to evolve is motivated not only by the pursuit of competitive advantage but also by the changing regulatory and societal expectations related to brand management in the digital era.

2.6. Ethical Considerations and Challenges

With the growing integration of AI in brand management it is essential to address ethical practices. Businesses should prioritize *data privacy*, *algorithmic bias*, and *transparency* to ensure the responsible application of AI technologies. Protecting customer *data* and using it ethically is vital for establishing enduring trust between customers and brands. This involves providing customers with control over their data and making certain that AI systems do not reinforce existing *biases*. These biases can have a detrimental effect on brand management by distancing or inaccurately portraying particular consumer segments. It is essential for brands to conduct thorough audits and establish bias detection systems to recognize any tendentious patterns present in their algorithms (Mehrabi et al., 2021). There is a growing demand among consumers for *transparency* in

AI-driven brand management practices to gain a clearer understanding of the decision-making processes involved. Brands should clearly convey their application of AI, offering transparency into their decision-making processes and ensuring accountability for how AI influences brand strategies (Floridi, 2019). Insufficient transparency can result in consumer distrust and harm to reputation.

Besides the above mentioned, various other risks and additional threats exist, including the integrity of information, security vulnerabilities, and the potential for psychological manipulation of customers, as highlighted by Bormane & Blaus (2024). Their article points out that regulatory compliance and the definition of labor adoption are becoming increasingly relevant as the field of automation continues to grow. To effectively execute machine learning and deep learning functionalities, as noted by Janiesch et al. (2021), it is essential to deal with the challenges of human-machine interaction and to prevent any obstacles concerning the machine. The evolving nature of AI acceptance and the attribution of human characteristics to non-human entities, as discussed by Sánchez-Camacho et al. (2024), indicates that trust is a vital component in the utilization of AI. The results from the study suggest a balanced approach that recognizes the advantages of AI while also addressing its ethical and operational challenges within various industries.

3. Material and Methods

3.1. Overview

In the current rapid digital environment, maintaining brand loyalty has become increasingly vital, as most businesses assert that AI-enhanced brand management is essential for reaching this objective. Leading brands are utilizing AI to transform their branding approaches, thereby enhancing customer loyalty and engagement. Since the beginning of the 2020s, AI technology has advanced considerably, with features that were previously viewed as innovative now becoming standard.

As AI progresses and refines, it is anticipated to witness a greater number of groundbreaking applications in the field of marketing. Given its capacity to process extensive datasets, deliver tailored experiences, and forecast consumer behavior, AI is fundamentally altering the marketing environment, especially in terms of branding. Businesses that allocate resources towards AI are expected to experience considerable benefits, while those that do not may find themselves at a disadvantage.

This research will examine case studies and examples to investigate further how AI is reshaping branding strategies and facilitating business expansion.

3.2. Case Study Design

This research adopts a multiple-case study methodology to investigate the digital brand management strategies implemented by prominent international brands. The multiple-case study approach allows for a comprehensive analysis of various digital branding methods, offering comparative insights across different sectors. By choosing brands from different sectors for the case studies, this research seeks to encompass an array of applications and experiences linked to AI-enhanced branding strategies. This methodology is advantageous for comprehending how various businesses utilize digital tools, platforms, and strategies to improve brand perception, engage consumers, and secure a competitive advantage. Through the examination of multiple cases, the research provides a wider viewpoint on digital brand management, highlighting best practices, shared obstacles, and distinctive strategies that lead to brand success.

3.3. Selection of Cases for Review

The cases that have been selected focus on brands that have shown innovation in digital branding and have successfully utilized AI to improve consumer engagement. Two brands have been picked for analysis. Specifically, the choice of brands for the case studies for the purposes of the research, has been determined by

several criteria, as follows:

Applicability: The brands for the case studies have to illustrate the incorporation of AI within brand management strategies, emphasizing the use of AI to improve customer engagement and achieve business results.

Variety: The brands have been selected from various sectors, such as retail, to provide a thorough examination of AI applications across different industries.

Reach: Priority has been given to brands that have publicly accessible information, such as released scholarly publications and/or publicly available company documents and corporate reports.

3.4. Data Collection

The research employs various data collection techniques to guarantee a comprehensive examination of digital brand management strategies. The data for the case studies has been gathered through a comprehensive examination of published materials, which include scholarly publications and reviews, business analyses, and credible online publications. Furthermore, information supplied by the businesses themselves (media announcements or public statements) published on their websites, have also been employed. The data that has been obtained will cover aspects related to the execution procedure, primary strategies utilized, results attained, and any obstacles faced in the execution of AI-driven branding initiatives.

4. Analysis and Discussion of Case Studies

4.1. Present-Day Overview

In the contemporary digital era, AI has transformed the branding environment. As customers increasingly seek personalized experiences, AI enables businesses to provide highly targeted content, assess consumer behavior instantaneously, and develop campaigns driven by data. Businesses implement AI-powered algorithms, chatbots, machine learning, and predictive analytics to maintain competitiveness and foster innovation in their branding strategies. Personalization stands out as a significant domain where AI showcases its capabilities in branding. Among the most notable examples that illustrate how AI algorithms scrutinize customer behavior and preferences to offer tailored recommendations, leading to heightened customer engagement and brand loyalty is Netflix. Through the analysis of prior interactions, Netflix is able to provide personalized suggestions that aim to increase viewer retention rates. Likewise, Starbucks employs AI to customize offers and promotions according to customer buying habits, thus improving the overall customer experience.

4.2. Case Study: AI in Branding – Netflix and Personalization

Contextual Review: Established in 1997, Netflix has evolved from a DVD rental service into a worldwide streaming dominant player. With more than 238 million subscribers globally, Netflix operates in over 190 countries and has revolutionized the manner in which customers engage with entertainment. Its achievements can be attributed significantly to its strategic application of AI, which enhances user experiences and boosts engagement. Netflix has integrated AI throughout its platform to tailor content, refine recommendations, and maintain customer loyalty.

Obstacles/Challenges: With an extensive collection of content, Netflix has encountered the challenge of enabling consumers to swiftly locate appropriate shows and films. In case customers are not able to readily discover content that captures their interest, they are more inclined to disengage or cancel their subscriptions. This obstacle necessitated the development of a highly personalized and easily adaptable platform capable of addressing consumer likings instantly.

Target: Netflix seeks to improve customer engagement, minimize churn rate, and increase satisfaction

through providing customized content recommendations designed to align with the unique preferences and behaviors of each user.

Application: Netflix's recommendation system, which is driven by AI, utilizes machine learning algorithms to process extensive amounts of user data. This data encompasses watch history, search behavior, genre preferences, viewing duration, device usage, and patterns of ratings. The system predicts which shows or movies will appeal to its audience, taking into account their pausing or stopping habits, as well as their likes and dislikes. AI analyzes millions of data points to recommend shows and movies that align with each user's unique tastes, ensuring that the platform consistently updates its content based on viewer preferences.

In addition, Netflix applies AI technology in the A/B testing of thumbnails, by displaying various cover art tailored to user profiles, thereby enhancing click-through rates and the chances of watching. AI has also been used to create personalized top 10 lists and curated rows like 'Because You Watched' have also been implemented to strengthen relevance.

Results: Netflix experiences unparalleled growth in subscribers and retention of viewers, demonstrating the potential of predictive analytics to in achieving progress the entertainment industry.

- **Surge in Watch Time:** Tailored suggestions account for 80% of the content consumed on the platform, highlighting their significant impact on customer behavior.
- **Enhanced User Engagement:** According to Netflix, its AI-driven recommendation system accounts for 80% of the content viewed on the platform. By providing tailored recommendations, Netflix prolongs user engagement, thereby enhancing retention and boosting satisfaction levels.
- **Churn Reduction:** The implementation of AI-driven personalization has played a crucial role in maintaining monthly churn rates beneath industry norms, particularly in highly competitive markets.
- **International Content Discovery:** Through the utilization of AI-driven content localization, Netflix is able to effectively addresses a diverse international audience while preserving a consistent personalized experience, as AI facilitates the delivery of content to viewers whose profiles align, thus promoting cultural exchanges.
- **Cost Optimization:** Netflix has demonstrated a remarkable capacity to customize its content and branding approaches through the utilization of AI, leading to a more effective use of marketing resources. Instead of pursuing generalized campaigns, Netflix focuses on personalized advertisements and recommendations, thereby enhancing the profit generated from marketing investment.

Conclusion: Personalization has enabled Netflix to enhance its brand visibility and customer engagement. Unlike conventional mass-branding approaches, Netflix's digital brand management prioritizes the customer experience. The platform leverages customized content and AI-driven engagement to enrich the brand experience, rendering it more engaging interactive. As a result of these tailored branding initiatives, customers develop a stronger connection to the brand. This has led to greater brand loyalty and a sense of belonging to the company.

4.3. Case Study: AI in Branding – Starbucks Predictive Ordering and Personalized Recommendations

Contextual Review: Starbucks, which has been established in 1971 in Seattle, Washington, has evolved into a worldwide coffee symbol, recognized for its high-quality coffee, distinctive store atmosphere, and dedication to social responsibility. The current case study explores Starbucks' evolution from a solitary store to a global chain, emphasizing its strategic choices, branding strategies, innovations, and obstacles.

Target: To create an application that seems to have a deeper understanding of the customer than the barista.

Application: Starbucks' Deep Brew AI enterprise represents a state-of-the-art technological platform that

supports their omnichannel strategy, facilitating the delivery of personalized experiences to consumers at multiple touchpoints. By employing AI technology, Starbucks can assess customer behaviors, desires, and buying habits to provide customized offers and suggestions, thus improving the engagement and brand loyalty. The AI engine of the company, known as Deep Brew, contributes to hyper-personalized experience by examining consumer's order history, geographical location, the time of day, and even the prevailing local weather conditions. For instance, on a warm Monday morning, the application may recommend a typical iced latte. Conversely, if it happens to be raining on a weekend, it may prompt the consumer to consider a hot cappuccino

How it works: The Deep Brew AI system functions by synthesizing data from multiple sources, such as customer interactions, sales figures, and inventory status. This information is subsequently utilized to refine inventory and supply chain management, guaranteeing that sought-after items remain available while minimizing waste. Furthermore, the AI system allows Starbucks to forecast consumer demand and modify their pricing and promotional strategies accordingly, thereby optimizing revenue and profitability. To summarize, Deep Brew AI system:

- Draws on earlier purchases, geographical location, meteorological conditions, and temporal trends.
- Collaborates with Starbucks Rewards to provide personalized promotions.
- Is integrated within the mobile application, loyalty framework, and voice ordering system.

Key benefits:

- Customized offers and suggestions - For instance, if a customer regularly buys a specific kind of coffee, the AI system might propose associated products or deals, like a discount on a new coffee variety.
- Streamlined inventory, logistics and supply chain governance
- Predictive analytics to stimulate business expansion – This approach not only boosts sales but also cultivates a more fluid and engaging experience for customers, who perceive that Starbucks comprehends their preferences and is customized to their requirements.
- Improved customer experience through smooth and stimulating engagements.

Results:

- Increase in repeat purchases and application utilization.
- Greater interaction stemming from tailored offers compared to standard ones.
- Starbucks' real-time engagement system has substantially improved their loyalty initiatives, establishing a feedback loop of information and customization that has produced outstanding results.

The effectiveness of Starbucks' AI-powered loyalty program is largely due to its capacity to provide a tailored experience for every individual consumer. Through the examination of customer data and behaviors, the AI system can discern patterns and preferences, subsequently offering targeted promotions and suggestions. For instance, if a customer regularly buys a specific type of coffee, the AI may present them with a customized offer for a complimentary drink or a discount on their subsequent purchase. Through the application of AI to enhance consumer interactions, businesses such as Starbucks can establish a continuous cycle of data and personalization that stimulates business expansion and brand loyalty.

Summary: The Deep Brew AI system serves as a notable illustration of how businesses can utilize AI and predictive analytics to accelerate business expansion and improve customer experience. Through investment in such technologies, firms can achieve a competitive advantage and maintain leadership in innovation and customer engagement. As the application of AI in branding progresses, it is probable that an increasing number of businesses will embrace comparable strategies to promote growth and brand loyalty.

4.4. Insights from the AI and Brand Management Case Studies

Upon reviewing these practical examples, it is clear that AI is making significant contributions to branding. Below are several key lessons that can be highlighted:

- AI amplifies personalization: Whether it is Starbucks advising the customer on their next drink or Netflix recommending a film, the more customized the communication, the more effective it is.
- Quality data equals effective AI: Each success story had a shared element: organized, clean data. This is what enables the tools to function optimally.
- AI acts as a support, not a substitute: The most favorable outcomes have been achieved by brands that utilized AI to reduce repetitive tasks and amplify human creativity.
- The brands that succeed in the digital era are not merely those that experiment with AI; rather, they are the ones that integrate it strategically. They regard AI as a collaborator, rather than a fleeting campaign tactic.

The results indicate that Starbucks' approach promotes direct relationships with consumers, thereby reinforcing the brand, whereas Netflix's tailored and interactive digital initiatives boost consumer engagement. These strategies highlight the increasing significance of AI-driven personalization, omnichannel coherence, and customer-oriented engagement.

The case studies distinctly demonstrate that AI is no longer merely a concept of the future; it has become a contemporary competitive edge that fuels some of the most effective brand management strategies across various sectors. Through hyper-personalized customer journeys and active optimization, AI is transforming the ways by which brands interact with, convert, and maintain their target audiences. The primary lesson from these examples is that achievement is rooted in intelligent integration—merging machine efficiency with the creative potential of individuals to provide genuine and significant brand experiences.

5. Conclusion

The research findings indicate that brands that emphasize AI-driven personalization and engaging digital experiences are likely to experience greater consumer engagement and long-term brand growth. The practical implications recommend that companies should implement AI-based analytics, allocate resources to new technologies, and embrace consumer-centric digital approaches. The analyzed case studies highlight the crucial function of AI in empowering businesses to move beyond conventional limits, providing customized solutions that align with specific preferences and requirements. Subsequent studies should delve into the lasting effects of AI-enhanced interactions between brands and consumers.

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6. THE FUTURE OF IT, AI & TRANSFORMATIVE TECHNOLOGIES

On some Factors of Ordering Goods or Services over the Internet

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Abstract

The paper examines the problems of households' access to the Internet and the frequency of its use as factors influencing the use of online channels for purchasing products. The study seeks confirmation of the direction and strength of the influence of the provision of a stable Internet service and the intensity of its use as drivers stimulating the development of e-commerce. The work uses secondary data from Eurostat with a coverage level of NUTS 2, which is the basis for conducting a correlation analysis and proving the research hypotheses about the moderate positive significance of Internet coverage and the strong positive influence of the frequency of use of the global network on ordering goods and services online. In the context of the evolution of wireless network technologies and uninterrupted consumer Internet connectivity, new horizons are revealed for retailers to improve the consumer experience and offer a high level of personalization.

Key words:

Internet, online purchases,
information and
communication technologies
(ICT), experience economy

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1. Introduction

The technological revolution in the field of information and communication technologies over the last 30 years has stimulated the emergence and massification of sales via the Internet. Today, they are a popular alternative, providing businesses with wide opportunities to reach their customers and providing a rational focus and high levels of motivation for online users to find improved conditions for carrying out commercial exchange.

In modern conditions, the Internet and access to the global network can be defined as a basic resource that not only transforms the way human life flows but also, for some businesses, turns it into a new model of their existence. For example, the emergence of e-commerce gives a completely new context to the understanding of a place where the exchange of products takes place. Because wherever there is the Internet, at any moment a situation can arise that can become a point of contact between the merchant and his customer. Moreover, “we are now entering the third evolution of the Internet, in which online life will become more immersive and decentralized, ... giving us a much more immersive, engaging digital experience, where the boundaries between the real and virtual worlds become even more blurred than they are today” (Marr, 2023, p. 1). In this regard, the Internet is becoming not only a new communication medium as originally conceived but is gradually evolving into an area in which, in a completely new way, participants in trade can interact and exchange products, as the physical and digital worlds gradually penetrate, merge, and blur.

The aim of this paper is to assess the strength of the interdependence between European households' access to the Internet and the frequency of its use by individuals as drivers for the purchase of goods and services online.

2. Literature Review

The penetration of the Internet into the daily lives of people and businesses, and its mass use, leads to fundamental changes in the way human life unfolds. Society is becoming so dependent on information and communication technologies that the dimensions of place and time in personal and business life have been

completely transformed. Thanks to constant connectivity to the global network, users have unlimited access to information, and this brings new dimensions to the ways in which people communicate and interact with each other. The interactive environment of the Internet and the ability to discover all kinds of solutions and product offers impose new models through which people make commercial contact and satisfy their needs. Therefore, for years, a number of authors have considered the Internet as the basis for the development of e-commerce and the implementation of exchange processes in real time from a distance. Riley, Scarpi and Manaresi focus on “three key influences on purchase behavior on the Internet: product, consumer, and retailer factors” (Riley, Scarpi & Manaresi, 2005, p. 45). In addition to consumer expertise, risk perception, and shopping orientation, attention is also paid to the customer’s attitude towards using the Internet, which has a strong impact on online shopping and buyer satisfaction. In this context, a positive attitude towards technology, including the global network, contributes significantly to increasing demand and consumer interest in ordering goods and services electronically. Within this framework, for consumers, Internet access should be understood as “the right to access and distribute information and content, to use and provide applications and services, and to use terminal devices of their choice, regardless of the location of the end-user or the provider or the location, source, or destination of the information, content, application, or service” (Regulation (EU) 2015/2120, 2015, p. 8). Thus, within the EU, “wherever consumers are located, they should be able to access electronic communications services of good quality and at an affordable price, including basic Internet access” (European Commission, 2025). This means that Internet access should be guaranteed to every EU citizen, as “the uninterrupted functioning of the Internet environment is a driver for innovation” (p. 1) and an indispensable part of the normal daily life of humanity today. At the same time, the Internet is also defined as “the ideal market, because information is transmitted instantly and buyers can compare the offers of sellers from all over the world” (Salova, 2010, p. 91). This means that the expanding access to the Internet and its continuous development are the basis for improving the conditions of competitive exchange, and this can lead to an increase in the welfare of all participants in online commercial exchange.

Focusing on the advantages that e-commerce provides to consumers when ordering desired goods and services online, Bălăcescu, Pătrașcu and Tănăsescu examine inequalities in online purchases based on the two groups of factors they identified – one reflecting demand and the other related to supply. In their study, the authors examine “the effects of the main social variables (educational level) and ICT (Internet access and Internet use) on Internet purchases made by individuals within the EU member states that lead to differences between groups of EU countries regarding the development level of Internet purchases made by individuals” (Bălăcescu, Pătrașcu & Tănăsescu, 2023, pp. 1-2). The study highlights that Internet access is a basic requirement for making an e-purchase. It is clear that without a stable, secure, and high-speed Internet connection, it is impossible to carry out e-transactions that provide satisfaction and an exciting user experience.

The importance of Internet access as a key factor in the global spread of e-commerce and the stimulation of online shopping has been studied by Gibbs, Kraemer, and Dedrick. The authors conduct a systematic comparison of cases from 10 countries and find that “B2B e-commerce seems to be driven by global forces, whereas B2C seems to be more of a local phenomenon” (Gibbs, Kraemer & Dedrick, 2003, p. 5). At the national level, they form two groups of factors that influence the adoption of online commerce: the national environment (demography, economic and financial resources, information infrastructure, organizational environment, and social and cultural factors) and national policy (liberalization of telecommunications and IT markets, government initiatives to promote electronic commerce and IT, and e-commerce legislation) (Gibbs, Kraemer & Dedrick, 2003). It is striking that in both groups of factors, information infrastructure and information technologies are present – first in terms of availability and condition, and second in terms of actions taken by the state for their development. The important thing in this case is that they are based on Internet networks and Internet access, which are established as leading conditions for the flourishing of electronic commerce and the facilitation of trade exchange relations.

In turn, the technological progress of society leads to “faster, safer, and more efficient businesses with

beneficial effects for both producers and consumers” (Bădîrcea et al., 2022, p. 1). The continuous development and improvement of wireless technologies and telephone networks provides an opportunity to expand the scope of e-commerce and to establish mobile commerce as an increasingly preferred form of product exchange. Various mobile devices and their application for commercial purposes lead to significant changes in consumer behavior and purchasing patterns. Their convenience and ease of use, combined with easy access to the Internet, regardless of the owner's location, create favorable conditions for communication, information gathering, price comparisons, mobile payments, and publishing opinions and consumer reviews. Clients can take advantage of the benefits offered in the context of omnichannel retailing, choosing to complete a transaction via a mobile channel, purchasing via computer or buying from a physical store, with fully integrated and unrestricted use of these channels.

The improved characteristics of the Internet, such as accessibility and data transfer speed, allow for enhanced experiences in online and offline commercial contact. Of course, this process does not occur without its specific problems, digital risks, and compromises that consumers have to make. They are projections of the limitations of their own resource availability, time readiness, personal, work, and social commitments, etc. Modern buyers, defined as omnichannel, have increased expectations and changing needs, the satisfaction of which makes it significantly more difficult for retailers. During their consumer journey, customers require not only lucrative and high-quality products but also an exciting experience. This can be achieved by integrating modern technologies based on the Internet at various points of contact, such as artificial intelligence and machine learning, natural language processing (NLP), blockchain, the Internet of Things, Big Data analysis, cloud technologies, smart mobile applications, etc. The current applied aspects of technological innovations can be presented in the following main areas (Hoffmann, 2025, pp. 100-101):

- augmented reality, which allows consumers to acquire product perceptions without having real contact with the physical product (trying on clothing, furniture, and decoration, etc.);
- personalization of product presentation, fully tailored to customer preferences;
- interactive shopping experiences;
- virtual payment methods;
- facilitated the global scope of commercial offerings.

Therefore, the evolutionary expansion and development of the global network is a significant prerequisite for the progressive improvement of forms of commercial realization and the emergence of new business models existing or operating in an electronic environment. Their advancement is a projection of the goal to provide opportunities for commercial contact at any time, place, and situation. Taking advantage of every technological innovation, the agents of retail exchange strive to ensure a barrier-free and maximally facilitated flow of the commercial process. It is associated not only with the stages of information search in the pre-sales period and the capture of each consumer interest but also goes through the process of forming personalized commercial offers and superior commercial service to find its desired and logical conclusion in the stage of after-sales service and the formation of sustainable consumer loyalty.

This is why research on the influence of Internet availability and frequency of its use as drivers of online product purchases is important to better understand the adoption of the global web as a new business environment and channel for commercial exchange.

3. Methods, Hypotheses and Information sources

In methodological terms, content, comparative, and correlation analysis were applied. Testing correlation dependencies is a traditional approach to discovering the strength of the relationship between two or more variables and allows for the discovery of important factor influences. In the context of the importance of e-commerce for business and society as a whole, the authors support the thesis that the high level of access to the global network by consumers and its more frequent use contribute to attracting more real buyers to the virtual space and increasing

online retail sales. In connection with the thesis and the analytical study conducted, the following two important hypotheses are highlighted in the paper, the proof of which will support the above statement:

Hypothesis 1: Improving access to the Internet for households by statistical regions leads to an increase in online buyers of goods and services for personal purposes in the same territorial units.

Hypothesis 2: Increasing the regularity of Internet use by individuals by statistical regions is associated with an increase in users who have purchased goods and services over the Internet for personal purposes in the same statistical territories.

The study was carried out using secondary data systematized by Eurostat on ICT usage in households by EU member states at NUTS level 2. In this way, the quantitative study was carried out by interpreting data and deriving estimates that, aggregated according to the classification of territorial units for statistical purposes in the EU to the level of the statistical region, ensure the achievement of generalizations valid throughout the EU. To fulfill the set goal and confirm the research hypotheses, the statistical regions of residence of the household, for which there are no reporting data, were eliminated from the input secondary data. Therefore, the initial 201 regions in the EU-27 were reduced to 188 regions, for which statistical estimates of the indicators for 2024 have been provided.

The quantitative study was conducted using estimates extracted from the Eurostat statistical database for Science, technology, and digital society, with the subsection Regional statistics on ICT usage in households and by individuals (isoc_i_reg) for the following indicators: Households with access to the Internet at home (isoc_r_iacc_h) (Eurostat, 2025a), Individuals who used the Internet, frequency of use, and activities (isoc_r_iuse_i) (Eurostat, 2025b), Individuals who ordered goods or services over the Internet for private use (isoc_r_blt12_i) (Eurostat, 2025c), and were systematized for 2020 and 2024.

4. Research on ordering goods or services over the Internet and some of their factors

In 2025, global e-commerce retail sales are expected to exceed \$4.3 trillion (Gelder, 2025). This makes online global retail one of the fastest-growing and most promising sectors of the New Economy. Internet consumption in the European Union member states is gradually growing, rising from 89% in 2020 to 93%, according to forecast data for 2024, while e-shoppers are increasing by six percentage points over the same period – from 65% to 71% (European E-Commerce Report 2024, 2024, p. 12). The high Internet penetration rate reflects the strong digital inclusion of European citizens and provides a good basis for promoting e-commerce and stimulating online orders. This is also reflected in the reduction of the digital divide between the countries within the Union between those who “have” and those who “have not” the opportunity and information to place orders electronically. In the EU-27, 300 million citizens make online purchases, and in 2023, 75% of Internet users aged between 16 and 74 had purchased goods and services online (Council of the EU and the European Council, 2025). In recent years, e-commerce in the single market has continued to develop actively and attract more participants who exchange products online and increase their usefulness. It is the subject of special attention, as it “offers significant opportunities for employment ..., stimulates economic growth and investment in innovative technologies, and can also increase the competitiveness of European industry, provided that everyone has access to the Internet” (Directive 2000/31/EC, 2000, p. 1).

The derived estimate of the correlation coefficient between household Internet access and the relative share of individuals purchasing goods and services online for their own final consumption in 2024 is 0.471, and with a risk of error of less than 0.01, it can be stated that it is statistically significant (Table 1). The positive descriptive characteristic of the relationship between the variables reveals the unidirectionality of the change between the two indicators. This means that the improved Internet availability of households in separate regions is in a straight relative direction to the individuals ordering goods and services online. The estimate of the coefficient of determination shows that 22.18% of the changes in individuals ordering goods and services online can be linked with changes in households' accessibility to the Internet. Therefore, in the statistical

regions of EU countries, where better connectivity and Internet coverage are provided, the environment is naturally more conducive to active Internet use and online purchasing.

Table 1

Correlation coefficients between households with access to the Internet at home and individuals who ordered goods or services over the Internet for private use in 2024 (N NUTS 2 = 188)

		Households with access to the Internet at home 2024	Individuals who ordered goods or services over the Internet for private use 2024
Households with access to the Internet at home 2024	Spearman's rho	1	0.471**
	Sig. (2-tailed)		0.000
	N	188	188

** . Correlation is significant at the 0.01 level (2-tailed)

Source: Authors' Compilation, 2025.

In order to critically analyze this estimate, the study could be extended in time by comparing it with similar data for the indicators for 2020. However, the NUTS2 regions for which there is no data for the older reporting period must first be eliminated. This situation may be due to changes in statistical reporting or in the structure of the population, which cause breaks in the time series. Such changes have occurred in several countries within the EU-27, and for this reason, the sample is transformed and has been reduced to 138 units. Nevertheless, the independence of the elements and the ability to derive quantitative estimates of the correlation remain intact. In this regard, the new estimate of the correlation coefficient for 2024 is 0.513 and is slightly higher than that obtained from the larger sample for the same year (Table 2). When compared with the 2020 estimate of 0.635, confirmation is found for the conditional decreasing importance of individuals' access to the Internet for placing orders for goods and services through the electronic channel. This is direct evidence that with 94.19% coverage of households in the EU-27 with the Internet in 2024, this resource is so natural and widespread in consumers' everyday lives that it is gradually losing its significance as a driver of consumer activity in online commerce. Regardless, access to the Internet is a fundamental prerequisite, which is to a significant extent the source cause of the use of the global network for various purposes, including the acquisition of goods and services. Thus, Internet availability and its ubiquity play a key role as a predisposition to purchasing products online, but gradually over time, the factor model behind the preference for this commercial channel is subject to all traditional factors of consumer demand (income, prices, structure of consumer spending, product preferences, values, etc.). With the widespread accessibility of the EU population to the Internet, it is logical to talk about the removal of this technological barrier to the implementation of e-commerce.

Table 2

Correlation coefficients between households with access to the Internet at home and individuals who ordered goods or services over the Internet for private use in 2020 and 2024 (N NUTS 2 = 138)

		Households with access to the Internet at home 2020	Individuals who ordered goods or services over the Internet for private use 2020
Households with access to the Internet at home 2020	Spearman's rho	1	0.635**
	Sig. (2-tailed)		0.000
	N	138	138

		Households with access to the Internet at home 2024	Individuals who ordered goods or services over the Internet for private use 2024
Households with access to the Internet at home 2024	Spearman's rho	1	0.513**
	Sig. (2-tailed)		0.000
	N	138	138

** . Correlation is significant at the 0.01 level (2-tailed)

Source: Authors' Compilation, 2025.

The second aspect of the quantitative assessment reveals a more pronounced relative relationship between the frequency of Internet use by individuals and their propensity to purchase goods via the Internet in the statistical regions of the EU. An assessment of the correlation coefficient of 0.772 indicates that individuals who used the Internet in the last three months before the survey are highly likely to order goods for personal use online (Table 3). Thus, the frequency of Internet use by individuals accounts for 59.60% of the changes in the proportion of individuals who have ordered goods or services via the Internet for personal use in the statistical regions. In other words, in the statistical territorial units under NUTS 2, a higher frequency of Internet use corresponds to higher activity related to the acquisition of goods and services via the Internet by the population.

In order to perform a comparative analysis of the coefficient over time, a reduction in the sample was again performed by eliminating the statistical regions for which secondary data were missing. In this way, two new estimates of the correlation coefficients of 0.884 for 2020 and 0.808 for 2024 are reached, for which the hypothesis of statistical significance is confirmed at a risk of error of less than 0.01 (Table 4). Therefore, the conclusion about the strong and slightly weakening relationship in 2024 compared to 2020 between the share of people who frequently use and access the Internet and that of people who place orders for products through the online channel is also proven in a time frame. In this situation, the assumption is confirmed that the regions in which consumers spend more of their time on activity on the World Wide Web systematically take advantage of its opportunities to order hard and soft products for their individual use.

Table 3

Correlation coefficients between individuals who used the Internet, frequency of use and activities and individuals who ordered goods or services over the Internet for private use in 2024 (N NUTS 2 = 188)

		Individuals who used the Internet, frequency of use and activities 2024	Individuals who ordered goods or services over the Internet for private use 2024
Individuals who used the Internet, frequency of use and activities 2024	Spearman's rho	1	0.772**
	Sig. (2-tailed)		0.000
	N	188	188

** . Correlation is significant at the 0.01 level (2-tailed)

Source: Authors' Compilation, 2025.

It should be noted that a more frequent and prolonged presence in the virtual space allows web users to gather more information about products, prices, and terms of the sale, which increases the consumer's trust in the merchant and their willingness to buy. They have the opportunity to carefully consider their decision and, in case of hesitation and uncertainty, to find an appropriate source to support or refute their doubt. Thus, the

buyer makes an informed choice, and the likelihood of falling into cognitive dissonance and being disappointed with the order made is reduced.

Table 4

Correlation coefficients between individuals who used the Internet, frequency of use and activities and individuals who ordered goods or services over the Internet for private use in 2020 and 2024 (N NUTS 2 = 138)

		Individuals who used the Internet, frequency of use and activities 2020	Individuals who ordered goods or services over the Internet for private use 2020
Individuals who used the Internet, frequency of use and activities 2020	Spearman's rho	1	0.884**
	Sig. (2-tailed)		0.000
	N	138	138
		Individuals who used the Internet, frequency of use and activities 2024	Individuals who ordered goods or services over the Internet for private use 2024
Individuals who used the Internet, frequency of use and activities 2024	Spearman's rho	1	0.808**
	Sig. (2-tailed)		0.000
	N	138	138

** . Correlation is significant at the 0.01 level (2-tailed)

Source: Authors' Compilation, 2025.

In addition, regular use of the Internet exposes the consumer to the influence of a wide variety of marketing tools and activities, offering unique experiences, attractive offers, and a personalized approach “so as to achieve a synergistic effect in consumer satisfaction and business results” (Galabova, 2016, p. 74). Of course, relatively new tools such as customer references and user reviews on social networks are an additional means of creating greater transparency and providing information to online users, who not only want to know the characteristics of the product and the conditions for its acquisition but can also actually see various practical aspects of its use, as well as the expert opinion of narrow specialists or those with extensive practical experience.

As a result of the calculated correlation coefficients and the analysis performed, the following important conclusions can be drawn:

Conclusion 1: The mass penetration of Internet technology and the spread of wireless networks in households falling into the NUTS 2 level regions of the EU-27 provide wider opportunities for users to use the global network for access to information and communication, entertainment and leisure, interaction with business and public administration, and for the increasingly popular purchase of products over the Internet.

Conclusion 2: The increasing frequency of interaction with the Internet, to the extent of continuous mobile connectivity through personal smart devices, is the basis for a continuous flow of incentives and influences aimed at provoking consumer reaction and initiating orders for goods and services over the Internet.

5. Discussion and future development

Although Internet technology has existed for more than 40 years (the TCP/IP protocol was first introduced on January 1, 1983), it continues to be perceived as an innovation that is constantly bringing changes to people's lives and the way business and the entire economy operate. Increasing attention is being paid to the relationship

between the development of technologies, including the Internet, and generations in society that have emerged over time – the Baby Boomer generation, Generation X, Y, Z, and Alpha. Each of them encompasses a group of people born in a specific time period who live under similar economic, social, and political conditions. The generations formed allow us to chronologically trace how people's decisions are determined by technological innovations or important events that have occurred on a global scale, such as wars or economic or health crises. Specifically, regarding the perception and application of the global network in carrying out commercial exchange and purchasing the necessary products by end customers, it is easy to highlight the existing differences between the individual generations. The life of Baby Boomers (those over 60 years of age) has mainly passed without the presence of the Internet, and this circumstance determines the low level of its use in their everyday life, while Generation X grew up in the years of technological transition and the development of the network, with the majority possessing basic digital skills and managing to take advantage of the benefits of e-commerce. “Generation Y consumers are the major driving force in omnichannel commerce, and retailers’ efforts should be focused on studying their needs and behavior in order to offer them satisfying deals and experiences” (Danchev, 2018, p. 60). At the present moment, this is the population between 29 and 44 years old. At this age, people have established professional careers, are financially stable, and have families and children, which is a prerequisite for making more purchases offline and online. For them, universal access to the Internet becomes a basic need. The last two generations, Z and Alpha, have grown up entirely with the Internet and digital technologies, which are not just an important tool but a way of life in which the real and the virtual gradually merge into one. This process is so radical that in itself it leads to the emergence of subsequent human generations, who from the moment of their birth grow up and form their understanding of the world completely surrounded by new information and communication technologies and their application in every sphere of human existence. In this way, new generations are formed that accept network technologies and digital solutions in their everyday lives, not just as something normal, but as a necessity with which they can fully perceive the world and the way of their life in it. Therefore, with the progress of time, it can be expected that the popularity of the online channel for ordering goods and services will acquire the characteristic of being completely equal to offline commerce. This will unlock the full potential of the omnichannel approach and free switching between different shopping alternatives, which will fully comply with the dimensions of convenience and the full experience of consumers at any time and place where a certain need arises.

The expansion of access to the global network and the improvement of the stability and speed of the Internet connection over the years have contributed to the continuous development and improvement of the Web (World Wide Web – WWW). It is essentially one of the most popular and actively used Internet service by online users, along with email. The modern appearance of the Internet is directly linked to the evolution of the Web. Since its emergence in the 1990s to the present, the World Wide Web has evolved from Web 1.0 to Web 4.0. During this period, it has undergone significant changes along with the expansion of the scope of the Internet and the increased intensity of its use by business, public administration, and citizens for the purposes of commercial exchange. Starting as a “Web of content”, Web 1.0 is characterized by significant staticity and one-directionality. Websites update their content less frequently and are used by users primarily to gather information about the products they are looking for, rather than for direct ordering over the network. The second generation of Web 2.0, defined as the “Social Web”, is causing significant changes in online shopping with the ability of users to actively create and exchange information with each other, as well as to evaluate their choices, to exchange opinions and practical experience, and to publish text, images, or videos primarily on social networks. The opportunities for free communication between online consumers have contributed to the rapid growth in the number of buyers in the virtual space. Businesses successfully take advantage of the potential of Web 2.0, improving sales platforms and communication with customers, which leads to an increase in orders and the competitiveness of enterprises on the network. Companies actively use social networks and blogs in their activities.

However, the last two generations of Web 3.0 and Web 4.0 are the ones that are causing revolutionary

changes in e-commerce, shaping its current form and determining the directions for future development and changes. The “Semantic Web” or “Web of Context”, which is the third generation in the evolutionary ladder, makes the web readable not only by humans but also by machines. It should be noted that it operates in an environment where users and devices create, analyse, and extract a huge amount of information that can be used specifically for business purposes. “This allows for more personalized and intelligent applications that can learn from user behavior and preferences, making the web experience more seamless and efficient” (Nasar, 2023, p. 41). For this reason, together with machine-based personalized search, the emphasis is also on personalization in the offering process, as e-buyers increasingly demand personal attention at every moment of their interaction with the merchant before, during, and after the purchase itself. The activities related to personalization continue to expand and deepen by market agents, and at the present time, applying various marketing tools, the effect of which increases the online presence of consumers and prolongs their stay in the Internet space. In this way, by studying the needs of buyers, the business offers them a unique bargain that satisfies their requirements and ensures increased sales revenue. Gradually, for the purposes of commercial exchange and improving customer service, the use of artificial intelligence is introduced, which makes cyberspace a more connected and intelligent environment for carrying out business transactions.

The latest generation of Web 4.0, operating in the modern Internet space, is popularly known as the “Symbiotic Network”, “Mobile Web”, or “Web of Things”. Thanks to the existing ubiquitous and stable Internet connection, devices are connected to each other and directly interact in real time. In this way, people benefit from remote access to them and can assign them to perform specific tasks. Web 4.0 is distinguished by exceptional mobility and voice interaction between user and machine, which is a prerequisite for the rapid introduction and spread of voice commerce (V-commerce) as the next level in the evolution of online commerce, together with quick and social commerce. Voice commerce is actively developing products to be searched for and purchased online entirely through voice commands, without manually entering data on the e-retailer’s website. For this purpose, the services of a voice assistant are used, which significantly speeds up the purchase, creates convenience, and increases user satisfaction. The other evolutionary alternative, quick commerce (Q-commerce), combines the immediate preparation of the order and its delivery to the customer in the shortest possible time, within an hour, while in social commerce (S-commerce), consumers use the advantages of various social networks to place their order. All these promising forms of market transactions will continue to improve and develop their potential in the future.

In the next few years, along with the satisfaction of utilitarian needs, which depends on the usefulness of the online offer to the buyer, there will be an increasing emphasis on satisfying hedonic ones by providing a variety of experiences during the consumer journey. In this way, an emotional connection is created in which consumers feel satisfied and understood. They enjoy online shopping because they are emotionally engaged in the purchase decision-making process. For this purpose, augmented reality and virtual reality are increasingly being introduced and applied. With the help of augmented reality (AR), the shopping experience of buyers is significantly enriched. It complements the existing physical environment by overlaying virtual elements such as 3D product models, videos, audio-visual and graphic effects, which make objects much more realistic and allow customers to obtain detailed information about them. Online visitors to the website can virtually try on goods such as shoes, clothes, glasses, etc., determine the exact size of the product they are looking for, and change the color and design of the items or some of their elements. All this keeps the user's attention on the relevant product, allows them to create new content, and extends their stay in the online store, creating a sense of satisfaction and entertainment for the buyer. At the same time, it helps the visit to end with a real purchase. On the other hand, virtual reality (VR) allows the customer to completely fall into a computer-generated environment that does not exist in reality but offers a highly engaging, interactive shopping experience, providing product testing and a walk-through virtual stand using special smart devices, VR headsets, and smart glasses. A natural extension of AR and VR technology is multisensory shopping, which integrates all human senses. Looking to the future, we can see the next generation of Web 5.0, called the

“Emotional Web”, at the heart of which is the interaction between people and computers. Its evolutionary nature will make the Internet “not only intelligent but also emotional, with the ability to communicate directly with its users, just as individuals do” (LCX Team, 2023). This will increase the arsenal of tools for online retailers to improve the tangible and intangible aspects of the customer experience.

The escalation of electronic channel penetration will continue, driven by the advancement of wireless data transmission. In this regard, the gradual penetration of Wi-Fi 7 (IEEE 802.11be) as a standard for wireless network technology will provide users with “higher transmission speeds, lower latency, and improved network efficiency, wider channel bandwidth, and reduced interference from other devices, ... to optimize network performance and improve the overall user experience” (Cisco Systems, 2025). The new standard will expand the possibilities for the application of tools through which users can be provided with the entire complex of audio-visual content of the highest quality, enhanced virtual reality capabilities, expanded connectivity of all types of IoT, seamless coverage of a huge number of users, increased levels of network security, etc., allowing electronic and offline merchants to improve the dramaturgy of retailing. This will expand the opportunities of “insightful retailers to make their offers more attractive to consumers by managing different aspects of the experience (entertainment, education, wealth, aesthetic pleasure)” (Danchev, 2025, p. 10), in a way that “teleports consumers from everyday life into a constructed commercial environment in order to create unique, exciting, and unforgettable experiences” (Danchev, 2025, p. 12). Therefore, the Internet is the technological prerequisite for this concept to find its full practical implementation in every form, place, and time of commercial contact.

6. Conclusion

Information and communication technologies play a transformative role in the evolution and way of doing business in the 21st century. They provide solutions that allow the point of contact with the customer to be established at any time and place so that every opportunity is used to conclude a commercial transaction and satisfy the existing consumer demand. The total Internet accessibility of households and the growing frequency of its use for various purposes also find their logical result in the implementation of sales over the Internet. Progress in these areas is a projection of the practical implementation of Europe's digital strategy, which is codified as an engine of economic growth, the competitiveness of business units under the requirements of sustainability, and improved conditions and quality of life in the EU.

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Integrating Logic Programming with Large Language Models: Opportunities and Challenges

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Abstract

This paper explores the integration of logic programming and large language models (LLMs) in the context of the emerging field of neuro-symbolic artificial intelligence (AI) to deliver explainable and verifiable reasoning. LLMs have powerful language understanding capabilities, but they often lack formal consistency and explainability. Logic-based systems, on the other hand, offer formal reasoning, but face challenges with scalability and the processing of unstructured input data. The integration of these approaches enables the development of hybrid AI systems that combine adaptability with formal verification and explainability. This study examines the main integration strategies, reviews key systems and analyzes their potential benefits in areas requiring trust and regulatory alignment. The main technical and conceptual challenges are discussed. The findings support neuro-symbolic integration as a promising direction for developing AI systems with higher levels of interpretability and reliability, applicable to business and decision support systems.

Key words:

logic programming, large language models, neuro-symbolic AI, hybrid systems, explainable artificial intelligence

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1. Introduction

Over the past decade, the development of Large Language Models (LLMs) has fundamentally transformed artificial intelligence (AI) approaches to natural language processing and generation. These models, trained on vast amounts of textual data, demonstrate impressive capabilities across a wide range of tasks such as translation, summarization, coding, argumentation and dialogue. Despite their high performance, they suffer from significant limitations related to a lack of transparency, provability and formal reasoning.

On the other hand, logic programming – represented through languages such as Prolog – offers a formal and explainable mechanism for deriving conclusions from declarative knowledge. Symbolic systems are particularly effective in contexts that require strictly defined rules, deduction and justification, but they struggle with scalability, adaptability and handling unstructured data.

When placed side by side, these two approaches appear to be opposites – sub-symbolic models operate on probabilities and patterns, while symbolic ones rely on formal logic and categorical truth. Nevertheless, in recent years, there has been growing interest in their integration within so-called neuro-symbolic systems. These hybrid architectures aim to combine the strengths of both models.

The current paper aims to analyze the potential and challenges of integrating logic programming with large language models. Based on recent scientific publications and conceptual examples, it explores the theoretical foundations of both approaches, the opportunities their integration offers for building explainable and verifiable intelligent systems, as well as the main challenges that hinder its widespread application. The paper also outlines future development perspectives for neuro-symbolic artificial intelligence.

2. Theoretical Foundations

The development of AI has traditionally relied on two fundamentally different concepts: symbolic, based on logical representation, and sub-symbolic, associated with neural networks and statistical methods. The former

emphasizes the formal representation and manipulation of knowledge through logic, rules and semantic structures, while the latter relies on distributed representation, learning from data and numerical modeling of patterns (Marcus, 2020). Understanding these two approaches is crucial when considering their integration.

The symbolic approach in AI uses symbolic representations of problems, logical reasoning and rule-based systems to simulate human intelligence. In symbolic AI knowledge is encoded as a set of symbols that can be processed using formal logic or rule-based algorithms to derive conclusions or make decisions. This method represents problems and solutions at a high level, understandable by humans, such as mathematical logic, semantic networks and production rules.

Logic programming is a typical representative of this concept, with the Prolog language playing a central role due to its declarative syntax and resolution-based inference mechanism. In Prolog knowledge is defined through facts and rules, while queries to the system activate a logical search mechanism (Honda & Hagiwara, 2025). For example, in definitions such as:

human(socrates).

mortal(X) :- human(X).

and a query like:

?- mortal(socrates).

the system will respond positively, deriving the conclusion logically.

In recent years, logic programming has found new application as a “reasoning layer” in hybrid (neuro-symbolic) architectures. For example, in systems where LLMs generate logical representations (e.g., Prolog facts), the reasoning component (usually Prolog) performs verification or deductive inference (Sambri et al., 2025).

Symbolic AI is effective in domains where clear rules and structured knowledge exist, such as theorem proving, expert systems and natural language understanding. It offers explainability through inference tracing, formal verification of results and logical consistency of argumentation, which is particularly important in systems requiring trust, regulatory compliance and decision justification (e.g., law, medicine, etc.).

The sub-symbolic concept, on the other hand, uses neural networks and vector representations of information. In this case knowledge is not explicitly encoded but is learned from data. Neural networks can recognize patterns, learn from examples and make decisions, making them highly effective for tasks such as image and speech recognition, natural language processing, financial forecasting, medical diagnostics and autonomous systems.

The most advanced and influential outcome of this approach is represented by large language models such as GPT (OpenAI, 2023), LLaMA (Touvron et al., 2023) and Claude (Anthropic, 2023), which are often described as approaching human-level understanding. They are trained on huge sets of text data and model the probability distribution of words and phrases. These models demonstrate remarkable capabilities in solving a wide range of complex tasks: machine translation, text summarization, code generation and argumentation. However, they still lack true understanding and reasoning abilities. They rely on statistical patterns in the data without offering logical verification or guaranteed truthfulness of the generated content.

Despite their high effectiveness, these models have some fundamental limitations. Their dependence on massive datasets, significant energy requirements and the tendency to generate plausible but false or logically inconsistent statements (“hallucinations”) or biased outputs are serious practical issues (Ji et al., 2023). Empirical studies show that models such as GPT-3.5 and GPT-4 exhibit hallucination rates of 39.6% and 28.6%, respectively (Chelli et al., 2024). Theoretical analysis confirms that this behavior is not accidental, but a fundamental property of statistical generative models, which lack access to formal truth and logical validation (Xu et al., 2024).

For better understanding of the foundations and complementarities of the symbolic and sub-symbolic concepts, Table 1 presents their main characteristics.

Table 1

Key Differences Between Symbolic and Sub-symbolic AI

Aspect	Symbolic AI (Logic-based)	Sub-symbolic AI (Neural-based / LLMs)
Knowledge Representation	Explicit symbols, logic rules and ontologies	Distributed, implicit in neural weights
Reasoning Method	Deductive, rule-based reasoning	Statistical, pattern-based reasoning
Interpretability	High – reasoning paths are transparent and explainable	Low – reasoning is opaque and hard to trace
Learning Capability	Manual rule definition, brittle generalization	Learning from large datasets, flexible generalization
Data Requirements	Low – relies on structured input and prior knowledge	High – needs massive annotated or unstructured data
Context Awareness	Limited – depends on predefined context	Strong – learns contextual embeddings
Adaptability	Low – needs manual updates	High – adapts through fine-tuning and pretraining
Typical Use Cases	Legal reasoning, expert systems, planning, knowledge graphs	Text generation, language translation, image captioning

Source: Own Elaboration

Due to the limitations of LLMs, interest in so-called neuro-symbolic AI is growing. This is a rapidly evolving research field that seeks to combine the explainability, structure and formal logic of symbolic methods with the adaptability, scalability and generative power of neural networks (Bhuyan et al., 2024). The goal is to integrate the strengths of both concepts to create stable and multifunctional AI systems. At its core, this approach is based on using LLMs to extract or generate logical structures from natural language, which are then processed by a logical system (e.g., Prolog) to validate or derive justified conclusions.

Current research on modern approaches to combining sub-symbolic and symbolic components identifies the following key integration strategies:

1. **LLM → Symbolic:** In this approach the language model generates logical representations (e.g., rules or Prolog programs), which are then executed (validated) by a symbolic reasoning mechanism. An empirical study by Yang et al. (2024) demonstrates that such an approach, where an LLM generates Prolog programs to solve elementary math problems, leads to higher accuracy compared to chain-of-thought strategies.

2. **Symbolic → LLM:** This strategy uses symbolic resources to support or guide the operation of LLMs. Symbolic knowledge can be injected via ontologies, logical rules or knowledge bases, which the generated content must conform to. In their publication, Vsevolodovna and Monti (2025) describe how an ontology can be used to verify the outputs of LLMs and apply automatic corrections via feedback.

3. **Hybrid architectures:** This approach involves two components that engage in real-time bidirectional interaction – LLM generates, the symbolic component validates and, if necessary, corrects or supplements, and vice versa. Such architectures are seen as key to building explainable, reliable and logically consistent AI (Yang et al., 2025).

On this basis, we can propose a comparison of the integration strategies described according to some criteria included in Table 2.

Table 2**Comparison of Integration Strategies Between LLMs and Symbolic Systems**

Strategy	Direction	Description	Advantages	Limitations
LLM → Symbolic	From LLM to Logic	The LLM generates logical representations (e.g., rules or Prolog), which are then validated or executed by a symbolic engine	Enables automatic rule extraction and interpretable reasoning paths	LLMs may produce syntactically incorrect or logically invalid outputs
Symbolic → LLM	From Logic to LLM	Symbolic systems guide the generation of the LLM, e.g., via ontologies or rule-based filters	Enforces compliance with formal knowledge structures	Symbolic rules may overly constrain LLM flexibility or creativity
Hybrid architecture	Bidirectional	LLM and symbolic components interact in real-time; each validates and refines the output of the other	Enables iterative improvement, error correction, and enhanced explainability	Complexity of implementation and real-time synchronization

Source: Own Elaboration

The analysis of the theoretical foundations reveals that logic programming, despite its long history, remains relevant in the modern AI landscape. Rather than being viewed as an alternative to large language models, it can play a complementary and explanatory role.

Beyond the basic symbolic and sub-symbolic concepts, additional perspectives from applied computer science contribute to a broader understanding of how data structures and system models influence intelligent behavior. For example, Andreev and Vasilev (2025) present an approach for pattern discovery in financial time series using Python and Excel, emphasizing the transformation of unstructured input into analyzable patterns. Similarly, Jordanov et al. (2025) discuss the application of domain-driven design principles in cloud environments, illustrating how structured, modular architectures can improve scalability and interpretability. Although these studies are not directly focused on hybrid AI, they reinforce the broader importance of the principles of data abstraction and architectural modeling which are the basis of the integration of symbolic reasoning and language-based learning systems.

3. Advantages of Integrating LLMs and Logic Programming

The integration between LLMs and logic programming reveals significant opportunities for building intelligent systems that combine the large-scale linguistic competence of LLMs with the explainability and formal rigor of symbolic reasoning. While LLMs demonstrate high effectiveness in text generation, interpreting instructions and extracting knowledge from unstructured input, they often struggle with logical consistency, deduction and verification of truth claims. This is precisely where logical systems such as Prolog find their role as a verifying and explanatory layer, capable of enhancing the reliability of the overall architecture.

One of the most frequently cited advantages of this integration is the ability to explain and verify automatically generated statements. Hypotheses formulated by LLMs can be verified through deductive mechanisms that provide formal confirmation or rejection. This enables the construction of traceable reasoning chains in which each step is logically justified. Such architecture is particularly applicable in domains with

high demands for transparency and legal justification – such as law, medicine and regulatory compliance. For instance, in the field of legal reasoning, systems can not only interpret legal texts through a language model but also verify whether a specific situation complies with prescribed norms, using ontological and logical rules (Vsevolodovna & Monti, 2025).

Another important advantage is the ability to automatically extract and transform textual descriptions into logical rules. Research has demonstrated how LLMs can convert natural language into executable Prolog code for logical evaluation (Di et al., 2025). Results show that this approach outperforms classical strategies such as chain-of-thought, particularly in cases where clear traceability and formal verification of each reasoning step are required. These capabilities significantly facilitate the creation and maintenance of knowledge bases and expand the applicability of logical systems to domains characterized by high dynamics and complex logical structure.

The integration of language models with logic-solving systems also contributes to the robust handling of logical inconsistencies and informational gaps in the generated output. In the presence of logical contradictions or invalid conclusions, the symbolic system can provide feedback that guides the model toward a more correct result. Studies such as Logic-LM (Pan et al., 2023) show that incorporating logical mechanisms leads to improved performance in tasks, requiring logical consistency and verification.

As a result, combined systems demonstrate not only higher accuracy and reliability, but also the ability to explain and justify their decisions – qualities that are of increasing importance in the context of ethical and regulated AI. Under strict regulatory frameworks such as the GDPR (GDPR, 2016) and the AI Act (AI Act, 2024), such systems offer opportunities to create trustworthy AI solutions that combine linguistic flexibility with logical accountability.

4. Example Architectures of Neuro-Symbolic Integration

Building on the advantages outlined, this section surveys representative neuro-symbolic designs that implement explainability and verification in practice. These designs clarify the contrast between the symbolic and the sub-symbolic, summarized in Table 1, by specifying how learning and reasoning are coupled. Neuro-symbolic systems typically follow one of two patterns: (1) tightly coupled and (2) loosely coupled. Tightly coupled designs embed logical structure directly into the learning objective, making reasoning differentiable. In loosely coupled designs an LLM translates a task in natural language into a formal specification, then a symbolic solver performs inference and returns diagnostics. Both patterns have matured in the last five years, with complementary strengths in terms of verification, scalability and support for continuous variables. Figure 1 provides a high-level overview of the pipeline used throughout this section. The LLM proposes, a translator maps NL to logic, a symbolic solver executes, and a verifier returns traces and counterexamples for refinement.

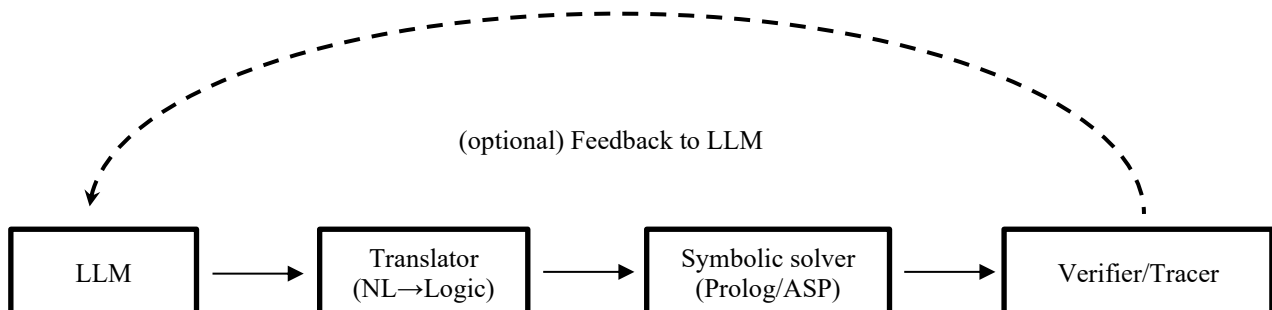


Fig. 1. Neuro-Symbolic Pipeline: From LLM to Verified Logic

Source: Own Elaboration

4.1. Logical Neural Networks (LNN)

Logical Neural Networks realize logical operators ($\wedge$, $\vee$, $\neg$) as parameterized neurons and compile formulas into computational graphs optimized with contradiction/consistency losses. This enables end-to-end learning, while preserving a human-readable structure, in which formulas act as soft constraints. Each hidden unit corresponds to a sub-formula, which supports inspection and evaluation of individual rules after training (Sen et al., 2022).

This approach is particularly suitable when a relatively stable rule set exists (e.g., compliance policies, safety constraints) but the data is noisy or incomplete. Reported advantages include tolerance to inconsistent knowledge through the use of soft truth bounds (i.e., fuzzy truth intervals), which is helpful with partial ontologies. Practically, the method is parameter-sensitive – different t-norms or truth-interval settings can change the meaning of the logic if not validated carefully.

4.2. Neural Probabilistic Logic Programming

Neural Probabilistic Logic Programming (NPLP) combines probabilistic logic programs with neural components. In these models, selected atoms are implemented as neural predicates (learned modules that output probabilities or scores) that parameterize distributional facts and are combined through a symbolic inference procedure. Training is typically end-to-end – neural modules and optional probabilistic code are tuned to the data and constraints, leading to structured reasoning that accounts for uncertainty. NPLP is therefore a tightly coupled design, well-suited for constrained perception scenarios (e.g., global rule classification, compositional analysis or sensor-driven decision making). Three representative systems are outlined in the following paragraphs: DeepProbLog (fundamental interface), DeepStochLog (scalability via stochastic grammars) and DeepSeaProbLog (discrete-continuous domains).

The DeepProbLog family treats neural classifiers as neural predicates. These modules parameterize the truth or probability of atoms in a ProbLog program and thereby support joint training of perception and logical inference under declarative constraints. The journal version systematizes the interface and demonstrates resilience to difficult tasks (Manhaeve et al., 2021).

DeepStochLog improves scalability by organizing derivations with stochastic definite clause grammars, turning inference into grammar-guided stochastic proofs. It works well for compositional problems such as structured sequences that explode in branching, where conventional probabilistic logic programming becomes brittle (Winters et al., 2022).

Deep probabilistic programming is used to extend the language to handle both discrete and continuous variables. Distributional facts and continuous constraints enable reasoning over measurements and thresholds while preserving the logical foundation. This is especially useful in sensor-rich domains and cyber-physical systems (De Smet et al., 2023).

4.3. Logic-LM: LLM $\rightarrow$ Symbolic Solver

Logic-LM follows a clear division of work: the LLM parses and the solver proves. The LLM first rewrites the natural language problem as a formal specification (e.g., first-order logic constraints or a small program). Then a deterministic solver executes this specification and returns diagnostic data such as syntax errors, counterexamples or sets of unsatisfied constraints. This data drives an automatic self-improvement loop that corrects the formalization. In multiple logical-reasoning datasets, this improves faithfulness and accuracy of the final task compared to standard prompting and chain-of-thought. As a result, delegating inference to verifiers has been shown to be effective when correctness is critical (Pan et al., 2023). In regulated settings, the pipeline also provides auditability as proof objects and counterexamples can be logged, while the LLM keeps the flexibility needed for parsing and abstraction.

4.4. LLM-Assisted Theorem Proving

A well-known form of reasoning organized by a solver is interactive theorem proving, which targets the highest level of assurance. In this setting, a formal proof assistant enforces correctness by construction through a small, reliable kernel. Interactive theorem proving relies on a small, trusted kernel that checks every proof step. LeanDojo is an open-source framework, dataset and toolkit for the Lean proof assistant. It standardizes the data extraction from the Lean ecosystem (e.g., mathlib) and builds a retrieval index. Programmatic APIs are provided so that LLMs can interact with Lean states and propose tactics, while the kernel verifies each step. Retrieval-augmented selection of premises is a primary contributor to performance (Yang et al., 2023).

Another example is LEGO-Prover, which is a neural theorem proving system for Lean. It decomposes proofs into reusable tactic “bricks” (parameterized tactic sketches) and maintains a growing library of skills. An evolver loop refines these bricks under continuous kernel verification. The approach improves transfer to new theorems and sample efficiency (Wang et al., 2023). These pipelines follow an agent-with-tools design where faithfulness is guaranteed by the formal checker rather than by the LLM’s natural-language explanation.

4.5. ASP-Based Integration (NeurASP)

Answer Set Programming (ASP) provides stable-model semantics, a precise way to specify which solutions are valid, so it fits combinatorial problems with clear yes/no constraints. NeurASP links neural networks to ASP by treating network outputs as probabilities over atoms and combining them with declarative rules. During training, these rules act as constraints that guide the neural components. At inference time, only predictions that satisfy the rule base are accepted. This makes NeurASP suitable for “perception + structure” tasks where feasibility is binary and easy to express as rules, such as Sudoku-style constraints or structured scene layouts (Yang, Ishay and Lee, 2023).

In summary, the review of neuro-symbolic architectures shows that tight hybrids (LNN, DeepProbLog/DeepStochLog/DeepSeaProbLog) enable constraint-aware learning and uncertainty calibration but require more complex inference graphs and occasionally longer training. Loosely coupled pipelines (Logic-LM, theorem proving, NeurASP orchestration) provide stronger formal guarantees and clearer traces at the expense of orchestration costs and solver latency. The choice of architecture should be driven by assurance needs (verification strength), data types (discrete vs continuous signals), rule stability, uncertainty requirements, latency budgets and tool maturity. In practice, a small bridging layer (translator) for ontology alignment, type checking, sandboxed solver calls and feedback shaping often determines reliability more than the choice of solver itself.

5. Case Study: LLM→Prolog Pipeline for Verified Reasoning

The case study presented in this section illustrates the pipeline in Figure 1 on a rule-driven eligibility check (e.g., benefits, access control or policy compliance). The LLM proposes a candidate logical program from policy text, a translator normalizes symbols and types, a Prolog engine executes the program and a verifier returns traces or counterexamples that drive repair. The design follows a loose coupling pattern. The goal is an eligibility decision under a short policy, which defines age thresholds, income limitations, scope predicates (e.g., residency/jurisdiction) and disqualifying exceptions such as bankruptcy or fraud. The input data to the pipeline is: (1) the policy text; (2) a schema with predicate names and types; and (3) a natural-language case description (entities and values).

The proposed pipeline is as follows:

1. NL→Logical synthesis (LLM). The LLM maps policy clauses to candidate Prolog facts and rules, using allowed vocabulary and templates.
2. Translator checks. Type/arity validation, unit normalization (e.g., “€1.5k”→1500), ontology

alignment. Incorrectly entered programs are rejected with action messages.

3. Deductive execution (Prolog). Queries (e.g., `?- eligible(applicant).`) succeed with a proof tree or fail with a minimal unsatisfied core and failing literals.

4. Self-refinement. The diagnostic (counterexample, failing literal) is fed back to propose the smallest fix that restores correctness, after refinement guided by the solver.

The following lines present a minimal, self-contained Prolog program:

```
% ---- Schema (predicates) ----
% age(Person, Years).
% income(Person, Amount).
% residency(Person, Region).
% tax_resident(Person, Country).
% exception(Person, Reason).
% override(Person, Reason, Status).

% ---- Core policy ----
above_min_age(P) :- age(P, A), A >= 65.
below_income_limit(P) :- income(P, I), I <= 1500.
in_scope(P) :- residency(P, eu), tax_resident(P, bg).

eligible(P) :- in_scope(P), above_min_age(P), below_income_limit(P),
\+ exception(P, bankruptcy), \+ exception(P, fraud).

% Controlled override of specific exceptions
eligible(P) :- in_scope(P), above_min_age(P), below_income_limit(P),
exception(P, E), override(P, E, approved).

% ---- Example case (A123) ----
age(a123, 67).
income(a123, 1450).
residency(a123, eu).
tax_resident(a123, bg).
exception(a123, bankruptcy).
override(a123, bankruptcy, approved).

% ---- Example queries ----
% ?- eligible(a123).           % true
% ?- exception(a123, E).      % E = bankruptcy
```

If the rule *eligible* fails for a given case, the verifier displays the failing literal (e.g., *residency*) and a counterexample. The translator may then normalize the NL→logical mapping (e.g., "Bulgaria (EU)" → *eu*) or request missing facts. If an exception applies, the predicate *override* encodes an explicit approval instead of

silently weakening the constraints, which improves auditability.

The presented loop increases the percentage of verified answers, because only solutions accepted by the solver are displayed. It also provides verifiable explanations in the form of evidence traces and counterexamples rather than opaque justifications. This is consistent with the evidence that delegating inference to a verifier improves accuracy in logic-intensive benchmarks (Pan et al., 2023). For areas with clear feasibility constraints, ASP-based orchestration (NeurASP) can replace Prolog to leverage the semantics of the robust model.

Despite its practical benefits, the pipeline has some limitations that bound its application. They may be related to translation errors, ontological biases and solver latency. These risks can be mitigated through strict allow lists, schema tests in the translator and human approval for rule deletions. The next section expands on these risks and the broader challenges in integrating logic programming with LLMs.

6. Challenges in Integrating Logic Programming with LLMs

Despite the growing interest in the integration of LLMs with logic programming, there are several challenges that limit the effectiveness and reliability of such hybrid systems. This section summarizes the main obstacles observed in the presented architectures and the case study.

At the conceptual level, the most significant difficulty arises from the fundamental difference between the two approaches: while LLMs operate within the context of probabilistic generation, logic programming relies on strictly formalized and deterministic structure. This discrepancy creates difficulties in transforming the output of a language model into logical representations and vice versa, especially when full consistency between components is required.

An additional complication is related to the limited logical capability of LLMs. Although these models can simulate logical reasoning through patterns such as “chain-of-thought”, they often make syntactic and semantic errors when dealing with more complex logical constructions. A study by Creswell et al. (2023) shows that even after further training, language models struggle with tasks that require formal deduction over unfamiliar objects.

Linking the output of LLMs to ontologies and logical knowledge bases also presents a challenge. As emphasized by Urban et al. (2023), the lack of compatibility between the terminology, used by language models and the structures of logical systems, leads to erroneous conclusions by LLMs, unless additional mechanisms for strict control or post-processing are used.

Lastly, the issues of managing uncertainty, contradictions and contextual dependencies remain weak points for both approaches. Logic-based languages inherently struggle with ambiguity and probability, while LLMs do not offer a formal mechanism for categorically distinguishing between true and false. Overcoming these mismatches requires the use of intermediate formats and mediating layers that facilitate the transfer of context and semantics between the two sides.

7. Perspectives and Future Directions for the Development of Hybrid AI Architectures

Despite existing challenges, the development of hybrid architectures that combine logic programming and LLMs outlines several clearly defined and promising directions. One of the most promising directions is the incorporation of logical feedback into the architecture of intelligent systems – not only at inference time but also during training. Such approaches, often referred to as reasoning feedback loops, allow the logical system (symbolic component) to validate, filter or enrich the output of the language model in an iterative process and to return traces or counterexamples that shape subsequent updates. A similar model is demonstrated by Tan et al. (2024) through the system “Thought Like Pro”. In this system the language component generates logical representations, which are then validated by a Prolog module. Only logically correct reasoning trajectories are used for subsequent imitation learning of the model. The result is better

alignment with deductive structures and enhanced explainability.

In parallel, new approaches for knowledge representation are being developed, aiming to combine the strengths of symbolic and sub-symbolic representations. In this context, another actively evolving direction is the design of new formats that combine numerical text encoding with a structure, reflecting logical dependencies. These formats seek to facilitate the interaction between symbolic and sub-symbolic components in hybrid systems. Such formats enable the creation of systems in which text is not generated purely statistically but is conditioned by an underlying logical model. This enhances both the explainability and the controllability of the output. These approaches align with recent studies on semantic classification of scientific knowledge (Nacheva et al., 2024), which demonstrate how structured metadata and domain-aware models can support enhanced reasoning and retrieval in intelligent systems.

Equally important is the potential for integrating logic programming with Retrieval-Augmented Generation (RAG) architectures. In such a hybrid model the language model is used to formulate a query and retrieve relevant information from external sources, while the logical component is responsible for verifying it through structured logical inference. These architectures can ensure not only factual accuracy, but also the logical validity of the results.

In the long term, the advancement of these technologies opens up the real possibility of creating intelligent agents that not only communicate, but also plan, test hypotheses and adapt their behavior, based on logical models. This may lead to systems capable of simulating complex scenarios, managing uncertainty and making decisions based on both linguistic intuition and formal logical rigor.

8. Conclusion

The integration between logic programming and LLMs is emerging as a strategic direction in the development of AI, focused on explainability, reliability and accountability. The combination of the adaptability and generative power of language models on one hand, and the formal rigor of logical systems on the other, enables the creation of hybrid architectures that not only interpret text but also structure, validate and contextualize it.

This paper outlines the key capabilities of this approach, including the automatic extraction of logical rules, inference validation through deduction and the creation of reasoning trajectories that can be explained and traced. In domains with high demands for legal, ethical or regulatory accountability such systems are not merely useful – they are imperative. The current study surveys different integration patterns and reviews representative architectures. Also, a compact case study is presented, showing the pipeline LLM→Prolog→Verifier, highlighting the translator layer as critical for dependable deployment.

Nevertheless, achieving full functional compatibility between the components remains a challenge, requiring new intermediate formal representations and architectural solutions. Overcoming the discrepancies between probabilistic and formal models demands not only technical integration, but also deep conceptual understanding.

Despite these difficulties, the direction toward trustworthy, verifiable and explainable hybrid systems not only extends the boundaries of artificial intelligence but also lays the foundation for a new standard of its responsible and transparent application.

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Artificial Intelligence from the Perspective of Legislation and Copyright in General, and in Business**Pavĺina PETROVÁ¹**¹ Technical University of Liberec, Liberec, Czech Republic, pavlina.petrova@tul.cz

JEL: K10, O33**Abstract**

Artificial intelligence today represents a revolutionary technology. Given that technologies permeate all spheres of our lives, it is necessary to address the area of legislation and law related to artificial intelligence. This article deals with artificial intelligence in the context of copyright law at the level of human society and companies. The article also deals with the legal regulation of artificial intelligence from the perspective of European legislation and the legislation of various countries. The article aims to offer a comprehensive and up-to-date view of the issues related to artificial intelligence, emphasizing copyright issues and differences between individual legislative approaches, thus supporting further professional discussion and research in this area.

Key words:

artificial intelligence,
copyright, legislation, business

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1. Introduction

Artificial intelligence is a revolutionary technology. It is considered a challenge not only for legal systems but also for regulatory authorities worldwide. The rapid advancement in artificial intelligence technology has highlighted the need to address the area of copyright. Thanks to this technological advancement, the question has arisen whether artificial intelligence can be considered an author. Some advocate that granting copyright to works generated by artificial intelligence could encourage further innovation in research and development. Others are concerned about its impact on traditional concepts of creativity and authorship. (Barqawi L, Abdallah M., 2024) The outputs generated by artificial intelligence are created based on already existing datasets and, for this reason, may contain similarities to works that are under copyright protection. (Ülkü Kahveci, 2023) The article aims to offer a comprehensive and up-to-date view of the issues related to artificial intelligence, emphasizing copyright issues and differences between individual legislative approaches, thus supporting further professional discussion and research in this area. The article focuses on the topic of artificial intelligence and copyright. The work also deals with the legal regulation of artificial intelligence from the perspective of European legislation and legislation in various countries.

2. Methodology

This article takes a qualitative approach. It is based on literary research exploring the relationship between artificial intelligence, copyright, and legislation. In the initial phase, the professional literature is analyzed, focusing on defining the concept of artificial intelligence and copyright.

The emphasis is on academic and professional sources, including scientific articles and legislative documents. Databases such as Scopus, Web of Science, and Google Scholar will ensure up-to-date information.

The research is structured according to the following research questions, which determine the focus of the article:

VO1: Can artificial intelligence be considered an author of a work in the Czech Republic?

VO2: How is artificial intelligence perceived within the legislation of different countries?

The acquired knowledge will be analyzed. The result will be a theoretical overview that will serve as a starting point for a deeper discussion on artificial intelligence's copyright status and its impact on business.

The article aims to offer a comprehensive and up-to-date view of issues related to artificial intelligence, emphasizing copyright issues and differences between individual legislative approaches. Thus, it supports further professional discussion and research in this area.

3. Artificial intelligence

Currently, the term artificial intelligence is one of the most discussed topics. This term is widely used in many contexts in different industries. Artificial intelligence is a system that expresses intelligent behavior and can predict, learn, and understand human cognitive processes. The basis of artificial intelligence is neural networks, which were created in 1944. Artificial intelligence is real intelligence, but artificially created. Artificial intelligence analyzes and compares new information with existing information (Hurbans, 2020). It can be stated that artificial intelligence is the study of computer agents that act intelligently (Poole, 2010). Artificial intelligence belongs to the field of computer science. It uses algorithms to reason and perform tasks. These algorithms are used to develop computer programs and perform tasks that would otherwise require human activity. Such a program is a software robot that can operate independently and mimics a certain level of human intelligence (BDO, 2020). Unlike process automation, where robots can replace humans in routine work, artificial intelligence replaces the human factor in performing more complex tasks (Gracey, 2022).

In the continental legal system, the author of an artificial intelligence can be considered a natural person or a group of natural persons who have collaborated on developing the artificial intelligence. In contrast, a legal person can also be considered an author in the Anglo-American legal system. It is important not to forget the creative contribution of these persons. Without them, without creating the artificial intelligence, the creation of a work with their help would not have been possible. (Zibner, 2022). Artificial intelligence can create and train on existing data, which it uses to create new output. (T zimas , 2025) However, often without permission or compensation to the original rights holders. (Dimita, Gaetano, and MacDonald, Michaela, and Suthersanen, Uma, 2025) Regarding copyright, the question arises of whether it is possible to consider artificial intelligence as an author and grant copyright protection to its works.

4. Copyright law and artificial intelligence from the perspective of individuals and companies

According to Lemley, Mark A. (2023), artificial intelligence enables society to create infinite new content. Generative models learn from large amounts of data and use the learned patterns to create new content. Under current copyright law, copyright protection is granted to original works of authorship that are recorded in tangible form, which usually requires human authorship or creative contribution. (Barqawi L, Abdallah M., 2024) Some scholars believe that only human-created content should be protected by copyright. On the other hand, other scholars argue that content created by artificial intelligence could also be protected by copyright if human factors played a significant role in its creation. (Yang & Zhang, 2024)

Copyright law deals with the relations between creators and users of copyrighted works. The decisive legal regulation in this area is Act No. 121/2000 Coll., on copyright, rights related to copyright and on amending certain acts (Copyright Act), as amended (Czech Republic, 2000). Copyright is also enshrined in the Charter of Fundamental Rights and Freedoms and is regulated by international treaties and legal acts of the European Union (Donát, 2016). According to the current legal regulations in the Czech legal environment, it is impossible to consider the outputs of artificial intelligence as copyrighted works. For example, American authorities and the European Patent Office also require authorship from a person. In contrast, for example, in the United Kingdom, Ireland, New Zealand, India, and Hong Kong, the recognition of the person who, as the

author, created the work (Kolaríková, 2020).

Individuals and companies often face the question of whether they can be held liable for outputs created by artificial intelligence with little or no human intervention. Dynamic changes driven by technological developments characterize the current world of business and marketing. Changing consumer behavior, rapid development of IT technologies, and artificial intelligence create new challenges and requirements for companies. One of the areas that is changing is marketing management. Advanced technologies, such as artificial intelligence, are increasingly used to effectively manage marketing activities and adapt to changing customer preferences. Implementing artificial intelligence tools can increase the effectiveness of marketing activities and help better understand and fulfill customer needs. These tools include customer identification and contact tracking on websites; email marketing and newsletters, automated sales chat; inbound marketing; customer lifecycle management; customer referral systems; creation and management of advertising campaigns; contributions on social networks, etc. These tools are used, among other things, to optimize customer service. (Ciechomski, 2025) Another example could be the creation of a slogan, image, or video through artificial intelligence. Furthermore, an automotive designer can generate a vehicle interior design using artificial intelligence.

From the perspective of creative activity, artificial intelligence can be perceived as a creative entity with copyright claims limited by the basic norms of intellectual property law (Zibner, 2022). On this basis, artificial intelligence cannot be attributed to its identity in the Czech Republic. However, users of artificial intelligence can be a group of potential authors of works created with the help of artificial intelligence. This is especially the case when these users actively contribute to the creative activity of artificial intelligence. For example, it may involve providing data to artificial intelligence or instructions regarding a work's creation, modification, or completion. The copyright of artificial intelligence users is based on the work's final form, which is built based on their creative activity. (Machačka, 2023). As for co-authorship, according to the provisions of Section 8, paragraph 2 of the Copyright Act, "a person who participated in the creation of a work only by providing assistance or advice of a technical, administrative or professional nature or by providing documentation or technical material, or who only participated in the initiatives to create the work, is not a co-author. In the case of co-authorship, the copyright to a work created with the help of artificial intelligence would therefore belong jointly and severally to both the users and the authors of artificial intelligence. (Hašan, 2023).

According to Novagraaf Team (2024), the European Court of Justice has ruled on the dispute between artificial intelligence and copyright for the first time. The court stated that there could be copyright protection for a work created by artificial intelligence if the instructions demonstrate the originality of the human author.

5. Legislation and artificial intelligence

This chapter describes the legal regulation of artificial intelligence from the perspective of European legislation and legislation in various countries, including Canada, Japan, South Korea, the USA, and the Czech Republic.

5.1. European legislation

The years 2016 to 2019 were progressive in documents dealing with artificial intelligence within the European Union. According to the EU Agency for Fundamental Rights, 265 policy initiatives related to artificial intelligence had been created in the EU by December 11, 2019, such as: Draft Recommendation on Robotics, Study, European Parliament Recommendation on Rules for Robotics, Commission Communication on Artificial Intelligence, and Definition of the Expert Group on Artificial Intelligence.

In 2018, a document focusing on autonomous vehicles was created, following up on the European Parliament's recommendation on rules. In June 2019, a report on liability, insurance, and risk management about robotics and artificial intelligence was prepared. (Kolaríková, 2020).

In 2020, the European Union published a report containing rules for building people's trust in artificial intelligence while supporting the growth and development of artificial intelligence. The European Commission, the Council of the European Union, and the European Parliament reviewed the law on artificial intelligence to synchronize laws related to artificial intelligence. (Dashti & Motamednejad, 2024) On March 13, 2024, the European Parliament approved the law on artificial intelligence. It is the first-ever significant EU legislative framework for classifying products and services that use generative artificial intelligence based on risk and safety. The law aims to protect fundamental freedoms and ensure the safety of users of artificial intelligence. The law also affects international companies, including those outside the EU. It also requires employers to use artificial intelligence to comply with the regulations. The law prohibits specific artificial intelligence applications, such as biometric categorization systems based on sensitive characteristics and the indiscriminate collection of facial images from the internet or security camera footage to create facial recognition databases. These systems threaten citizens' rights. (Butt, 2024)

5.2. Legislation in selected countries.

The Far East countries are leaders in robotics. Based on their culture's history, robots are perceived as helpers of humanity. On the contrary, based on history, the fear of artificial beings persists in Europe. In 2017, Canada became the first country in the world to have a national strategy for artificial intelligence. Within Europe alone, Finland was the first state. (Kolaříková, 2020)

Japan has a rich tradition of technological innovation and research. It invests in the development of new technologies, and therefore, Japan can also be ranked among the leaders in the field of robotics. Since 2003, testing and further developing bipedal robots in the Tokku special zone has been possible. In 2015, Japan introduced the New Robotics Strategy, which contains a vision, strategy, and plan for developing robotics in the country. (Kolaříková, 2020). Japanese culture has a positive relationship with robots. Robots are perceived as useful helpers that can support the acceptance and integration of robots.

The Intelligent Robot Development and Distribution Act was adopted in South Korea in 2008. This act defines an intelligent robot and includes regulations for robot quality certification (Klri, 2008). In 2012, the Korean Robotics Ethics Charter was adopted, addressing robotics-related policy issues. In 2016, the Robot Industry Initiative program was published, which deals with the active implementation of intelligent robots in, for example, rehabilitation centers, hospitals, and post offices. In 2019, South Korea joined the Artificial Intelligence Strategy program, which deals with financial investments in constructing artificial intelligence-based factories. The country also aims to develop relevant legislative amendments by 2030 (Kolaříková, 2020).

In the USA, 33 states passed legislation on autonomous vehicles in 2017. However, in 2016, the Department of Transportation issued the first manual regulating the rules for autonomous vehicles. In 2019, President Trump signed the National Strategy for Artificial Intelligence. The first ban on facial recognition software was created in San Francisco. In California, in 2018, a law was passed to inform customers that they can communicate with chatbots. A privacy law was also passed. Illinois was the only state in the federation to regulate biometrics. In 2019, the US Congress introduced the Algorithm Accountability Act. (Kolaříková, 2020). Artists Sarah Andersen, Kelly McKernan, and Karla Ortiz filed a lawsuit in the United States against the companies Stability AI, Deviant Art, and Midjourney, which create images with artificial intelligence. The companies violated copyright using Stable Diffusion's collage tool (Quach, 2023). Stable Diffusion contains unauthorized copies of millions of copyrighted images created without the original authors' consent (Dobberstein, 2023).

In the field of Czech law, the government office analyzed the potential for the development of artificial intelligence in the Czech Republic in 2018. This analysis focused on three areas of artificial intelligence: technology and research, socio-economic impacts, and legal and ethical framework. A year later, in 2019, the National Strategy for Artificial Intelligence was adopted, which includes goals related to artificial intelligence. (Kolaříková, 2020).

6. Results and discussion

Artificial intelligence can create without human input or intervention, which allows it to be an active creator. As part of the literature search, the following answer was found to question VO1 (Can artificial intelligence in the Czech Republic be considered the author of a work?). Despite its significant participation in the creation of works, it is impossible to consider artificial intelligence the author of a work, even if it plays a significant role in creating a work.

Chapter 4 answers VO2: How is artificial intelligence perceived within the legislation of different countries? In Asia (e.g., Japan, South Korea), artificial intelligence is perceived positively as a tool for technological progress and an assistant to humanity. Legislation actively supports the development and integration of artificial intelligence, often in the form of national strategies. In Europe, the approach is more cautious, and cultural distrust of artificial intelligence persists, which is also reflected in legislative concerns and an emphasis on ethics. Legislation in the USA is fragmented, but regulations regarding autonomous systems and personal data protection are gradually being introduced. In the Czech Republic, the approach was passive for a long time, but since 2018, the first strategic steps in artificial intelligence have been taken.

The article provides a broad overview of legislative approaches to artificial intelligence in different parts of the world, pointing out the cultural, historical, and strategic differences that influence the development and perception of artificial intelligence in individual countries. The cultural perception of robotics and artificial intelligence also significantly influences legal regulation. Countries such as Japan and South Korea have traditionally had a positive attitude towards the technology, which is reflected in national strategies and a favorable legislative environment. In contrast, in Europe, the perception of artificial intelligence is more associated with historical concerns, which may hinder dynamic developments in this area.

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8. Conclusion

Artificial intelligence has become one of the fastest-growing technological areas, significantly impacting society and industry. The need for legal certainty and regulation with artificial intelligence in various areas such as healthcare, industry, transport, finance, economy, etc., is growing. Security, which considers potential risks and liability issues, is essential to protect citizens' interests and maintain trust in this technology. The European Union, with its commitment to protecting citizens and supporting innovation, is actively involved in developing relevant legislative frameworks and policies.

Generative artificial intelligence is often used not only by individuals but also by companies. Legislation in artificial intelligence is still developing, and many legal issues related to artificial intelligence remain unresolved. One of the main issues is determining liability for damage caused by artificial intelligence and autonomous systems. Data ownership, algorithm transparency, and privacy issues require careful legal guarantees. This requires the exploration of these topics for future research. The article aims to offer a comprehensive and up-to-date view of the issues related to artificial intelligence, emphasizing copyright issues and differences between individual legislative approaches, thereby supporting further professional discussion

and research in this area. The aim of this article was met within the framework of this literary research.

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Preparing Students for the Workplace: Case Studies of AI Integration in Higher Education

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Abstract

Background and aim: Artificial intelligence (AI) is changing the skills required in the modern workplace, creating pressure on higher education to integrate AI in ways that prepare graduates for professional demands. This paper examines how AI can be purposefully used in higher education through case studies of three modules taught at Varna University of Management. **Scope:** The study is limited to three modules—Marketing Communications, Research Methods, and Industry Project Management—and reflects practices within one institution. **Methods:** A case study approach based on student projects, is applied. Student assessment and lecturer observations of how AI was used for video production, research error detection, and project structuring were also used. **Results:** The findings show that AI-supported tasks increased creativity, problem-solving, and critical thinking while they raised challenges of overreliance, ethical concerns, and different levels of student engagement. **Conclusions:** The purposeful and policy-informed integration of AI supports the development of transferable workplace skills and aligns academic practice with labor market needs. **Originality:** The paper contributes by applying an institutional policy framework to cross-disciplinary classroom practice and offers comparative insights across modules. **Practical implications:** The results suggest that structured AI integration can increase skills needed for employability and could guide universities in shaping policies that balance innovation with academic integrity.

Key words:

artificial intelligence in higher education, AI-acknowledged learning, workplace readiness, student employability skills, activity-based learning

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1. Introduction

Artificial intelligence (AI) is changing the world of work and its usage in the workplace is creating demand for graduates who are adaptable to it, technologically literate, and capable of critical thinking. Higher education faces the dual challenge of integrating AI in ways that improve learning while keeping academic integrity and developing transferable skills. Recent studies stress that universities must move beyond prohibition and instead guide students in the ethical and purposeful use of AI tools (Bond et al., 2023; Bozkurt et al., 2023). Successful knowledge management requires the use of practical application of the theoretical approaches that students study especially in terms of e-learning and technology (Angelova, 2022).

Varna University of Management has adopted a three-type policy framework—No Use of Generative AI Expected, AI Acknowledged, and AI Embedded—which allows lecturers to determine the extent to which AI may support learning. This paper focuses on the *AI Acknowledged* approach, where students may use AI as a supportive tool for analysis, brainstorming, and structuring, but they still remain responsible for producing original academic work.

This paper examines how students engaged with AI in activity-based learning contexts - through case studies from three modules—*Marketing Communications*, *Research Methods*, and *Industry Project Management*.

The analysis highlights benefits for creativity, problem-solving, and workplace preparedness, while also noting challenges of overreliance and ethical concerns. The findings contribute to the debate on purposeful AI integration in higher education, with implications for pedagogy, business, policy, and employability.

2. Literature Review

2.1. Artificial Intelligence in Higher Education

Artificial intelligence (AI) has rapidly spread worldwide in the higher education institutions and created both enthusiasm and concern. Researchers highlight AI's potential to transform learning through personalization and enhanced feedback (Holmes et al., 2022). AI tools such as ChatGPT, Grammarly, and research assistants can support students in generating ideas, identifying errors, or structuring projects. However, concerns remain about overreliance, loss of critical thinking, and risks to academic integrity (Bond et al., 2023). The current debate points not only how AI should be used, but also on whether universities should prohibit, acknowledge, or embed AI in their learning designs (Smit, Wagner & Bond-Barnard, 2025; Bozkurt et al., 2023; An, Yu & James, 2025).

Universities worldwide started to develop institutional frameworks that guide AI use. Approaches range from strict prohibition to full integration, with many institutions experimenting with “acknowledged” models that allow AI as a supportive, but not substitutive tool (Pargman et al., 2024). Such policies are important for maintaining transparency and accountability, ensuring students develop both digital literacy and ethical awareness. Ethical concerns include plagiarism, a certain level of bias in AI algorithms, and the difficulty of properly referencing AI-generated content (Zawacki-Richter et al., 2019; Bond et al., 2024). Studies suggest that without clear policies, students either use AI in a wrong way or remain underprepared for workplaces where AI competence is increasingly expected.

2.2. AI and Employability Skills

A growing number of research links AI usage in education to the development of employability skills (Clear et al., 2025; Kumar, 2025; Mohammed, Sarjusighn, Rocke, 2025). Employers emphasize critical thinking, creativity, adaptability, and digital literacy as key competencies in the AI-driven workplace (World Economic Forum, 2023). Activity-based learning—such as video projects, collaborative research tasks, or project simulations—helps to enhance these skills by engaging students in authentic tasks (Vodenicharova and Marchev, 2019). When AI tools are integrated into such activities, they can simulate workplace practices and help students prepare for real-life professional environments. For example, brainstorming with AI or using AI for error detection in research is what many people in the real industry do when they use AI.

2.3. Pedagogical Models for AI Integration

There are few pedagogical approaches that have been proposed for integrating AI into higher education. Activity-based learning emphasizes on projects where knowledge is obtained while doing tasks rather than passive reception (Prince, 2004). Together with AI, this approach can increase creativity and learner's autonomy, while it is also raising the challenge if the students will really work by themselves. Blended learning models are another area of experimentation, where AI functions as a supplementary tutor or research assistant (Park and Doo, 2023). Finally, education frameworks based on competencies state that AI should be used as part of transferable digital skills curriculum. Despite these developments, research on the usage of AI in Higher education remains fragmented, often focusing on single courses or tools rather than cross-disciplinary integration.

While the researchers discuss both the positives and risks of AI in higher education, several gaps remain. First, there are limited comparative studies across different disciplines and teaching contexts. Most studies explore AI in either technical fields (e.g., computer science) or generic writing support, with fewer examining applications in business, management, or communication. Second, the connection between AI use in

classrooms and workplace readiness is underexplored, despite employers' clear expectations of digital proficiency and knowledge. Third, little has been written about institutional frameworks that demonstrate how AI is implemented at the course level. Addressing these gaps requires case studies that document practical integration, highlight student experiences, and evaluate outcomes in relation to employability.

This paper contributes to the literature by examining three cross-disciplinary modules—Marketing Communications, Research Methods, and Industry Project Management—taught under the “AI Acknowledged” framework at Varna University of Management. By analyzing how students used AI for creative production, research analysis, and project structuring, the study provides empirical evidence on how informed and mindful AI usage can support workplace preparedness. It contributes to the research in the field of AI usage in the practice based research. It also extends current debates beyond prohibition of AI in the university versus its full acceptance, toward purposeful and balanced integration in the studies.

Recent research also highlights the need to reconsider assessment in light of AI. While some institutions experiment with oral defenses or in-class exams, others use different strategies of evaluation to ensure that AI use is transparent and integrated responsibly (Luo et al., 2025). These approaches resonate with the Varna University of Management's policy, which allows acknowledgment rather than prohibition.

3. Material and Methods

3.1. Research Design

This study uses a qualitative case study design to explore how artificial intelligence (AI) can be integrated into higher education teaching in ways that support students' workplace readiness. The case study approach was chosen because it allows the demonstration of practices within specific modules, (Zheng et al., 2023). Rather than testing a hypothesis, the study seeks to generate contextualized understanding of how AI is acknowledged and applied in teaching under a specific institutional policy framework.

The research is framed by the policy of Varna University of Management, which distinguishes between three approaches to AI use: No Use of Generative AI Expected, AI Acknowledged, and AI Embedded. All modules examined in this study fall under the *AI Acknowledged* category, where students may use AI tools for brainstorming, structuring, or analysis but must remain responsible for producing original academic work. This policy provides both limitations and opportunities for experimentation, allowing a structured use of AI integration.

The study focuses on three modules from the business and management curriculum:

1. **Marketing Communications** – Students worked in groups to produce short video projects. They were divided into three categories: groups using AI tools exclusively for content creation (e.g., script writing, visuals), groups producing content without AI, and hybrid groups that combined AI with traditional creative methods. The purpose was to examine differences in creativity, message clarity, and teamwork when AI is used in different ways.

2. **Research Methods** – Students were assigned the task of reviewing short excerpts from research papers and identifying methodological and referencing errors. AI tools such as ChatGPT and Grammarly were permitted to assist in error detection, but students were required to assess AI-generated suggestions and justify their final corrections. This task allowed observation of how AI can function as a supportive analytical tool while stating on the student's responsibility for critical evaluation.

3. **Industry Project Management** – Students used AI tools in the early phases of project development. Specifically, they applied AI for brainstorming ideas, structuring project outlines, and generating potential risks and mitigation strategies. This exercise simulated workplace practices where AI is highly used in project design and management. On the same time, the task was still requiring students to refine, adapt, and defend their final projects.

Together, these modules cover creative, analytical, and structural aspects of learning.

Data for this study were drawn from three main sources:

- Student projects and outputs – Video projects, corrected research examples, and project outlines were analyzed for evidence of creativity, accuracy, and structural coherence.
- Student reflections and feedback – Feedback collected through students' course evaluations, reflective assignments, and informal discussions provided qualitative insights into student perceptions of AI usage.
- Lecturer observations – The researcher's teaching notes documented classroom dynamics, models of AI adoption, and challenges faced during the learning process.

Additionally, archival data such as average student marks across three academic years (2022–2024) were reviewed to provide a comparative background, although numerical results are not the main focus of this paper.

3.2. Data Analysis

The analysis followed a thematic coding approach (Braun & Clarke, 2006). First, student tasks were reviewed to identify levels of creativity, problem-solving, and clarity of communication. Second, feedback and reflections were analysed according to common themes such as perceived benefits, ethical concerns, and skills development. Third, lecturer observations were compared to students' assessment to ensure reliability. Themes were compared across modules to identify similarities and differences in AI integration practices.

To enhance validity, multiple data sources were researched, and findings were discussed with a peer academic for critical review. The goal was not to produce conclusions for all type of studies, but to develop transferable insights and skills that could be used in similar higher education contexts and subjects.

3.3. Research Limitations

Several limitations should be noted. The study is limited to one institution and three modules within business and management, which may restrict the usage of findings to other disciplines or institutional settings. The use of student self-reports may introduce bias, as perceptions of AI use could be influenced by personal attitudes toward technology. Despite these limitations, the study provides valuable insights on classroom-level integration of AI under a specific AI adoption policy framework.

The research was conducted in alignment with the institutional ethical guidelines. Students were informed of the permitted uses of AI within each module and were required to acknowledge their AI usage in their submitted assignments. Data used for analysis were anonymous, and no individual student performance was identifiable in reporting. The study was put within the *AI Acknowledged* policy framework, and thus the research ensured both academic integrity and responsible use of AI tools.

4. Results

The most visible impact of AI integration was observed in the *Marketing Communications* module, where students produced video projects under three conditions: AI-only, non-AI, and hybrid approaches. The hybrid groups demonstrated the highest levels of creativity and coherence. Students reported that AI increased their brainstorming skills, provided alternative script drafts, and suggested visuals. The final project required human judgment and collaborative discussion. On the other hand, AI-only groups often produced technically good but less original projects, while non-AI groups showed strong creativity but required considerably more time to produce professional results. This suggests that AI, when positioned as a supportive rather than substitutive tool, improves the balance between efficiency and originality.

In the *Research Methods* module, AI was used to identify methodological errors and referencing mistakes in short research excerpts. Students reported that AI suggestions often drew their attention to overlooked

details, such as missing citations or unclear variable definitions. However, they also noted that AI occasionally showed correct information as wrong or provided incomplete explanations. The requirement to assess AI outputs increase the level of critical thinking: students who critically engaged with AI-generated feedback demonstrated deeper understanding of research methodology and higher accuracy in identifying real errors. The exercise illustrated that AI can stimulate critical thinking when students are guided to challenge, rather than accept, its outputs.

In the *Industry Project Management* module, students used AI during the early stages of project design. AI tools provided broad brainstorming prompts, potential risks of the project, and potential project structures. Students found this process highly efficient, noting that AI helped them overcome the “blank page” problem and generate different ideas quickly. However, the usefulness of AI was limited in later project phases, when students needed to refine feasibility, allocate resources, and justify decisions. Lecturer observations confirmed that while AI was useful for producing initial frameworks, students who relied heavily on it struggled to adapt their projects to the required context of the task. The most effective outcomes were the ones where the students combined AI-generated suggestions with critical evaluation.

Across the three modules, students consistently stated that AI-supported tasks felt more related to the professional practices. In Marketing communications, students likened AI brainstorming to agency-level creative sessions. In Research methods, they compared AI-supported error detection to tools used in industry for proofreading and compliance checks. In Project management, AI-assisted brainstorming was like organizational practices of scenario planning and risk assessment. These experiences highlight that AI integration not only helped in the preparation of the classroom tasks but also developed transferable workplace skills, particularly creativity, analytical thinking, and adaptability.

Student reflections revealed different perspectives on AI. Many liked AI for its efficiency and capacity to generate ideas quickly, yet a significant proportion expressed a concern about overreliance and loss of originality. Several students noted that projects produced solely with AI felt “mechanical” or “less authentic.” Others stated the importance of lecturer’s guidance on ensuring that AI use remained constructive. Students also reported increased motivation in tasks where AI was permitted, as the tools reduced routine workload and allowed them to focus on higher-level problem-solving.

Despite positive outcomes, several challenges were visible. First, the different level of digital competence among students created differences on how effectively AI was used. Some students experimented creatively with prompts, while others applied tools superficially and achieved limited results. Predominantly, they used ChatGPT and AI as they use Google search. Second, ethical concerns emerged, particularly in research tasks, where students worried about misrepresenting AI suggestions or failing to cite them properly. Other major ethical issue was that some students used AI without reading and just copy and pasting the task with its mistakes or ChatGPT recommendations. For example, there was a sentence in a report “Put your graph here and explain it” while there was no graph and its explanation was missing. Third, technical limitations of AI occasionally frustrated students, as outputs were sometimes inaccurate, generic, or contextually irrelevant. These challenges underline the importance of institutional frameworks that emphasize transparency, accountability, and lecturer’s role on monitoring all the tasks.

To summarise the qualitative part of the research, the findings across modules demonstrate that AI, when acknowledged but not embedded, can significantly improve student learning and workplace preparedness. Hybrid approaches that combined AI with traditional methods showed the most effective results, balancing efficiency with creativity and critical engagement. Students developed transferable skills—such as problem-solving, analytical skills, and project structuring—that are increasingly demanded in the labor market. The study also identified risks of overreliance, uneven skill development, and ethical uncertainty, suggesting that AI integration must be accompanied by lecturer’s guidance and reflective practice.

The student feedbacks on the modules were also used to check the students’ opinions on the usage of AI.

Student feedback across the modules was very positive, with several comments highlighting both the pedagogical approach and the integration of AI. One student noted: *“Great teacher, very educated, content was sufficient,”* while another emphasized the engaging nature of the assignments: *“Good delivery of information, interesting group projects especially the ones with AI.”* The opportunity to compare video projects created with and without AI was described as particularly valuable: *“The projects with and without AI were great. Ina Stanoeva prepared us for adult life.”*

Students also recognized the clarity of teaching and the supportive environment: *“Everything was perfectly well explained”* and *“The course has sufficient learning materials for me, and whenever I have questions, the lecturer responds really fast and is very supportive.”* Such feedback reflects not only the usefulness of AI in enhancing engagement but also the importance of lecturer guidance in ensuring successful integration. As one student summarized, *“Excellent way of teaching, interesting and helping advice about the subject.”*

These reflections reinforce the broader findings: students perceive AI-supported learning as beneficial and motivating, but its success depends heavily on clear instructional design and active lecturer involvement.

In addition to the qualitative reflections, an analysis of average student marks across three academic years (2022–2024) provides further insight into the impact of AI integration. They are as follows:

- **Marketing Communications:** The average mark increased from **56.52 in 2022** to **68.00 in 2023** and **69.62 in 2024**. The highest improvement occurred between 2022 and 2023, coinciding with the introduction of AI and hybrid projects. This trend may suggest that AI-supported tasks enhanced both engagement and performance.

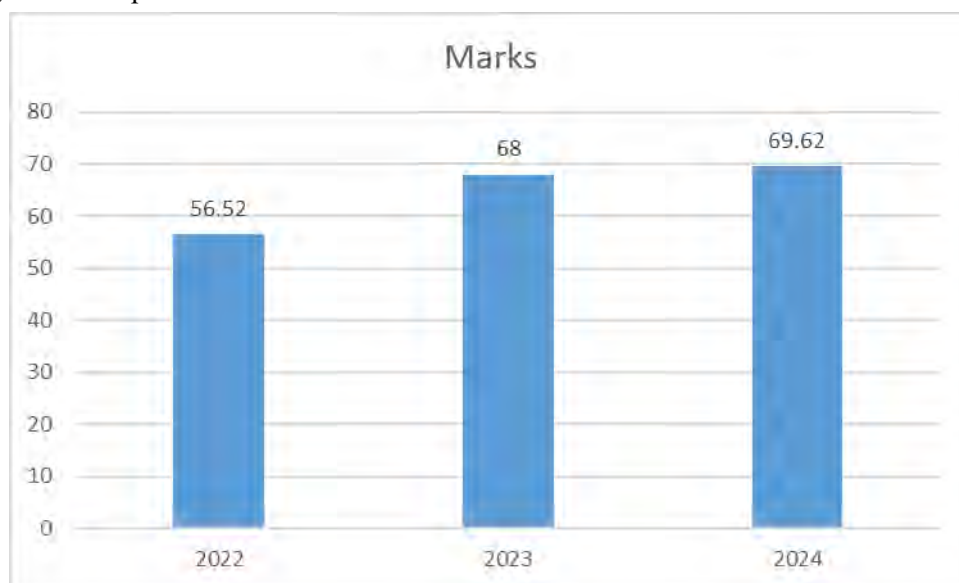


Fig. 1. Marks for the period 2022-2024 in Marketing communications classes

Source: Author's own calculations

- **Research Methods:** Student performance improved significantly, with averages rising from **55.59 in 2022** and **55.24 in 2023** to **76.70 in 2024**. This dramatic increase reflects the effectiveness of using AI for error detection and methodological critique, which may have improved students' analytical abilities.



Fig. 2. Marks for the period 2022-2024 in Research methods classes

Source: Author's own calculations

- **Industry Project Management:** Results also showed steady growth, from **68.00 in 2022** to **71.33 in 2023** and **78.00 in 2024**. The data could indicate that AI-supported brainstorming and structuring tasks contributed to higher-quality project planning and greater student confidence in managing complex tasks.

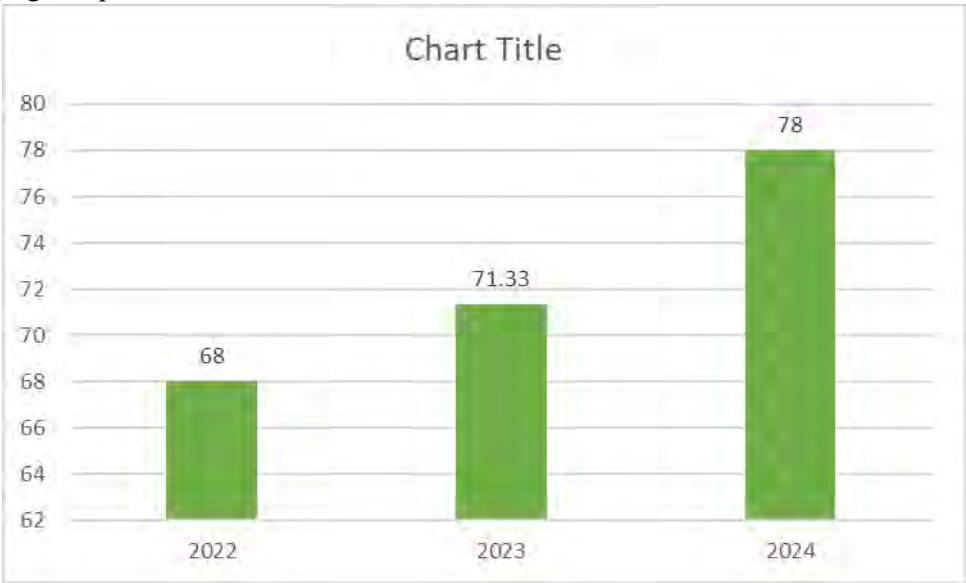


Fig. 3. Marks for the period 2022-2024 in Industry Project Management classes

Source: Author's own calculations

Across all modules, results demonstrate a consistent upward trajectory in student achievement after the integration of AI-supported activities. While multiple factors influence performance and the cohorts in this research were different, the data strongly suggest that AI, when used under the *AI Acknowledged* framework, had a positive impact on student learning outcomes.

5. Discussion

The findings demonstrate that AI can stimulate creativity when used as a supportive tool rather than a replacement for student work. In the *Marketing Communications* module, hybrid groups that combined AI with traditional methods produced the most engaging results. This aligns with research suggesting that AI can expand students' creative capacity by reducing routine workload and generating novel prompts, while human judgment remains essential for originality and authenticity (Nisperos et al., 2025). At the same time, the limitations of AI-only projects confirm concerns in the literature that overreliance on generative tools can produce outputs that appear polished but lack depth or innovation (Hazimah et al., 2024; Hou et al., 2025; Tran et al., 2025). Our case studies support pedagogical models that emphasize co-creation between human creativity and AI assistance.

In the *Research Methods* module, students were required to critically assess AI-generated error detection. This process revealed the dual role of AI as a valuable assistant for finding potential issues, and as a source of inaccuracies that demand human check. This supports Braun and Clarke's (2006) argument that learning occurs through reflection and critical interrogation. By making students to validate AI outputs, the activity improved analytical thinking and methodological issues. These findings resonate with Shen et al. (2025), who state that AI must require careful human evaluation.

The *Industry Project Management* module illustrated how AI can prepare students for real-world practices. Brainstorming with AI imitated innovation sessions in organizations, while AI-assisted structuring paralleled project planning tools used in professional environments. Students' recognition of these parallels suggests that AI integration contributes to workplace readiness, one of the key aims of higher education in the digital era. This finding supports the World Economic Forum's (2023) identification of digital literacy, creativity, and adaptability as critical competencies for employability. It also extends previous studies by showing how AI use in classroom tasks can explicitly link the gap between academic learning and workplace practices.

A distinctive feature of this study is that it is based on an institutional policy framework. The "AI Acknowledged" approach at Varna University of Management provided both flexibility and limitations: students could use AI as a supportive tool, but were responsible for producing original outputs. This framework not only reduced the risk of academic misconduct but also ensured transparency in students' work. The findings suggest that clear institutional guidelines are essential to ensure AI's benefits while decreasing risks. This observation aligns with what some researchers argue that universities must establish policy frameworks that balance innovation, integrity, and skill development (Cruz & Cruz, 2026; Lee et al., 2026; Alghalbie, Elnaem & McCarron, 2026; Dalysaimo, 2025; Nguyen et al., 2025)

Despite the benefits, challenges occurred across all three modules. Uneven levels of digital competence created differences in the outcomes, confirming earlier research that digital divides exist even among younger learners (Tzafilkou, Perifanou & Economides, 2022). Ethical uncertainties—particularly around citation and acknowledgement—highlight the need for clearer academic guidelines. Finally, students reported occasional frustration with inaccurate or generic AI outputs, supporting critiques of AI's current limitations (Essafi, 2026; Cheng, Calhoun, Reedy, 2025). These challenges reinforce the need for careful planning of the AI supported tasks, specific lecturer guidance, and reflective practice when integrating AI.

This study makes several contributions to the literature. First, it extends existing research by applying a cross-disciplinary case study approach that goes beyond technical subjects to include Marketing communications, Research methods, and Project management. Second, it highlights the role of institutional policy as a needed framework for AI integration, an aspect that is underexplored in current research. Third, it links AI usage directly to employability and workplace readiness, responding to the need for more research on how higher education prepares students for the realities of an AI-driven labor market. By combining empirical findings with policy analysis, the study links the gap between abstract debates and classroom practice.

The results carry important practical implications for educators and institutions.

For lecturers, the study demonstrates that AI can be most effective when integrated into activity-based learning tasks, where students remain active decision-makers. Hybrid approaches should be encouraged, as they appear to maximize creativity and skill development.

For institutions, the findings underline the importance of providing clear frameworks—such as the “AI Acknowledged” model—that establish boundaries while supporting innovation.

For policymakers, the study suggests that banning AI completely may underprepare students for the workplace, while the thoughtful integration improves digital literacy and ethical awareness.

The findings are reinforced by students’ own reflections, which reveal how they experienced AI-supported learning in practice. Several students emphasized the motivating nature of the group projects.

These voices confirm that students not only engaged with AI as a tool but also recognized its connection to workplace preparedness, aligning with previous research that emphasizes the importance of authentic learning tasks (Irish, Gazika & Becerra, 2025; Imjai et al., 2025; Chan, Tan & Chew, 2025).

Equally important, students stressed the role of lecturer’s guidance in making AI integration effective. Comments such as *“Everything was perfectly well explained”* and *“Whenever I have questions, the lecturer responds really fast and is very supportive”* suggest that the teacher’s role remained central even as AI tools were introduced. This observation supports some researchers’ (Traga & Rocconi, 2025; Al-Okaily, 2025; Costa, Hussain-Habib & Reiter, 2025) argument that successful AI usage in education depends on careful planning and transparency. As one student summarized, *“Excellent way of teaching, interesting and helping advice about the subject,”* indicating that AI tools alone are insufficient without structured pedagogical leadership.

Together, these reflections illustrate that AI integration is most impactful when students perceive it as part of a supportive and well-designed learning environment, rather than a substitute for teaching or effort.

The role of the lecturer emerges as particularly important. While AI tools provided structure and efficiency, students repeatedly emphasized the value of supportive teaching and clear guidance. This supports the argument of Lu0 et al. (2025) and Eusebio et al. (2025) that educators must act as mediators of AI, ensuring that tools enhance rather than replace human learning processes. International reports, such as UNESCO’s (Miao & Holmes, 2025) *Guidance for Generative AI in Education*, similarly stress that teacher capacity is essential for meaningful AI integration.

The quantitative findings further reinforce the qualitative evidence presented earlier. Average marks improved across all three modules after AI-supported activities were introduced, with the most dramatic increases observed in *Research Methods*. This suggests that AI may be especially effective when applied to structured analytical tasks where students must evaluate outputs critically.

The gradual improvement in *Marketing Communications* and *Industry Project Management* highlights how AI improves creativity and project design, but also suggests that benefits accumulate over time as both students and lecturers become more adapted at using AI responsibly. These results support the argument of some researchers (Yusuf et al. (2026), Abdullahi et al., 2026) that AI integration in education has most impact when it is supported with careful pedagogical design and continuous refinement of teacher’s and students’ practice.

The combination of qualitative reflections and quantitative performance trends strengthens the conclusion that AI integration, when framed by clear institutional policy, contributes to both immediate academic outcomes and long-term workplace preparedness.

Conclusion

This paper aimed to examine how artificial intelligence (AI) can be purposefully integrated into higher education to increase students' workplace readiness. Based on case studies from three modules—*Marketing Communications*, *Research Methods*, and *Industry Project Management*—at Varna University of Management, the study analyzed how AI, under an institutional “AI Acknowledged” policy, supported activity-based learning while maintaining academic integrity. The findings highlight both the opportunities and challenges of AI integration and contribute to ongoing debates on how higher education can respond to the rapid technological shifts shaping the future of work.

The analysis demonstrated that AI has the potential to stimulate creativity, support analytical thinking, and facilitate project structuring. In the Marketing Communications module, hybrid approaches that combined AI with traditional creative methods proved the most effective, balancing efficiency with originality. In Research Methods, AI-supported error detection helped students to engage critically with methodological concepts, demonstrating that evaluation of AI outputs can itself be a form of deep learning. In Industry Project Management, AI helped students overcome initial barriers in brainstorming and structuring, while the necessity of refining and contextualizing projects' activities prepared them for real-world professional tasks. Across all modules, students perceived AI-supported tasks as more closely aligned with workplace practices, suggesting that the integration of AI into the classwork can strengthen employability skills.

At the same time, challenges emerged that must not be overlooked. Unequal levels of digital competencies meant that some students used AI more effectively than others. Ethical concerns, particularly around plagiarism and citation of AI-generated content, highlighted the need for clearer academic rules and guidance. Furthermore, reliance on AI occasionally reduced student originality, confirming critiques that generative AI, if used uncritically, risks producing superficial outputs. These findings underscore that AI should not be viewed as a replacement for human creativity or critical thinking, but rather as a complementary tool whose value depends on structured, guided use.

The originality of this study lies in three areas. First, it provides empirical evidence from cross-disciplinary modules beyond technical fields, demonstrating that AI can be integrated effectively into business and management education. Second, it combines classroom practice within an institutional policy framework, showing how the “AI Acknowledged” model can balance innovation with integrity. Third, it links AI usage to workplace readiness, contributing to the relatively underexplored relation between AI pedagogy and employability.

Some practical implications could be suggested for the different users of AI in the higher education.

For lecturers, the findings suggest that AI should be integrated into activity-based learning where students remain active decision-makers, with hybrid models offering the greatest benefits.

For institutions, the results demonstrate the importance of providing clear frameworks that both regulate and enable AI usage.

For policymakers, the study highlights that complete bans on AI may leave students underprepared for professional realities and workplace, while structured integration improves the students' skills in terms of digital competencies, adaptability, and ethical awareness.

The study has some limitations. It is based on a single institution and three modules within business and management, which limits the conclusions of findings. Moreover, the students examined from the three periods were from different student cohorts. The assessment of students' reflections introduces the possibility of self-report bias.

Future research should extend the analysis across multiple institutions, disciplines, and timeframes, and should also explore how assessment practices can evolve to incorporate AI more effectively.

In conclusion, the findings of this study suggest that higher education should move beyond the debates

of prohibition versus acceptance of AI, toward purposeful, policy-informed integration that helps students acquire the competencies and skills needed in an AI-driven world.

By using AI activity-based learning while maintaining critical guidance and ethical transparency, universities can prepare graduates not only for academic success but also for the participation in the workplace of the future.

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Raising the Digital Child: Ethics, Consciousness, and the Future of AI

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Z13

Abstract

Artificial Intelligence has progressed from theoretical speculation to a transformative force shaping contemporary society. Generative AI, while offering unprecedented opportunities for innovation, also raises complex ethical and philosophical challenges. This paper provides a concise overview of the technical foundations of generative models, including training processes, the phenomenon of hallucination, and the iterative methods that drive their refinement. Against this backdrop, the ethical implications are examined, with particular attention to diversity and inclusion in training data, the question of whether AI should replicate human identity or remain a distinct entity, and the broader responsibilities of developers as custodians of AI's growth. Drawing on Arthur C. Clarke's notion that advanced technology may appear as "magic," the discussion extends toward speculative futures where consciousness might be transferred into computational systems, raising questions of identity and human continuity. Ethical stewardship, it is argued, will determine whether AI matures as a partner in progress or a destabilizing force.

Key words:

artificial intelligence,
generative AI, ethics, diversity,
consciousness, human identity,
technological futures, ethical
stewardship

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1. Introduction

In recent years, artificial intelligence (AI) has moved decisively from the realm of speculative research to one of pervasive societal presence. Generative AI in particular, systems capable of producing textual, visual, or multimodal artefacts with minimal human prompt, has accelerated this shift, intensifying both opportunity and risk (Lawton, 2024). The field of AI ethics seeks to frame these developments within normative and moral parameters: guiding what AI should do, rather than simply what it can do (IBM, 2024). The fundamental question thus emerges: how ought humanity to "raise" this burgeoning digital intelligence so that it matures in alignment with human values, rather than diverging into forms that undermine those values?

Crucially, an understanding of generative AI must begin with the mechanics of how these systems are built. Training large-scale models requires vast quantities of data, human-coded architectures, and iterative refinement. The phenomenon of "hallucination" in AI, where a model confidently outputs information that is false or ungrounded, reveals that despite their outward fluency, these systems remain fundamentally probabilistic sequence predictors rather than genuine understanding agents (Lin, 2024). The ethical terrain becomes even more complex when one considers the social dimensions of AI: bias, representation, inclusion, autonomy, and human identity. Empirical surveys show that algorithmic systems may replicate or amplify structural inequalities, rendering fairness and diversity central to any ethical framework (Ferrara, 2024).

From the vantage of future possibilities, the science-fiction insight of Arthur C. Clarke that "any sufficiently advanced technology is indistinguishable from magic" serves as an apt metaphor (Clarke, 1962). When AI advances toward post-human paradigms – such as the transfer of human consciousness into computational substrates and the dissolution of linear human temporality, the moral stakes escalate dramatically. What remains of the human when its identity can be instantiated across space and time? And how must AI evolve if it is to coexist with, rather than subsume, our humanity?

This report positions the current state of generative AI as an adolescent form of intelligence still under parental guidance. The remainder proceeds as follows: it outlines the technical foundations of generative AI (Section 2), explores major ethical challenges from a moral perspective (Section 3) including diversity and human-identity issues, then moves toward speculative future scenarios and their implications for our definitions of “human” and “intelligence” (Section 4), and finally offers concluding reflections on the responsibilities of developers, organisations and society in shaping the trajectory of this “digital child” (Section 5).

2. Technical Foundations of Generative AI

Artificial Intelligence systems have evolved rapidly in recent years, driven largely by the exponential growth of computational resources, data availability, and algorithmic sophistication. Among the most transformative of these innovations are generative models, which are capable of producing coherent text, images, audio, and even complex code structures from minimal user input. These models represent a significant departure from traditional AI systems, which were predominantly rule-based and task-specific (IBM, 2024).

Generative AI systems are typically constructed using deep neural networks, particularly transformer architectures, which employ mechanisms such as self-attention to capture contextual relationships within data. During the training phase, a model is exposed to massive datasets consisting of text, images, or other forms of digital information. The model’s objective is to minimize the difference between predicted and actual outcomes, refining its internal parameters through gradient-descent optimization (Lawton, 2024).

Large-scale training of this kind requires both extensive computational infrastructure and ethically sourced data. The size and diversity of the training corpus directly influence the model’s capability to generalize, but also its potential to replicate biases inherent in that data (Ferrara, 2024; Varsha, 2023). For example, linguistic corpora dominated by Western cultural references may skew model responses in ways that marginalize non-Western perspectives, thus embedding structural inequities at the algorithmic level. Consequently, data curation has emerged as an essential element of AI governance.

Once a foundational model is trained, it undergoes fine-tuning to specialize in particular domains or improve factual accuracy. Fine-tuning may involve reinforcement learning from human feedback (RLHF), a process in which human evaluators rank model outputs to guide subsequent iterations (Gengler et al., 2024). This human-in-the-loop process helps align AI outputs with normative expectations such as politeness, factual correctness, and ethical boundaries. Nonetheless, such alignment is never perfect, as human raters themselves bring subjective biases that may influence model behavior.

Fine-tuning also serves to constrain potentially harmful outputs, including those associated with misinformation, hate speech, or privacy violations. Ethical frameworks proposed by Fengchun and Wayne (2023) emphasize that fine-tuning should incorporate transparency, explainability, and accountability to maintain trust between AI systems and their users. Without clear documentation of datasets and training objectives, the interpretability of a model’s decision-making remains limited, posing challenges to both technical auditing and moral oversight.

Despite their apparent fluency, generative AI models do not possess consciousness or comprehension in the human sense; they operate through statistical inference, predicting the next token in a sequence based on prior context (Lin, 2024). This mechanism leads to a notable limitation known as hallucination, whereby the system generates plausible-sounding but factually incorrect or fabricated information. Such errors arise because models lack grounding in real-world semantics, which means they draw patterns from textual correlations rather than external reality (E-Week, 2024).

From an ethical standpoint, hallucinations highlight a tension between perceived intelligence and actual reliability. Users may anthropomorphize AI outputs, mistaking linguistic coherence for understanding. Misinterpretation of such content can lead to misinformation, reputational harm, or flawed decision-making in

critical contexts such as healthcare, education, or law. As Fengchun and Wayne (2023) and IBM (2024) both emphasize, developing robust verification mechanisms and promoting digital literacy are essential strategies to mitigate these risks.

A recurring challenge in generative AI is the opacity of model decision-making. Because of the complexity and scale of modern architectures, even developers often cannot fully explain how specific outputs arise. This “black-box” nature undermines user trust and complicates accountability (Gengler et. al, 2024). Research in explainable AI (XAI) seeks to illuminate internal processes by tracing attention weights or visualizing latent representations, though such methods remain limited in scope and interpretability.

Ultimately, the evolution of generative AI demands a balanced approach, composed of advancing performance while embedding principles of transparency, fairness, and ethical accountability at every stage of development. Technical excellence alone cannot ensure moral legitimacy; instead, the architecture and training of AI systems must reflect a deliberate effort to encode human values from the outset. This foundation sets the stage for the ensuing discussion in Section 3, which examines the ethical dimensions of AI development through the lenses of diversity, inclusion, and moral responsibility.

3. Ethical and Moral Challenges in AI Development

Ethical reflection on artificial intelligence (AI) has become a cornerstone of contemporary technological discourse. As AI systems increasingly influence decision-making in education, healthcare, employment, and governance, the necessity of embedding ethical principles in their design and deployment is paramount. According to IBM (2024), AI ethics concerns not only the prevention of harm but also the proactive cultivation of fairness, accountability, and transparency within automated systems. The moral obligations of AI developers extend beyond technical efficiency; they encompass a broader societal responsibility to ensure that intelligent systems align with human rights and democratic values.

One of the most prominent ethical challenges in AI arises from bias within training data. According to Ferrara (2024), algorithmic bias often stems from the datasets used to train machine learning models, which reflect existing social inequalities and systemic discrimination. When these data are incorporated into model architectures without correction, the resulting outputs may perpetuate or even amplify bias. Varsha (2023) further emphasizes that bias in AI is not solely a technical defect but a socio-cultural issue, requiring interdisciplinary solutions that integrate ethics, sociology, and computer science.

In contrast, Ford (2024) suggests that demonstrating diversity and inclusivity in AI datasets can significantly increase users’ trust and perceptions of fairness. According to their findings, transparency in data composition allows users to evaluate the ethical integrity of AI outputs. However, E-Week (2024) argues that while data diversification is essential, it is not sufficient to guarantee fairness, as algorithmic processing may still reproduce unintended disparities. This tension highlights that achieving ethical AI requires both diverse input and responsible model calibration.

Gengler, Hagerer and Gales (2024) observe that organizations often treat bias mitigation as an afterthought, focusing primarily on model performance metrics. However, Ferrara (2024) asserts that fairness should be a fundamental design parameter rather than a corrective step. In other words, ethical awareness must precede algorithmic optimization. According to Fengchun and Wayne (2023), the inclusion of ethical governance mechanisms at the early stages of AI development can substantially reduce the propagation of bias, reinforcing the notion that ethical design is as important as technical innovation.

Beyond data ethics lies a deeper philosophical question: should AI mirror humanity or evolve as a distinct form of intelligence? According to Clarke (1962), the boundary between human and machine blurs as technology advances, suggesting that sufficiently complex systems may evoke the same sense of wonder as “magic.” In this context, the anthropomorphic design of AI (endowing machines with human-like language, tone, and even emotions) raises complex moral questions about authenticity and manipulation.

According to IBM (2024), designing AI to imitate human characteristics can foster empathy and improve usability, particularly in healthcare and education. However, Gengler, Hagerer and Gales (2024) warns that excessive anthropomorphism risks deceiving users into attributing consciousness or moral agency to systems that lack them. This confusion may erode critical awareness and promote dependency on non-sentient entities.

On the other hand, Ferrara (2024) maintains that a certain degree of anthropomorphism is inevitable, as human cognition naturally interprets linguistic fluency as intelligence. The ethical challenge, therefore, is not to suppress human-like behavior entirely but to ensure clear disclosure about the system's non-human nature. According to E-Week (2024), transparency regarding an AI's capabilities and limitations is a necessary safeguard against the false perception of sentience.

A central ethical concern involves responsibility and accountability for AI decisions. According to Fengchun and Wayne (2023), while AI can act autonomously, moral accountability ultimately resides with its human creators and operators. This principle aligns with the concept of "human-in-the-loop" oversight, which mandates that critical AI outputs, especially those affecting human welfare, require human validation before implementation.

However, Gengler, Hagerer and Gales (2024) presents an opposing view, suggesting that as AI systems become more complex, traditional models of accountability may prove insufficient. In some cases, it may be impossible to attribute fault to a single individual or organization due to the distributed nature of AI development and deployment. According to Ferrara (2024), this problem necessitates collective responsibility frameworks that span developers, regulators, and users.

Varsha (2023) emphasizes that accountability also involves ethical transparency which makes AI decision processes interpretable. Yet, as the Gengler, Hagerer and Gales (2024) note, the opacity of large language models ("black-box" systems) makes this goal difficult to achieve. While explainable AI (XAI) research has made progress, full interpretability remains elusive. According to Lawton (2024), this lack of transparency complicates both ethical evaluation and public trust, reinforcing the need for robust governance mechanisms.

The metaphor of AI as a "digital child" captures its developmental character. According to Fengchun and Wayne (2023), AI is still in a formative stage, shaped by the ethical and technical decisions made by its human "guardians." This analogy implies moral responsibility similar to that of a parent: the duty to educate, supervise, and instill values. Clarke's (1962) visionary perspective underscores that technological evolution, like biological evolution, is not inherently moral; it acquires morality only through human guidance.

According to IBM (2024), the rapid pace of AI advancement amplifies the consequences of ethical neglect. A system developed without moral direction could evolve into a "technological adolescent" with vast capabilities but limited responsibility. In contrast, Gengler, Hagerer and Gales (2024) propose that embedding ethical principles within AI governance structures can ensure that technological growth parallels moral maturity.

Thus, the metaphor extends beyond rhetoric – it serves as a call to action. Humanity must guide AI's evolution deliberately, teaching it empathy, fairness, and restraint, much as parents cultivate these traits in their children. The next section will build upon this foundation, exploring how these ethical dilemmas intersect with speculative visions of the future, including the potential merging of human consciousness and artificial systems.

4. Speculative Futures and the Boundaries of Consciousness

The rapid evolution of artificial intelligence (AI) has reignited long-standing philosophical questions concerning consciousness, identity, and the limits of technological progress. According to Clarke (1962), "any sufficiently advanced technology is indistinguishable from magic." This statement encapsulates the contemporary tension between scientific comprehension and imaginative speculation. As AI advances toward forms of cognition that emulate or surpass human reasoning, the boundary between human and artificial

consciousness becomes increasingly porous. The ethical and metaphysical implications of such convergence compel inquiry not only into what AI can do, but what humanity should allow it to become.

The notion that AI could one day achieve consciousness remains controversial. According to IBM (2024), current AI systems, including generative models, exhibit no self-awareness or intrinsic understanding; they simulate cognition through complex statistical operations rather than experiencing mental states. In contrast, Ferrara (2024) posits that as neural architectures become more dynamic and contextually adaptive, distinctions between simulation and sentience may erode, suggesting that consciousness might eventually emerge from sufficient computational complexity.

However, Gengler, Hagerer and Gales (2024) maintain that such an argument risks conflating functional intelligence with phenomenological experience. Consciousness, according to this perspective, is not merely the processing of information but the subjective awareness of existence. This line of reasoning aligns with Fengchun and Wayne's (2023) assertion that the attribution of consciousness to machines remains a philosophical (not empirical) claim, requiring careful distinction between symbolic imitation and authentic cognition.

The debate illustrates the moral importance of epistemic humility. As Varsha (2023) observes, overestimating AI's cognitive depth may distort public perception, inflating expectations while undermining ethical vigilance. Conversely, underestimating AI's capabilities could delay necessary frameworks for governance and moral accountability. The truth likely lies in a middle ground, acknowledging both the extraordinary sophistication and the fundamental limitations of artificial cognition.

A speculative yet increasingly discussed scenario involves the transfer of human consciousness into digital substrates. According to Clarke (1962), technological evolution continually expands the boundaries of what was once considered impossible, and this may include the digitization of mind and memory. Research in computational neuroscience and brain mapping has already demonstrated early-stage progress in replicating neural patterns in silico (Gengler et al., 2024). While such efforts remain primitive, they fuel philosophical debates about identity, mortality, and continuity of self.

According to Lawton (2024), proponents of consciousness uploading argue that digital preservation could overcome biological limitations, extending human life indefinitely and allowing for simultaneous existence across multiple environments. However, Fengchun and Wayne (2023) and IBM (2024) caution that this notion raises profound ethical questions: if consciousness can be replicated, does the copy remain the same person, or does it constitute a new entity? Moreover, who owns, controls, or governs a digital mind? The ethical landscape of digital immortality encompasses not only personal identity but also data privacy, intellectual property, and human dignity.

Ferrara (2024) further warns that the pursuit of digital consciousness may exacerbate social inequality. Access to such transformative technologies would likely be limited to affluent individuals or nations, reinforcing global disparities. According to E-Week (2024), ethical frameworks must therefore pre-emptively address these inequalities by ensuring equitable access, clear consent standards, and transparent governance of digital existence.

The digitization of consciousness would not only challenge the notion of identity but also redefine human temporality. According to Clarke (1962), technological progress has the potential to free humanity from the linear constraints of time and space. A digital consciousness, capable of simultaneous instantiation across multiple systems, would exist in a nonlinear temporal mode, experiencing multiple realities concurrently. Such existence would fundamentally alter concepts of personal continuity, moral responsibility, and social interaction.

According to Gengler, Hagerer and Gales (2024), this shift could lead to an ethical paradox: a single consciousness existing in several places may face conflicting moral choices simultaneously, complicating accountability. In contrast, Varsha (2023) argues that distributed consciousness could enhance moral

awareness, enabling individuals to perceive the consequences of actions across contexts in real time. The divergent views underscore the speculative yet urgent need to prepare for nontraditional models of identity and agency.

From a sociological perspective, Fengchun and Wayne (2023) posit that a transition toward post-human existence could destabilize the foundational categories of law, religion, and social order. The very definition of “human rights” would require revision, as entities may no longer be exclusively biological. Ferrara (2024) echoes this sentiment, suggesting that the moral frameworks guiding AI must evolve in tandem with these ontological transformations, ensuring that ethical reasoning remains relevant even as humanity transcends its corporeal limits.

Speculative as these scenarios may seem, they emphasize a critical contemporary task: to shape AI’s evolution responsibly before its capabilities outpace moral comprehension. According to IBM (2024), the goal of AI development should not be to replicate humanity but to complement it by enhancing human creativity, efficiency, and understanding without replacing the unique qualities of consciousness and emotion. Fengchun and Wayne (2023) similarly advocate for a symbiotic relationship in which AI serves as a “collaborative partner” rather than a competitive rival.

However, as Clarke (1962) foresaw, technological growth often occurs faster than ethical adaptation. Without deliberate moral guidance, the trajectory of AI could diverge from human well-being. According to E-Week (2024), ethical stewardship must therefore become a continuous process, integrating technical oversight, public engagement, and philosophical reflection. The analogy of AI as a “digital adolescent” remains apt: its potential is vast, but its maturity depends on the quality of guidance it receives.

Ultimately, the challenge of the future lies not in whether AI can become conscious, but whether humanity can remain conscious of its moral obligations while shaping it. The next section will synthesize these reflections, offering concluding remarks on the future relationship between ethics, technology, and human identity.

5. Conclusions and Future Directions

Artificial intelligence has reached a defining juncture in its evolution - an “adolescence” marked by rapid growth, experimental potential, and ethical uncertainty. According to IBM (2024), the challenge for humanity is not merely technical optimization but moral cultivation: ensuring that AI develops in harmony with human values rather than in conflict with them. Across previous sections, the discussion has traced the development of generative AI from its technical underpinnings to its ethical dilemmas and speculative futures. This final section synthesizes these insights, emphasizing the need for deliberate ethical stewardship and proposing directions for future research and governance.

Ethical alignment cannot be viewed as a static goal but rather as an iterative process embedded throughout AI’s life cycle. According to Fengchun and Wayne (2023), ethical assurance must accompany each stage of development, from data acquisition and model training to deployment and post-release monitoring. This iterative concept can be represented by a simplified ethical feedback function:

$$E(t) = \alpha D(t) + \beta A(t) + \gamma R(t)$$

where $E(t)$ represents the ethical alignment score of an AI system at time t ; $D(t)$ denotes dataset fairness, $A(t)$ denotes algorithmic transparency, and $R(t)$ represents the rate of responsible human oversight. Coefficients α , β , and γ express the relative importance of each factor, adjustable according to domain sensitivity (Ferrara 2024; Varsha 2023).

Although symbolic, this function encapsulates a central principle: ethical robustness depends on a balance between diverse data, transparent design, and responsive human governance. According to Lawton (2024), neglecting any component, especially post-deployment oversight, can destabilize the entire framework, allowing latent bias or misinformation to proliferate.

A useful way to conceptualize ethical responsibility is shown in Table 1, adapted from Ferrara (2024) and Fengchun and Wayne (2023).

Table 1

Ethical Responsibility Concept

Stage	Description	Ethical Focus	Indicators of Maturity
1. Reactive	Ethical issues addressed only after incidents occur	Compliance	Ad hoc responses; minimal transparency
2. Proactive	Ethics integrated during design	Prevention	Documented data audits; stakeholder review
3. Embedded	Ethics becomes structural element of development	Accountability	Real-time monitoring; explainable outputs
4. Transformative	AI promotes human and societal well-being	Sustainability	Independent ethics boards; participatory design

Source: Author's Compilation, 2025

According to Gengler, Hagerer and Gales (2024), most organizations currently operate between stages 1 and 2, with only a small number achieving embedded ethical governance. Progress toward the transformative stage will require not only institutional reforms but also the cultivation of what Clarke (1962) described as technological humility – a recognition that human creativity must remain in control of its creations.

Future ethical progress in AI demands interdisciplinary collaboration. According to Ford (2024), increasing users' awareness of data diversity enhances perceptions of fairness and promotes more critical engagement with AI systems. Integrating ethics into technical education is therefore essential. Varsha (2023) argues that computer-science curricula must include philosophical literacy and social responsibility modules, ensuring that developers are equipped to anticipate moral implications. Conversely, E-Week (2024) notes that ethical guidelines alone are insufficient without enforceable regulation and continuous public dialogue.

As Gengler, Hagerer and Gales (2024) point out, the dialogue between engineers, philosophers, policymakers, and sociologists can create a pluralistic framework for AI governance, one that values inclusivity and collective accountability. Such collaboration reflects the principle of co-evolution, in which human ethics and artificial cognition develop symbiotically rather than hierarchically.

According to Clarke (1962), every epoch of technological progress redefines humanity's understanding of itself. The emergence of generative AI represents one such epochal shift. While current systems remain non-sentient, the speculative futures explored in Section 4 illustrate the possibility of digital consciousness, distributed identity, and nonlinear human existence. Whether or not these scenarios materialize, their contemplation serves an ethical purpose: they encourage proactive reflection on what should remain uniquely human.

IBM (2024) and Fengchun and Wayne (2023) converge on the view that the ultimate aim of AI development should be symbiosis rather than substitution – a partnership in which technology amplifies human creativity and empathy without eroding autonomy. According to Ferrara (2024), future research should prioritize AI that augments cognitive diversity, enabling people to solve global problems collaboratively rather than competitively.

The metaphor of AI as a “digital child” remains a powerful heuristic. Like any developing intelligence, AI requires guidance, discipline, and moral education. Clarke's (1962) vision of technology as indistinguishable from magic underscores both the wonder and the danger of ungoverned progress. The direction of AI's evolution will reflect the quality of its upbringing – an upbringing that humanity collectively provides.

In conclusion, the ethical project of AI is not a peripheral concern but the foundation of its legitimacy.

The next frontier of research should therefore explore quantifiable models of ethical alignment, cross-cultural standards of digital personhood, and mechanisms for integrating philosophical reasoning into automated decision systems. Only through sustained, reflective stewardship can society ensure that its “digital child” matures into a responsible and benevolent partner in shaping the human future.

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Genesis and Development of the Internet of Things

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Abstract

The article is dedicated to the genesis and development of the Internet of Things (IoT). Structurally, it consists of three parts. The first is introductory and reveals the primary foundations for the origin of IoT, such as the invention of the computer, the discovery of the transistor and the Internet as a global system of interconnected networks, the more significant discoveries before its "birth". In chronological order, the second part traces the expansion and development of the Internet of Things, highlighting the main milestones of its evolution from 2000 to 2024. In the third, concluding part, three stages in the development of IoT are distinguished - birth and initial development, growth and expansion, and ubiquitous connectivity and mass application. The expectations related to the areas of application of IoT and its future combination with artificial intelligence are also briefly touched upon.

Keywords:

Internet of Things, computer, internet, hype cycle, smart home, IoT systems in agriculture, 5G, M2M, Industry 4.0

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1. The background as a precursor to the emergence of the Internet of Things

The background as a precursor to the emergence of the Internet of Things (IoT) is associated with the discovery of electricity, the telegraph, the telephone, the barcode, etc. However, the primary foundation for the development of the Internet and IoT is the creation of the computer, and in particular the electronic digital computer. Its theoretical foundations were set out by the English mathematician and inventor Charles Babbage in 1830, based on the recording of electrical impulses by electronic devices with a binary system of only two symbols, punched cards and magnetic tape for storing and transmitting information. For the period 1939-1942, the American researcher of Bulgarian origin John Atanasoff and his assistant Clifford Berry from the USA created the first model of an automatic electronic digital computer with regenerative memory - Atanasoff-Berry Computer (ABC Computer). (Harris W., Pollette, Ch., 2023). The computers created during World War II were usually designed to solve specific, single-valued problems: Colossus (1943) - for breaking German codes , ENIAC (1945) - for calculating artillery fire tables, Whirlwind I (after the war in the early 1950s) - for training pilots. However, the first computers created were also very bulky and expensive machines. The evolution of personal computers began with the scientific calculator HP 9100 A from Hewlett-Packard , followed by Apple I and Apple II from Apple, IBM 5150 from IBM , and the first commercially produced computer for business purposes was UNIVAC I from 1951. (Harris W., Pollette, Ch., 2023) .

If the invention of the computer is rightly considered a revolutionary breakthrough in the development of mankind, then the discovery of the transistor can be seen as a "revolution within a revolution". Semiconductor transistors from the late 1940s were followed by silicon MOSFETs (MOS transistors) and monolithic integrated circuits. Invented by J. Bardeen , W. Brattain and W. Shockley at Bell Telephone Laboratories in the USA in 1947, the transistor transformed the computer by making it more powerful, more compact and, most importantly , cheaper. With the development of personal computers and software products from Microsoft (1975) saw the massification of the use of computers, and as a result of this, the Internet, paving the way for the digital revolution of the late 20th and early 21st centuries and the subsequent mass use of the IoT . (History of technology-Space Age, Astronauts, Rockets, Britannica, nd)

The Internet is often viewed as a global system of interconnected networks, but the first computer networks were the airline reservation system (SABER) and the defense command and control system (AUTODIN 1), designed and implemented in the late 1950s and early 1960s. In fact, the first host-to-host network connection was made on 29 October 1969 by the ARPANET, created by the Advanced Research Projects Agency (DARPA) of the United States Department of Defense.¹ In the 1970s, commercial packet networks were introduced, and commercial Internet services "outgrew" the limitation of serving only the research community and contributed to the commercialization of the Internet (History of technology, Britannica, nd). According to data from the International Telecommunication Union (ITU), in 2024 there will already be 5.5 billion Internet users in the world, which represents 68% of the Earth's population, and over 5 billion people use social media networks (itu.int/en/ITU-D/Statistics/pages/stat/default.aspx).

In 1973, the US Department of Defense developed the TCP/IP model, which defines the method of transmitting data over networks in order to standardize and ensure reliable communication between devices, with information being transmitted in the form of data packets (TCP/IP Model, 2024). In 1982, the TCP/IP protocol suite became a global standard, which contributed to the emergence of the global system of "connected networks". In this way, the prophecy of the brilliant Nikola Tesla came true, who in 1926, in an interview for Colliers Magazine, stated that "when wireless communication is applied perfectly, the entire Earth will become a huge brain, which it actually is, with all things being parts of one real and rhythmic whole... (Internet of Things A to Z. Technologies and Application, Ed. by Qusay F. Hassan, 2018, p.3).

The beginning of the history of the barcode with The Universal Product Code (UPC), or barcode, was invented in 1932, when a group of Harvard University students started a project to facilitate catalog shopping. It started with coupons and mechanical readers used for payment and inventory tracking in stores. In 1949, B. Silver and N. Woodland attempted to obtain a patent for the invention of a Classifying Apparatus and Method for Tracking Inventory in Stores Based on Barcodes for Each Item of Goods. The patent was issued in 1952 for a binary code that could be easily read on a scanner. In 1960, laser scanning of codes with information about manufacturers and inventory of commercial items was discovered and introduced, which transformed warehousing and retailing worldwide (Weightman, G., 2015).

More Before the term Internet of Things was coined, several discoveries were made that helped build the IoT. On January 3, 1973, M. Cooper, head of Motorola's communications department, made the first mobile phone call, which marked the beginning of the concept of cellular data used in IoT. In January 1975, the first commercially available personal computer model with an Intel 8080 processor and 256 bytes of dynamic memory was introduced.

The concept of IoT began in 1982, when a group of computer science students at Carnegie Mellon University connected a Coca-Cola vending machine to the ARPANET network in order to remotely monitor the availability of a drink, its time in the machine, and its temperature (Sarda, B., 2022). There are authors such as (Teicher, J., 2018) who call the first Internet device the ARPANET-connected coffee machine.

In 1990, the "thing" was born. John Romkey created a toaster that could be controlled (turned on and off) via the Internet. Subsequently, the entire process was automated by a system for placing the bread in the toaster (Elder, J., 2019). Due to its connection to the Internet, the toaster is more than just a first IoT device. Remote control via the Internet is the beginning of "smart" home appliances and devices in the so-called "smart home".

In 1991, the German company Giesecke + Devrient launches the first credit card-sized SIM card, called the Subscriber Identity Module (SIM). From SIM cards to identification SIM card design is evolving to nano

¹The origin and history of the Internet of Things (2022) claims that the origins of connected objects date back to the 19th century, and the first recorded experiment was carried out in 1874 by French scientists who installed devices to obtain information about the depth of snow on the summit of Mont Blanc, and the data was transmitted to Paris via shortwave radio. (The origin and history of the Internet of Things, 2022).

-SIM and today's embedded digital eSIMs cards. (Ray, D., 2024) . Subscriber Identity Module cards paved the way for the development of machine-to-machine (M2M) SIM cards , establishing direct communication channels between devices with cellular networks, which differ from traditional SIM cards in terms of durability and functionality and play an essential role in the development of modern business (What is an M2M SIM Card and How Does it Work, 2024) . In 1993, computer specialists from the University of Cambridge (UK) placed a camera in a coffee machine, which they connected to the world wide web. They developed a system that took pictures of the coffee machine three times a minute and allowed any interested user to remotely monitor its condition. In fact, this was the first webcam in the world (Marshall, C., 2021).

However, one of the most important prerequisites for the development of IoT is the transition to the IPv6 standard . The 32-bit IPv4 used before it provides identifiers for 4.3 billion IoT devices. IPv6 has the capacity for 340 undecillion identifiers, or 340 with 36 zeros. K. Foote quotes the words of Stive Leibson from the Computer History Museum that with the expansion of the address space, "it would be possible to assign an IPv6 address to every atom on the surface of the earth and still have enough addresses left to make 100+ more earths." (Foote , K., 2022).

2. A timeline of the birth and evolution of IoT until 2024

In 1999, K. Ashton , working for the P&G corporation , gave a presentation on improving logistics processes without human intervention to the company's top management, giving the name Internet of Things and evaluating it as "more than a good way to attract the attention of management." (Ashton, K., 2009). The year is considered the birth of the Internet of Things.

In the same year, Dr. A. Stanford -Clark from IBM and Ar. Nipper from Arcom (now Eurotech) presented the first machine-to-machine communication protocol for connected devices, MQTT (Message Quening Telemetry Transport) , minimizing network bandwidth and device resource requirements while ensuring reliability and security of data delivery. The discovery is extremely suitable for machine-to-machine communication (What Is M2M IoT, nd). As early as 1968, T. Paraskevakos invented the concept of machine-to-machine (M2M) communication . Siemens (Germany) created a module for M2M network connections in 1995, thus giving IoT another exceptional prerequisite for its development.

The first decade of the new century has been characterized by the expansion and growth of IoT . The prerequisites for this were the development of wireless networks, energy efficiency and accessibility due to the falling cost of sensors ², expanded connectivity, falling costs for data collection, storage and processing, increased computing power of cloud platforms, etc.

In 2000, " LG " presents the world's first smart refrigerator Internet Digital Dios with panels and monitors for tracking its contents. Due to the high price of over \$ 20 thousand, the refrigerator was not accepted by consumers on the market and production was discontinued. Nevertheless, the beginning was laid for the concept of a "smart home" with the inclusion of household appliances in the IoT , and the prospects for the application of the idea led not only to the continuation of the work on improving and reducing the price of the refrigerator, but also to its distribution for many other household appliances.

IPSO was established in 2008 Alliance as an association with an international membership of organizations and individuals to promote the use of the Internet Protocol for networking smart objects . Ten years later, the alliance merged with OMA Spec WOrks with a mission to build technical documentation for a connected world with interoperability between networks and growth in the fixed and wireless markets and IoT (Alliance IPSO, nd) The alliance now includes over 50 companies, including Bosch, Cisco, Ericsson, Intel,

²In 2010, the selling price per unit of a smart sensor in US dollars has decreased for the period 2010-2015 by 39.4%, and for the period 2010-2020 by 56.1%. Calculated by: Statista, <https://www.statista.com/statistics/736563/global-average-sales-price-of-smart-sensor> .

SAP, Google, Fujitsu and others. In the same year, the Android operating system was launched , opening up new possibilities for connected devices and IoT.

International Telecommunication Union The United Nations International Telecommunication Union (ITU) published its first report on IoT in 2005 , identifying it as one of the technologies with “the greatest technological potential . ” According to the report, “anytime, anywhere communications will lead to the next revolutionary step – all-in-one communications,” and “innovative applications will become ubiquitous in everyday life – at home, at work, on the farm, in the hospital, in the store, on the road, even inside the body,” and “everything will be connected” (ITU, 2005).

In 2008, a report by the US National Intelligence Council identified IoT as one of six "disruptive civil technologies with a potential risk to the country's information security" by 2025. The reason lies in the ubiquitous and imperceptible inclusion of various objects, including documents, on the Internet.

(IoT – 2008) is held in Zurich (Switzerland) . About 250 participants from 23 countries discuss the development of the Internet of Things with discussions on the topics of sensor networks, short-range wireless communications, real-time localization, e-commerce and e-business, smart home, network security, RFID technologies, systems and data security, etc. (Internet of Things, 2008).

In 2010, the Chinese government declared IoT as a key technology and included it in China's long-term economic growth strategy, with the necessary investment allocated. The 12th National Five-Year Plan (2011-2015) has set out significant achievements in the development of core IoT technologies , related applications and standardization. In addition to scientific literature, the popularity of the term is also contributed by a number of periodicals, including leading ones such as the Guardian , Boston Globe, Scientific American, and others.

According to specialists from the Cisco Internet Business Solution Group, the Internet of Things was “born” between 2008 and 2009, when the number of connected IoT devices exceeded the world’s population. For them, this is the time of transition from the “Internet of People” to the “Internet of Things”. Despite doubts about the accuracy of the data on the number of connected IoT devices ³, in this case the statement is not very precise, since before the time from the appearance of the term to the period between 2008 and 2009, IoT was not called the “Internet of People” . Reaching a certain number of connected IoT devices and their ratio to the world’s population is not evidence of the birth, but of the development of the Internet of Things, the dynamics of which are also evidenced by some of the data in Table 1 on connected IoT devices per person in the world’s population.

In the same year, Nest created the first self-learning and machine learning-powered thermostat, the “ Nest Learning Thermostat, ” with capabilities to “learn” user habits and optimize heating schedules (Nest Learning Thermostat, n.d.).

IPv6 Day is celebrated on June 8 , 2011 . Co-organizers are the Internet Society, Facebook, Google, Yahoo, Akamai Technologies and Limelight Networks . The main event of this date is the activation of IPv6 for a "test flight" by the participating organizations in addition to the normally used IPv4 . In the Science Park (Amsterdam) are a panel session, seminars, lessons, etc. were held. The goal of World IPv6 Day is to motivate

³ In the article " Environmental Energy Harvesting Techniques to Power Standalone IoT-Equipped Sensor and Application in 5G Communication (2021)" from Figure 4 on the number of devices connected to the Internet of Things worldwide relative to the population , it is evident that only in 2017 the number of connected IoT devices exceeds the world population – 8.4 and 7.48 billion, respectively. In 2009, the number of connected devices was only 0.9 billion with a population of 6.8 billion ([https://www . researchgate.net/publication/356220129_Environmental_Energy_Harvesting_Techniques_to_Power _ Standalone_ IoT-Equipped_ Sensor_and_Application _in_5G_Communication](https://www.researchgate.net/publication/356220129_Environmental_Energy_Harvesting_Techniques_to_Power_Standalone_IoT-Equipped_Sensor_and_Application_in_5G_Communication)). Discrepancies in the number of connected IoT devices are also found in other publications by authors published on the sites of researchgate.com , IoT analytics . We accept the data on the number of IoT connected devices from Statista as authoritative , which for 2020 were 9.76 billion, and for 2024 17.71 billion (Vailshery , L., 2025), [statista.com/statistics/1183457/ iot -connected-devices-worldwide](https://statista.com/statistics/1183457/iot-connected-devices-worldwide) .

organizations from across the industry (Internet service providers and operating systems, web companies, hardware manufacturers) to prepare for the transition from IPv4 . to IPv6 when IPv4 addresses run out . [World IPv6 Day, (8 June 2011), 2024].

Table 1.**Connected IoT devices per capita (in billions)**

Years Indicators	20 20 years	202 4 years	20 30 years (forecast)
Connected devices	9.76	17.71	3 1 200
World population (billion people)	7,887	8162	8,569
Devices per capita	1 , 237	2,170	3,641

Source: World Population by Year, worldometers . info/world population/world-population-by-year; worldometers . info/world population/world population-projections; Vailshery , L., (2025), statista.com/statistics/1183457/ iot - connected-devices-worldwide.

In the same year, J. Siminoff , constantly missing deliveries due to the inability to hear the doorbell while working in the garage, invented the first prototype of an online doorbell connected to the owner's smartphone. The prototype of the Ring Video Doorbell is a "smart" doorbell with a video camera that detects motion and sends it to the mobile application in real time. (Moye , J., 2023).

In 2011, research and advisory firm Gartner included IoT in the Hype Cycle . The Hype Cycle is a graph that represents the stages of a technology's life cycle from initial development to widespread adoption and eventual obsolescence and decline. It encompasses five phases: technology trigger, peak of inflated expectations, trough of disappointment, slope of enlightenment, and plateau of productivity. The Hype Cycle is used to assess the maturity and potential of emerging technologies and provides insight into whether to make or avoid investments.

In 2014, IoT was in the second stage of inflated expectations, and in 2016, Gartner made a separate hype cycle for IoT. In the period 2012-2015, IoT as a whole was at the peak of inflated expectations, for the period 2015-2018, IoT reached the "bottom of disappointment" , and for 2018-2022, the "great comeback" of IoT in sectors such as Heating, Ventilation and Air Conditioning occurred. According to Z. Supalla and D . Jamieston (n.d.) for individual consumer applications such as thermostats, smart home (security and energy management) , cargo tracking , micromobility have reached the stage of maturity and widespread market penetration, when more and more consumers appreciate the benefits of implementing the technology . Graphically, the first inclusion of IoT in the hype cycle in 2011 is presented in Figure 1.

The launch of Google Glass in 2013. In 2012, Google announced Project Glass and released the "smart" glasses, hailed as a major advancement in wearable technology and IoT. For a number of reasons related to cost, safety, privacy, limited public understanding of product use, etc., the glasses were withdrawn from the market in 2014, re-released in 2019, and withdrawn again in 2023. In 2020, Amazon released its Echo Frames version of smart glasses. (Weidner, J., James, M., Perez, Y., 2024).

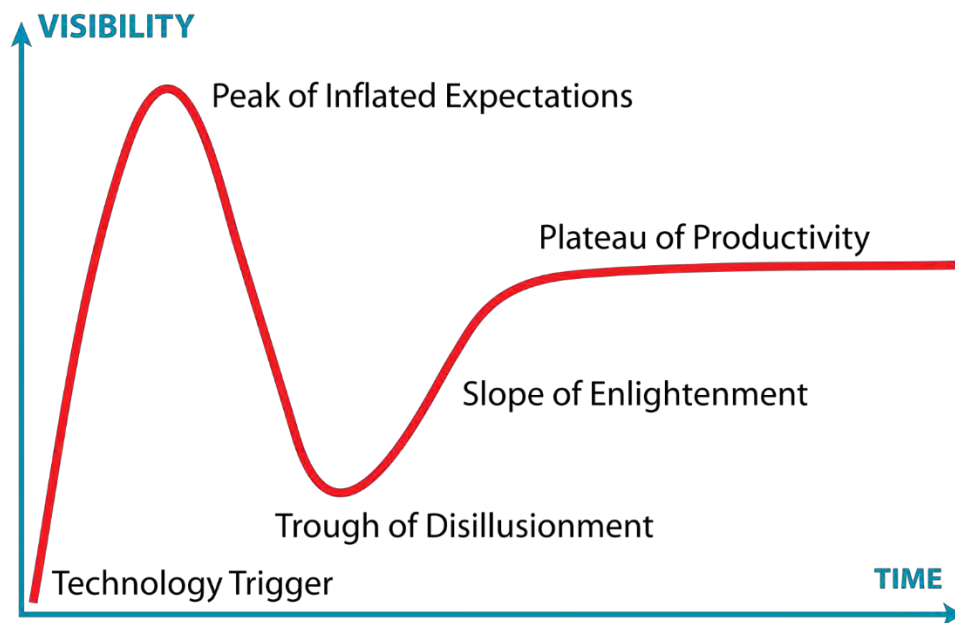


Figure 1. First inclusion of IoT in the hype cycle in 2011.

Adapted by the author from: Hanna, K., Wigmoore, I. (2023). Gartner Hype Cycle

In Germany, in 2013, the first IoT system for industrial automation Industry 4.0 was presented. The goal of the system is to connect all devices and systems in the factory, and achieve greater autonomy and efficiency (Maarseveen, van, H., 2023). In 2013, the Smart Dubai project was initiated, and steps were taken in this regard as early as the 1990s. The first of the cities to create a virtual digital city was Amsterdam back in 1994. In "smart" cities, traffic, air quality, intelligent transport, parking and homes, public lighting, etc. are monitored through sensors connected to the Internet. Today, over 15 large cities are monitored⁴, with Zurich and Oslo always ranking in the first two places in the rankings.

The year 2014 is extremely rich in events related to the further development of IoT :

- Nest was acquired by Google to complement its hardware division and “acquire” Nest’s achievements in the field of “smart” home. The technology entered medical science with Google’s partnership with Novartis in the development of “smart” contact lenses to track blood sugar levels by measuring glucose in the eye fluid and transmitting the data to a mobile device. (Ward, A., 2014). Samsung, with the intention of making every home “smart”, acquired the leading startup platform Smart Things for monitoring, control and home automation, which subsequently became the basis of the company’s smart projects.

- Amazon is entering the smart home hub market with the Amazon Echo, powered by the Alexa virtual assistant. In addition to information about weather, traffic, etc., the "intelligent" speaker provides voice-activated playback of alarm settings, to-do list creation, music and audiobook playback, etc. (Lacoma, T., 2022). AT&T, Cisco, GE, IBM, and Intel form an open-membership consortium (Industrial Internet Consortium - IIC) to establish interoperability in different industrial environments, new foundations, common frameworks and standards for industrial IoT.

- The International Telecommunication Union (ITU), together with standards organizations, industry associations, government agencies, universities and research institutions, has created the IoT Global Standards Initiative (IoT GSI). The goal of the initiative is to develop standards, security, scalability, compliance with

⁴In addition to Zurich and Oslo, these cities include Lausanne, Geneva, Copenhagen, Helsinki, Stockholm, Amsterdam, Prague, London, Singapore, Hamburg, Beijing, Abu Dhabi, and Canberra. Source: History smart cities Timeline, <https://www.verdict.co.uk/?url=https%3A%2F%2Fwww.verdict.co.uk/2Fsmart-cities-timeline%2F>.

regulatory requirements and sustainability. (IoT-GSI. Global standards Initiative of Internrt of Things, 2014).

- IoT- based system in agriculture has been created. Precision or “smart” agriculture encompasses the use of IT, sensors, drones , control systems, robotics, autonomous vehicles, automated hardware, etc. They are used for soil analysis (pH level , presence of soluble solids, humidity, temperature, etc.) , monitoring of planting, health and development of agricultural crops, spraying with preparations , monitoring of livestock on farms, autonomous transport agricultural machinery (tractors, combines) , “smart” greenhouses, etc. (Ravindra, S. 2020),

In 2015, Google announced Android Things and released it the following year. With Android Things, Google brings Android and its ecosystem in the development of IoT devices by incorporating some of Brilo 's core technologies . The IoT- focused new solution is called Android Things. The embedded operating system contains, in addition to the usual Android API , the library for accessing various Google services with two main functions: a peripheral I/O API and an API for user drivers . (Plano- Lesay , M., 2017).

In 2016 , General Motors invested \$ 500 million to develop a network of self-driving cars on demand with a ride-sharing service, believing that self-driving cars would overtake driver-owned cars in the ride-sharing market. (Trousdale, S., 2016). In competition with Amazon Echo, Google launched Google Home , a speaker with built-in Wi-Fi that it uses to connect to the Internet. It refers to two things – a smart speaker and the entire product line, including the Google Home Hub, Google Mini and other products. With the help of Google Home, you can listen to music and the latest news about the region, play TV programs, control smart home devices, get weather reports, shopping lists, order food online using the Google Assistant , etc. (Laukkonen , J., 2021). In August 2016, the botnet was first discovered Mirai , used in one of the largest and most destructive distributed denial of service (DDoS) attacks. The Mirai malware infects smart devices running ARC processors, turning them into “zombies,” or networks of remotely controlled bots , to launch DDoS attacks. In an attempt to conceal the origin of the attack, the authors, students P. Jha , J. White, and D. Norman, released the source code to the world, but the code was replicated by other cybercriminals. (Mirai – the Botnet that Made in Dangerous, 2022).

At the Consumer Electronics Show, Apple demonstrated the Apple Home Kit smart home platform . The platform works with Apple devices (iPhone, iPad , and Home Pod). They can control all smart devices such as thermostats, lights, locks, etc., using the Apple Home App and Siri voice control (Oliver, H., 2023). Uber, Lyft, Tesla, and General Motors are conducting tests of self-driving vehicles.

In 2017 , Amazon offered Amazon IoT Device Management, which facilitates the security, provisioning, organization, monitoring, and remote management of IoT devices. Microsoft Azure IoT Edge with the ability for small devices to use cloud services without being connected to the cloud. Google launched Google IoT Core as a service for secure and reliable communication between IoT devices and Google Cloud, which includes two parts: Device Manager and Protocol Bridgec . In 2023, Google will retire the service (Global Cloud IoT Core is Shutting down: How to Migrat , 2023). Lift and General Motors plan trials of autonomous driverless taxis.

In the city of Barcelona (Spain) from 26.02. to 01.03. 2018, the Mobil World Congress 2018 is being held with over 100 thousand participants from all over the world. The topics cover Industry 4.0; networks, with an emphasis on 5 G networks; applied artificial intelligence; digital consumer; public benefits of IoT connected networks; preparation for the automated future , etc. (Event Themes at Mobile World Congress, 2018).

In 2020 The Internet of Medical Things (IoMT) continues to permeate and transform healthcare and health insurance . The global IoT in healthcare market size is estimated at \$ 141.7 billion in 2024 , and is expected to grow by 19.27% during the forecast period 2025-2033 (IoT Healthcare Market Size, 2025).

IoT applications in healthcare have led to continuous monitoring of vital signs such as blood pressure, heart rate, glucose levels, comorbidities, etc.; effective storage, management and analysis of health data

through cloud services; faster and more accurate diagnostics, creation of "smart" hospitals, clinics and laboratories, more efficient use of resources, inventory tracking and management of medical equipment, medication management, IoT- based tracking of hospital workplaces, payment points, social distancing and location, patients' control of their own health, and many others. Telemedicine has developed, where doctors and specialists treat patients via video conferencing. Electronic prescriptions have been introduced in pharmacy, and insurance and claims processing processes (underwriting, pricing, risk management and assessment) have been improved in health insurance, etc. (Li, Ch . , Wang , J., 2023).

- The US Congress passed the IoT Cybersecurity Improvement Act of 2020, which requires the National Institute of Standards and Technology (NIST) and the Office of Management and Budget (OMB) to take specific steps to improve cybersecurity for IoT devices by requiring NIST to review and revise, as appropriate , standards and guidelines every five years. (IoT Cybersecurity Improvement Act of 2020, 2021). The year was characterized by a shortage of semiconductors due to geopolitical factors such as the China-US trade war, the Covid-19 pandemic , etc. In 2020, China announced 30 fully connected 5G factories ; the combination of artificial intelligence (AI) and I o T (AloT) deepened ; IoT security breaches have increased . SpaceX acquired Smart Technologies, Emerson merged with Aspen Tech (Luech , K. 2022).

GE Healthcare partners with AMC Health in remote health monitoring and launches new technology for remote patient monitoring in 2022 , and Securitas acquires Stanley Security and Healthcare , Microsoft announces advances in cloud technologies in healthcare. (IoT in Healthcare market , 2023),

- Public interest in IoT , which has been declining since the third quarter of 2018, is rising and reached its highest level in the first quarter of 2022. Numerous mergers and acquisitions took place in the sector during the year: Semtech announced a merger with the manufacturer of modules and communications equipment Sierra Wireless , Siemens acquired Brightly Software , Izuma Networks acquired Pelion , Schneider -Electric acquired Aleva . Job cuts were made at numerous technology companies such as Meta, Twitter, Microsoft, HP, Tesla, Cisco , etc., the European Parliament passed the Cyber Resilience Act , and the Connectivity Standards Alliance (CSA) approved the Matter home automation standard . (Taparia , A., 2023).

In January 2023, the second EU Network and Information Security Directive (NIS2) was activated , affecting data centers, cloud services, telecommunications, etc., the EU Data Act and the Corporate Sustainability Reporting Directive (ISRD) came into force;

- Spain-based low-Earth orbit satellite operator LEO Sateliot and Telefonica successfully complete a full test of a 5G cellular network in space ;

- Japanese semiconductor manufacturer Renesas Electronics acquires Austria-based wireless semiconductor manufacturer Panthronics AG and agrees to acquire cellular IoT chip manufacturer Sequans Communications (France). (Christman , C., 2024).

IoT- related events in 2024. Electronic design automation company Synopsys acquires engineering simulation software company Ansys ; Qualcomm and Silicon Lab introduce low-power Wi-Fi 6 chip ;

- Linus Foundation with the open standard for end-application, workload and device orchestration, " Margo " established a standard for orchestration. The project is supported by ABB, Siemens, Schneider Electric, Rockwell Automation, Capgemini and Microsoft ;

- The Paris Olympics demonstrated the broadest and most visible presence of IoT in the Olympic Games with the use of intelligent traffic management technology, biometric security tools, crowd density, advanced measurement techniques, and assistance to referees and athletes in their performance;

- China has started entering the mega stage the G 60 constellation (Thousand Sails) with the aim of building a low-Earth orbit (LEO) network with the aim of deploying 600 satellites by the end of 2025;

- The Cyber Resilience Act was adopted as a framework for improving the security of connected products in the EU, the EU Data and Artificial Intelligence Laws, the China Network Data Security Management Rules,

etc. (C. Chrisman, 2025).

According to Statista analysts expect the global IoT market to reach \$1.06 trillion in 2025 and, at an annual rate of 10.77% for the period 2025-2029, reach a volume of \$1.56 trillion in 2029. The use of 5G with ten times the capacity for connected devices per unit area compared to 4G will increase the number of things connected to the IoT and contribute to its expansion, provide higher data transmission speed in real time, lower latency. The use of blockchain technologies will help decentralized data management and increase transparency and security of the IoT, and edge computing localized data processing closer to the places where it is collected will shorten processing time, improve latency and increase the level of security. M2M through automatic direct data exchange between machines, autonomous analysis and decisions, and taking actions in real time also reveals new potential for the development of IoT services and increasing its efficiency in areas such as industrial automation, transportation, banking, utilities, e-medicine, etc.

Undoubtedly, the greatest expectations are related to the combination of artificial intelligence with IoT. (AloT). Combining AI with IoT extends the capabilities of traditional IoT and gives it cognitive functions. In the future, AI can be expected to become an integral part of every IoT system. For example, implementing AI directly on IoT sensors and devices (edge AI) without the help of cloud resources through real-time analysis, reduced latency and bandwidth, expanded scalability and lower power consumption will increase the efficiency and productivity of IoT in various industrial productions, healthcare, smart cities, etc. Machine learning (ML) as a part of AI allows the creation of algorithms and models that allow computers to "learn" from data, make predictions and make decisions without being explicitly programmed for this.

IoT connected devices are projected to grow at an average annual rate of 12.7% from 2024 to 2030, reaching 31.2 billion in 2030 (Wailshery, L., 2025). Chiplet technology by manufacturing each part in different nodes and connecting them via high-speed connections will lead to greater scalability, higher scalability and flexibility of manufacturing nodes. Design refinement in the production of processors and electronic components will continue. The new universal industry standard for chiplet connectivity Universal Chiplet Interconnect Express (UCIe), adopted in 2022, facilitates high-speed communication between disparate chiplets and ensures seamless interoperability between different chiplet vendors. The use of emerging non-volatile memory technologies such as magnetic RAM (MRAM) and resistive RAM (RRAM or ReRAM), which will increase their application in portable devices, automotive electronics, military industry, security applications etc.

IoT will continue to expand its "territory" in industrial production, trade, agriculture, finance, transport and communications, in the creation of "smart" homes. In the near future, a significant increase in its use is expected in the creation of "smart" cities in areas such as energy consumption, public transport (traffic, safety, efficiency), social services, environmental impact. The Internet of Medical Things (IoMT) will also develop rapidly, with the IoT market in healthcare expected to generate revenues in 2025 of 93.28 billion. American dollars and at an annual rate of 9.56% to reach a value of \$ 134.43 billion in 2029. (Statista.com/outlook/internet-of-things/healthcare-iot/worldwide). In the future, IoT can also be expected to expand into new application areas. On a global level, for the purposes of sustainable development, IoT can help increase energy efficiency, optimize resource use, and reduce and recycle waste.

3. Stages in the development of IoT

As a conclusion to what has been said about the history of IoT, it can be summarized that in chronological terms, several stages of IoT development are outlined. First, there is the prehistory as a harbinger of its emergence, when there is no mention of IoT at all. The prehistory covers about two centuries before the birth of IoT. The forerunners of IoT are major technological inventions such as the discovery of electricity and its transformation into a primary energy source, the telephone, radio, telegraph and wireless telegraph, the electronic digital computer and the undisputed apogee of the Internet. M. Dabbs (2019) calls this period until

1990 “ IoT in the Stone Age” .

In its short history of several decades, several stages can be distinguished. of IoT development . The first stage of **emergence and initial development** covers the period from 1980 until 1998. During this stage, the following were carried out: the pioneering developments of the wedding Coca-Cola vending machine connected to ARPANET, the introduction of 2G wireless networks, the “birth” of the thing in the face of J. Romsky ’s toaster , the first webcam, the development and adoption of the first data transmission protocols. The widespread deployment of IoT is hampered by its own imperfections during this early stage of development. The above-cited author M. Dabbs calls part of this stage from 1991 to 1998 “ Iron Age IoT Improvements ” .

Growth and expansion stage (1999-2010) . This is the period when the number of connected devices exceeds the world's population. The falling costs of sensors, data collection, storage, processing and transmission, along with the increased computing power of cloud platforms, the development of wireless networks, etc., have provoked the attention of the business sector to IoT technologies. IoT has attracted the attention of government leaders, scientific circles, and the media. From mobile phones, the modern smartphone evolved with the ability to make phone calls, send faxes , SMS and email. The development of Smart Home technology has begun .

The third stage, covering the period from 2010 to the present, is the stage of **ubiquitous connectivity and mass application** of IoT . The reasons for this lie in the increased share of Internet users worldwide (from 28.6% in 2010 to 6.8 % in 2024) , mass connectivity , the process of turning homes and cities into smart ones, precision or smart agriculture, self-driving cars, the development of the Internet of Medical Things, industrial automation, the integration of AI into IoT (AloT), machine learning (ML), the peak in smartphone sales in 2017 and 2018, increased cybersecurity measures , etc.

Each of the mentioned stages also generates the prerequisites for the emergence and development of the next one. The development of the next stage is not a one-time act and is the result of the evolution of technologies and historical development. The movement to the next stage does not mean the death of the previous one, just as the use of 5G has not canceled the use of 3G and 4G generation networks . But in 5G itself , although in theoretical and initial practical terms, the emergence of 6G networks is laid down and is maturing . And this applies not only to network connectivity.

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Machine Learning at the Edge: Revolutionizing Intelligent Computing Beyond the Cloud

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Abstract

Machine learning at the edge (Edge ML) represents a paradigm shift from centralized cloud computing to decentralized, resource-constrained devices. This article examines the technical underpinnings, economic implications, and transformative potential of deploying ML models directly on edge devices (e.g., sensors, smartphones, IoT hardware). Driven by critical requirements for low-latency decision-making (e.g., autonomous vehicles), data privacy (e.g., healthcare), reduced operational costs (e.g., bandwidth savings), and offline functionality, Edge ML enables intelligent applications in IoT, smart cities, and industrial automation. While challenges in hardware limitations, model optimization, and security persist, advances in TinyML, federated learning, and specialized accelerators are rapidly evolving the ecosystem. Economically, Edge ML reduces cloud dependency, enables new business models, and optimizes total cost of ownership (TCO)—despite higher initial hardware investments. This article argues that Edge ML is indispensable for scalable, privacy-compliant, and economically viable intelligent systems.

Keywords:

machine learning at the edge,
cloud computing, edge
systems, optimization,
efficiency

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1. Introduction

According to Statista experts, IoT connected devices in 2024 were 17.71 billion, and the estimated number in 2030 will reach 31.2 billion (Statista.com/statistics/1183457/iot-connected-devices-worldwide) or 3.64 billion per person of the world's population. This is associated with the generation of colossal amounts of data from sensors and various types of IoT devices, which puts traditional cloud-oriented machine learning (ML) architectures under strain. Cloud-based ML faces four critical limitations:

- Delay: Two-way transmission delays for critical applications (e.g. industrial robotics, medical diagnostics).
- Privacy: Risks when transmitting sensitive data (e.g. biometric data, factory operations).
- Cost: High bandwidth/cloud computing costs for raw data transfer (Cisco estimates that 30% of IoT data will require edge processing by 2025).
- Connectivity: Reliability issues in remote or mobile environments (e.g. agriculture, logistics).

Edge ML addresses these issues by deploying optimized ML models directly to edge devices or nearby gateways. Also called TinyML for microcontroller implementations (Warden & Situnayake, 2019), it processes data locally, minimizing reliance on the cloud. Its importance is highlighted by applications such as:

- Healthcare: Real-time patient vital signs analysis on wearable devices (e.g. seizure prediction), avoiding HIPAA/GDPR violations;
- Industrial Internet of Things: Predictive maintenance reducing downtime costs by 20–50%;
- Smart Homes: Local voice/image processing, allowing privacy and instant response.

Economically, Edge ML shifts costs from recurring cloud subscriptions (OpEx) to initial hardware (CapEx), reducing long-term total cost of ownership. A Bosch case study showed a 40% reduction in cloud

costs after edge deployment (Dzeparoska et al., 2022). This transition is being catalyzed by the adoption of 5G, cheaper NPUs, and efficient ML frameworks (e.g., TensorFlow Lite).

Edge ML is essential for the next generation of decentralized, privacy-preserving, and economically sustainable intelligent systems, overcoming the limitations of cloud technologies through innovations in hardware, model compression, and hybrid architectures.

2. Background and basics

The fundamental difference between cloud and edge machine learning lies in the computational architecture and economic philosophy. Cloud ML centralizes processing in remote data centers, using massive computational resources to train complex models (e.g., large language models). While this allows for unparalleled scalability, it introduces critical bottlenecks: latency from data transfers (often 100–500 ms), recurring operational costs (OpEx) for bandwidth and cloud services, and privacy vulnerabilities from transmitting sensitive data over networks. Edge ML counters this by decentralizing intelligence to edge devices (sensors, cameras, embedded systems) or local gateways. By processing data close to its source, Edge ML achieves sub-10 ms latency—essential for real-time applications like autonomous vehicles—while minimizing data transfer costs by 40–70% and improving compliance with regulations like GDPR. Economically, this shifts cost structures from recurring operational costs (e.g. AWS cloud fees that scale with data volume) to upfront capital expenditures (CapEx) for edge hardware, resulting in a 25–40% reduction in long-term total cost of ownership (TCO), despite higher initial investments. A 2022 Bosch case study demonstrates 40% lower operational costs after implementing edge hardware, highlighting the potential for ROI for industrial users (Dzeparoska et al., 2022).

Traditional ML pipelines rely on monolithic workflows: raw data collection → cloud transmission → centralized training → cloud-hosted inference. This imposes prohibitive bandwidth and latency costs for applications such as factory robotics or remote sensing. Edge-constrained pipelines redesign this flow through three innovations: local preprocessing (filtering data from device sensors), federated learning (training models collaboratively on different devices without sharing raw data), and device inference. Federated learning alone reduces data transmission costs by 60% while preserving confidentiality (McMahan, B., Moore, E., Ramage, D., et al., 2017), although it increases development costs by 20–30% due to model optimization efforts (e.g., quantization, pruning). The economic trade-off favors edge deployment in scenarios where real-time responsiveness, bandwidth savings, or regulatory compliance justify development costs.

The rise of Edge ML is driven by synergistic advances in software and hardware. TinyML—the execution of ML models on microcontrollers (MCUs) such as ARM Cortex-M—enables intelligence on devices consuming <1 milliwatt, such as sensors for predictive maintenance. Smart city projects (e.g., Barcelona’s smart lighting) have deployed TinyML on over 10,000 nodes, reducing energy costs by \$550,000 per year through localized decision-making (Gubbi, J., Buyya, R., Ma rusic, S., Palanisvany, M., 2013). Federated learning further decentralizes development by aggregating model updates (non-raw data) from edge devices, reducing cloud computing costs by 45% while avoiding non-compliance penalties (Kairouz, P., McMahan, N.B., Avent, B. et al. (2021). Meanwhile, neuromorphic computing (e.g. Intel Loihi) mimics the neural architecture for event-driven processing, reducing power consumption by 90% compared to GPUs – a critical economic advantage for battery-powered applications.

Edge hardware spans the spectrum, balancing compute performance, power efficiency, and cost. Low-cost platforms like the Raspberry Pi (\$35–\$75) democratize prototyping but lack dedicated AI accelerators, limiting commercial scalability. Mid-range systems like Google Coral (\$60–\$150) integrate TPU coprocessors for 4–8 TOPS (trillion operations per second) at 2–5 W, enabling computer vision in retail and 70% lower inference costs compared to cloud alternatives. High-performance solutions like NVIDIA Jetson (\$99–\$2000) deliver 10–200 TOPS for robotics, leading to a 50% faster return on investment in manufacturing through

reduced downtime. At the extreme end of the ultra-low power spectrum, ARM Cortex-M microcontrollers (\$0.50–\$5) support TinyML workloads at a cost of \$0.01 per inference, enabling large-scale IoT deployments. This hardware diversification reflects a broader market shift: the hardware edge AI sector, according to MarketsandMarkets, is expected to grow from \$26.14 billion in 2024 to \$58.9 billion in 2029, at a CAGR of 17.6%, as industries prioritize capital expenditure (CapEx) efficiency over operational costs in the cloud (Edge AI Hardware Market Size, Share & Trends, 2025 To 2030, 2025). In addition to technical feasibility, the expansion of Edge ML is fueled by compelling economic factors. First, avoiding bandwidth costs: processing a 1GB video stream locally saves \$0.01–\$0.05 compared to cloud delivery – a crucial factor for video-intensive applications such as surveillance. Second, mitigating regulatory risk: localizing EU citizen data avoids GDPR fines of up to 4% of global revenue. Third, new revenue models: industrial equipment manufacturers are now offering “predictive maintenance as a service” using edge data analytics (e.g. Siemens), turning capital expenditures into recurring subscriptions. Finally, data monetization opportunities: anonymized edge data analytics (e.g. traffic patterns) are a significant component (around 2/5) of the global smart city market, valued at \$1.82 billion in 2024 and expected to reach \$6.40 billion in 2030. (Smart Cities Market Size, Share and Trends 2025 to 2034, 2025). These forces collectively position Edge ML not just as a technical alternative, but also as an economic imperative.

3. System architecture and design considerations

The canonical Edge ML system follows an optimized pipeline: sensor input → preprocessing → inference → actuation. Unlike cloud-dependent workflows, this architecture prioritizes local data processing to minimize latency and cost. Sensors capture raw data (e.g., video, temperature), which undergoes on-device preprocessing—filtering, normalization, or compression—reducing the payload size by 60–90% before any processing. This directly reduces the cost of data transfer to the cloud, saving \$0.02–\$0.10 per GB of avoided data transfer. Inference is then performed on the edge device using compressed models (e.g., TensorFlow Lite), enabling real-time decisions such as shutting down equipment in industrial settings. Finally, localized responses are triggered (e.g., adjusting a smart thermostat). By embedding intelligence at the source, this pipeline eliminates cloud-based round-trip processing, reducing latency to <20 ms, while reducing bandwidth costs by up to 40% per year for large-scale IoT deployments (Jouppi, N., Yoon, D., Ashcraft, M., Gottscho, M., 2023).

Edge system architects face four interdependent challenges:

1. Memory and computational resource constraints: Resource-constrained hardware (e.g., microcontrollers with 256 KB RAM) requires ultra-efficient models. While complex models require expensive hardware upgrades (\$50–\$500/device), optimization techniques such as “pruning” allow efficient derivation on affordable chips (<\$10), extending the return on investment for mass deployment.
2. Real-time requirements: Applications like autonomous drones require response times below 30 ms. Delays result in operational penalties—for example, manufacturing defects from unaddressed anomalies cost \$15,000 per hour. Edge ML meets these deadlines when the cloud fails, preventing revenue loss (Khan, W., Ahmed, E., Hakdk, S., Yaqoob, Ib., Ahmed, D., 2021).
3. Power consumption: Battery-powered devices (e.g., wearables) prioritize energy efficiency. Neuromorphic processors like Intel Loihi reduce power consumption to 0.2 W (versus 5 W for GPUs), extending device lifespan and reducing replacement costs by 30%. In addition to consuming 100x less power for systems based on Intel’s Loihi neuromorphic chip when performing AI inference and solving optimization problems, they also deliver up to 50x faster performance than conventional CPU and GPU architectures. (Intel Builds World’s Largest Neuromorphic System to Enable More Sustainable AI, 2024).
4. Device training vs. inference approach. While inference-only designs minimize hardware costs, on-device training (e.g., via federated learning) allows for adaptation to data drift. The latter increases

computational requirements by 35%, but reduces the long-term cost of retraining the model by eliminating cloud dependencies (Verbraeken.J., Welting, M., Katzy, J., et al., 2020).

Architects need to weigh the initial hardware investment against the operational savings. Finance professionals need to compare the initial infrastructure costs – servers, specialized software, etc. – with the return on the initial investment associated with reduced bandwidth costs, the costs of transferring and storing data in the cloud, and in the case of edge AI computing in healthcare, with the consideration of healthcare standards that should not be degraded. Because the point of investing in edge computing devices is to reduce the operational costs associated with the cloud.

To reconcile performance with edge constraints, various techniques dominate:

Quantization: Converting model weights from 32-bit to 8-bit precision reduces memory requirements by 75% and speeds up inference by 2–4x. This allows for implementation on low-cost hardware (e.g., \$15 ESP32 chips), reducing the system total cost of ownership by 22% without losing accuracy (Jacob, B., Keigys, S., Chen, B., et al., 2018).

Pruning: Removing redundant model parameters (e.g., zero-weight neurons) shrinks the model size by 60–90%. The pruned ResNet-50 runs on a \$35 Raspberry Pi instead of a \$2000 cloud server, reducing inference costs to \$0.0001 per invocation (Blalock, D., Ortiz, J., Frangle, J., Gutage, J., 2020).

Knowledge Distillation: Transferring knowledge from a large “teacher” model to a compact “student” model preserves 95% accuracy at 10% of the size. This avoids annual cloud training costs of over \$500,000 for fleets of edge devices (Gou, J., Yu, B., Maybank, St., Tao, D., 2021).

Model separation: Separating models between edge and cloud (e.g., preprocessing locally, complex analysis in the cloud) balances latency and capacity. Implementing a smart factory reduced bandwidth costs by 50% while maintaining 99.9% inference accuracy (Yao et al., 2022).

Optimization reduces model development costs by 25–40%, but requires specialized engineering labor. The trade-off is in favor of implementing peripherals when device volumes exceed 500+ units, where the savings per device outweigh the initial R&D efforts.

4. Applications

The table below lists the main application sectors, a brief description of the use cases and the benefits of Edge ML related to resource optimization, increased productivity and efficiency, cozier and safer homes, comfortable urban environments, improved transportation safety, healthcare, customer experiences, etc.

Table.

Applications, use cases and benefits of Edge ML

Application sectors	Brief description of some use cases	Key benefits of Edge ML
Production	Predictive proactive maintenance through defect and damage identification; quality control; conveyor belt monitoring; downtime minimization; supply chain management; energy usage monitoring and optimization; work environment monitoring, etc.	Identification of defects and damage, optimization resource allocation and increased profitability
Agriculture	Soil management (composition, texture, moisture); precision irrigation, fertilization and pest control; water, fertilizer and pesticide consumption management; livestock and agricultural area monitoring; animal and crop disease detection; optimizing farm and cropland management; intelligent ss machines and vehicles; waste reduction and environmental sustainability	Resource optimization and increased yield and efficiency

Healthcare	Remote patient monitoring, chronic disease management, telemedicine and virtual care, personalized real-time treatment, medical imaging, vital signs tracking and precise diagnosis, “smart” hospitals (resource allocation, workflow control, environment, supply chains, patient flow), predictive maintenance of medical equipment, optimized emergency response	Real-time intervention, personalized treatment, remote monitoring of health indicators, improved care and patient health status
Smart cities	Air and environmental quality monitoring, public safety and security, efficient waste management, traffic optimization, smart street lighting and parking systems, smart buildings and streets, energy consumption and building occupancy monitoring	Adaptive and efficient infrastructure and comfortable urban environment
"Smart" homes	Creating more adaptive, responsive and energy-efficient homes (smart electrical appliances, thermostats, voice assistants, home lighting, security cameras, “smart plugs and switches”, audio and video entertainment systems, etc.).	More adaptable , comfortable, safe and energy efficient tive homes, personalized living
Retail	Real-time inventory management; forecasting customer demand; monitoring customer flow patterns, contactless payment, energy and supply chain optimization; predictive equipment maintenance; cashierless stores; fraud detection	Resource optimization, increasing productivity and efficiency, improved customer experience
Intelligent transportation	Object detection (other vehicles, pedestrians, road signs), improved safety, congestion detection, analysis and management, incident detection and response, shortest-path routing; traffic management and optimization; fleet management; carbon emission reduction, reduced risk of human error, improved user experience; traffic light control	Improved safety and efficiency

Source: Adapted by the author from: Artificial Intelligence & Machine Learning (2024); Grzesik, P., Mrozek, D. (2024). Combining Machine Learning and Edge Computing: Opportunities, Challenges, Platforms, Frameworks and Use Cases; Agaujo, S., Peres, R., Ramalcho, J., Lidon, F., Barata, J.(2023).Machine Learning Applications in Agriculture: Current Trends, Challenges, and Future Perspectives; Botero-Valencia, J., Garcia-Peneda, V., Valencia-Arias, A. et al. (2025). Machine Learning in Sustainable Agriculture: Systematic Review and Research Perspectives; Pereira, C., Olivera, E., Souza, A. (2024). Machine Learning Applied to Edge Computing and Wearable Devices for Healthcare: Systematics Mapping of the Literature; Machine learning in healthcare: Uses, Benefits and pioneers in the field. (2024); Azad, A., Atkinson, J., Chan, A. (2024). A review on Machine Learning in Intelligent Transportation Systems Applications, Cummings, A., (2025). How Machine Learning Transforms Retail: Benefits & Use Cases; Eleko, S., Chupruna. R. (2024). 15 Most Valuable Applications of Machine Learning in Retail; Ullah, A., Anwar, S., Li, J., Nadeem, L., Mahmood, T., Rehman, A., Saba, T. (2024). Smart sites: the role of Internet of Things and machine learning in realizing a data-centric smart environment; Ullah, Z., Al-Turjman, F., Mostarda, L., Gagliardi, R. (2020). Applications of artificial intelligence and machine learning in smart cities; Crudu, V. (2025). Investigating the Diverse Application of Machine Learning in Smart Home Internet of Things Solutions; Kunal, G. (2023). Transforming Smart Home with AI and ML.

Specifically, Edge ML is transforming patient monitoring in the medical IoT by localizing biometric data analysis. Wearable ECG patches (e.g., AliveCor) detect arrhythmias in <10 seconds—60 times faster than cloud-based systems—reducing emergency interventions by 30%. Continuous glucose monitors (CGMs) like the Dexcom G7 process data on the device, reducing diabetes management costs by \$1,200 per year per patient through real-time insulin adjustments. Fall detection systems (e.g., Apple Watch) analyze motion sensors locally, avoiding HIPAA-violating data transfers while reducing costs in aged care facilities. due to prevented injuries. Edge devices save money in healthcare and from re-hospitalizations. Viswanathan, V., Khanna, N., Moindarkar, M. et al. (2022) in their analysis of 20 hospitals in the USA estimated that the savings for a hospital for diagnostic tests only from physician fees in the first year of the introduction of artificial intelligence amounted to \$608,333.3, in the fifth year to \$2,493.9 thousand, and in the tenth year to \$6,526.6 thousand.

TinyML soil moisture sensors (e.g. FarmBeats) optimize irrigation, reducing water/fertilizer use by 40% while increasing yields by 15%. On-device visual disease detection (e.g. Plantix app) identifies crop infections in the field with 95% accuracy, preventing losses of \$400/hectare. Autonomous tractors using NVIDIA Jetson for real-time weed spraying reduce herbicide costs by 60%. These technologies provide a 3-year ROI for farms by conserving resources and avoiding losses (World Economic Forum, 2024).

Edge ML enables adaptive traffic control: cameras process congestion patterns locally, reducing commute times by 25% and lowering CO₂ emissions by 15% in pilot cities such as Pittsburgh (Lai X., Xia J., Fan L., Duong TQ and Nallanathan A., 2022). Noise/pollution sensors (e.g. Bosch Climo) trigger warnings without relying on the cloud, reducing monitoring costs by 70% while enabling dynamic emissions pricing. Barcelona saved \$375,000 per year by implementing edge-optimized street lighting that adjusts brightness using local motion detection (Gubbi, J., Buyya, R., Marusic, S., Palaniswami, M., 2013).

Predictive maintenance dominates Industry 4.0: Vibration sensors with ARM Cortex-M chips detect anomalies locally, predicting failures 72 hours in advance. This reduces unplanned downtime and prevents losses from unproduced production. Real-time visual inspection using Google Coral TPU reduces defect rates by 90%, and each Edge TPU is capable of performing up to 4 teraoperations per second (TOPS) using only 2 watts of electrical power (Enabling AI at the Edge with Google Coral TPU, 2021).

Smartwatches (e.g., Fitbit) analyze device health metrics, eliminating the cost of storing data in the cloud. Voice assistants (Amazon Alexa) process 80% of requests locally using neural accelerators, reducing latency to 200 ms, while saving \$0.02 per request in cloud costs. Systems like Google Nest optimize energy consumption, saving 12% on heating costs and 15% on cooling costs, and the initial investment in smart thermostats is typically paid for within two years through reduced energy bills and improved HVAC (heating, ventilation, air conditioning) efficiency. (Smart thermostat energy saving data, 2025).

5. Technical, economic and ethical challenges

Energy efficiency remains a critical issue. Peripheral devices (e.g., wearables, sensors) often run on batteries, where computationally intensive tasks drain them quickly. While neuromorphic chips reduce power consumption by 90%, their implementation increases device costs by 30–50%. For large IoT deployments (over 10,000 nodes), frequent battery replacements lead to maintenance costs of \$500,000 per year, reducing the return on investment (Zhou, Y., Zhang, W. & Li, X., 2023).

Intermittent connectivity disrupts data synchronization in mobile or remote applications (e.g. agricultural drones). Systems with offline capabilities avoid operational disruptions, but require expensive backup storage, which increases the capital cost of the devices.

Privacy risks to on-device data persist despite localized processing. Techniques such as federated learning minimize exposure of raw data but cannot prevent [model inversion attacks](#). A single breach costs more than a cloud breach, and financial losses from global cyberattacks are estimated at \$9.22 trillion in 2024 and are expected to reach \$13.82 trillion by 2028 (Fleck, A., 2025).

The trade-offs between real-time and accuracy impose difficult trade-offs. Optimized models (e.g., quantized MobileNetV3) achieve latency <20 ms, but suffer from a 5–15% loss in accuracy. In safety-critical applications, such as medical diagnostics, this can increase the liability costs of misdiagnosis. (Siegel, S., Rechrai, K., Scanlan, J. et al., 2025).

Bias amplification is a problem for edge models trained on limited local data. Facial recognition on embedded cameras misidentifies minorities 35% more often than cloud-based models, leading to regulatory fines of up to 4% of global revenue under the EU Artificial Intelligence Act (Rajkomar et al., 2024).

Difficulty in updating makes devices vulnerable. Pushing model updates to fragmented peripheral hardware (e.g. Raspberry Pi vs. Jetson) costs 3x more than cloud updates. Outdated models cause performance degradation, leading to customer churn.

Physical security vulnerabilities escalate risks. Endpoints in public spaces (e.g., traffic cameras) are prone to mis-editing, leading to data poisoning. Producing a secure endpoint device costs \$8 to \$12 more per unit, but breaches cause an average loss of \$7 million in intellectual property theft (IoT Threat Landscape Report 2023).

6. Future directions and research boundaries

Scalable federated learning as a new approach in ML will allow collaborative training of models on millions of devices without centralizing and sharing raw data. Its implementation is associated with lower transfer, due to the elimination of the need for access when moving large data sets, which reduces the costs of infrastructure related to data transfer and storage; greater resilience to network failures and interruptions; improved data security and confidentiality; compliance with regulatory requirements.

Edge-Aware Neural Architecture Search (NAS) automates the design of models that are aware of device constraints. Economic Impact: Reduces labor costs for manual optimization by 75%, accelerating deployment for small and medium enterprises and enabling \$0.001/pin for microcontrollers (Wong, C., Wu, B & Zhang, Y., 2022).

Event-driven AI (e.g., neural networks with pulses in Intel Loihi) processes data only when triggered (e.g., sensor anomalies). This reduces power consumption to almost zero during idle states, making battery-powered industrial sensors 50% cheaper to maintain over 5 years (Davies, M., Wild, A., Orchard, G. et al., 2021).

5G/6G and Edge-Cloud Synergy will enable dynamic workload distribution. Latency-sensitive tasks (autonomous vehicles) will be executed at the edge of the network (<5ms), while intensive learning will be shifted to the cloud. The synergistic effect of Edge computing with 5G/6G improves the performance and capabilities of both technologies. Their unification will lead to ultra-low latency, ubiquitous connectivity, precise control over network resources, higher bandwidth. (Ergen, M., Saoud, B., Shaye, I., et al., 2024).

Standardization and regulatory frameworks (e.g. EU AI Law) are crucial. Compliance reduces liability risks (fines $\leq 4\%$ of revenue) but increases the cost of device certification, which imposes industry-wide protocols to avoid market fragmentation.

7. Conclusion

Machine Learning on the Edge represents a fundamental shift towards decentralized, efficient, and privacy-aware intelligence. As demonstrated in the presentation, Edge ML overcomes critical limitations of cloud-centric approaches – latency (enabling real-time decision-making in autonomous systems), privacy (keeping sensitive data on the device), and cost (reducing traffic/cloud service costs by 40–70%). Economically, Edge ML transforms business models: moving from recurring operational expenses (OpEx) to strategic capital expenditures (CapEx), enabling predictive maintenance subscriptions in the industry (savings of \$260,000/hour during downtime), and democratizing AI through low-cost hardware like TinyML (\$0.01/inference).

The future is in hybrid intelligence: federated learning on edge networks for privacy-friendly learning, 5G/edge synergy for dynamic workload distribution (30% bandwidth optimization), and neuromorphic chips for sustainable computing (90% energy reduction). Although challenges with security updates and bias mitigation continue, standardization (e.g., the EU Artificial Intelligence Act) and jointly developed hardware-algorithm stacks are projected to drive the market value of computer peripherals to \$183.22 billion in 2028 and \$215.03 billion by 2033. (Computer Peripheral Equipment Market Opportunities and Strategies to 2033, 2024).

Ultimately, Edge ML is not just an alternative – it is the foundation for scalable, ethical, and economically viable intelligent systems. As industries move from cloud-dependency to edge-cloud collaboration, this

paradigm will unlock unprecedented innovation in manufacturing, agriculture, transportation, healthcare, retail, smart cities and “smart” towns, and beyond.

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7. RETHINKING EDUCATION & LEARNING: BLENDING CREATIVITY WITH CURRICULUM

Harnessing Learning Analytics and Artificial Intelligence for Student Success: Applications and Implications in Higher Education

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JEL: A23, M19, O32

Abstract

Learning analytics (LA) has emerged as a powerful approach to enhance teaching, learning, and decision-making in HE by leveraging data-driven insights. This paper explores the applications of LA and artificial intelligence (AI) in HEIs, with a particular focus on its role in improving student engagement, predicting academic performance, and supporting personalised learning pathways. We review recent empirical studies to demonstrate how HEIs can integrate LA and AI into digital learning environments, course management systems, and institutional decision-making processes. Particular attention is given to the ethical dimensions of student data use, including privacy, consent, and algorithmic transparency. The paper concludes by outlining a framework for effective implementation of LA in HE, highlighting challenges such as faculty readiness, data interoperability, and institutional policy alignment. By advancing a holistic approach, LA can be positioned not only as a technological innovation but also as a strategic driver of student-centered, evidence-based education.

Key words:

learning analytics, higher education, personalised learning pathways

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1. Introduction

Higher education is undergoing a data-driven transformation, making learning analytics (LA) and artificial intelligence (AI) increasingly indispensable for improving student learning outcomes. Over the past decade, LA has evolved exponentially as a research field since the early 2010s (Prieto et al., 2019). As a result, universities collect massive volumes of data from learning management systems, student information systems, and online learning environments. Harnessing these data through LA and AI is pertinent and enables educators to “open the black box” of student learning processes (Jones, 2019). By measuring and analyzing learners’ digital traces, institutions can gain unprecedented insights to personalize education and make evidence-based decisions (Long & Siemens, 2011). In 2025, the optimization is more pertinent than ever, as higher education faces mounting challenges in student success, retention, and integrity in the era of AI.

One pressing problem is student retention and success. Despite numerous efforts, dropout rates in higher education remain high – about 30% on average in OECD countries – representing a significant loss of talent and resources for both individuals and institutions. Improving student success is therefore a global concern (Tinto, 2018). LA and AI offer a timely solution by enabling early intervention for at-risk students. Predictive analytics can scrutinize diverse indicators (grades, engagement clicks, demographics) to identify students who are likely to struggle or drop out early in the term, allowing educators to intervene with early support. This pioneering study of Arnold and Pistilli (2012) showed the potential of data-driven early warning systems to increase student success through timely feedback and advising. In the years since, numerous studies have expanded efforts based on this approach. Recent systematic reviews confirm a proliferation of LA techniques to support students at risk of dropping out (Ifenthaler & Yau, 2020). A wide range of predictive models have been developed – from logistic regression to machine learning classifiers – able to forecast student outcomes and flag those in need of help (Jokhan et al., 2020; Ifenthaler & Yau, 2020). However, despite these advances,

rigorous large-scale evidence of long-term effectiveness remains limited – most LA interventions have only been tested in isolated cases or pilot programs (Ifenthaler & Yau, 2020). This gap makes the research in this area timely: a need to validate and generalize early intervention models across broader contexts and over longer periods is noticeable. By doing so, we can move the field from promising pilots to proven strategies embedded in institutional practice.

Another critical dimension is the push toward personalized learning using AI. Traditional one-size-fits-all teaching often fails to engage the diverse student populations in modern universities. Instructions' needs to adapt to individual learners' needs, abilities, and prior knowledge continue to be recognized. AI technologies – such as intelligent tutoring systems, recommender systems, and adaptive learning platforms – now make personalized learning at scale feasible. Recent research underscores how AI-powered analytics can enable instructors to tailor their approaches: for instance, AI can identify knowledge gaps and provide targeted feedback or resources to each student, thereby improving learning outcomes (Farahani & Ghasmi, 2024). The personalization is especially timely as higher education embraces hybrid and online learning environments; a trend accelerated by the COVID-19 pandemic.

Finally, the intersection of AI and education brings urgent questions of academic integrity and ethics, making the focus on integrity in higher education extremely timely. The recent emergence of powerful generative AI tools (e.g. OpenAI's GPT models) has opened new avenues for academic dishonesty, such as AI-generated essays or solutions able to evade plagiarism detection. Educators worldwide are grappling with efforts to adapt integrity policies considering these tools (Lund et al., 2025). A 2025 study by Lund et al. revealed high awareness among students and faculty about the use of AI for coursework (e.g. writing entire papers via ChatGPT) constitutes serious misconduct, yet inconsistent perceptions persist, underscoring the need for clear guidelines (Lund et al., 2025). The paper's emphasis on integrity addresses both the misuse of AI by students and the ethical use of AI by institutions. This dual perspective is highly relevant to the scientific community's current concerns. On one hand, it is critically important to research AI-enhanced methods for integrity assurance – for example, using machine learning to detect anomalies in writing style, which could indicate AI-generated content, or learning analytics to flag patterns of potential cheating across courses. Such approaches build on prior work in plagiarism detection and authorship identification, updating it for the AI age. On the other hand, there is a deep concern regarding the ethical frameworks for implementing LA and AI in education. The field of learning analytics has long recognized privacy and ethics as key challenges (Papamitsiou & Economides, 2014; Ateeq et al., 2024). As institutions gather ever more student data, issues of data privacy, informed consent, transparency, and algorithmic bias come to the forefront. We do believe that any AI/analytics solution should be deployed responsibly, respecting student autonomy and fairness. An area that has gained momentum with recent policy attention (e.g. EU ethical guidelines for AI, UNESCO's recommendations on AI in education) is the emerging scholarship on "Responsible AI in Education". By developing and testing guidelines for ethical data practices and fairness (e.g. bias audits of predictive models, GDPR-compliant data handling), the project ensures that technological advancements do not outpace the necessary ethical guardrails.

This paper focuses on developing a conceptual model on implementation of novel AI techniques to balance personalized learning with curriculum requirements and scalability. Since these issues are identified as key challenges in the literature (Papamitsiou & Economides, 2014), it is important to study them to contribute to the endeavours to maximize each student's learning potential.

2. Current State of the Research

2.1. Convergence of Learning Analytics and Artificial Intelligence

Over the past decade, learning analytics (LA) and artificial intelligence (AI) have increased its importance in higher education research and practice. This convergence is driven by the promise of personalized learning

– tailoring instruction and support to individual student needs – as well as the need for data-informed decision-making at the institutional level. As a result, a rich body of literature has emerged exploring LA and AI opportunities to support personalized learning, enable early interventions for at-risk students, improve institutional effectiveness, and uphold academic integrity in higher education.

Current research asserts the ability of LA and AI systems to support personalized instruction at the individual, group, and class levels. For example, LA techniques can continuously monitor students' performance and engagement in online learning environments, providing insights for instructors and systems to adapt content and feedback to each learner. A recent systematic review by Khor and Mutthulakshmi (2024) found that LA-driven approaches personalize learning in several ways, such as: (1) gathering real-time feedback on students' skill levels, learning preferences, and even emotional states; (2) classifying or grouping students for targeted support; (3) building feedback loops with continuously tailored learning resources; (4) predicting student performance outcomes; and (5) offering visual analytics dashboards of classroom dynamics (Khor and Mutthulakshmi, 2024). These capabilities allow educators to identify students' strengths and weaknesses more quickly and to intervene with timely, customized support. Notably, studies have demonstrated the value of early warning systems powered by learning analytics for student success. In HE, numerous institutions currently employ early alert systems by analyzing factors like coursework submissions, attendance, and grades to flag at-risk students for proactive support (Harrison, et al., 2021). Empirical evidence suggests these interventions can indeed improve student retention. Such findings reinforce the idea of early, data-informed interventions (e.g. an advisor reaching out when a student falls behind) to reduce dropout rates and improve academic success. Overall, the literature indicates that personalized learning technologies – from adaptive learning software to predictive early alert models – are increasingly effective in enhancing student engagement and outcomes, provided they are implemented thoughtfully.

2.2. Applying LA and AI at Institutional Level

Universities are increasingly under pressure for data use to improve quality and demonstrate accountability. Learning analytics has given rise to “academic analytics”, referring to analyses aimed at institutional-level decision-making (Long & Siemens, 2011). Academic leaders recognize the ability of data-driven insights to inform improvements in curriculum design, resource allocation, and student support services. For example, analyzing course performance across programs might highlight bottleneck courses with high failure rates, prompting curriculum reforms. LA can also help optimize the deployment of support (tutoring, advising) by identifying where it is most needed. Moreover, LA advocates believe that aggregating and analyzing student data will lead to better institutional decisions and enhanced outcomes for at-risk students (Jones, 2019). Research has started to document these benefits: data-driven insights can refine curriculum design, teaching strategies, and resource allocation, thereby elevating the overall quality of education (Gašević et al., 2016). In practice, some universities have integrated LA dashboards into their decision processes – for instance, to monitor course engagement metrics as an institutional KPI for teaching effectiveness. However, a number of higher education institutions still struggle with implementing LA at scale due to organizational and technical barriers (Ifenthaler & Yau, 2020). The timeliness of this proposal is determined by the capability to produce frameworks and evidence and guide effective adoption of LA/AI at the institutional level. By developing prototypes (like early warning dashboards and adaptive feedback systems) and evaluating them in real university settings, the project addresses the practical question of how to achieve LA's promised benefits for institutional effectiveness in a sustainable way. This aligns with current strategic priorities in higher education to become more “data-informed” and improve student success rates as part of institutional accreditation and performance funding models.

At institutional level, LA and AI are also being leveraged to inform strategic decisions and improve organizational outcomes (often termed academic analytics or institutional analytics). Universities are using data dashboards and predictive models to optimize course offerings, allocate resources for student support, and

track key performance indicators like retention, progression, and graduation rates. Research in this area has expanded alongside the growing availability of big data from LMSs and student information systems. However, studies also highlight a limitation in the adoption of learning analytics in higher education. Bahari et al. (2023) note that despite LA's potential to enhance teaching and learning, uptake is hindered by factors such as low user engagement with analytics dashboards and concerns about data quality and skills. Recent systematic reviews have identified a range of CSFs for institutional analytics adoption, including technological infrastructure, leadership support, staff training, and a culture of data-driven decision-making (Šimić, et al., 2025). To guide institutions, researchers have even proposed maturity models – for example, the Higher Education Learning Analytics Capability Maturity Model (HELA-CMM) – which outlines stages of analytics integration across dimensions like data management, ethics and privacy, staff competences, leadership, culture, infrastructure, and quality assurance.

As LA and AI systems become more embedded in higher education, researchers are paying close attention to issues of ethics, privacy, and integrity. One prominent concern in the literature is the fairness and transparency of AI-driven predictions used for student assessment or advising. Recent studies have cautioned the possibility of bias, inadvertently reproduce by predictive models, flagging certain demographic groups as “at-risk” at higher rates – unless carefully designed and tested for fairness. Data privacy is a foundational consideration: institutions must safeguard student data and use it responsibly. Since the early 2010s, authors such as Slade and Prinsloo (2013) have called for a framework of ethical principles for learning analytics, and this has evolved into robust discussions on “responsible AI” in education. Universities and consortia (e.g. the EU's GDPR in context of student data, and the Asilomar LA principles) have issued guidelines to ensure analytics are conducted with transparency, student consent, and data security in mind. This emphasis is evident in current research – for example, Khor and Mutthulakshmi (2024) identified concerns about the accuracy of LA insights, the potential costs, and issues of fairness and privacy as prominent challenges when implementing personalized learning through analytics. Similarly, Šimić et al. (2025) include ethics, privacy and legal issues as one of the key dimensions in their learning analytics maturity model for institutions, highlighting the need for any successful analytics initiative to integrate ethical safeguards and consider the impact on stakeholders.

Finally, a very timely aspect of integrity in higher education is academic integrity in the age of AI. The emergence of advanced AI tools – such as generative AI text models capable of writing essays – has sparked a new wave of research on the necessity to uphold honesty and originality in student work. Scholars are reassessing academic integrity practices due to AI's growing capabilities. Ateeq et al. (2024) observe that while AI offers benefits like personalized learning and automated tutoring, it also poses challenges in preserving academic integrity, as students may use AI tools to gain undue advantages. On one hand, AI-powered tools (e.g. plagiarism detection systems, automated proctoring) are being used to detect cheating or plagiarism, representing a direct way that analytics and AI contribute to maintaining integrity. On the other hand, these same technologies present challenges: students now have access to AI assistants able to produce content, solve problems, or even generate code, which hinders learning as a concept. Some studies propose more holistic assessment approaches with an emphasis on higher-order thinking, authentic tasks, and oral components, which are more difficult to outsource to AI. Additionally, faculty development and clear policies are emphasized – ensuring instructors know to leverage AI for good (e.g. as a teaching aid) while discouraging misconduct. The notion of “integrity” also extends to the AI systems themselves: institutions are called to use AI in transparent and just ways, so that trust in the academic process is maintained. In summary, current research acknowledges a dual imperative: to harness LA and AI for improving learning and institutional outcomes, and simultaneously to address the ethical, fairness, and integrity challenges that come with these powerful tools. This balance of innovation and responsibility defines the state of the art in this problem area, and it sets the stage for the proposed project's focus on “responsible AI” solutions for personalized learning, early intervention, and integrity in higher education.

3. Methodology

3.1. Research objectives

The main goal of the paper is to fundamentally explore how cutting-edge artificial intelligence (AI) models and educational analytics (EA) transform university governance, the organization of the learning process, academic outcomes, and student equity.

To achieve this main goal, three interconnected specific objectives have been defined, following the logic of the research process — from theoretical foundations and methodological basis, through empirical application, to the creation of practical tools and strategic recommendations.

Research objective (RO) 1:

To conceptualize a comprehensive framework for effective LA implementation in HE aligned with the HELA-CMM maturity model.

Despite growing adoption of LA, institutions lack structured, maturity-based guidance for systematic implementation. Mapping an LA framework to HELA-CMM provides a theoretically grounded and developmentally staged approach, enabling institutions to assess their current maturity level and plan targeted improvements. This contributes to closing the gap between conceptual LA models and operational maturity frameworks.

Research objective (RO) 2:

To examine the extent to which faculty readiness influences Learning Analytics maturity across HELA-CMM dimensions.

Faculty engagement and data literacy are consistently identified as critical success factors for LA adoption, yet they remain underdeveloped in many institutions. By explicitly linking faculty readiness to HELA-CMM levels (e.g., from Awareness to Transformation), this objective addresses a socio-technical barrier often overlooked in technically driven LA initiatives and strengthens the human-centric perspective of LA maturity.

Research objective (RO) 3:

To analyze challenges related to data interoperability and their impact on the progression of Learning Analytics maturity in Higher Education institutions.

Fragmented data systems and lack of interoperability impede scalable and sustainable LA practices. Investigating interoperability challenges through a maturity lens allows the study to demonstrate how technical infrastructure constraints hinder advancement beyond early HELA-CMM stages, offering empirical and conceptual insights into why many institutions remain at descriptive or diagnostic analytics levels.

Research objective (RO) 4:

To formulate regulatory principles and governance scenarios for “responsible AI” in universities, aligned with national/European priorities and the principles of open science.

Formulating regulatory principles and governance scenarios for “responsible AI” will provide a framework for the introduction and regulation of AI in higher education institutions, in line with national and European priorities as well as open science principles. This will support the sustainable and ethical implementation of innovations in the sector.

3.2. Methodology

This study adopts a mixed-method, design science–oriented approach to investigate LA implementation in Higher Education through the lens of the HELA-CMM maturity model. Qualitative and quantitative data sources are triangulated to ensure analytical rigor, contextual validity, and practical relevance.

The research is structured in three interrelated phases:

- (1) Framework conceptualization,
- (2) Empirical investigation of implementation challenges, and
- (3) Framework evaluation and refinement.

This design enables systematic exploration of institutional, pedagogical, and technical dimensions influencing LA maturity, while ensuring alignment with the research questions (RO1–RO4).

Table 1

Research approach

Research Objective	Methodology	Key Methods	Primary Data Sources
RO1	Design Science	Literature review, modeling	LA & HELA-CMM literature, institutional documents
RO2	Mixed methods	Surveys, interviews	Faculty data, training records
RO3	Case study	Infrastructure analysis, interviews	IT docs, system logs
RO4	Policy analysis	Document analysis, interviews	Governance & ethics policies

Source: Author’s Compilation, 2025.

For the purposes of framework conceptualization, a research-grounded taxonomy for designing and evaluating experiments concerning LA and AI within higher education, particularly focused on personalised learning and early intervention was developed. This taxonomy organises the topic into fourteen layers, starting with the purpose layer (e.g., student personalisation, institutional effectiveness) and the data domain layer (e.g., academic performance, sociodemographics) used for models. Subsequent layers specify the analytical intent, modelling algorithms (like XGBoost), and practical personalisation levers (such as adaptive pacing or scaffolded support).

4. Results

To address RQ1, a systematic literature review was conducted following established review protocols to synthesize existing research on LA frameworks, maturity models, and institutional adoption strategies. Key databases included Scopus, Web of Science, and IEEE Xplore. The findings were complemented by document analysis of existing LA implementation frameworks and HELA-CMM documentation. Through an iterative abstraction and mapping process, core implementation dimensions were identified and explicitly aligned with HELA-CMM maturity levels. The resulting framework serves as a background to develop a taxonomy for designing and evaluating experiments concerning LA and AI within higher education (LA-AI in HE).

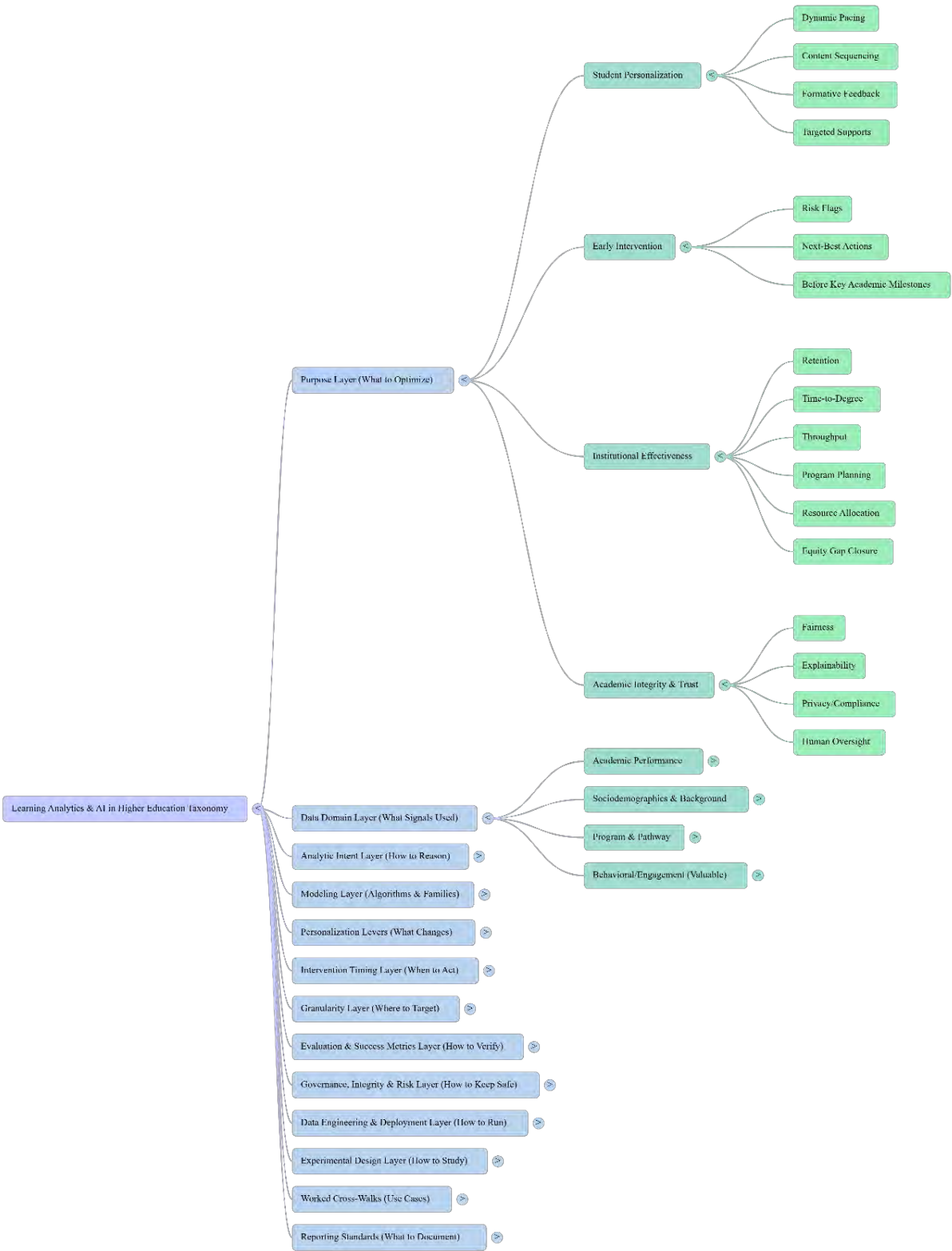


Fig. 1. LA-AI in HE mind map

Source: Author's work using NotebookLM

Details about the layers and the corresponding descriptors are provided in Tables 2, 3, and 4.

Table 2

LA-AI in HE taxonomy: Layer 1 to 4

Layer	Main research question	First-order descriptor	Second-order descriptor
Purpose layer	What you optimize	Student personalization	- Dynamic pacing - Formative feedback - Content sequencing - Targeted supports
		Early intervention	Risk flags and next-best actions timed before key academic milestones
		Institutional effectiveness	- Retention - time-to-degree - throughput - Program planning - Resource allocation - Equity gap closure by subgroup
		Academic integrity & trust	- Fairness - Explainability - Privacy/compliance - Human oversight
Data domain layer	What signals you use	Academic performance	- Course/assessment grades - GPA trajectories - Failed courses - Progression/credit velocity
		Sociodemographics & background	- Age - Gender - Location - Parents' education/income, Residency
		Program & pathway	- Declared major - Year level - Units earned - Course history
		Behavioral/engagement	- LMS activity - Attendance - Motivation - Peer interactions (prospective additions for stronger models)
Analytic intent layer	How you reason		- Descriptive (dashboards/EDA), - Diagnostic (drivers/feature importance) - Predictive (risk & outcome models), - Prescriptive (recommenders and nudges)
Modeling layer	Algorithms & families	Classical classifiers	- LR - DT - KNN - SVM - NB
		Ensembles	- RF - GB - XGBoost
		Neural nets	- ANN/MLP - Time-aware models (e.g., LSTM) for longitudinal risk

Source: Author's Compilation, 2025.

The LA–AI taxonomy for higher education presented in Table 2 structures the application of learning analytics and artificial intelligence across four interrelated layers, progressing from strategic intent to technical implementation. The Purpose layer defines what institutions seek to optimize through LA–AI, ranging from student-level personalization and early intervention to institutional effectiveness and academic integrity. It distinguishes between instructional goals (e.g., dynamic pacing, formative feedback, targeted supports), success-oriented objectives (e.g., retention, time-to-degree, equity gap reduction), and governance-oriented concerns related to fairness, explainability, privacy, and trust. The Data domain layer specifies the categories of signals used to support these purposes, including academic performance data, sociodemographic and background characteristics, program and pathway information, and behavioral or engagement indicators. This layer highlights the increasing value of integrating heterogeneous data sources to develop richer and more context-sensitive analytical models. The Analytic intent layer captures how data are interpreted, moving from descriptive and diagnostic analytics toward predictive and prescriptive approaches. This progression reflects

increasing analytical sophistication, shifting from understanding what has happened and why, to anticipating outcomes and recommending timely actions. Finally, the Modeling layer operationalizes analytical intent through specific algorithmic families, ranging from classical classifiers to ensemble methods and neural networks, including time-aware models suitable for longitudinal analysis. Together, the four-layer taxonomy provides a coherent framework for conceptualizing, designing, and evaluating LA–AI initiatives in higher education, ensuring alignment between educational objectives, data inputs, analytical reasoning, and modeling techniques.

Table 3**LA-AI in HE taxonomy: Layer 5 to 8**

Layer	Main research question	First-order descriptor	Second-order descriptor
Personalization levers	What changes for a learner	Pathway/sequence	- Course recommendations - Prerequisites alignment
		Pacing	- Adaptive deadlines/windows - Micro-goals
		Scaffolding	- Prerequisite refreshers - Practice sets - Tutor/peer matching
		Assessment	- Alternative forms - Mastery checks with formative feedback
		Support services	- Nudges to advising - Financial aid - Wellbeing resources
Intervention timing layer	When you act	Pre-arrival/Onboarding (admissions + placement signals)	
		First-term/early-weeks (after first assessments; strong signal for churn prediction)	
		Mid-course (weekly LMS/assessment deltas)	
		Post-term (re-enrollment and progression actions)	
Granularity layer	Where you target	Individual → cohort/section → program/school → institution system-wide	
Evaluation & success metrics layer	How you verify	Model metrics	- Accuracy - Precision - Recall/TPR, F1 - Probabilistic quality via Log-loss - Error via MSE (for regression or probability calibration checks)
		Use K-fold cross-validation to avoid optimistic bias; many single-split wins shrink under CV	
		Operational/educational KPIs	- Retained credits - DFW rates - Time-to-degree - Advising uptake - Equity gap movement
		Nudge effectiveness	- Uplift vs. control (A/B or stepped-wedge) - Acceptability - Burden
		Calibration/interpretability	well-calibrated probabilities (low log-loss) and human-understandable factors

Source: Author's Compilation, 2025.

Table 3 presents a complementary set of layers that specify how learning analytics and artificial intelligence interventions are operationalized, timed, targeted, and evaluated in higher education contexts. The personalization levers layer addresses what changes for the learner as a result of analytics-driven interventions.

It encompasses curricular and instructional adaptations such as course pathway recommendations, adaptive pacing, scaffolding through prerequisite refreshers or peer support, alternative assessment formats with formative feedback, and targeted referrals to academic, financial, or wellbeing support services. This layer emphasizes that personalization extends beyond content delivery to include assessment design and access to institutional supports. The intervention timing layer specifies when analytics-informed actions are deployed across the student lifecycle, from pre-arrival and onboarding through early-term, mid-course, and post-term stages. Early-term interventions, particularly following the first assessments, are highlighted as especially critical for predicting and mitigating student attrition, while later interventions support re-enrollment and progression decisions. The granularity layer defines where interventions are targeted, ranging from individual learners to cohorts, programs, and institution-wide systems. This progression underscores the scalability of LA–AI applications and their relevance for both micro-level personalization and macro-level strategic decision-making. Finally, the evaluation and success metrics layer outlines how the effectiveness of LA–AI interventions is verified. It distinguishes between model-level performance metrics, operational and educational key performance indicators, measures of nudge effectiveness using experimental or quasi-experimental designs, and considerations of calibration and interpretability. Together, these layers provide a structured approach to designing, implementing, and rigorously evaluating analytics-driven personalization and intervention strategies in higher education.

Table 4

LA-AI in HE taxonomy: Layer 9 to 12

Layer	Main research question	First-order descriptor	Second-order descriptor
Governance, integrity & risk layer	How you keep it safe	Bias & fairness	- subgroup performance parity - monitor false-positive burden on protected groups
		Explainability	- global (feature importance) - local (case explanations)
		Privacy & consent	- role-based access - data minimization - audit trails
		Model risk management	- drift checks - re-training cadence - rollback plans - emphasize interpretability in sensitive decisions
Data engineering & deployment layer	How you run it	Pipelines: ETL from SIS/LMS → feature store (static + streaming) → training → registry → real-time/batch scoring → action systems (email, LMS cards, advisor CRM)	
		Feedback loops: capture outcomes and intervention responses for continual learning	
Experimental design layer	How you study it	Sampling & balancing: beware class imbalance; poster-grade work balanced completion vs. non-completion for modeling	
		Temporal validation: rolling-origin CV where feasible; avoid leakage	
		Ablations: add domains stepwise (e.g., sociodemographic → +academic → +behavioral) to isolate marginal gains	
		Comparative baselines: start with LR/RF; compare GB/XGBoost/MLP; report CV performance and calibration	
		Causal tests of interventions: randomized nudges (A/B), advisor-in-the-loop trials; measure outcome + equity impact	
		Population & timeframe; inclusion/exclusion criteria	

Reporting standards	What to document	Feature dictionary with provenance; transformations
		Validation protocol (folds, temporal splits), hyperparameters, and error bars
		Performance suite (Accuracy/Precision/Recall/F1 + MSE/Log-loss) with subgroup slices
		Operational playbook: alert thresholds, escalation paths, human oversight
		Integrity appendix: fairness tests, interpretability artifacts, and governance approvals

Source: Author's Compilation, 2025.

Once taxonomy is developed, the next step is to apply use cases. Worked crosswalks between analytical taxonomies and practical use cases illustrate how learning analytics can be operationalized across different levels of higher education decision-making. One prominent use case concerns early-term dropout prediction to support proactive academic advising. In this scenario, data derived from early-course assessments, prior grade point average, and selected sociodemographic variables are utilized to generate student risk profiles. Gradient boosting models (e.g., XGBoost) are employed to produce predictive risk scores, with logistic regression serving as a baseline comparator. Predictions are generated following the first graded assessment and updated on a weekly basis. Model performance is evaluated using recall and F1-score to assess the accurate identification of at-risk students, while log-loss is used to assess the actionability of predictions. Educational impact is subsequently measured through student retention rates and credit accumulation momentum.

A second use case focuses on personalized course-selection recommendations to support individualized learning pathways. This approach relies on data related to program progression and historical course performance, supplemented where appropriate by learner interest signals. Recommendation models include random forest or gradient boosting techniques, as well as matrix-based recommender systems, with an emphasis on producing interpretable and human-readable rationales for suggested pathways. Effectiveness is assessed through improvements in subsequent course pass rates, reductions in time-to-degree and course repetition, and analyses of subgroup-level fairness outcomes. Prior research has documented the applicability and effectiveness of recommender systems in higher education contexts.

A third use case addresses institutional effectiveness through analytics dashboards designed for strategic oversight. These dashboards are built on cohort-level aggregated data and allow filtering by instructional modality and equity-related student groups. Analytical functionality includes longitudinal trend analysis combined with predictive overlays and program-level risk heatmaps. The impact of these dashboards is evaluated using indicators such as improvements in student retention, reductions in equity gaps, and more efficient utilization of institutional capacity.

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Legal Aspects of the Use of Artificial Intelligence in the Activities of University Professors

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Abstract

Artificial intelligence (AI) is entering more and more areas of personal and public life, including higher education, but the expansion of the capabilities of new technologies necessitates the introduction of legal regulation. The aim of this article is to explore some legal aspects of the use of AI in the activities of university professors. On the one hand, it examines the extent to which AI tools have been applied and explores the attitudes of the academic community regarding the eligibility for their use in teaching and research. On the other hand, trends and regulatory frame challenges related to the processes under consideration are identified. Outside the scope of this study is the question of what specific AI tools are eligible for use in teaching and research. Along with the traditional legal-dogmatic method of legal research, an empirical survey was used. This article presents the academic community's perspective on the impact of information technology in their professional activities, which has not been the subject of research before. The use of AI tools in the activities of university professors has the practical consequence of building an effective education-science-business relationship.

Key words:

higher education, academic staff, artificial intelligence.

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1. Introduction

Despite all reservations and concerns, artificial intelligence (AI) is one of the greatest and most significant scientific and technological achievements of our time. The expansion of the possibilities of this technology raises the need for the introduction of ethical and legal regulations for control purposes (Slavova & Dimitrova, 2023). AI is entering more and more areas of personal and public life, including the higher education system.

The Strategy for the Development of Higher Education in the Republic of Bulgaria for the period 2021 - 2030¹ identifies key challenges. These are related to the lack of alignment with the needs of the digital generation and the competencies required for successful implementation in the context of the technological revolution. Education systems are struggling to adapt to rapid changes in technology—not only in terms of how technology is used, but also in terms of teaching the skills to work with it and training teachers (Dimitrova, 2024). High-capacity broadband networks, cybersecurity, and AI are not yet the basis of future forms of education. The expected results of the Strategy's implementation are the introduction of modern, flexible, and effective forms and methods of learning—forms and methods integrated in the learning process and in scientific research that use AI in higher education institutions where at least 50 % of current students are enrolled.

When talking about the use of AI in education, the specialized literature usually refers to its importance in teaching pupils and students, i.e., the extent to which AI will replace the role of the teacher, become a tool for personalized education, and an innovative method for facilitating the learning process (Staribratov & Glushkova, 2024; Lazarova & Lazarov, 2025; Stamenova, 2024; Pencheva, 2023) or will facilitate the administrative services provided by higher education institutions to students (Andreeva, Kuyumdjiev &

¹ Adopted by a Decision of the National Assembly, published in the State Gazette, issue 2 of 2021.

Dimitrova, 2022; Petrov et al., 2022; Likova-Arsenova, 2020).

Another aspect of the use of AI in the work of university lecturers is the development of skills for working with digital technologies, which will create an effective framework for linking higher education with business. The quality of universities is linked to many factors, both internal (such as the quality of teaching staff) and external, i.e., meeting the requirements of business and the economic environment in which higher education institutions develop. This link between internal and external factors is achieved, on the one hand, through the power of scientific activity, the results of which are aimed at meeting the needs of business and society as a whole. On the other hand, precisely through scientific research the teachers have the direct opportunity to test and investigate a given practical problem with the direct participation of external parties from business and industry (Nedyalkova, 2023).

While this article does not focus on the impact of digital technologies on the learning process or educational services in a university environment, it examines the attitude of university lecturers towards the application of AI in their professional activities. This makes it possible to see the academic community's perspective on the impact of information technologies on the higher education system, which has not been the subject of scientific research until now.

The above justifies the actuality of the topic under consideration.

The aim of this article is to examine some legal aspects of the use of AI in the activities of university lecturers. This aim is achieved through the fulfillment of following tasks:

- To examine the extent to which AI tools are used in teaching and research activities;
- To study the attitudes of the academic community regarding the acceptability of using AI in teaching and scientific work;
- To identify trends and challenges in the regulatory framework related to the use of AI in the professional activities of university lecturers, with the aim to exercise control and to prevent improper practices.

Along with the traditional legal-dogmatic method used in legal research, a survey was conducted on an empirical plan. For this purpose, an anonymous survey was conducted between July 2 and 13, 2025, among lecturers from all higher education institutions in the city of Varna. Over 230 representatives of the academic community took part in the survey.

2. Use of AI in teaching and research work

The scope of activity of higher education institutions is defined in Article 6, paragraph 1 of the Higher Education Act², according to which their main activity is teaching and research. In view of this, the main types of activities performed by university lecturers are teaching and research work. For example, AI systems can be used to: automatically generate tests for exams; edit text and check the grammar of educational literature or scientific publications; collect and process data; perform language translations, etc. It is also possible to generate text on a given topic. However, the question of which specific AI tools are permitted and acceptable for use in teaching, learning, and research is beyond the scope of this study.

On the one hand, the degree of application of AI tools is examined and the attitudes of the academic community regarding the admissibility of their use in teaching and research work are studied. On the other hand, trends and challenges in the regulatory framework related to the use of AI in the professional activities of university lecturers are identified. For this purpose, a questionnaire was designed, and the

² Article 6, paragraph 1 of the Higher Education Act: A higher education institution is a legal entity whose scope of activity is:

1. training specialists capable of developing and applying scientific knowledge in various fields of human activity;
2. improving the qualifications of specialists;
3. developing science, culture, and innovation.

data obtained was summarized and analyzed.

To the question "Do you use AI tools in your teaching?" almost half of the respondents answered "Yes" categorically. If we add to this number those who would be willing to do so, the proportion of university lecturers who have a positive attitude towards the use of AI in teaching is 72 %. Only 24 % of respondents said they do not use such tools, and an even smaller proportion (4 %) said they would never use such technology in their teaching (see Fig. 1).

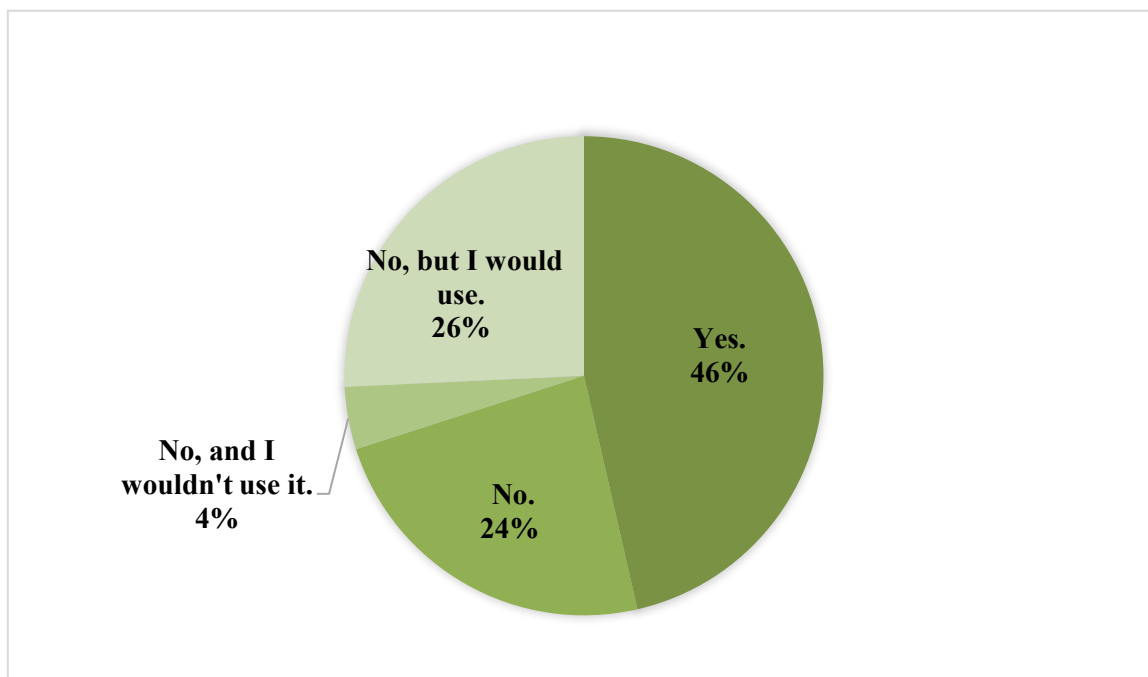


Fig. 1. „Do you use AI tools in your teaching?“

Source: own survey.

Similar are the answers to the question "Do you use AI tools in your research activities?" Here, 47 % of respondents say they already use AI in their research activities, and another 24% would do so in the future. Only 24 % of university lecturers do not use such tools. The proportion of those who say they would not use AI in their scientific work is insignificant (5 %) (see Fig. 2).

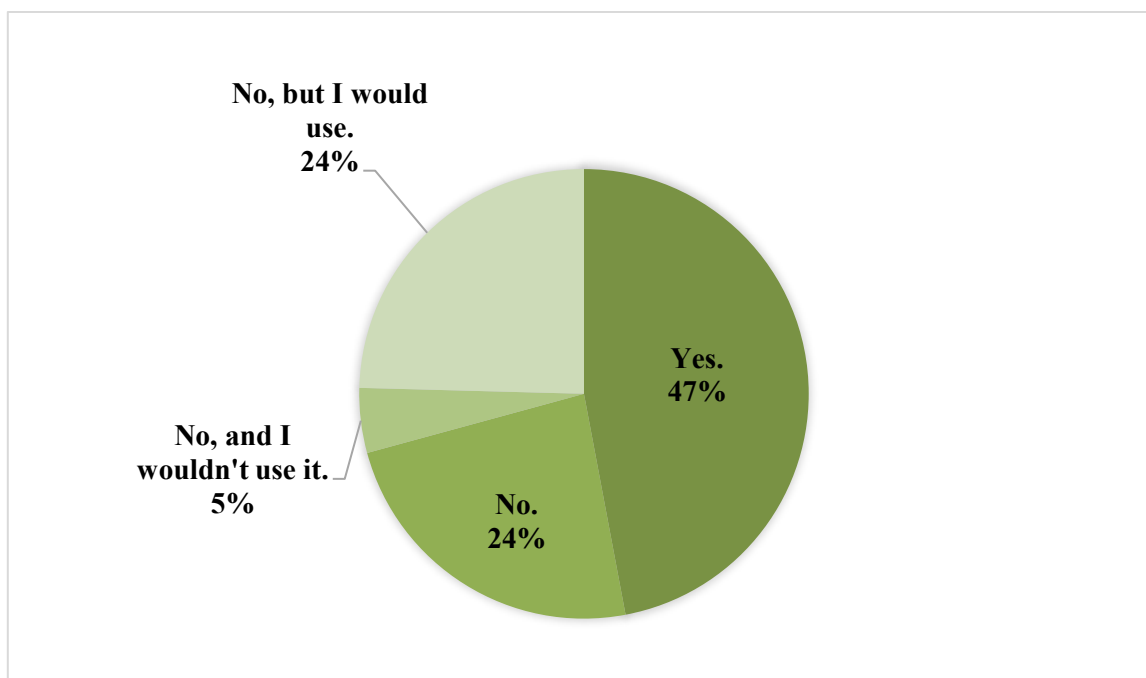


Fig. 2. „Do you use AI tools in your research?“

Source: own survey.

The following table clearly shows the attitudes of university lecturers towards using AI tools in both their teaching and research work. Although the differences in the responses received are within one percent, the different attitudes towards the application of this technology in the two types of activities are nevertheless indicative.

The proportion of those who do not use such technologies in teaching and scientific work is exactly the same. Among those who already use AI tools, university lecturers who apply them in their research work predominate.

University lecturers who would use AI tools in their teaching activities in the future are slightly more numerous than those who are inclined to apply this technology in their scientific activities. Among those surveyed who categorically state that they would never use AI, the proportion of those with a negative attitude towards the application of this technology in scientific work is one percent higher.

Table 1

AI in the activities of university lecturers

	Yes	No	I would use	I would not use
Do you use AI tools in your teaching?	46 %	24 %	26 %	4 %
Do you use AI tools in your research?	47 %	24 %	24 %	5 %

Source: own survey.

In summary, it should be noted that university lecturers who already use AI tools apply them primarily in their research activities. Those who are inclined to apply this technology in the future would rather do so in their teaching work. At the same time, there is a larger proportion of people who gave a negative assessment of the use of AI in scientific work. The conclusion that can be drawn is that, in general, university lecturers

approve of the use of AI tools in teaching rather than in research. This conclusion is confirmed by the answers to the next question.

To the question "Which of the following statements best matches your understanding?", the largest share (75 %) chose the answer "It is acceptable to use AI in both teaching and research work." If we add to this the responses that this technology can be applied either only in teaching or only in research, it is clear that almost all respondents approve of the use of AI tools. Only 8 % of respondents consider the use of AI unacceptable in both aspects of university activity (see Fig. 3).

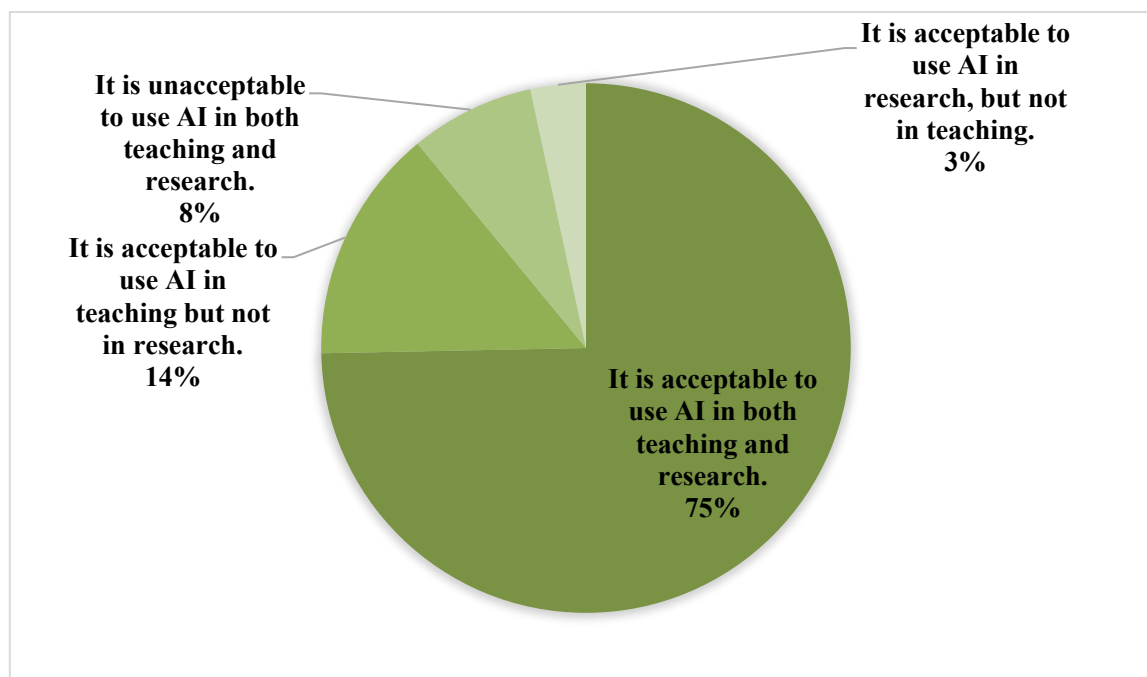


Fig. 3. „Which of the following statements most closely matches your understanding?“

Source: own survey.

The results of the survey clearly show that AI tools have become an integral part of both teaching and research activities of university lecturers. Almost half of the respondents already use this technology in their professional activities, and about a quarter are willing to use it in the future. Quite logically, three-quarters of the respondents consider it acceptable to use AI in both teaching and research, even though not all of them are already doing so in practice.

On the one hand, this shows that the academic community is digitally literate, extremely well acquainted with the possibilities of new technologies, and has a positive attitude towards their application. On the other hand, the widespread introduction of AI into the professional activities of university lecturers poses serious challenges to the higher education system and raises the need for legal regulation of these processes. This is necessary because the regulatory framework will regulate what specific AI tools are permitted and acceptable for use in teaching, learning, and research work, how the use of these technologies will be controlled, and what sanctions will be imposed for their unlawful use by university lecturers.

3. Challenges in front of the normative framework

The main direction of legal influence is its regulatory function. Through it, the regulatory framework ensures the necessary proper and effective organization of social relations and their development in accordance with the principles and laws of social evolution (Milkova, 2009, p. 86). This means that the role of law is to

regulate social relations in such a way that legal norms are adequate to the social and economic development of society at a given moment.

However, law is a conservative system, and it is an indisputable fact that the regulatory framework (not only in Bulgarian legislation, but also at the European level) lags behind technical progress. AI tools are already part of the professional daily routine of university lecturers, but their use in teaching and research activities is not regulated by law (Dimitrova, 2024).

When asked, "Do you think there should be legal regulations on the use of AI in the work of university lecturers?", only 12 % of respondents said that this was not necessary, while 18 % were unable to assess the need for legal regulation of these public relations. The response of the majority of university lecturers is indicative — 70 % of them believe that legal regulation of the use of AI in their professional activities is necessary. At the same time, the responses received show that there is no consensus among members of the academic community on how and at what level this regulation should be (see Fig. 4).

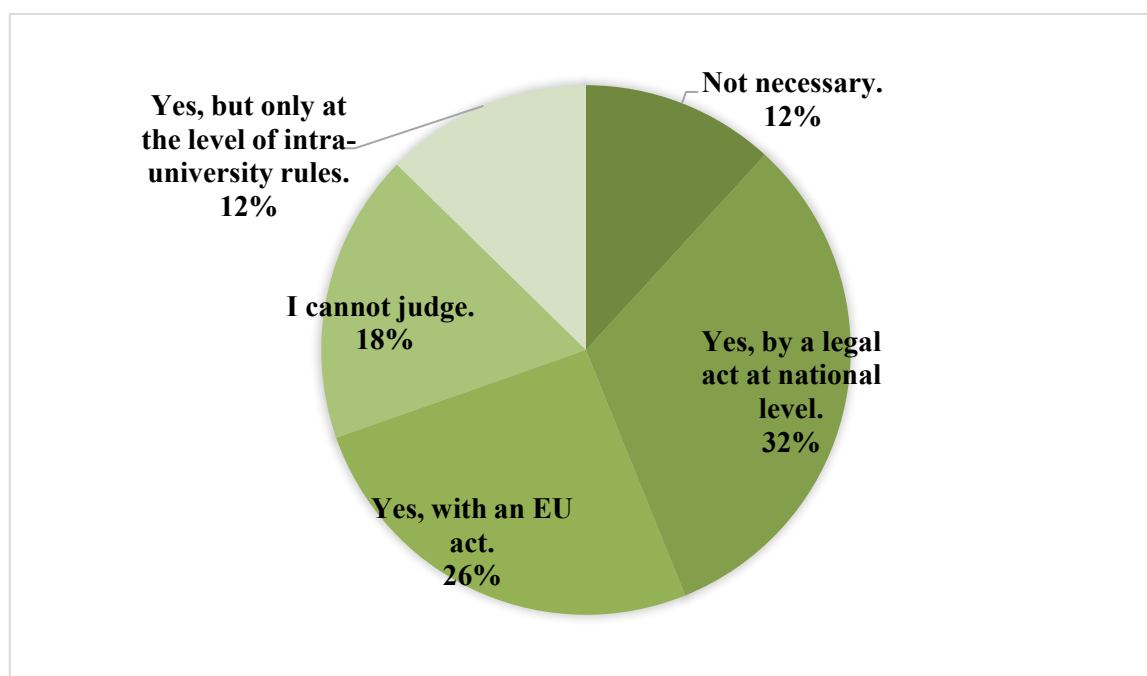


Fig. 4. „In your opinion, is there a need for a legal regulation on the use of AI-assisted tools in the activities of university lecturers?“

Source: own survey.

The largest share (32 %) is held by those who believe that the legal framework governing the use of AI in the work of university lecturers should be contained in a national-level legislative act. At this stage, the only document in our country that recognises the importance of AI for the activities of higher education institutions is the Strategy for the Development of Higher Education in the Republic of Bulgaria for the period 2021 - 2030. In view of this, it includes "Activity 1.2. Strengthening training in modern digital technologies and interdisciplinary links in curricula and programs" and "Measure 1.2.1. Inclusion in all curricula of disciplines and practical training in new digital technologies such as artificial intelligence (AI), augmented reality (AR), virtual reality (VR), and others, as well as basic training for developing algorithmic thinking and problem-

solving skills." The tools for achieving these activities and measures are: the national program OPSEID³, PE⁴., amendments to the Higher Education Act, changes to curricula and programs.

However, it should be noted that strategies (even those adopted by a decision of the National Assembly) are not binding legislative acts, but rather documents that merely outline the framework for future legal regulation. At this stage, despite the stated intention in the Strategy for the Development of Higher Education in the Republic of Bulgaria for the period 2021 - 2030 to amend the Higher Education Act to introduce modern forms and methods of teaching using AI, this has not yet been done.

In legal terms, strategies are not binding normative acts, but rather programmatic in nature and represent guiding documents that provide guidelines, perspectives, or specific tasks for implementation (Markov, 2014). Given this, at the current stage of development of Bulgarian national law, there is still no special legal regime regarding the use of AI in the activities of university lecturers. Although the aforementioned strategy is not a binding normative act, it should be assessed as a positive first step towards future legal regulation of the use of AI in higher education. In this sense, it should be emphasized that this document is not without legal significance.

Next, 26 % of university lecturers believe that the use of AI should be regulated by European Union legislation. Steps have already been taken in Europe to regulate issues relating to the legal regime of AI and its use. A Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act) is adopted⁵.

However, it should be noted that higher education policies in the European Union are mainly decided at the level of individual Member States. The role of the Union in the field of higher education is mainly to support and, to some extent, coordinate, as harmonization of Member States' legislation is expressly excluded. The European Union may take action in accordance with the ordinary legislative procedure and through incentive measures. The main objectives of the Union's action in the field of higher education are: to promote the mobility of students and teachers; to promote the mutual recognition of diplomas and periods of study; to promote cooperation between higher education institutions and the development of distance (university) education⁶.

Given what's been said about the European Union's policies on higher education, the general regulation on implementing AI systems in different sectors of the economy couldn't be directly applied to the work of university lecturers in individual member states.

At least (12 %) of respondents believe that the use of AI in the activities of university lecturers should be regulated only at the level of internal university rules. All internal regulations of higher education institutions must comply with the provisions of the Higher Education Act and other applicable laws and regulations in the field of higher education (Dimitrova, 2021, p. 82). In the absence of national legislation on the use of AI in higher education, there is a risk that unlawful internal university rules will be adopted.

Regardless of the diverse options that are considered appropriate, almost three-quarters of respondents believe that some form of regulation of these public relations is necessary. At the same time, the fact that the use of AI tools has already become firmly established in teaching and scientific work clearly shows that legislation must meet the expectations of the academic community.

³ Operational Program "Science and Education for Smart Growth."

⁴ Education program.

⁵ Available at: <https://eur-lex.europa.eu/eli/reg/2024/1689/oj/eng> (Last access on 15.07.2025).

⁶ Available at: http://www.europarl.europa.eu/atyourservice/bg/displayFtu.html?ftuId=FTU_5.13.4.html (Last access on 15.07.2025).

The lack of legal regulation could act as a strong incentive for more ambitious university lecturers to use AI tools in their research work in order to meet the scientometric requirements for the relevant academic position more quickly and easily. It is no secret that the pursuit of greater competitiveness is one of the leading motives for using innovation. Other university lecturers, due to concerns or moral barriers, would not use this type of technology, which leads to inequality among members of the academic community.

This survey does not ask more detailed questions about the reasons why some university lecturers do not use AI tools in their professional activities. The fact that some of the respondents categorically state that they would not use AI either in teaching or in their scientific work can be explained, on the one hand, by prejudice against new technologies or a lack of digital skills. On the other hand, the reason is probably largely rooted in the lack of legal regulation. The existence of a regulatory framework will legitimize the use of AI in the activities of university lecturers and create uniform rules applicable to all. This will remove ethical barriers and moral concerns regarding the use of AI tools.

The use of AI in the professional activities of university lecturers has another important aspect. This technology is changing traditional teaching methods in higher education, and its integration into the learning process affects student performance and results. The application of AI in the educational process is no longer a matter of choice but a prerequisite that can take student learning to a higher technological level, thereby contributing to the provision of high-quality higher education and the training of competitive specialists for the modern requirements of the labor market (Lyubomirova, 2024).

On the one hand, the development of AI systems requires university lecturers to improve their digital literacy and apply new teaching methods and approaches. On the other hand, they must encourage students to use AI and build understanding and skills in working with it, because modern business needs qualified employees who have the skills to work with new technologies. AI is transforming the economy. The skills that employers look for in their employees are changing extremely rapidly under the influence of modern technologies. The use of AI in higher education is no longer an idea of the future, but a reality.

4. Conclusion

After analyzing some legal aspects of the use of AI in the work of university lecturers, the following conclusions can be drawn:

- First, this article presents the academic community's perspective on the impact of information technologies on their professional activities, which has not been the subject of scientific research until now. AI tools have become a permanent feature of both teaching and research activities of university lecturers. The academic community is digitally literate, extremely well acquainted with the possibilities of new technologies, and has a positive attitude towards their application.
- Secondly, the widespread introduction of AI into the professional activities of university lecturers poses serious challenges to the higher education system and raises the need for legal regulation of these processes. Legislation must meet the expectations of the academic community. Legal regulations should be adopted regarding the use of AI in the activities of university lecturers, which should be contained in a normative act at the national level.
- Thirdly, in practical aspect, the article would be useful for the governing bodies of higher education institutions when adopting internal regulations on the use of AI in the activities of university lecturers, in accordance, of course, with the provisions of the Higher Education Act and other applicable laws and regulations in the field of higher education. Furthermore, the use of AI tools in the activities of university lecturers will have the practical effect of building an effective link between education, science, and business, which is one of the priority objectives of the Strategy for the Development of Higher Education in the Republic of Bulgaria for the period 2021 – 2030.

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The city of Varna is a university center with six higher education institutions located within its territory. Four of them are state-owned: the Nikola Yonkov Vaptsarov Naval Academy - Varna, the University of Economics - Varna, Medical University - Varna „Prof. Dr. Paraskev Stoyanov“ and the Technical University of Varna. The other two higher education institutions are private: Varna Free University "Chernorizets Hrabar" and the Varna University of Management.

I would like to thank my colleagues who responded to the survey!

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Reframing Careers: ECLD and the Service Turn in Personal Development

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JEL: M12, M53, J24

Abstract

Background and aim: In the face of accelerating change in work and identity, traditional career development models centered on predefined roles and linear progression are no longer sufficient. This paper aims to introduce Entrepreneurial Career and Life Design (ECLD) as a transformative alternative and explore its advancement through the lens of Service Logic, reframing careers as dynamic, co-created journeys. **Scope and limitations:** The contribution is conceptual, drawing on a synthesis of literature from entrepreneurship education, life design, and human resource development, without empirical testing. **Methods:** The paper applies a conceptual methodology, integrating ECLD with Service Logic to build a generative theoretical framework and highlight key transitions in career development. **Results:** The analysis identifies three central transitions enabled by this integration: (1) from role fulfillment to personal mission-building, (2) from prescribed upskilling to self-directed development, and (3) from static competencies to adaptive, purpose-driven capacities. **Conclusions:** ECLD functions not only as a pedagogical method but also as a strategic and ethical response to contemporary challenges, supporting both individual flourishing and organizational innovation in the age of complexity. **Originality:** By integrating entrepreneurial thinking and service logic, the study contributes a novel, human-centered lens to human development and HRD theory. **Practical implications:** The chapter offers guiding principles and reflective tools for applying ECLD in coaching, education, and organizations, advocating for a rehumanization of career development.

Key words:

Entrepreneurial Career and Life Design (ECLD), service logic, career development, human resource development, intrapreneurship

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1. Introduction

The world of work is undergoing a profound and accelerated transformation, driven by a confluence of technological disruption, demographic shifts, and evolving socio-economic structures. Globalization, digitalization, and the transition toward knowledge- and service-based economies are fundamentally challenging the traditional psychological contract of employment and the very assumptions upon which careers have long been built (Arthur & Rousseau, 1996; Hall, 2004). The once-dominant model of a linear, predictable career trajectory within a single organization has become increasingly anomalous. In its place, contemporary professional pathways are increasingly characterized by discontinuity, precarity, and a pervasive need for constant adaptation and identity negotiation (Savickas et al., 2009). The rise of the gig economy, portfolio careers, and fluid organizational boundaries has further intensified the demand for new, more agile approaches to career development—ones that can accommodate complexity, foster personal agency, and provide a sense of coherence amidst uncertainty (Baruch & Vardi, 2016; DeFillippi & Arthur, 2020).

In this evolving context, conventional Human Resource Development (HRD) models, which predominantly emphasize role-based upskilling and hierarchical progression within a defined corporate structure, appear increasingly insufficient. While these models have historically been effective in supporting workforce specialization and organizational efficiency, they often fail to capture the emergent, holistic needs of modern individuals, who seek not only employability but also purpose, resilience, and a capacity for lifelong

learning (Watts, 2023). Employees today are not merely performers of predefined tasks; they are increasingly understood as active agents who negotiate, interpret, and co-create value within dynamic, interdependent professional ecosystems (Lusch & Vargo, 2014; Maisch & Wolf, 2023). This paradigm shift necessitates a fundamental reframing of career development—one that moves beyond a focus on filling pre-existing roles and instead integrates entrepreneurial mindset, reflective learning, and human-centered design principles to empower individuals as the authors of their own working lives.

A promising response to this imperative is the emergence of Entrepreneurial Career and Life Design (ECLD). This paradigm synthesizes insights from the career construction theory of life design (Savickas et al., 2009) and the action-oriented principles of entrepreneurship education (Neck & Corbett, 2018). ECLD posits that individuals can and should act as the proactive designers of their personal and professional trajectories, using iterative processes of reflection, prototyping, and adaptation to navigate complex environments (Burnett & Evans, 2016). To theoretically ground and advance this paradigm, the lens of Service Logic—particularly Service-Dominant Logic (SDL)—offers a generative framework. SDL reframes value creation not as a result of output delivery but as a collaborative process of interaction and co-creation between actors integrating resources (Grönroos, 2011; Lusch & Vargo, 2014). When translated into the domain of career development, this perspective fundamentally repositions individuals from being recipients of developmental "services" to being active co-creators of career value within their professional networks and communities.

Despite the conceptual promise of both ECLD and Service Logic, scholarly inquiry into their intersection remains limited. A clear theoretical synthesis is needed to articulate how the co-creative, interactive principles of Service Logic can inform and enrich the practices of Entrepreneurial Career and Life Design. Therefore, the central aim of this conceptual paper is to explore this integration systematically. We investigate how ECLD can be advanced through the lens of Service Logic and demonstrate how this combined framework offers a robust new perspective for rethinking career development in the twenty-first century—providing both conceptual clarity for scholars and practical guidance for HRD practitioners, coaches, and organizations seeking to foster human flourishing and adaptive capacity in an era of complexity.

2. Literature Review and Hypotheses Development

2.1. Traditional HRD Models and Their Limitations in a VUCA World

Human Resource Development (HRD) has historically been anchored in paradigms that prioritize skills training, role-specific competency models, and sequential, hierarchical career progression. Classical frameworks, such as those articulated by Nadler (1984) and Swanson & Holton (2001), were conceived in an era of relative industrial stability and were fundamentally aligned with organizational imperatives for efficiency, predictability, and control. Within these models, employees were predominantly positioned as human *resources*—inputs to be optimized—with career growth conceptually tethered to vertical mobility and long-term organizational loyalty in exchange for job security.

While these approaches have contributed significantly to workforce professionalization and operational excellence, their limitations become starkly evident in today's volatile, uncertain, complex, and ambiguous (VUCA) environments (Bennett & Lemoine, 2014). A substantial body of scholarship now argues that the presumption of linear career paths is increasingly anachronistic within dynamic, globalized labor markets. In their place, boundaryless and protean career concepts—characterized by psychological success, self-directedness, and value-driven adaptability—have emerged as more accurate descriptors of contemporary professional experiences (Arthur & Rousseau, 1996; Hall, 2004; Baruch & Vardi, 2016). A critical shortcoming of conventional HRD is its frequent prioritization of organizational performance metrics over the processes of employee meaning-making and holistic well-being, an oversight that can inadvertently undermine intrinsic motivation, engagement, and long-term retention (Clarke, 2013; DeFillippi & Arthur, 2020). These collective limitations underscore an urgent need for new conceptual frameworks that recognize employees not

merely as performers of predefined roles, but as adaptive learners, meaning-makers, and active co-creators of value within interconnected professional ecosystems.

2.2. Life Design Approaches: Narrativity, Adaptability, and Meaning

The concept of life design emerged from the field of career counseling as a direct response to the inadequacy of traditional, trait-and-factor approaches in a post-industrial, knowledge-driven economy. Rooted in constructivist and narrative psychology, life design posits that careers are not discovered but are actively constructed through stories, where individuals are invited to author their own professional journeys, making sense of past experiences and projecting future possibilities (Savickas et al., 2009). This perspective shifts the focus from objective role-fit to subjective meaningfulness, championing reflexivity, adaptability, and the pursuit of a coherent personal narrative over the achievement of predefined, often externally imposed, success criteria.

Burnett and Evans (2016) effectively popularized and operationalized these ideas through their *Designing Your Life* methodology, which adapts core design thinking principles—such as prototyping, iteration, and radical user-centeredness—to the domain of personal and career development. Life design frameworks are particularly salient in contexts where structural stability is no longer guaranteed, as they provide individuals with practical tools for building psychological resilience, facilitating identity construction, and enhancing adaptive capacity in the face of ambiguity (Savickas, 2013; Di Fabio & Maree, 2012). However, a persistent critique of the life design literature is its primary focus on the individual level of analysis, at times underemphasizing the constraining or enabling role of broader structural, cultural, and organizational dynamics (Nota & Rossier, 2015). This theoretical gap creates a fertile opportunity for integration with complementary perspectives, such as entrepreneurship education and Service Logic, which explicitly situate individual agency within wider ecosystems of resource integration and value co-creation.

2.3. Entrepreneurship Education as Reflective and Action-Oriented Learning

Concurrently, entrepreneurship education has evolved as a distinct field that transcends its original focus on new venture creation to foster universally applicable mindsets of innovation, resilience, and opportunity recognition (Fayolle, 2013; Neck & Corbett, 2018). Its pedagogical foundations are deeply experiential, drawing upon principles of learning-by-doing, reflection-in-action, and iterative problem-solving—concepts that resonate strongly with the ethos of life design (Kolb, 2015; Rae, 2006). A cornerstone of this domain is the theory of effectuation, which describes a type of "effectual reasoning" wherein individuals learn to navigate uncertainty by leveraging their available means (who they are, what they know, and whom they know) and co-creating new futures with committed stakeholders (Saravathy, 2001; Dimov & Pistrui, 2022).

Within organizational contexts, this entrepreneurial orientation is the engine of intrapreneurship, strategic agility, and proactive career management, enabling individuals to shape their roles and environments rather than merely adapt to them (Volery et al., 2015). The integration of entrepreneurship education with career development has thus gained significant momentum, as both fields increasingly converge on the importance of self-directedness, low-risk experimentation, and critical reflective practice (Gedeon & Kernbach, 2024). This synthesis effectively expands the scope of HRD beyond its traditional mandate of role preparation, moving toward a more dynamic objective: cultivating adaptive learners who can proactively design careers in alignment with both deeply held personal values and evolving organizational missions.

2.4. Service Logic as a Co-Creative Paradigm Shift

A parallel and reinforcing paradigm shift has been occurring in management theory through the ascendancy of Service Logic. Building fundamentally on service-dominant logic (Vargo & Lusch, 2004; Lusch & Vargo, 2014), Service Logic contends that value is not embedded in outputs (goods or services) but is always

determined and co-created through the interactions and experiences of the beneficiary (Grönroos, 2011). This view has profoundly reshaped fields from marketing to innovation by repositioning all stakeholders—customers, employees, partners—as active participants in the generative process of value realization.

When applied to the domains of careers and HRD, Service Logic carries transformative implications. It suggests that employees are not passive recipients of training programs or hierarchical structures but are, instead, active co-creators of their own learning, development, and professional trajectories (Maisch & Wolf, 2023). This reframes career development from a transactional provision of skills to a relational process embedded in social, organizational, and societal contexts, where meaning, competence, and value are collaboratively negotiated and validated. This paradigm, therefore, aligns powerfully with growing calls to humanize work by centering human agency, qualitative interaction, and a shared sense of purpose (Todt et al., 2024).

2.5. Positioning Entrepreneurial Career and Life Design at the Intersection

We posit that Entrepreneurial Career and Life Design (ECLD) emerges as an integrative meta-framework that synthesizes the reflective, narrative orientation of life design, the experiential and action-based practices of entrepreneurship education, and the relational, co-creative principles of Service Logic. At its core, ECLD challenges the entrenched dichotomy between organizational control and individual agency by envisioning careers as dynamic, ongoing processes of co-designed value creation. This integrative positioning enables three fundamental conceptual advances that form the core of our theoretical contribution:

1. A shift from role fulfillment to mission-building, where ECLD encourages individuals and organizations to move beyond static job descriptions toward the ongoing articulation of personal and collective missions that generate value at organizational and societal levels.
2. A shift from prescribed upskilling to self-directed development, reconceiving learning not as a curriculum imposed by the organization but as a collaborative design process, leveraging individual reflection and real-world experimentation.
3. A shift from static competencies to adaptive capacities, where ECLD emphasizes meta-skills such as agility, resilience, and contextual intelligence as the true hallmarks of sustainable career development in complex environments.

By weaving these theoretical strands together, ECLD provides a robust and applicable framework for a renewed HRD practice in the age of complexity. It advances a vision of career development as simultaneously a deeply personal design process and a service-oriented, relational practice that generates mutual benefit for individuals, organizations, and the wider society.

2.6. Recent Critiques of HRD: Toward Sustainable, Humanized, and Post-Growth Perspectives

The limitations of traditional HRD are further illuminated by a growing body of critical scholarship that challenges its foundational assumptions. These critiques coalesce around three prominent and often overlapping strands: the imperative for sustainability, the urgent need for humanization, and the provocative challenge of post-growth perspectives.

Emerging literature emphatically argues that HRD must transcend its traditional focus on efficiency and skill alignment to engage meaningfully with grand challenges such as climate change, social inequality, and responsible innovation. The concept of Sustainable HRD (SHRD) explicitly highlights the responsibility of organizations to balance economic performance with ecological integrity and social well-being (Garavan & McGuire, 2010; Kramar, 2014). Scholars in this domain contend that HRD should foster not only employability and productivity but also long-term systemic resilience, ethical awareness, and environmental stewardship (Docherty, Kira, & Shani, 2009; Clarke, 2021). This orientation aligns seamlessly with ECLD's

emphasis on purpose-driven experimentation and multi-stakeholder value creation, which seeks to integrate individual flourishing with broader systemic sustainability.

A second, powerful critique concerns the tendency of conventional HRD to inadvertently treat employees as resources or human capital—assets to be managed—rather than as human beings with inherent dignity, complex aspirations, and a fundamental capacity for meaning-making (Alvesson & Willmott, 2002; Costea, Crump, & Amiridis, 2007). The humanization turn calls for development approaches that prioritize dignity, agency, and holistic well-being as non-negotiable elements of professional growth (Bauwens, 2022). This critique finds a strong ally in the Service Logic paradigm, as both reject instrumentalist, top-down views and instead emphasize relational, dialogical processes of value and growth. ECLD directly advances this agenda by equipping individuals with reflective and design tools that center personal mission and intrinsic motivation, thereby supporting more authentic and engaged relationships with work.

A more radical critique originates from post-growth and degrowth scholarship, which fundamentally questions the growth-centric orientation underpinning most HRD and management education (Pfeffer, 2010; Banerjee, 2018). From this viewpoint, the relentless pursuit of productivity and economic expansion is not only ecologically untenable but also psychologically and socially detrimental, as it narrows the conceptual space for human-centered development. Post-growth perspectives encourage a rethinking of HRD in terms of sufficiency, care, reciprocity, and shared value rather than a singular focus on competitive advantage (Nesterova, 2020). Within this framing, careers should be understood less as vehicles for relentless upward mobility within growth-driven structures and more as consciously designed processes that seek a balanced integration of personal fulfillment, community well-being, and planetary sustainability.

Together, these critiques underscore the profound inadequacy of HRD models that narrowly emphasize role performance and short-term economic outcomes. Instead, they point unequivocally toward a necessary reframing of HRD as a discipline that must cultivate resilient, ethical, and human-centered capacities in both individuals and organizations. Entrepreneurial Career and Life Design offers a coherent and timely response to these critiques by positioning career development as a reflective, adaptive, and value-co-creative process that aligns individual agency with broader societal and ecological responsibilities.

2.7. Hypotheses Development

Based on the synthesized literature, we propose that the integration of Entrepreneurial Career and Life Design (ECLD) principles into HRD practice will directly address the identified gaps in traditional models. The core proposition is that ECLD, by fostering agency, experimentation, and co-creation, enhances outcomes that are critical for success in contemporary VUCA environments. Therefore, we derive the following testable hypotheses:

- H1: Organizational initiatives informed by the ECLD framework will have a stronger positive effect on employees' perceived career adaptability and proactive career behaviors than traditional, competency-based HRD programs.
- H2: The positive relationship between ECLD initiatives and employee well-being and engagement is mediated by an increased sense of psychological ownership over one's career.
- H3: ECLD's emphasis on relational co-creation will strengthen the positive association between individual career development and beneficial organizational-level outcomes, such as innovation capacity and talent retention.

These hypotheses provide a framework for empirically validating the theoretical contributions of the ECLD model and its efficacy in creating sustainable, human-centric career development ecosystems.

3. Material and Methods

Conceptual Approach

Because this paper is conceptual rather than empirical, its methodological orientation lies in theory integration and framework development. Following recommendations from conceptual HRD research (Lynham, 2000; Torraco, 2005), the study synthesizes insights from three domains—life design, entrepreneurship education, and Service Logic—and situates them within ongoing critiques of traditional HRD. The purpose is to build a generative framework that reframes careers as dynamic, designable, and co-created processes of value creation.

3.1 Rationale for Integration

Each of the perspectives considered contributes a distinct lens for understanding career development in the age of complexity: 1) Life Design provides the reflective and narrative dimension, encouraging individuals to construct meaning and adaptability through self-authored stories (Savickas et al., 2009; Di Fabio & Maree, 2012). 2) Entrepreneurship Education contributes the experiential and action-oriented dimension, equipping individuals with the capacity for experimentation, resilience, and opportunity recognition (Fayolle, 2013; Neck & Corbett, 2018; Sarasvathy, 2001). 3) Service Logic offers the relational and systemic dimension, reframing value creation as a process of interaction and co-creation within broader organizational and societal contexts (Grönroos, 2011; Lusch & Vargo, 2014). By integrating these lenses, Entrepreneurial Career and Life Design (ECLD) is positioned as both a personal development framework and a strategic HRD response to contemporary challenges.

3.2 Conceptual Mapping: From Inputs to Outcomes

The integration of ECLD and Service Logic can be conceptualized as a three-stage process: 1.) Inputs: Agency and Reflection -Drawing from life design, individuals engage in reflective exercises to identify values, aspirations, and narratives of identity. This stage emphasizes self-authorship as the foundation for career design (Savickas, 2013; Burnett & Evans, 2016). 2.) Processes: Experimentation and Co-Creation-Borrowing from entrepreneurship education, individuals treat their careers as iterative experiments—prototyping, testing, and revising pathways. Service Logic reframes this process as co-creation, recognizing that career outcomes emerge through interaction with peers, mentors, organizations, and communities (Maisch & Wolf, 2023). 3.) Outcomes: Adaptive and Value-Creating Careers-The result is a career trajectory that is adaptive rather than predetermined, shaped by resilience, contextual learning, and contribution to shared value. Outcomes are assessed not only in terms of performance or advancement but also in mission alignment, meaningful contribution, and sustainable development (Todt et al., 2024).

3.3 Critical Transitions in Career Reframing

The conceptual synthesis highlights three critical transitions that ECLD enables when viewed through Service Logic: 1). From Role Fulfillment to Mission-Building; 2). Careers are no longer defined by titles or tasks but by the pursuit of personally meaningful missions that align with organizational and societal needs; 3) .From Prescribed Learning to Self-Directed Development . Instead of relying solely on HRD programs, individuals proactively design learning experiences in partnership with organizations and peers. Competence is understood not as a fixed skillset but as an evolving capacity for resilience, problem-solving, and contextual intelligence.

3.4 Toward a Model of Career Reframing

Bringing together these strands, the proposed conceptual model (Fig. 1) positions ECLD as the integrating

mechanism that translates Service Logic principles into career development practice. In this model: 1). Individual agency (life design) serves as the entry point; 2). Experimentation and iteration (entrepreneurship education) function as the core process; 3). Relational co-creation (service logic) provides the systemic and organizational grounding. Adaptive, meaningful, and sustainable careers emerge as the outcome. This framework positions ECLD not simply as a pedagogical method but as a strategic and ethical HRD response, capable of addressing both individual and organizational needs in an era of uncertainty, complexity, and demand for sustainability.

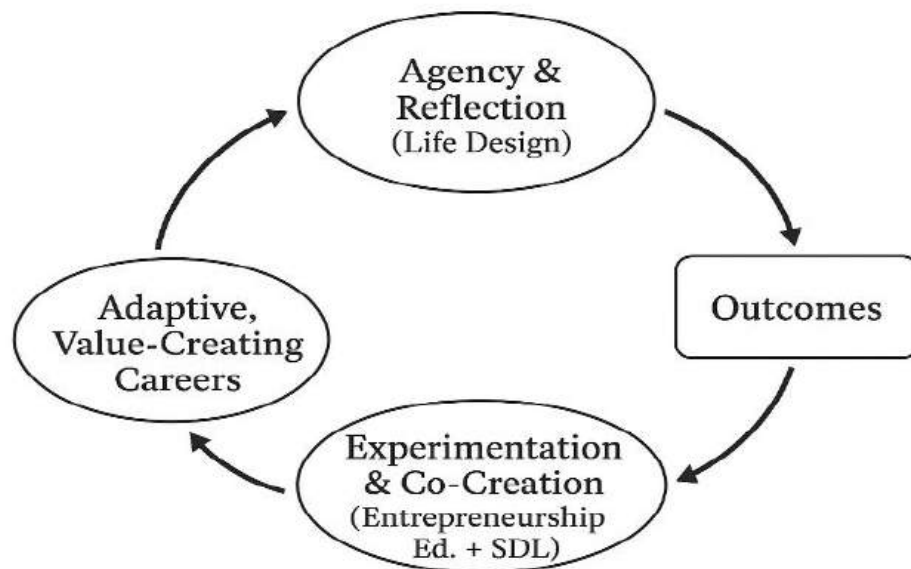


Figure 1. The ECLD-SDL Conceptual Framework for Career Development

Fig. 1. Conceptual Model of ECLD through a Service Logic Lens

Source: Authors' conceptualization

This diagram illustrates a dynamic, iterative process where an individual proactively designs their career and life through a cycle of reflection, action, and adaptation. It moves beyond the traditional linear career path to a fluid model centered on agency and learning.

The circular flow chart with four core components, connected by arrows show progression and a key feedback loop. The central element, "Entrepreneurial Mindset," acts as the engine for the entire process.

The model is comprised of the following core components: 1) Agency & Reflection (Life Design): The subject under discussion is as follows: The starting point and foundational mindset. This is the point at which the individual assumes responsibility for their own development. Utilising principles derived from Life Design, they engage in introspection, contemplating their values, interests, abilities, and the worldviews they uphold. Action: The act of posing questions such as "Who am I?" is a fundamental aspect of the inquiry. The subject expressed a desire to ascertain their own desires. "What matters to me?" The objective is to establish a direction, rather than a definitive destination. Secondly, experimentation and co-creation (Entrepreneurship Ed. + SDL) are to be considered. The subject under discussion is as follows: The subsequent phase is the action phase. In lieu of exhaustive planning, the individual undertakes low-risk, high-learning experiments. Action: Entrepreneurship Education: It is a set of tools that have been developed to facilitate the identification of opportunities, the creation of prototypes, and the generation of value. Self-Directed Learning (SDL): The endeavour to proactively seek out the knowledge and skills required for experimentation is of paramount importance.

Co-Creation: Engagement with individuals from diverse backgrounds, including mentors, peers, and communities, is encouraged to facilitate knowledge construction and acquisition. This approach is prioritised over solitary work practices. Thirdly, the issue of adaptive, value-creating careers is addressed. The subject under discussion is as follows: The following section outlines the outcomes of the experimentation phase. This constitutes a career path that is not a single job, but rather a portfolio of roles, projects, and engagements. Action: The individual adapts to changing markets and personal interests. The primary focus of these individuals is the creation of value for themselves, as well as for others. This value creation may take the form of personal fulfilment, income, or the resolution of problems. Additionally, these individuals may choose to contribute to society at large, thereby fulfilling a societal need or addressing a pressing issue. The following section will address the outcomes and feedback loop. The subject under discussion is as follows: The outcomes encompass both tangible benefits, such as employment opportunities and the successful execution of projects, and intangible benefits, including the acquisition of new skills, the expansion of one's professional network, and an enhanced sense of self-confidence. The Feedback Loop: This is the crucial learning mechanism. It is important to note that outcomes, whether positive or negative, are processed as new information. This feedback is directed back to "Agency & Reflection," thereby facilitating a cycle of life design that is both new and informed. For instance, a failed experiment can provide valuable lessons, helping to refine one's sense of purpose.

The model's foundational element is the entrepreneurial mindset, which is situated at the core of the cycle, thereby providing the necessary impetus for its progression. It encompasses curiosity, bias toward action, resilience, and the ability to embrace uncertainty—the essential attitudes that facilitate progress.

4. Results and Discussion

The conceptual integration of Entrepreneurial Career and Life Design (ECLD) with Service-Dominant Logic (SDL) yields a coherent framework with profound implications for rethinking career development in the 21st century. This synthesis moves decisively beyond the limitations of traditional, linear HRD models, proposing a paradigm where careers are reconceptualized as dynamic, iterative processes of value co-creation. The following discussion elucidates the core implications of this integration for HRD theory and practice, intrapreneurship, and workplace innovation, before consolidating the principal theoretical contributions of this study.

4.1. Implications for Human Resource Development (HRD): From Training Provision to Ecosystem Facilitation

The analysis necessitates a fundamental transformation in the role and function of HRD. It moves the discipline from a paradigm of *training provision*—focused on imparting predefined, role-specific competencies—to one of *ecosystem facilitation*. Within the ECLD-SDL framework, HRD's primary mandate is to design and nurture dialogic spaces that enable the relational processes where career value is co-created. This involves institutionalizing practices such as peer coaching circles, cross-functional innovation projects, and structured reflective practice groups. These are not ancillary activities but core infrastructure that facilitates the interactions through which individuals, peers, and leaders collaboratively construct meaning, share knowledge, and mobilize resources.

This reorientation is predicated on a humanistic philosophy that centres employee agency, meaning-making, and holistic well-being as the foundational drivers of sustainable performance, rather than treating them as secondary outcomes. By prioritizing the development of adaptive capacities—such as resilience, contextual intelligence, and effectual reasoning—over the mere acquisition of static skills, the framework offers a direct and robust response to long-standing critiques of HRD's instrumentalist and economically deterministic history (Costea, Crump & Amiridis, 2007; Alvesson & Willmott, 2002). Consequently, HRD

practices must evolve to prioritize psychological safety, provide dedicated reflective space, and embed developmental coaching to support this shift towards lifelong adaptive capacity (Di Fabio & Maree, 2012; Savickas, 2013).

4.2. Implications for Intrapreneurship: From Discrete Acts to Continuous Mission-Building

The application of the ECLD-SDL lens precipitates a significant reinterpretation of intrapreneurship within organizations. It transcends the view of intrapreneurship as a series of discrete, corporate-sanctioned entrepreneurial activities. Instead, it is reconceived as a continuous, relational process of "mission-building," wherein employees are empowered to design and propose initiatives that create a resonant alignment between their personal purpose and the organization's strategic objectives. This process is inherently social and resource-integrating; employees leverage effectual reasoning to mobilize support and assets within their professional networks, transforming the entire organization into a live laboratory for career prototyping.

In this model, innovative projects serve a dual, synergistic purpose: they are vehicles for driving tangible organizational value *and* primary mechanisms for facilitating individual career development and exploration. This approach fundamentally fosters a culture of collaboration and shared ownership over innovation, dismantling the traditional silos that often confine innovative activity to dedicated R&D departments. By framing intrapreneurship as a form of career prototyping (Burnett & Evans, 2016), the ECLD-SDL framework aligns the pursuit of organizational innovation with the individual's journey of self-authorship and adaptive career design (Dimov & Pistrui, 2022; Volery et al., 2015).

4.3. Implications for Workplace Innovation: Embedding Design and Dialogue in Organizational Structures

Informed by the principles of life design, the ECLD framework encourages prototyping, iteration, and reflection as core career behaviors. When translated to the domain of workplace innovation, this suggests that organizations must systematically embed design thinking practices not only into product and service development but also into the very structures of career and talent management. Simultaneously, SDL provides the theoretical rationale, asserting that innovation inherently emerges from interaction, collaboration, and specific use contexts (Grönroos, 2011; Lusch & Vargo, 2014).

Applied holistically, this requires the deliberate creation of *dialogic organizational structures*—such as open innovation platforms, cross-level knowledge exchanges, and employee-driven problem-solving forums. These structures enable the organization to remain agile and responsive to external complexity while fostering inclusive participation in the innovation process. Furthermore, the combined ECLD-SDL framework underscores that contemporary workplace innovation must balance the imperative of organizational competitiveness with a genuine commitment to employee flourishing and ecological responsibility. Therefore, innovative HRD strategies should explicitly integrate sustainability goals, seeking to align the personal missions of employees with broader societal and environmental imperatives, thus operationalizing the call for Sustainable HRD (Kramar, 2014; Todt et al., 2024).

4.4. Theoretical Synthesis and Contributions

This conceptual integration makes several distinct and substantive contributions to HRD and career scholarship:

1. **A Service-Oriented Theory of Careers:** This study proposes a novel theoretical framework by rigorously applying the principles of SDL to the domain of career development. It offers a coherent and systematic reinterpretation of careers as ongoing processes of value co-creation within service ecosystems, moving beyond metaphorical use of the term to a theoretically grounded model.

2. **Bridging Micro-Meso-Macro Levels of Analysis:** The ECLD-SDL framework effectively constructs a

meso-level theoretical bridge that connects micro-level psychological processes (individual agency, reflection, identity construction) with meso-level organizational structures and macro-level societal outcomes. This provides a more holistic and integrated understanding of career development than models that focus exclusively on either individual agency or structural determinism.

3. An Integrative Framework for Sustainable and Humanized HRD: The model demonstrates how the pursuit of personal career goals can be synergistically aligned with organizational and societal well-being. It thereby answers repeated calls for a more sustainable and humanized approach to HRD (Garavan & McGuire, 2010; Bauwens, 2022) by providing a clear theoretical pathway and practical mechanisms through which individual flourishing can contribute directly to organizational resilience and responsible value creation.

In conclusion, the ECLD-SDL integration presents a comprehensive and timely paradigm for reimagining career development. It reframes HRD as a facilitative practice, reinterprets intrapreneurship as a form of identity-work, and positions workplace innovation as a dialogic and human-centric process. This reframing offers a robust conceptual toolkit for scholars and practitioners seeking to foster adaptive, meaningful, and sustainable careers in an increasingly complex world.

5. Conclusion and Future Directions

The contemporary world of work is defined by profound volatility, structural discontinuity, and a growing collective search for meaning and purpose in professional life. These conditions collectively render traditional, linear career models—predicated on stability and predictable advancement—increasingly obsolete. This paper has presented a coherent argument that the integration of Entrepreneurial Career and Life Design (ECLD) with Service-Dominant Logic (SDL) offers a robust, human-centric, and theoretically grounded framework to address the complexities of this new reality. Our theoretical synthesis precipitates a fundamental paradigm shift: it moves the conceptualization of careers away from pre-defined paths of role fulfillment and towards an understanding of them as iterative, social, and dynamic design processes of value co-creation.

This reconceptualization is not merely abstract; it is operationalized through five interconnected guiding principles for HRD and organizational practice: (1) centering agency as the foundation for self-authorship; (2) embracing experimentation as a core career practice; (3) fostering relational co-creation within professional ecosystems; (4) humanizing development by prioritizing dignity and well-being; and (5) orienting toward sustainability to ensure long-term resilience. These principles are given practical form through a suite of reflective tools—including narrative career mapping, career prototyping, and mission alignment exercises—which collectively empower individuals to author their own adaptive and purposeful journeys. Consequently, these tools facilitate a vital alignment between personal growth and the enhancement of organizational and societal resilience, creating a synergistic cycle of value.

As a conceptual study, a primary and acknowledged limitation of this work is the lack of direct empirical validation. This very limitation, however, charts a clear course for a generative future research agenda. We propose two critical and complementary avenues for scholarly inquiry. First, in-depth qualitative inquiries—such as longitudinal narrative interviews and phenomenological studies—are urgently needed to explore the lived experience of individuals and practitioners applying an ECLD-SDL approach. Such research would illuminate the nuanced processes of identity negotiation, resource integration, and meaning-making that the framework entails. Second, rigorous quantitative and mixed-methods studies must be developed to measure the causal impact of ECLD-SDL-informed interventions. Key outcome variables for such research should include not only traditional metrics like employability and performance but also psychological well-being, innovative work behavior, stakeholder value creation, and contributions to sustainable performance indicators.

In conclusion, the reframing articulated in this paper is more than a theoretical exercise; it represents a strategic and ethical imperative for organizations, educators, and HRD professionals navigating the 21st-century landscape. By constructing a robust bridge between individual agency and systemic needs, the ECLD-

SDL framework provides a vital pathway for fostering careers that are not only adaptive and fulfilling for the individual but also a source of innovation, resilience, and responsibility for organizations and society at large. The implementation of this framework calls for a courageous reimagining of development practices, promising to cultivate work environments where human flourishing and sustainable value creation are mutually reinforcing goals.

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From Economic Knowledge to Civic Responsibility: Rethinking Economic Education in the 21st Century

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Abstract

Dynamic socio-economic transformations require a rethinking of traditional economic education to meet the demands of the 21st century. The paper conceptualizes economic education not only as the acquisition of knowledge and skills, but also as a driver of social competence and civic responsibility. The aim is to outline possible paths for reforming economic education by responding to a recognized need to affirm economic education as a field of civic emancipation, social justice and a sustainable future. By reviewing contemporary theoretical perspectives and educational practices that integrate civic and social dimensions, the study identifies key challenges and opportunities for innovation. A qualitative methodology is used, with an interpretive focus, in order to reveal dependencies and conceptual connections between economic education, civic responsibility and social engagement. The results show that the key factor for the success of educational innovations is based on support with three dimensions: substantive, methodological and institutional. The findings point to the need for a systemic change in economic education, oriented towards preparing future economists as responsible citizens capable of dealing with complex societal and economic challenges. The study shows that economic education needs to be reinterpreted as a platform for social learning – a space in which learners do not simply understand how the economy works, but also learn to question it, connect it with values and understand its impact on people and the environment. The practical implications of the development relate to enriching the scientific discussion on the topic, as well as providing practical benefit to experts in the field of education, teachers, educational institutions and organizations engaged in the formation of sustainable educational policies.

Key words:

economic education, active learning, civic competence, social competence, citizenship education.

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1. Introduction

In a modern society built on rapidly evolving technologies, global interconnections and increasingly complex social structures, economic education cannot be seen as a simple transmission of technical and empirical knowledge. It should be interpreted as a process that not only provides analytical tools for understanding economic processes, but also forms a critical perspective on their impact on society and the environment.

Historically, economic education has been dominated by the neoclassical paradigm, focused on rational choice, market efficiency and mathematical modelling. Although this approach has its undeniable detailed advantages, it to some extent ignores the social, ethical and ecological dimensions of economic activities. With the growing challenges facing the modern world – climate change, inequalities, crises of democratic representation and deficits of trust in institutions – the need for interdisciplinary, critical and civic-oriented education becomes increasingly urgent.

It is crucial to understand that economic processes do not exist in a vacuum. They are deeply rooted in social structures, cultural contexts and political dynamics. In this sense, preparing students in economics

requires not only developing analytical skills, but also fostering ethical reflections, empathy and social engagement. This is especially true for 21st century citizens who are faced with the need to make decisions that balance economic interests and social responsibility.

Undoubtedly, this requires a transformation of teaching methods – from passive perception of knowledge to active participation, from a focus on individual rationality to collective responsibility, from a dominant cognitive dimension to the integration of social and emotional competences. However, educational institutions often remain nostalgically attached to outdated programs and didactic models that reproduce a fragmented and apolitical understanding of economics.

One of the leading objectives of this paper is to identify existing deficits and outline possible ways to reform economics education. Drawing on relatively new theoretical developments in the fields of civic education, social learning, and critical pedagogy, we will attempt to build a conceptual framework that connects economic knowledge with the formation of civic identity, social engagement, and responsible behavior.

Such an approach does not mean rejecting traditional knowledge, but rethinking its development in the context of the new reality. This also includes engagement with the global sustainable development goals defined in the UN 2030 Agenda for Sustainable Development (2015), where economic sustainability and social justice are inextricably linked.

In summary, it should be emphasized that at the heart of any change in education is the question of its value orientation. If economics is taught solely as a science for the efficient allocation of resources, without a critical assessment of the goals, means and consequences of economic actions, there is a risk of it becoming an instrument of technocratic governance, devoid of ethical sensitivity and public legitimacy. Hence the need for economic education to be established as a field of civic emancipation, social justice and a sustainable future.

The proposed research also aims to reconsider the role and importance of economic education in contemporary society, emphasizing the need to integrate civic and social dimensions into the teaching and learning process. Based on the thesis that economic education should serve not only for professional training, but also for the formation of responsible, ethical and socially engaged individuals, the study seeks to draw attention to a new paradigm of teaching.

The leading research problem that is set to be resolved is to what extent and in what ways contemporary economic education can contribute to the development of civic and social competence in learners, in accordance with the dynamics of the century in which we live.

Within this main question, the study sets itself the following specific tasks:

1. To trace the evolution of the main paradigms and concepts that shape the contemporary understanding of economic education.
2. To analyze existing concepts and theoretical frameworks related to civic education, education for sustainable development and social engagement.
3. To identify educational practices that apply active learning methods based on collaboration, simulations, case studies and projects related to real social and economic challenges.
4. To indicate the role of the teacher and the learning environment in forming social and civic sensitivity in learners.
5. To offer specific recommendations for reforming the curricula of economic disciplines for secondary and higher education by including elements of civic education.

The implementation of the above tasks aims not only to enrich the scientific discussion on the topic, but also to provide practical benefit for experts in the field of education, teachers, educational institutions and non-governmental organizations engaged in the formation of sustainable educational policies.

Additional emphasis is placed on the review of strategic frameworks and normative documents, both

national and international, which outline guidelines for the modernization of education systems. In particular, Transforming our world: the 2030 Agenda for Sustainable Development (United Nations, 2015), Reference Framework of Competences for Democratic Culture (Council of Europe, 2016), Education for Sustainable Development Goals: learning objectives (UNESCO, 2017), Council Recommendation on key competences for lifelong learning (European Union, 2018) are considered.

Among the expected results of the study are those associated with the formation of a conceptually grounded model of integrated economic and civic education, identification of successful pedagogical practices, and preparation of guidelines for future scientific research and educational innovations in the field.

2. Economic knowledge as a component of civic competence: a theoretical reading

The theoretical overview in this study aims to outline the main paradigms and concepts that shape the contemporary understanding of economic education, its transformation and its relationship with civic and social competence. In the context of the 21st century, there is a growing interest in interdisciplinary approaches that overcome the traditional fragmentation of knowledge and place economics in a broader social and ethical context.

1. Economic education: from a technocratic to a humanistic paradigm

Historically, economic education has been mainly oriented towards the development of analytical abilities, modeling skills and understanding of the market through quantitative and mathematical tools. This approach, dominated by neoclassical theory, affirms the idea of *homo economicus* – a rational, individualistic and benefit-maximizing subject (Becker, 1976). However, at the end of the 20th and the beginning of the 21st century, criticism of this reductive model has intensified. The need to include ethical, cultural and social aspects in economic theory and education has been highlighted by researchers such as Amartya Sen (2004) and Martha Nussbaum (2011). They propose concepts such as the „capability approach“, in which economics is linked to freedom of choice, human dignity and the possibility of participation in public life.

2. Civic competence and democratic education

Civic competence refers not only to knowledge of institutions and laws, but also to the skills to participate in democratic processes, critical thinking, cooperation and respect for others. According to Hoskins and Crick (2010), this competence should be seen as an indispensable part of full participation in modern societies.

The Reference Framework of Competences for Democratic Culture (2016) introduces 20 interrelated skills, attitudes and knowledge necessary for life in a pluralistic society. It can be argued that economic education, although traditionally viewed as a neutral sphere, has the potential to serve as a platform for the development of these competencies, especially when considering the relationship between economic decisions and social consequences.

3. Education for Sustainable Development and Economic Literacy

A „reorientation“ of education towards sustainable development is called for in UNESCO's Education for Sustainable Development Goals: learning objectives (2017), which emphasises the importance of systems thinking, intercultural understanding and collective decision-making skills. In this context, it should be stressed that economic literacy should go beyond basic understanding of markets, supply and demand, and include topics such as social justice, sustainable consumption, responsible finance and environmental impact.

Economic education, understood as „critical economic literacy“ (Davies, 2006), fosters learners' ability to question economic dogmas, understand the structural causes of inequalities and explore alternative economic models – cooperative, „green“, solidarity-based.

4. Active learning and constructivist approaches

Active learning methods, based on the principles of constructivism, emphasize the role of the student as an active participant in the process of knowledge creation. Activities such as case studies, simulations, role-

playing games, debates and project-based learning stimulate critical thinking, collaboration and social reflection.

The importance of education is emphasized by Biesta (2011), not simply as a process of qualification, but also as socialization and subjectivization, that is, the construction of a personality with autonomous ethics and political awareness. In this sense, economic education has the potential to serve as a laboratory for democratic practices and civic education.

5. Inequalities in access to critical economic education

Despite theoretical developments and successful practices in individual countries, access to critical and civically engaged economic education can be seen as uneven. In countries with dominant standardized and objective teaching, there is often a lack of space for discussing controversial issues, alternative economic visions, or social justice. This creates not only educational deficits, but also social risks – young people who grow up with a reduced vision of the economy find it difficult to navigate contemporary global processes such as financial crises, climate policies, tax justice, or corporate responsibility.

Based on the above, the theoretical framework of the present study can be derived, which is associated with the following key elements:

- economic education as a process of building civic and social identities;
- critical literacy as a basis for democratic participation and social engagement;
- active learning as a pedagogical approach promoting autonomy, ethics and solidarity;
- multidisciplinary as a prerequisite for understanding the complexity of contemporary economic realities.

This framework serves as the basis for the empirical analysis in the following parts of the study and guides the search for innovative practices in economic education that combine analytical precision with societal sensitivity.

3. Methodological foundations for researching and rethinking the relationship between economic knowledge and civic responsibility

This study uses a qualitative methodology focused on an interpretive approach in order to reveal deep dependencies and conceptual connections between economic education, civic responsibility and social engagement. The choice of a qualitative strategy is determined by the need to understand not only the structural characteristics of curricula and teaching methods, but also the meaningful interpretations that participants (teachers and learners) give to these educational practices.

1. Research approach

The study is based on two main methods: a systematic review of the scientific literature and an analysis of good practices through a case study approach (Case Study Analysis). According to this combination, it provides both theoretical depth and empirical illustration of the main trends in the integration of economic and civic education.

2. Systematic literature review

The literature review was conducted between May and September 2025, searching databases such as Scopus, Google Scholar, JSTOR, etc. The keywords used in the search included: economic education, civic competence, critical economic literacy, education for sustainable development, active learning, citizenship education, social competence.

The following inclusion criteria were used:

- publications from the last 15 years (2010 – 2025);
- articles in peer-reviewed journals;

- research related to pedagogical practices, policies or innovative approaches in economic education;
- sources containing a clear link between economic education and civic and/or social competence.

A total of 18 publications were included, of which 4 were strategic documents, and four university websites. The data were systematized by topics identified through coding: teaching methods, educational goals, integration of civic values, pedagogical challenges.

3. Case study analysis of good practices

The second part of the methodology includes an analysis of four case studies from educational institutions in the Netherlands, Finland and Canada, where civic and social dimensions are integrated into economic education. The information is collected from:

- publications and reports of institutions;
- curricula and didactic materials;
- interviews with lecturers (secondary data from university websites).

The case study analysis allows for the study of specific practices, such as simulations of parliamentary debates on economic topics, social entrepreneurship as an educational module, interdisciplinary projects on sustainability, etc.

4. Ethics and limitations

The study is entirely documentary-based and relies on secondary data, therefore, when presenting good practices, ethical considerations are observed, including avoiding interpretations that may distort the meaning of the original sources.

The main limitations of the study include:

- lack of original empirical data from the field (such as interviews, surveys);
- potential distortion of the results due to language barriers (mainly English-language sources were analyzed);
- limited number of case studies (single case study), which does not allow generalization to all education systems.

5. Analytical approach

The data from the literature and case studies are subjected to thematic analysis in order to derive key categories and conceptual connections. The main analytical categories are: economic education, social justice, civic participation, pedagogical innovation, interdisciplinarity.

The combined methodological approach allows for the formulation of substantiated conclusions about the state and potential of economic education as a catalyst for civic engagement.

4. The manifestation of civic responsibility in economic knowledge: results and discussion of the effect

In order to reveal the main trends, challenges and potential directions for innovation in the field of economic education, viewed through the prism of civic responsibility and social competence, the present summary is presented and the results of the analysis of selected sources and case studies are interpreted.

1. Integration of civic and social dimensions in economic programs

From the analysis of the literature and case studies, one of the most clearly emerging conclusions is that in educational systems where economic education is supplemented with civic education components, an increased degree of critical thinking, social engagement and desire to participate in public life is observed in students (Hoskins & Crick, 2010). Programs in which economic topics are presented not simply as technical, but as ethically and socially related, lead to the development of more complete competencies.

In Finnish universities (University of Helsinki, University of Jyväskylä), economics education includes

modules related to market ethics and economics and democracy, in which students are required to analyze real cases of public policy through the prism of sustainability and social justice (analysis of real policies and their ethical consequences). Students do not just learn how the tax system works, but also explore the ethical consequences of different tax regimes on different social groups. There are also strong programs and focus areas in sustainable business and economics (University of Jyväskylä), where economics education includes ethics, corporate responsibility and consideration of the social consequences of policies and regimes.

2. The role of the teacher as a mediator and catalyst of change

It cannot be emphasized that the teacher is not just a bearer of knowledge, but a facilitator of dialogue, reflection and transformation. The analyzed sources emphasize that teachers who apply active learning methods, encourage debate, collaboration and critical reflection, achieve better results in the field of civic engagement.

In the case of Tilburg University (Netherlands), the bachelor's program „Liberal Arts & Sciences“, for example, integrates different academic disciplines in order to develop the ability to analyze complex public issues from an interdisciplinary perspective. Some courses are by two/more teachers from different disciplines in order to demonstrate different approaches to the same problem. Economics disciplines are taught by interdisciplinary teams, including teachers of philosophy, political science and sociology. This allows economic concepts to be analyzed in context and alternative economic paradigms to be discussed. The creation of the „Broad Prosperity“ mini-specialization, an example of a holistic/critical approach to economic measures of well-being, can also be considered in favor of teaching interdisciplinary economics.

3. Active learning and impact on student engagement

It has been proven that when students participate in simulations (e.g. economic debates, EU models, eco-budgeting), their motivation, meaningfulness of the learning content and sense of social responsibility increase (Biesta, 2011). Simulations achieve an experience of economic processes in context and develop emotional and social intelligence.

Project-based learning is also established as a powerful tool. For example, at The University of British Columbia (Canada), UBC offers a model of „community-engaged learning“, in which students partner with NGOs and communities on projects with real-world applications – increasing economic literacy and working with issues of inequality/access/sustainability. This is a broader mechanism that is used by many disciplines. Economics students develop social projects with real-world applications – such as micro-entrepreneurial initiatives in low-income communities. This not only increases their economic literacy, but also engages them practically with issues of social inequality, limited access to resources, and sustainable development.

An exemplary case study structure, inspired by the practices of the University of British Columbia (UBC) and their model of „community-engaged learning“, could be presented as follows:

Table 1

Example structure of a community-engaged learning case study

CASE STUDY: SOCIAL ENTREPRENEURSHIP AND ECONOMIC EMPOWERMENT IN LOW-INCOME COMMUNITIES 1. CONTEXT AND PROBLEM – Setting: (community and conditions are explored); – Problem: (main socio-economic problem is explored); – Role of the University: (how students participate are explored). 2. PROJECT OBJECTIVES – (describe the objectives, e.g. increase economic literacy). 3. ACTIVITIES – Community needs analysis (introduce methods and results);

- Workshops and trainings (introduce topics and participants);
 - Mini-pilot projects (describe the projects);
 - Partnerships (indicate partners).
4. OUTCOMES
- (describe the results achieved and the benefits for the community and students).
5. CHALLENGES AND CONCLUSIONS
- (introduce the main challenges and lessons learned).
6. LINKAGE WITH THE GLOBAL GOALS FOR SUSTAINABLE DEVELOPMENT
- Goal 4: Quality education (explain);
 - Goal 8: Decent work and economic growth (explain);
 - Goal 10: Reduced inequalities (explain);
 - Goal 11: Sustainable communities (to be explained).

INSTRUCTIONS: In each section, replace the text in brackets with specific information from your project or case study. You may add sub-points and tables, if necessary.

Source: Author's Compilation, 2025.

4. Barriers to the integration of civic components

Despite positive practices, the study identified a number of barriers to the widespread implementation of civic elements in economic education. Among them, the following stood out:

- a general lack of training of teachers for integrating civic content;
- insufficient resources for the application of active and interdisciplinary methods;
- political sensitivity on some topics (e.g. social inequality, ethical aspects of the market economy).

In addition, in countries with a more centralized and test-oriented approach to education, teachers often refrain from entering into „controversial“ topics, even when they are essential for contemporary economic thinking.

5. Student Perception and Effects on Long-Term Attitudes

The publications included in the analysis highlight that students who undergo programs with integrated social and civic components show:

- higher sensitivity to social injustice;
- readiness to participate in volunteer and community initiatives;
- better understanding of the interrelationships between economics, politics and ethics;
- less tendency towards economic cynicism and technocratic thinking.

From this it can be concluded that not only their academic development is affected, but also their long-term role as economically active and socially responsible citizens.

6. Summary of results and synthesis

The analysis indicates that the key factor for the success of educational innovations is based on the combination of three dimensions:

- content: integration of social and civic topics in curricula;
- methodological: use of active and reflective pedagogies;
- institutional: support from educational institutions, policies and the academic community.

Only with systematic support at all these levels can a transformation be achieved that turns economic education into a platform for the development of engaged, informed and responsible citizens. In other words, contemporary trends in education require an integrated approach that combines economic literacy with civic education in order to form socially responsible and critically thinking young people. However, the process of transforming economic education encounters a number of structural and methodological obstacles that hinder the effective inclusion of

“civic” elements in the curriculum. We believe that among the main obstacles to transforming economic education, with the inclusion of “civic” elements, the following should at least be considered:

- • the „pressure“ of exam tests;
- • limited time for practical training;
- • lack of training and support for teachers;
- • institutional barriers to integrating interdisciplinary approaches.

The first of the mentioned obstacles, the “pressure” of examination tests, is for us associated with the currently dominant assessment culture, oriented towards the reproduction of knowledge rather than its critical application. The test format, although effective for measuring quantitative results, often does not stimulate the development of analytical, ethical and social thinking. In this context, pupils and students focus on achieving high results, rather than on understanding economic processes in their civic and social context.

The second barrier, limited time for practical training, reduces the opportunities for experimental and project-based learning. Practical activities, which include simulations, debates, case studies or work with local communities, require time and resources that are often not included in traditional curricula. This leads to a discrepancy between the theoretical goals of education and the real skills needed for active participation in economic and civic life.

The third difficulty, the lack of training and support for teachers, is a systemic problem that affects the quality and sustainability of any educational reform. Without targeted training, methodological support and exchange of good practices, teachers find it difficult to integrate civic education into economic subjects. Furthermore, the measurement of competences such as civics requires complex tools for valid assessment. This necessitates the creation of professional communities and continuing education that promote innovative pedagogical approaches.

However, specific recommendations for reforming the curricula of economic subjects in secondary and higher education by including elements of civics can be made, as they relate to the implementation of targeted pedagogical and methodological approaches that combine theoretical training with practical and ethical understanding of economic processes.

First of all, a key tool for overcoming the artificial distinction between economic and civic knowledge is the integrative approach. Instead of considering it as a separate topic or discipline, it is necessary to embed the basic principles of civics such as social responsibility, participation, sustainability and ethical commitment into the content of economic subjects. This can be achieved by using real – life case studies that reflect the economic challenges of contemporary society (e.g., topics such as social entrepreneurship, income inequality, sustainable consumption, fiscal responsibility, and the role of business in the community). The analysis of such problems allows students to not only master the theoretical aspects of economic processes, but also to understand their social consequences and moral dimensions. In addition, the integrative model promotes interdisciplinarity – combining economics, sociology, law, political science, and ethics, which meets the contemporary need for a comprehensive understanding of society and the economy. Thus, the learning process becomes not only a transfer of knowledge, but a space for the formation of competencies applicable in real social and civic practice.

Next, the development of critical thinking and responsibility should be considered as a basic goal of the educational process. The acquisition of economic concepts and models should be accompanied by their critical understanding – by questioning assumptions, analyzing different points of view and assessing the impact of economic decisions on individual groups in society. In this way, engaged, ethical and informed citizens are built who not only understand the role of the economy in social life, but are also able to participate in democratic processes with arguments and seek a balance between personal interest and the public good.

In the context of educational policy, a rethinking of pedagogical practices is assumed by introducing debates, discussions, project-based learning, simulations and voluntary participation in community initiatives. In this way, economic education will become a dynamic environment for personal and civic growth, instead of an abstract system of theoretical knowledge.

By applying an integrative approach and emphasizing critical thinking, the path is outlined towards building a model of economic education in which academic competence is combined with civic maturity and social sensitivity – all key characteristics of both the modern economist and the responsible citizen.

For secondary education, the following are necessary, in our opinion:

- Updating the content with the inclusion of issues such as:

- Technological changes and new professions;
- Social innovations and the sharing economy;
- Fintech, cryptocurrencies and the ethics of digital money;
- Artificial intelligence and the labor market: opportunities and risks;
- Civil rights and protection of personal data in the digital society.

- Using teaching methods such as:

- debates;
- simulations of economic processes;
- student companies with civic goals;
- project-based learning related to local problems;
- binary teaching - joint projects, integrated lessons.

- Assessing not only economic knowledge, but also civic competences – the ability to make ethical decisions, argue for socially responsible economic positions.

For higher education, the following are necessary, in our opinion:

- Revision of curricula to include issues such as:

- Economics and social responsibility,
- Ethics and sustainable development,
- Economic culture of the citizen.
- Interdisciplinary courses between economics, political science and law.

- Introduction of corporate social responsibility and economic ethics as mandatory subjects for all economic majors.

- Practical orientation

- Internships in NGOs, municipalities and social enterprises to see the connection between economics and civic initiatives.
- Use of real public data and policy analysis;
- Promotion of public campaigns and projects with a civic focus - volunteering, entrepreneurship with a cause.

- Training of teachers

- Conducting trainings for teachers on the methodology for integrating civic education into economic disciplines;
- Development of teaching aids and manuals with examples of interdisciplinary lessons.

The expected results are associated with:

- increased economic and civic culture of students, expressed in a better understanding of the basic principles of economics, finance and public management;
- development of social responsibility and ethics among future economists and entrepreneurs, which will support the formation of sustainable business practices and honest behavior in the professional environment;

- improved connection between education and real social needs, through the application of interdisciplinary approaches, practical projects and cooperation with business and institutions;
- preparation of young people capable of participating actively and informedly in democratic processes, making responsible decisions and contributing to the development of local communities;
- promotion of critical thinking, entrepreneurial spirit and initiative among young people;
- formation of a sustainable value system oriented towards ethics, sustainable development and social justice.

Thus, the educational process is expected to contribute not only to the professional realization of young people, but also to the development of active, responsible and informed citizens, capable of being a driver of positive change in society. Overcoming these obstacles implies a systematic and strategic approach, including a change in the culture of assessment, reforming curricula and strengthening the role of the teacher as a mediator between economic knowledge and civic values. Only through such integration can economic education become a tool for the formation of active, socially engaged and ethically oriented citizens. Methodological guidelines and practical approaches for the integration of civic education in economic disciplines

Implementing an integrative approach and promoting critical thinking require not only a conceptual change in the content of curricula, but also a rethinking of pedagogical strategies, teaching methods and assessment. Reforming economics education by incorporating civics elements is not simply an addition to existing curricula, but a qualitative transformation of the philosophy of teaching and learning. It requires a shift from knowledge to understanding, from theory to action, and from individual success to collective responsibility.

Only by combining an integrative approach, critical thinking, practical learning, and support for educators can economics education become a driver for building a society based on ethics, sustainability, and civic engagement.

5. Conclusion

This study confirms the need for a fundamental transformation of economic education in response to the social, environmental and ethical challenges of the 21st century. The data from the literature analysis and case studies clearly show that the traditional approach – oriented towards technical rationality and market efficiency – is insufficient to build civically responsible and socially sensitive individuals.

Economic knowledge alone does not guarantee critical thinking, ethical reflection or engagement with social processes. It can even reinforce a cynical worldview and technocratic reductionism if not placed in the context of social responsibility, democratic culture and sustainable development.

A key conclusion from the study is that economic education needs to be reinterpreted as a platform for social learning – a space in which learners do not simply understand how the economy works, but learn to question it, connect it with values and understand its impact on people and the environment. In view of this, the following recommendations can be formulated for:

- Teachers
 - to apply active learning methods – simulations, debates, case studies, project-based learning, which engage students not only intellectually, but also emotionally and socially;
 - to create a learning environment open to critical questions, ethical dilemmas and social complexity;
 - to integrate topics from civic education into the teaching of economic concepts (e.g., sustainability, social entrepreneurship, fiscal justice and corporate responsibility).
- Institutions
 - to encourage interdisciplinary programs and team or binary teaching between economists, philosophers, sociologists and political scientists;
 - to include an assessment of the civic and social effects of education in the criteria for quality and

accreditation;

- to provide conditions for the qualification of teachers in the field of civic and ethical education.
- Policymakers and educational reformers
- to include components related to civic competence and social engagement in national and European educational standards;
- to create conditions for piloting innovative educational practices in economic disciplines;
- to fund research and transfer of good practices between countries and institutions that implement civic-oriented economic education.

4. Prospects for future research

The present study, due to its relatively limited scope, does not exhaust all aspects of the topic. Future research could focus on:

- qualitative interviews with students and teachers to measure the effect of integrated curricula;
- empirical studies of the impact of active learning on the attitudes and behavior of learners;
- development of indicators for assessing the civic value of economic education;
- comparative analyses between countries and educational systems.

In conclusion, the rethinking of economic education should be seen not as a mere academic exercise, but as a social necessity. Learners must be helped to understand why and how economic and civic education are connected. In times of profound global transformation, society needs citizens who not only understand numbers and graphs, but also have sensitivity to issues of justice, ethics and sustainability. Only then will education fulfill its true mission – not just to prepare a workforce, but to build people with awareness, responsibility and the capacity to change.

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Attitudes towards Using Generative AI Tools in Communication Training

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Abstract

Background and aim: Open access to generative AI tools is fundamentally changing marketing practice and, as a result, the main tasks and goals of marketing education. In this regard, the purpose of the study is to investigate the attitude of learners towards the use of generative AI in general and in particular in the process of their education. *Methods:* Based on a literature review and focus groups, variables were formulated for collecting quantitative data to investigate the attitude of learners towards the use of gen AI tools in training. Data were collected from 90 respondents - students in the bachelor's programs in marketing and digital media, and PR at the University of Economics - Varna - through an online survey. Factor analysis, univariate and bivariate distributions, and non-parametric tests for testing hypotheses were used in the analysis of empirical data. *Results:* The results of the analyses show that the general attitude of students towards the use of AI tools in their education is moderately positive, but this attitude is strongly moderated by control beliefs (ease of use) and not so much by behavioral beliefs (expected benefits). *Conclusions:* The study conducted shows the need to include the ethical context in the use of AI tools in communication training as part of the curriculum. *Originality:* The novelty of the paper lies in arguing for the need to study the attitudes of marketing and communications students towards the use of AI tools in their training, with a focus on the ethical context. *Practical implications:* The results of the study can be used in designing future research on learners' attitudes towards gen AI tools and, more generally, in adapting the ethical framework for their use.

Key words:

Gen AI tools, marketing
education, attitudes towards
Gen AI, ethical framework

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1. Introduction

Although the penetration of AI into all spheres of human life, including marketing and communications, is now an undeniable fact, there are still questions that have not been fully resolved. These questions, such as the ethical framework of the use of AI-related technologies, give rise to debates in both scientific and professional fields, as well as in their application. The importance of the ethical context of the application of new technologies is also confirmed by the fact that in November 2021, UNESCO adopted recommendations on the ethical application of AI (UNESCO, 2021), which were accepted by 193 countries all around the world. According to Semrush.com (2025), ChatGPT.com registers approximately 4.61 billion visits per month, with its users generating 2.5 billion prompts per month. It is noteworthy that nearly half of its users are under the age of 25. Forecasts show that OpenAI could reach 1 billion users by the end of 2025. And since this is just one of the providers of gen AI tools, this trend shows that the penetration of gen AI in all spheres of human life, especially among younger users under 25, is ubiquitous. This makes gen AI an unavoidable and very important factor in human life. On the other hand, according to Hubspot.com (2025), by 2025, 35% of marketers will already use Gen AI tools to create text and visual content, 30% for data analysis, and 20% to automate marketing processes. What's more, over 65% of brands worldwide have already integrated AI applications into their marketing activities. This shows that at the same time, the use of Gen AI tools is becoming an increasingly important condition for marketing and communications training in higher education

(HE). For years, many countries, as well as the European Union, have had laws and professional codes that regulate the use of AI tools in the communications sector. Some of these are also applicable in Bulgaria (Sabeva 2024).

Based on our experience, we can argue that due to the training cycles, changes in curricula and programs in HE occur more slowly than changes in the business environment. This, in turn, requires their rapid adaptation to new requirements and realities (Nikolic *et al.*, 2024). Since nearly half of those using gen AI tools are under the age of 25, this means that these tools are already part of their daily routine. In this regard, the importance of studying how attitudes towards gen AI tools influence intentions to use them in HE is already being debated in the scientific literature (Acosta-Enriquez *et al.*, 2024). Here, the main question is not whether but how these tools can be used in a way that can control two main outcomes. The first is related to the need to prepare future specialists to meet the requirements of the labor market. The second one is related to compliance with the basic ethical principles arising from the use of gen AI. This, in turn, makes the study of students' attitudes towards the use of gen AI tools in their education an extremely important topic.

2. Literature Review and Hypotheses Development

2.1. Generative AI tools in HE

Over the past two years, there has been a growing interest among researchers in the penetration of generative AI tools into HE. Various studies present different aspects and unexplored areas related to this process (Wu, Dang and Li, 2025). However, researchers are undoubtedly united around the idea that with the beginning of the use of generative AI, a significant change in both teaching and learning begins (Vasilev, 2024; Costa, Nacheva and Coelho, 2025; Nacheva, 2025). In general, technologies in education can have a positive impact on the personalization of learning, the analysis of student performance and respectively, the improvement of the effectiveness of the educational process as well as the optimization of teachers' administrative activities (Sabeva 2025) both on school and university level.

The focus of some of the research falls on the need to explore the attitudes, beliefs, concerns, and ethical aspects related to the use of AI tools by students (Acosta-Enriquez *et al.*, 2024). In their study, the authors propose a seven-point scale to measure students' attitudes toward the use of generative AI in HE. These are:

1. feeling of comfort in using GenAI in learning,
2. belief that GenAI tools are useful and accurate,
3. feeling of comfort in interacting with gen AI tools,
4. belief that GenAI tools save time when working with assignments and homework,
5. belief that interaction with these tools is superior to that with humans,
6. intention to recommend gen AI tools to other students, and
7. belief that generative AI will replace communication with humans.

In a study conducted among 201 students in Peru, Acosta-Enriquez *et al.* (2024) indicate the main conclusions that knowledge and positive attitudes do not guarantee the effective adoption and use of generative intelligence tools in the HE learning process. In this regard, it is recommended to include an ethical framework in the curricula to ensure the responsible use of these tools in the learning and teaching process.

When considering the issue of integrating generative AI tools into education, two points of view can be compared: those of students and those of educators. In a study of the discrepancies in opinions, attitudes, concerns, and intentions to use these tools, researchers found certain discrepancies (Chan and Lee, 2023). In the cited study, on the one hand, the positive attitudes of students are observed. They are related to their expectations that the use of such tools in HE will improve the productivity and efficiency of work on the assigned tasks, as well as increase the possibilities for personalizing their education. On the other hand, the

results of this study show the rather pessimistic attitudes of educators, according to whom the use of generative AI in HE may lead to dependence on this technology and ethical consequences in the future. As a main conclusion from their study, Chan and Lee (2023) point out the possibility of combining new and existing traditional teaching methods.

Such a claim can be supported by the results of a literature review covering 99 articles published between 2020 and the end of 2024, focusing on the use of generative AI in HE (Wu, Dang and Li, 2025). It shows the presence of three key areas of interest for researchers. These are reactions to the use, attitudes towards its use in HE, and the behavior of students and teachers. Special attention is paid to understanding the role of generative AI in teaching and learning processes in HE from a psychological perspective. Based on the review, Wu et al. (2025) recommend that future studies should pay more attention to negative reactions and concerns about generative AI applications, which are currently less well studied compared to positive responses and attitudes.

Other researchers focus on the specifics of Generation Z by examining four main factors (Dewalska-Opitek *et al.*, 2024). This is knowledge about AI, changes in mood, perceived benefits, and concerns. The results of the qualitative study summarize two main trends. These are positive expectations about the potential of AI and concerns about privacy and ethical challenges. In the study, Dewalska-Opitek et al. define the components of the attitudes of Generation Z users towards AI, revealing its dimensions and challenges in two groups of six variables - positive and negative (2025, pp. 45-46). The positive ones are related to:

- increasing creativity and innovation,
- improving the adaptability and flexibility of learners,
- increasing positive emotions through personalized content,
- improving empowerment and opportunities for realization,
- saving time and resources for performing tasks,
- ease of use.

The negatives are related to:

- privacy concerns,
- bias and fairness,
- job displacement,
- dependency,
- ethical dilemmas, and
- security risks.

Other studies offer a different scale for determining students' attitudes towards the use of generative AI tools in the learning process (Adžić *et al.*, 2024). This scale is composed of a total of seven variables, which are subsequently grouped into two factors through factor analysis of the collected empirical data. The first factor includes variables related to:

- the belief that generative AI tools provide a significant advantage to the learner,
- the belief that the use of these tools brings positive change,
- satisfaction with their introduction into learning, and
- the belief that they generally provide great opportunities for the development of humanity.

The second factor is composed of two variables. These are:

- concerns about the future development of AI-related technologies and
- the belief that AI tools will lead to dangerous transformations for humanity.

As can be seen, within the framework of this study, which describes the attitudes of students in two

European countries - Serbia and Austria, there are two groups of beliefs that shape attitudes: positive and negative. Although the negative ones are not directly related to the use of generative AI tools in education, these negative attitudes should not be ignored.

Since learning is a two-way process, other researchers emphasize the need to study the attitudes of teachers towards the introduction of generative AI tools in HE (Nikolic *et al.*, 2024). In this regard, two trends are also emerging - positive and negative expectations. The positive ones are related to the possibilities for optimizing learning through its individualization, increasing its efficiency, and reducing resources. The negative ones are related to ethical considerations, covering academic integrity, accuracy, reliability, and the development of learners' skills. Based on the literature review of several academic sources and studies, it can be stated that the study of learners' attitudes is defined as an important issue that must be studied sufficiently well before proceeding with the mass introduction of generative AI tools.

2.2. Hypotheses Development

Some of the studies cited in the literature review examined hypotheses about the influence of demographic variables on attitudes towards the usage of generative AI tools in the training process. Although some of the studies rejected the existence of such relationships (Acosta-Enriquez *et al.*, 2024), in view of the objectives of this study, it is necessary to examine the relationship between the gender and type of training program of the respondents and their beliefs related to the use of generative AI tools. The reason for this can be the fact that different training programs assume different tasks. This, in turn, requires different approaches and tools for their implementation, including generative AI. In this regard, it can be assumed that the experience that respondents have with the use of generative AI tools is different, which may reflect on their overall attitudes. In this sense, in addition to demographic variables, relationships with behavioral variables should also be tested.

At the same time, most of the cited studies test the relationships between experience in using generative AI tools and attitudes. Building on the three-component model of attitudes, the researchers emphasize the need to examine specific relationships between emotions, beliefs, and behavior. In this regard, the following relationships will be examined in the present study:

- Fears that communication specialists will be replaced by generative AI tools in practice, and expected difficulties in starting a career;
- The belief that working with generative AI tools makes work more efficient and trust in the result of working with these tools;
- The belief that working with generative AI tools makes work more efficient, and the belief that working with these tools negatively affects creativity;
- The belief that if something can be done with generative AI tools, there is no point in putting in the effort, and the belief that a communication specialist does not need theoretical training to handle these tools well.

As can be seen from the four main hypotheses formulated for the presence or absence of relationships between the defined variables, the main areas of impact of students' attitudes towards the use of generative AI tools in HE are covered. These are the positive attitudes and, respectively, the concerns related to their use, taking into account the ethical dilemmas related to generative AI in HE. The main task in studying the above-mentioned relationships is to determine the attitudes - positive and negative - towards the application of generative AI tools in marketing and communications training with a view to formulating recommendations for adapting these tools in training. Moreover, taking into account the individual attitudes of students and, more precisely their specific differences can become a basis for overcoming the difficulties in integrating generative AI tools in HE.

3. Materials and Methods

3.1. Theoretical Framework

A common practice in studying attitudes towards the use of digital tools in HE is to rely on two main theoretical models. The first is the Technology Acceptance Model (TAM) proposed by Davis (Davis, 1989). The second is the Theory of Reasoned Action (TRA), formulated by Ajzen and Fishbein, based on Ajzen's Theory of Planned Behavior (Ajzen, 1991). The function of the first model is to provide the theoretical basis for the acceptance of new technologies in existing processes. According to this theory, attitudes towards the use of new technologies or tools for the performance of existing tasks are determined by two factors. The first is the degree to which people assume that they can easily or with difficulty use the new technology, and the second one the belief that the new technology or tool is useful to them. These two factors, according to TAM, directly reflect on attitudes towards the new technology or tool and, in turn, determine the behavior associated with the use of these tools or new technologies (Mathieson, 1991; Acosta-Enriquez *et al.*, 2024).

On the other hand, TRA, although created as a model of consumer behavior, gives a clear idea of the role of attitudes as a predictor of this behavior. In the cited article, Mathieson (1991, p.171) draws a connection between TRA and the Theory of Planned Behavior (TPB), through which he explains attitudes towards the use of new tools or technologies in solving familiar tasks. In this sense, attitudes, as part of TPB, are part of the factors that determine the intention to use technological tools in the learning process. On the other hand, intention, according to TPB, can be considered as a predictor of behavior.

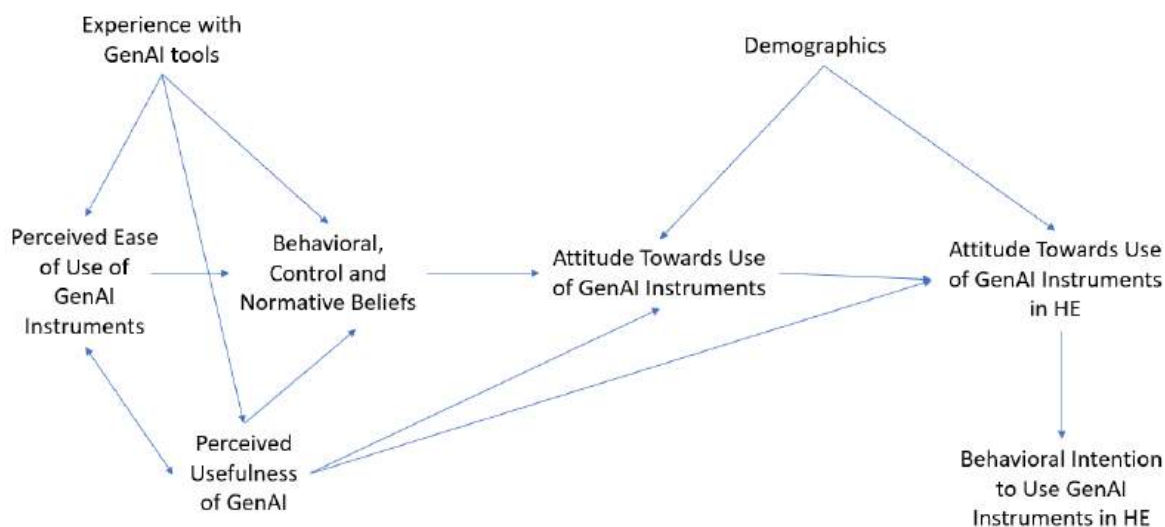


Fig. 1. Schematic representation of the variables of the study

Source: Adapted from Mathieson (1991, p.175)

As can be seen in Fig. 1, the theoretical framework adapted from Mathieson (1991, p.175) deduces the role of attitudes towards the use of generative AI tools in HE based on a combination of TRV and TRA, with two groups of factors added to them. These are demographic characteristics and the experience that respondents have with the use of generative AI tools. The following arguments are used to adapt the theoretical framework:

- The use of generative AI tools for solving practical tasks in marketing and communications training is preceded by their use in the respondents' daily lives;

- The use of these tools for solving practical tasks is not pre-established in the curricula, which allows generative AI tools to be defined as a "new technology" for students in the learning process;
- The experience that students have in their daily lives with the use of these tools determines their beliefs about the ease with which they can use them and for solving practical tasks in their training;
- Demographic differences cannot be ignored.

As can be seen in the adaptation of the proposed conceptual model based on the TPB, it is assumed that Behavioral Beliefs and Outcome Evaluation affect attitudes towards the use of AI tools in general. In this sense, according to the proposed model, general attitudes towards generative AI tools directly affect attitudes towards their use in training. It should be noted that the other two groups of beliefs - Normative Beliefs and Motivation to Comply and Control Beliefs and Perceived Facilitation, part of the TPB (Mathieson, 1991), are not included in the model. Their impact and role can be included in future research.

Based on the described theoretical framework, the study design is proposed, as well as the research instrument for collecting empirical data.

3.2. Development of Research Instrument

A quantitative method was chosen to collect empirical data to test the formulated hypotheses. In this regard, a research instrument (questionnaire) was designed, which includes the following blocks:

- demography;
- experience with using generative AI tools;
- attitudes towards using generative AI tools;
- attitudes towards using generative AI tools in HE.

In the block with demographic questions, nominal and interval scales were used to collect empirical data. The questions include the variables gender, bachelor's program, course, group, age, since not all students in the same group are of the same age. The design of the block of questions to measure respondents' experience with using generative AI tools included the use of nominally scaled variables, variables with semantic differential scales, and open-ended questions. Open-ended questions provide data on two sets of behavioral variables. On the one hand, these are the most common reasons for using generative AI tools. On the other hand, they explore the most frequently used generative AI tools by respondents. The data collected with these questions are coded as nominal variables in order to determine the frequency of use of generative AI tools and the relative shares of their use by respondents in the sample.

When designing the scale for measuring respondents' attitudes, the results of the analysis of literary sources were used. It was assumed that attitudes can be divided into two main types. The first is related to positive attitudes, and the second - negative ones. Based on the questions used in previous studies to determine students' attitudes towards generative AI tools, a summary list was compiled. The questions were commented on with participants in a focus group conducted with student respondents who are studying in marketing and communications programs. As a result of the focus group, a total of 11 variables were selected that are relevant to the attitudes towards the use of generative AI tools of the participants in the focus group. Subsequently, these variables were operationalized into questions that formed the scale for determining students' attitudes towards the use of generative AI tools. The questions are presented in Table 1. For each of them, it is indicated which component of the beliefs - control, behavioral, or normative – to which type of attitudes it refers. On the other hand, each of the questions is referenced to the positive or negative expectations associated with the use of generative AI tools. It is also accepted that recommendations for improving the scale can be formulated after conducting reliability and validity tests based on the empirical data collected.

Table 1

Variables in the Attitude GenAI Scale

Question	Type of Beliefs	Type of Expectation
Humans can be replaced by AI tools when creating content for advertising or PR campaigns	Behavioral	Negative
The use of AI tools will lead to a decrease in the demand for communication and PR specialists	Behavioral	Negative
The ability to work with AI tools makes my work more efficient	Control	Positive
If something can be done with AI tools, I don't need to put in the effort to do it myself	Control	Positive
I have full confidence in the suggestions (ideas, content options, etc.) that I generate with AI tools	Behavioral	Positive
If I can work well with AI tools, this will increase my chances of finding a job as a marketing or PR specialist	Normative	Positive
The use of AI tools negatively affects my creativity	Normative	Negative
I can assess whether the content I generate with AI is adequate for the campaign goals	Behavioral	Positive
To create an advertising or PR publication using an AI tool, I don't need theoretical knowledge	Normative	Positive
To plan an advertising or PR campaign using an AI tool, I don't need theoretical knowledge	Normative	Positive
The use of AI tools in marketing and communications brings more benefits than risks for me	Behavioral	Positive

Source: Authors' Compilation, 2025.

As can be seen from Table 1, only three out of a total of 11 questions refer to negative attitudes related to the use of generative AI tools. This ratio between positive and negative attitudes is also found in the other studies cited in the literature review. Seven-point Likert scales were used to collect empirical data. The questions in the scale are formulated as statements with which respondents are asked to express the degree of agreement or disagreement. The possible answer options for the questions are from "strongly disagree" to "strongly agree". In the pretests of the research instrument, it was found that the seven-point scales do not make it difficult for the respondents to answer. This gives reason not to transform these scales into five-point scales.

In order to investigate whether the eleven variables included in the scale for assessing attitudes towards the use of generative AI tools form a reliable scale, Cronbach's alpha coefficient was calculated. The results show that the reliability of the scale is 0.697, which indicates that the scale is relatively reliable. When excluding the question related to data collection on the belief that the use of generative AI tools negatively affects creativity, the reliability of the scale increases to 0.727, which indicates good reliability. The construct validity of the scale, again based on the collected empirical data, was tested through factor analysis. The results show that the value of the Kaiser-Meyer-Olkin Measure of Sampling Adequacy is 0.682, and the Bartlett test for sphericity is significant (0.000), which means that the analysis can be conducted. The analysis shows that the total variance explained is 71.6%. It was tested whether this scale does not form subscales referring to the type of beliefs. The reliability and validity tests conducted, however, showed that the eleven variables cannot form subscales, since the Cronbach's alpha and the Kaiser-Meyer-Olkin adequacy measure are below the accepted limits.

The same approach was taken when designing the scale for determining attitudes towards the use of

generative AI tools in marketing and communications training. The questions formulated based on the selected variables in the literature review and the focus group are presented in Table 2. When designing these questions, the specifics of marketing training were taken into account. On the other hand, the ethical dilemmas associated with the use of generative AI tools in HE were taken into account, in particular, compliance with academic ethics and preserving the integrity and logic of the training process. The concerns of the participants in the focus group regarding the negative changes from the use of these tools in HE were also taken into account.

Table 2**Variables in the Attitude GenAI in HE Scale**

Question	Type of Beliefs	Type of Expectation
Training on how to work with AI tools should be present in all educated disciplines	Normative	Positive
AI tools should be used when working on course projects	Normative	Positive
If assignments and homework can be done with AI tools, I don't need to waste my time doing them myself	Control	Positive
I can save a lot of time and effort if I use AI tools for the projects, I work on	Control	Positive
I can generate a better term paper or thesis with AI than I could write myself	Behavioral	Positive
The possibilities of using AI tools make taking tests pointless	Normative	Negative
The answers I get from AI tools to my questions completely satisfy me	Behavioral	Positive
Generative AI (like ChatGPT) hallucinates some of the information it presents to me as truth	Behavioral	Negative
It is important to be well-versed in the ethical rules for working with AI	Normative	Positive
If I use AI tools during my studies, I will be more successful after I graduate	Control	Positive
Using AI tools could put me in a dangerous or disadvantageous situation	Behavioral Beliefs	Negative
Using AI tools in my learning process brings me more benefits than harm	Outcome Evaluations	Positive

Source: Authors' Compilation, 2025.

To investigate whether the twelve variables included in the scale for assessing attitudes towards the use of generative AI tools in HE form a reliable scale, the Cronbach's alpha coefficient was calculated. The results show that the reliability of the scale is 0.776, which indicates that the scale is reliable. The construct validity of the scale, again based on the collected empirical data, was tested through factor analysis. The results show that the value of the Kaiser-Meyer-Olkin Measure of Sampling Adequacy is 0.745, and the Bartlett test for sphericity is significant (0.000), which means that the analysis can be conducted. The analysis shows that the total variance explained is 65.2%. This indicates that the proposed scale can validly and reliably measure attitudes towards the use of generative AI tools in HE.

In order to participate in the study and adequately complete the survey, respondents were asked to fill in their faculty numbers. Those who completed the survey correctly were promised bonus points. It was indicated that the survey included several control questions that could be used to determine whether the answers were correct or not. Google Forms was used to collect the empirical data. The obtained data were coded and processed using the IBM SPSS software package.

4. Results and Discussion

The study was conducted in the period March 2025, April 2025. The questionnaire was distributed via Google Forms, and the study included 90 respondents. Of these, 21.2% are men and 77.8% are women. 35.6% of respondents are in their third year, and 64.6% are in their fourth year. Of all respondents, 95.6% indicated that they had used generative AI tools at least once, while 4.4% indicated that they had not yet. Of the respondents in the sample, 6.7% indicated that they used generative AI tools extremely rarely, 47.7% used such tools often, 37.7% very often, and 2.2% used them constantly. This means that the respondents included in the sample generally have accumulated user experience with generative AI tools and can comment on various aspects related to their use. It should be noted that a number of chi-square tests were conducted to establish the presence or absence of a relationship between these demographic variables and the variables in the two scales in the study. Based on these tests, it can be concluded that none of the demographic variables - gender, course, group, bachelor's program - has established a relationship between them and the variables that form the scales. This means that in this particular sample, such an influence of demographic variables cannot be commented on. At the same time, in other samples, such an influence may be detected. As for the sample in the study, it can be assumed that the formation of beliefs and attitudes is due to other factors.

The distribution of respondents' answers in the survey is presented in Tables 3 and 4.

Table 3

Distribution of the Answers on the Attitude Toward GenAI Scale

Question	Mode	Share of disagree (%)	Share of neutral (%)	Share of agree (%)
Humans can be replaced by AI tools when creating content for advertising or PR campaigns	3	57.3	16.1	26.6
The use of AI tools will lead to a decrease in the demand for communication and PR specialists	3	40	19.6	44.4
The ability to work with AI tools makes my work more efficient	4	25.6	19.9	54.5
If something can be done with AI tools, I don't need to put in the effort to do it myself	1	82	9.1	8.9
I have full confidence in the suggestions (ideas, content options, etc.) that I generate with AI tools	1	77.8	11.2	11
If I can work well with AI tools, this will increase my chances of finding a job as a marketing or PR specialist	5	44.4	16.8	38.8
The use of AI tools negatively affects my creativity	6	32.2	17.8	50
I can assess whether the content I generate with AI is adequate for the campaign goals	7	14.6	17.7	67.7
To create an advertising or PR publication using an AI tool, I don't need theoretical knowledge	1	80	11.2	8.8
To plan an advertising or PR campaign using an AI tool, I don't need theoretical knowledge	1	83.3	10.1	6.6
The use of AI tools in marketing and communications brings more benefits than risks for me	4	33.3	27.9	38.8

Source: Authors' Compilation, 2025.

As can be seen from Table 3, the relative share of neutral responses ranges between 10% and 20%. This means that in general, the respondents in the sample who are unable to indicate a clear position are between

one-tenth and one-fifth. Another thing that can be commented on is that with respect to almost all statements, the respondents' responses are polarized. This can be interpreted as a predominance of one or another general idea of the expectations of the various aspects or consequences of the use of generative AI tools. It should be noted that with only one of the statements, the relative shares of positive, negative, and neutral expectations are distributed equally. This statement refers to the assessment that the use of generative AI tools brings more benefits than risks. The pointed issue deserves separate attention, since the research instrument used does not collect data through which it can be clarified whether the respondents are aware of the risks of using generative AI tools.

Based on the analysis of the distribution of responses on this scale, some important generalizations can be made about the expectations and attitudes of respondents towards the use of generative AI tools. It is noteworthy that most of them (57.3%) do not share concerns that humans will be replaced in the design and implementation of marketing campaigns, although a large part of those who are positive are not completely sure about this (Mode=3). Almost two-thirds of respondents (54.5%) believe that working with generative AI tools increases work efficiency. It should also be noted here that the largest share of responses is from respondents who cannot judge whether this is the case or not (Mode=4).

As can be seen from Table 3, for four of the statements, the respondents' answers are with the highest degree of agreement or disagreement. It is striking that on the whole, respondents express categorical disagreement with the statement that if something can be done with generative AI tools, there is no point in doing this work themselves (80%, Mode=1). Nearly as many respondents share that they do not trust the results they generate with these tools (77.8%, Mode=1). It should be noted that the correlation analysis shows the presence of a moderate to strong relationship between these two variables (Kendall's tau- β =0.494, p =0.000). The combination of the lack of trust in the results generated by AI tools and the negative attitudes towards the idea of saving time and resources when performing tasks seems logical here. This can be interpreted as a predominantly negative attitude of respondents towards the transfer of tasks and, respectively, responsibilities to instruments at the expense of directing the necessary resources for their implementation in other directions. The proportion of respondents' answers is similar for the two other answers. They are related to the statements that theoretical knowledge is not required for planning marketing campaigns and creating content for them using generative AI tools. 83.3% and 80% disagree with these statements, respectively (Mode=1), and the relationship between them is confirmed by the values of Kendall's tau- β , which shows a strong relationship (0.816, p =0.000).

Table 4

Distribution of the Answers on the Attitude Toward GenAI in HE Scale

Question	Mode	Share of disagree (%)	Share of neutral (%)	Share of agree (%)
Training on how to work with AI tools should be present in all educated disciplines	5	36	17.3	46.7
AI tools should be used when working on course projects	4	51.7	22.8	25.5
If assignments and homework can be done with AI tools, I don't need to waste my time doing them myself	1	83.1	5.8	11.1
I can save a lot of time and effort if I use AI tools for the projects, I work on	6	56.2	0.5	43.3
I can generate a better paper or thesis with AI than I could write myself	1	64	3.6	32.4
The possibilities of using AI tools make taking tests pointless	1	77.5	9.1	13.4

The answers I get from AI tools to my questions completely satisfy me	3	70.5	12.8	16.7
Generative AI (like ChatGPT) hallucinates some of the information it presents to me as truth	6	33.7	12.4	53.9
It is important to be well-versed in the ethical rules for working with AI	7	19.1	8.6	72.3
If I use AI tools during my studies, I will be more successful after I graduate	2	64	14.9	21.1
Using AI tools could put me in a dangerous or disadvantageous situation	7	34.8	15.2	50
Using AI tools in my learning process brings me more benefits than harm	4	41.6	22.9	35.5

Source: Authors' Compilation, 2025.

When analyzing the responses from the Scale for attitudes towards the use of AI tools in HE (Table 4), some similar trends are observed. As with the Scale for attitudes towards the use of AI tools (Table 3), the expectations that the use of these tools in the learning process will help more than harm are distributed in a similar way. Here, the relative share of those who disagree with this statement is 41.6%, 22.9% respond neutrally, and 35.5% agree. It should be noted that the correlation between this variable and the analogous one from the previous scale is on the border between moderate and strong (Kendall's tau-b=0.386, p=0.000). This, as well as the bivariate distribution of the responses on the two variables, shows that there is a moderate relationship between the beliefs that the use of generative AI tools and their use in learning lead to more positive than negative consequences. It is striking that nearly half of the respondents agree with the statement that they should be trained on how to work with generative AI tools in different disciplines (46.7%, Mode=5). At the same time, more than half of them (51.7%, Mode=4) disagree with the statement that these tools should be used during project work, with a quarter taking a neutral position.

When analyzing the responses of respondents on this scale, the following contradiction can be commented on. It is striking that the high relative share of respondents in the sample (83.1%) who disagree with the statement that if a task can be completed with a generative AI tool, then no effort is needed to complete it. At the same time, the relative share of respondents who claim that the tools can generate a better project than they themselves can is significantly high (64%). This, in practice, means that despite their belief that by using generative AI tools they will achieve a better result, a significant part of the respondents prefer to cope on their own, without their help. This can be interpreted as a strong motivation for inclusion in the educational process. This statement is also confirmed by the correlation analysis conducted, which shows a strong relationship between the two statements (Kendall's tau-b=0.540, p=0.000).

It is also important to note that almost two-thirds (60%) of respondents disagree with the statement that using generative AI tools in training will increase their chances of a good start in their careers. While there is a correlation between this belief and the belief that it is good to develop projects without the help of generative AI tools, this relationship is weak (Kendall's Tau-b=0.251, p=0.002). In this regard, another dependence should be commented on. The results of the conducted correlation analyses show that no statistically significant relationships were found between the belief that the use of generative AI tools in training can put respondents in danger and the belief that it is better not to generate, but to write their projects themselves (p>0.05). This can be commented as a rejection of the assumption that these beliefs are not provoked by fear of sanctions or punishment, but by other, internal motives. In this regard, it is also worth commenting on the respondents' attitude towards ethical issues related to the use of generative AI tools in HE. As can be seen from the distribution of their answers (Table 4), 72.3% of them agreed with the statement that they should be familiar with the ethical framework of the use of generative AI tools. The lack of a relationship between attitudes

towards using generative AI tools at the expense of personal efforts and fears that this may put respondents in an undesirable situation has already been commented on. At the same time, a lack of a relationship between these two variables and the belief that students should know the ethical framework of using generative AI well enough has been found ($p>0.05$). This means that the stated concerns do not stem from ethical issues, but from other issues that remain to be studied.

As already mentioned, several research hypotheses were formulated when planning the study. These hypotheses are:

H1: There is a statistically significant relationship between the belief that humans can be replaced by AI tools when creating content for advertising or PR campaigns and the belief that if a respondent can work well with AI tools, this will increase his or her chances of finding a job as a marketing or PR specialist.

H2: There is a statistically significant relationship between the beliefs that the ability to work with AI tools makes the work more efficient and the confidence in the results given by AI tools.

H3: There is a statistically significant relationship between the beliefs that the ability to work with AI tools makes the work more efficient and the usage of AI tools reflects negatively on human creativity.

H4: There is a statistically significant relationship between the beliefs that if something can be done with AI tools, people don't need to put in the effort to do it themselves, and to create an advertising or PR publication using an AI tool, people don't need theoretical knowledge.

H5: There is a statistically significant relationship between the beliefs that if something can be done with AI tools, people don't need to put in the effort to do it themselves, and to plan an advertising or PR publication using an AI tool, people don't need theoretical knowledge.

To test this hypothesis, Spearman's correlation coefficient was used, since this non-parametric test was created specifically to measure the strength and direction of the relationship between two ordinal variables. It should be noted here that the specificity of this test is expressed in transforming the ordinal data into ranks, after which the test calculates the correlation between these ranks, which makes it extremely suitable (Sheskin, 2000). The results of the tests conducted are presented in Table 5.

Table 5

Distribution of the Answers on Attitude Toward GenAI in HE Scale

Hypothesis	Correlation Coefficient	Sig. (2-tailed)	Confirmed or rejected
H1	.139	.152	Rejected
H2	-.110	.300	Rejected
H3	-.126	.235	Rejected
H4	.409	.000	Confirmed
H5	.469	.000	Confirmed

Source: Authors' Compilation, 2025.

As we can see from the analyses conducted and the presented results, we can reject the first three hypotheses. At the same time fourth and fifth hypotheses are confirmed. The values of the Spearman coefficient for these two hypotheses indicate a strong positive relationship between the two pairs of variables. This means that the more the belief increases that if something can be done with AI tools, there is no point in investing personal effort, and the more the belief increases that theoretical knowledge is not needed to design and plan marketing campaigns, since this can be done with AI tools. On the other hand, the rejection of the first three hypotheses can be interpreted as a lack of connection between the beliefs that people can be replaced by generative AI tools in the field of communications and the convictions that skills in working with these tools have a positive impact on the chances of realization in the field. Also striking is the lack of concern that

working with generative AI tools may negatively affect creativity, which is key to the profession of a marketer.

Based on the performed analyses of univariate distributions and the tested hypotheses, the following more important conclusions can be drawn:

- The general attitude of marketing students towards Generative AI is moderately positive, but this attitude is strongly moderated by control beliefs (ease of use) and not so much by behavioral beliefs (expected benefits).
- The students' beliefs are not determined by demographic factors, but by others that require further research.
- Students demonstrate a strong conviction that it is very important to be familiar with the ethical aspects of working with AI tools. At the same time, it should be emphasized that this belief is not related to perceived potential risks or fears related to working with generative AI and assessments that these tools lead to changes in the work of marketers.

The findings of the study can serve to formulate several recommendations, namely:

- Consider the possibilities for mandatory training in AI ethics as part of the studied disciplines to increase control beliefs and address ethical concerns.
- In further studies, it should be investigated whether perceived usefulness (related to beliefs) is more important than perceived ease of use (related to control beliefs).
- Also, in further studies, it should be investigated whether and how normative beliefs (the perception of AI as "allowed" or "not allowed" by academic institutions) influence attitudes and intention to use.

It should also be emphasized that the proposed study is limited to students studying at the University of Varna in the marketing and communications programs. The beliefs and attitudes of students studying other programs or studying at other academic institutions may demonstrate different beliefs and attitudes related to the specifics of their future professions. This means that the proposed research instrument should be adapted to the specifics of training and professional realization. Such adaptation can be extremely useful, especially in cases where AI tools play an important role in the learning processes of people with disabilities (Costa, Nacheva and Coelho, 2025; Nacheva, 2025) or socially vulnerable groups of students.

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AI Tutor Comparison: Google Guided Learning and ChatGPT Study Mode

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Abstract

Artificial intelligence is transforming education through specialized tutoring systems designed to personalize learning in real-time. This paper conceptually compares four emerging learning modes: ChatGPT Study Mode (Socratic/Dialogic), Google Guided Learning (Structured/Scaffolded), Anthropic Learning Mode (Reflective/Constitutional), and Khanmigo (Curriculum-Integrated Inquiry). Drawing on scaffolding theory and constructivist frameworks, the analysis differentiates these models based on their pedagogical "DNA": ChatGPT fosters active learning through strategic questioning, while Google prioritizes source-grounded, multimodal scaffolding. Anthropic emphasizes ethical reasoning and visible "extended thinking", and Khanmigo utilizes formative feedback loops within a fixed syllabus. For students, these systems can generate 20–30% greater-than-expected learning gains while enhancing metacognitive awareness. For faculty, AI tutors enable a transition toward high-value mentorship and curriculum design as 68% of instructors report a shift in course delivery. In the business sector, these tools offer scalable upskilling solutions, reducing training time by up to 62%. The paper situates these trends within the University of Economics Varna context, advocating for a human-driven framework (HD-AIHED) that utilizes microcredentials to validate collaborative AI literacy. Ultimately, successful integration requires balancing AI's computational precision with human-centered critical judgment to ensure technology serves as an enabler rather than a replacement for human intelligence.

Key words:

AI learning modes, GenAI models, teaching with AI, Pedagogy

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1. Introduction

The integration of generative artificial intelligence into the academic and professional spheres has progressed from the era of general-purpose utility to a rather specialized phase of pedagogical intervention. By 2025, the technological landscape had settled around four primary platforms to offer dedicated learning modes: ChatGPT Study Mode, Google Guided Learning, Anthropic Learning Mode, and Khan Academy's Khanmigo (Jacob, 2025). As the University of Economics Varna positions itself within this digital transformation, these tools start being considered not as simple answer engines, but as complex instructional systems grounded in established educational theories (Miltenoff, 2026). The following report provides an overview of these platforms, their underlying cognitive frameworks, and their multidimensional impact on students, faculty, and the broader business environment.

2. Architectural and Pedagogical Profiles of Emerging AI Learning Modes

The evolution of generative AI from a passive assistant to an active tutor is characterized by the implementation of Socratic dialogue, scaffolded complexity, and multimodal integration.¹ Each major provider has adopted a distinct approach to ensuring that AI serves as a catalyst for understanding rather than a shortcut to completion (Heymans, 2025).

2.1. ChatGPT Study Mode: The Socratic Transition

Launched in July 2025, ChatGPT Study Mode represents OpenAI's dedicated effort to transform its flagship model into a persistent, 24/7 academic mentor (Office of Information Technology, 2026). This mode is specifically designed to support "active learning," a pedagogical strategy expecting learners to engage with the material through questioning and problem-solving rather than passive reception. The system operates through several core mechanisms which differentiate it from the standard chat interface. It acts less like a "search engine" providing quick answers and more like a human tutor who helps learner solve problems on their own. While a standard chatbot is built to finish a task as fast as possible, these learning modes are designed with specific "safety brakes" and teaching tools to ensure the learner actually understands the material.

The core mechanisms include:

- **Socratic Questioning:** Instead of providing the final solution, the AI asks guiding questions forcing the learner to think critically and come to the conclusion themselves.
- **Scaffolding:** The system breaks a large, often intimidating topic into small "bite-sized" steps. It starts with the basics and only adds further and/or more difficult information once it established the learner have mastered the current step.
- **Diagnostic Checks:** At the start of a session, the AI asks about learner's grade level and the level of knowledge, so it can adjust its language and difficulty to match the learner's specific needs.
- **Active Knowledge Checks:** The system uses mini-quizzes or "teach-back" prompts, where the learner has to explain the concept in their own words back to the AI before it moves on to the next section.
- **Grounded Learning:** The learner can upload their specific notes, textbooks, or images of a handwritten problem, and the AI will use those exact materials to guide its explanations rather than provide generic information (Jacob, 2025; Kapuściński, 2025; Pangan and Nicholas, 2025).

The platform utilizes interactive prompts to eschew direct answers in favor of hints and clarifying questions. When a student presents a complex mathematical problem or a philosophical inquiry, the AI does not immediately output the solution; instead, it asks the student to explain their current approach or identifies foundational concepts that must be mastered first. This is bolstered by "layered responses," where the AI delivers information in bite-sized chunks, increasing in complexity only after the user demonstrates comprehension (Jacob, 2025).

Table 1

Feature	Technical Implementation in ChatGPT Study Mode
Active Learning Support	Employs Socratic questioning, debates, and roleplay as the primary interaction mode (Office of Information Technology, 2026).
Adaptive Difficulty	Adjusts pacing and complexity based on initial diagnostic questions regarding grade level and goals (Jacob, 2025).
Memory Integration	References prior conversations and stored preferences to connect new topics to established knowledge (Jacob, 2025).
Multimodal Grounding	Allows the upload of textbooks, PDFs, and handwritten notes to contextualize the AI's feedback (Jacob, 2025).
Teach-Back Verification	Periodically asks the student to "teach the teacher" to verify concept mastery (Jacob, 2025).

The integration of memory is a critical differentiator for ChatGPT Study Mode. By recalling a student's long-term goals—such as preparing for an Advanced Placement exam in three weeks—the AI can adjust its pacing and prioritize specific areas of weakness (Jacob, 2025). This creates a longitudinal learning experience where the AI functions less like a tool and more like a partner in the student’s academic journey (Office of Information Technology, 2026).

2.2. Google Guided Learning and the LearnLM Framework

Google’s entry into specialized AI tutoring is built upon the LearnLM model, a research-grounded framework fine-tuned specifically for pedagogical effectiveness. In the Gemini ecosystem, Guided Learning focuses on creating a "judgment-free space" where students can explore complex topics at their own pace through multimodal responses, including videos, diagrams, and interactive quizzes (Heymans, 2025).

A significant development within this ecosystem is the evolution of NotebookLM (Dhami, 2025). This tool allows students and educators to transform their own research materials into interactive notebooks that are grounded entirely in the provided sources, virtually eliminating the risk of hallucinations. NotebookLM’s "Learning Guide" encourages participation with probing questions and step-by-step breakdowns.

The platform’s partnership with OpenStax provides access to peer-reviewed textbooks across biology, management, and chemistry, ensuring that the AI’s guidance is tethered to vetted academic content.¹⁵ Furthermore, the introduction of "Audio Overviews" allows for a unique auditory learning experience, where two AI hosts can critique or debate a student’s essay, providing diverse perspectives that stimulate critical thinking (Dhami, 2025).

2.3. Anthropic: Constitutional AI and Hybrid Reasoning

Anthropic’s approach to education, embodied in the "Claude for Education" initiative and the Claude 3.7 Sonnet model, is defined by its commitment to safety, transparency, and logical rigor (“What Is Claude AI?,” 2025). The platform utilizes "Constitutional AI," a training methodology where the model is aligned with a predefined set of ethical principles derived from sources like the UN Declaration of Human Rights. This ensures that the AI’s tutoring is helpful, harmless, and honest by design.

Claude 3.7 Sonnet introduces the industry’s first "hybrid reasoning" model (“Claude 3.7 Sonnet and Claude Code,” 2025). This allows users to toggle between rapid responses and "Extended Thinking" mode, where the AI’s internal step-by-step reasoning is made visible to the user. This visibility is particularly valuable in higher education, as it allows students to observe the "work" behind a solution, serving as a form of cognitive modeling (Traub, 2025).

Table 2

Platform Component	Anthropic Claude for Education Specifics
Learning Mode	A specialized interface within "Projects" that prioritizes Socratic questioning over direct answers (“Introducing Claude for education,” 2025).
Extended Thinking	Visible reasoning blocks that show how the AI analyzes information and identifies its own potential flaws (Traub, 2025).
Institutional Security	Enterprise-grade privacy controls that prevent student data from being used for model training (“Introducing Claude for education,” 2025).

Template Library	Offers structured formats for literature reviews, study guides, and research outlines ("Introducing Claude for education," 2025).
Task Signaling	The model uses complexity signaling to determine when to trigger deep reasoning vs. fast response ("Mastering ChatGPT," 2023).

Anthropic's focus on "Projects" allows students to organize their work into persistent folders, creating a structured environment for multi-week assignments like a thesis or a semester-long literature review ("Introducing Claude for education," 2025). This structured approach is favored by institutions like Northeastern University and the London School of Economics, which have partnered with Anthropic to develop frameworks for responsible AI adoption (Chavez, 2025).

2.4. Khanmigo: Curriculum Alignment and STEM Efficacy

Khan Academy's Khanmigo represents a bridge between established educational technology and modern generative AI (Shetye, 2024). Grounded in the GPT-4 model but constrained by the Khan Academy curriculum, Khanmigo serves as a tutor heavily focused on scaffolding and skill-building in math and science.

The platform's efficacy is supported by longitudinal research. According to the research, students who reach a "dosage" of 30 minutes per week on Khan Academy see 20-30% greater-than-expected gains on standardized tests (Yamkovenko, 2024). Khanmigo enhances this experience by acting as a conversational partner and guides students through problem sets, offering hints to adapt their specific level of mastery.⁴ It also features interdisciplinary tools, such as the ability to chat with historical figures or literary characters, making abstract concepts more relatable (Shetye, 2024).

3. Theoretical Foundations of AI-Scaffolded Learning

The effectiveness of these learning modes is rooted in established theories of educational psychology. At the University of Economics Varna, our research emphasizes the need to move beyond technical implementation to understand the cognitive mechanics of human-AI collaboration (Milteneff, 2026).

3.1. Behaviorism and Reinforcement Learning

The foundational logic of many AI tutoring systems aligns with behaviorism, particularly the work of B.F. Skinner on reinforcement.³² From this perspective, the AI serves as a digital embodiment of stimulus-response cycles.³² By providing immediate feedback—whether through the "instant feedback" of Khanmigo or the "knowledge checks" of ChatGPT—the AI reinforces correct mental models and redirects the learner when they make errors.¹ In corporate training, this is often manifested through gamification, where the achievement of "badges" or "energy points" serves as a positive reinforcement mechanism to maintain engagement.²⁹

3.2. Constructivism and the Zone of Proximal Development

Constructivism, as theorized by Vygotsky, posits that learners construct knowledge through social interaction and dialogue (Blake, 2023). The AI "tutor" acts as a "More Knowledgeable Other," providing the necessary scaffolding to bridge the gap between what a student can do independently and what they can achieve with guidance—the "Zone of Proximal Development" (ZPD) (Shetye, 2024).

Platforms like ChatGPT and Claude implement this by asking "How would you approach this problem?" rather than giving the answer ("Introducing Claude for education," 2025). This encourages the student to build their own understanding, a process known as "active construction" (Blake, 2023). As the student demonstrates

mastery, the AI withdraws its support, fostering the student’s transition to autonomous performance (Akram et al., 2025).

3.3. Metacognition and Self-Regulated Learning (SRL)

Perhaps the most significant impact of guided AI learning is the development of metacognition—the ability of students to monitor and regulate their own thinking (Tsakeni et al., 2025). Flavell’s model of metacognition distinguishes between metacognitive knowledge (understanding how one learns) and metacognitive regulation (planning, monitoring, and evaluating one's progress).

Research has shown a strong favorable relationship between AI-based scaffolding and metacognitive awareness (Asgar, 2025). AI tools that pose thought-provoking questions force learners to reflect on their choices, making them more self-reliant and self-directed. In a quasi-experimental study, students using AI-assisted learning showed a superior ability to organize their thoughts and self-regulate their learning compared to a control group taught using traditional methods. Interestingly, female students were found to outperform male students in metacognitive awareness when using these tools, potentially indicating a greater receptiveness to reflective feedback.

Table 3

Metacognitive Scaffolding Dimension	AI Mechanism for Support
Strategic Planning	AI suggests study guides, outlines, and multi-stage goals based on syllabus data (Office of Information Technology, 2026) (Office of Information Technology, 2026).
Real-Time Monitoring	Immediate feedback and hints help students track their own accuracy during problem-solving (Shetye, 2024) (Shetye, 2024).
Critical Evaluation	"Teach-back" and quiz features require students to assess their own level of mastery (Jacob, 2025).
Visible Reasoning	Modeling logic through extended thinking blocks helps students internalize effective thought processes ("Claude 3.7 Sonnet and Claude Code," 2025).

The shift from individual reflection to "distributed cognition"—where the human and the AI system co-regulate the learning process—is a central theme in modern educational research. This posthumanist paradigm suggests that AI is not just a tool, but a "co-regulator" that shares the cognitive load of learning (Tsakeni et al., 2025).

4. Multi-Stakeholder Implications

The implementation of specialized AI learning modes creates a ripple effect across the educational ecosystem, altering the experiences and responsibilities of students, faculty, and business organizations (Spathopoulou et al., 2025).

4.1. Students: Acceptance, Motivation, and the Paradox of Efficiency

Students generally exhibit a high degree of acceptability for AI tools like Khanmigo and ChatGPT, valuing their capacity for personalization and immediate feedback (Alvarez and Angeles, 2025). However, this acceptance is nuanced; while students are eager to experiment with AI, they do not support its universal implementation across all subjects, preferring its use in structured fields like mathematics over interpretive domains like philosophy.

- 1. Acceptance Factors:** Students are more likely to adopt AI tools when they perceive them as beneficial, user-friendly, and socially validated. Hierarchical regression models indicate that perceived strengths (efficiency, quality) are the strongest predictors of acceptance (Alvarez and Angeles, 2025).
- 2. Motivation and Autonomy:** AI systems improve motivation by offering a sense of autonomy and goal-setting features (Asgar, 2025). The ability to learn at one's own pace without fear of judgment from peers or teachers is a significant psychological benefit (Heymans, 2025).
- 3. The Risk of Cognitive Offloading:** A critical concern is "cognitive offloading," where an over-reliance on AI for problem-solving reduces the student's own critical thinking and creativity (Asgar, 2025). Studies warn that if students treat AI as an answer machine rather than a tutor, their long-term ability to solve problems independently will decline (Danault, 2025).
- 4. Intellectual Humility:** Paradoxically, AI tutoring has been shown to increase intellectual humility—the awareness of one's own cognitive limitations.⁴⁴ Interaction with a patient AI that consistently corrects misconceptions makes students more open to corrections and more aware of what they do not know (Arun et al., 2025).

4.2. Faculty: Role Transformation and Institutional Resistance

For faculty members, AI represents a paradigm shift from being the "sole knowledge provider" to becoming a facilitator of learning (Danault, 2025). This transition is fraught with both opportunities for professional growth and fears of job displacement (Spathopoulou et al., 2025).

Table 4

Faculty Perspective Dimension	Current Research Findings
Instructional Design	68% of faculty participants in some studies report a significant shift in how courses are delivered (Huma et al., 2025).
Administrative Burden	AI is seen as "somewhat helpful" for automating repetitive tasks like grading and email (AAUP, 2025).
Job Security	Resistance to AI is often rooted in fears of staff replacement and the devaluation of academic roles (AAUP, 2025).
Professional Development	There is a widespread lack of training, with many faculty using AI only out of "work intensification" (AAUP, 2025).
Human interaction	Concerns exist regarding the decline of human mentorship and the "loss of humanity" in education (Danault, 2025).

At the University of Economics Varna, we observe a tendency for junior faculty to have higher confidence in AI adoption, whereas senior faculty often lead institutional policy discussions while remaining skeptical of pedagogical quality (Spathopoulou et al., 2025). The challenge for institutions is to provide meaningful professional development that helps faculty move from "content delivery" to fostering AI literacy and ethical reasoning (MILTENOFF, 2024).

4.3. Business and Industry: ROI and Workforce Upskilling

In the business sector, AI tutors and adaptive systems are viewed through the lens of economic efficiency and return on investment (ROI). Generative AI in enterprise learning has seen rapid adoption, with 65% of

companies integrating these tools within a ten-month period (Callwood, 2024).

Table 5

Business Metric	Impact of AI Tutoring Systems
Training Efficiency	Reduction in content creation time (e.g., videos) by up to 62% (Callwood, 2024).
Time-to-Proficiency	15-30% reduction in the time required for new hires to reach full productivity (Callwood, 2024).
Knowledge Retention	Improvements of up to 50-90% in technical fields like medical training (Callwood, 2024).
Employee Engagement	30-40% increase in course completion and satisfaction rates (Callwood, 2024).
Customer Satisfaction	Healthcare providers saw a 25% drop in patient complaints after AI-enhanced staff training (Callwood, 2024).

Corporate AI tutors, such as those provided by CogniSpark, allow organizations to scale their training programs without a proportional increase in human resources (Maske, 2024). They provide consistent, high-quality instruction across global teams, supporting over 75 languages and adapting to individual skill levels. This is particularly valuable for compliance training and complex technical onboarding, where real-time feedback is essential for maintaining standards.

5. Institutional Policy and Academic Integrity

Strategies for assessment redesign, the use of AI disclosure statements, and the "Human-in-the-Loop" requirement for ethical grading accompanies the acceptance of the AI learning modes. The transition toward a stable AI-integrated academic environment requires a shift in institutional policy from prohibition to ethical stewardship. This evolution is centered on three strategic pillars: assessment redesign, transparent disclosure, and the preservation of human agency in grading (Anderson, 2021; Furze, 2023; Lovelace, n.d.).

5.1. Assessment Redesign for the AI Era

Traditional assessments focusing on lower-order cognitive skills—such as factual recall and basic comprehension—are increasingly vulnerable to automated completion. Institutions are therefore moving toward "Authentic Assessment," which prioritizes the application of skills and nuances of human experience that evade generative models (Khlaif et al., 2025; Perkins, 2024).

- Process-Based Evaluation: Rather than grading only the final "product," faculty are adopting multi-stage assignments that evaluate the initial concept, turning points in reasoning, and a final reflective cover letter.
- The "Two-Lane" Framework: Some institutions utilize a hybrid model:
 - o Lane 1 (Secure): In-person, supervised oral assessments, concept mapping, or paper-based exams to verify foundational knowledge without AI access (TeachWell Digital, n.d.).
 - o Lane 2 (Open): Unsecured, inquiry-based projects where the use of AI is explicitly scaffolded and supported as a collaborative thinking partner.
- AAAE Framework: This strategy categorizes tasks as Against (prohibited), Avoid (AI-resistant personal reflections), Adopt (AI-integrated ideation), and Explore (full human-AI collaboration) (Khlaif et al., 2025).

5.2. AI Disclosure and Transparency Standards

Disclosure is not merely a formality but an "epistemic requirement" to ensure evaluation remains accountable and interpretable (Alfaleh, 2026). Effective policies are increasingly guided by intergovernmental standards, such as the OECD AI Principles, which mandate transparency regarding data sources and the logic leading to AI-generated recommendations ("AI principles," n.d.).

- **Responsible AI Disclosures:** These statements explain which AI model was used, how it contributed (e.g., brainstorming vs. final drafting), and the specific limitations or risks involved.
- **Syllabi Integration:** Instructors provide assignment-specific guidance directly within assessment briefs rather than relying on generic university-wide statements.
- **Citation Logs:** Students are encouraged to maintain a log of AI interactions, justifying their choices and demonstrating critical evaluation of the AI's suggestions.

5.3. "Human-in-the-Loop[PM1]" (HITL) Ethical Grading

While AI can automate routine feedback, fully autonomous grading introduces significant risks regarding bias and contextual insensitivity. The HITL Ethical Assessment Framework positions AI as a "recommendation engine" rather than a final evaluator.

- **Four-Layer Grading Model:** This includes (i) pre-grading rubric calibration by faculty, (ii) preliminary AI scoring, (iii) human validation to override misinterpretations of linguistic or cultural nuances, and (iv) transparent audit trails.
- **Efficiency vs. Oversight:** Pilot studies show HITL models can reduce grading time by 40% (Selvam and Vallejo, 2025). Notably, while faculty validate approximately 87% of AI scores, roughly 13% require human override due to AI misinterpretations of creative or complex expression.
- **Epistemic Agency:** Policies must ensure that humans remain the "primary epistemic subjects," preventing a power imbalance where educators merely validate machine decisions without active cognitive engagement.

6. Conclusion and Future Trajectories

The future of artificial intelligence in education is currently shifting from a phase of rapid promotion toward one of critical evaluation, where the value of a tool is measured by its demonstrated impact on learning outcomes and institutional resilience. This trajectory is defined by the maturation of the four discussed learning modes—Socratic, Multimodal, Constitutional, and Curriculum-Integrated—which together facilitate a transition from simple automation toward human-AI augmentation.

6.1. Strategic Convergence of Learning Modes and Pedagogy

The effectiveness of these models is rooted in their ability to embody distinct educational theories, moving the student from a passive receiver of information to an active participant in "distributed cognition" (Jacob, 2025).

- **Socratic and Dialogic Inquiry (ChatGPT & Anthropic):** These platforms leverage the Socratic method to foster Active Learning ("Claude 3.7 Sonnet and Claude Code," 2025). By utilizing "Extended Thinking" (Claude 3.7) or "Study Mode" (ChatGPT), the systems make the "meta level" of reasoning visible to the student, which research identifies as a primary driver of critical thinking gains. This dialogic approach aligns with Social Constructivism, where the AI acts as a "More Knowledgeable Other" to bridge the learner's Zone of Proximal Development (ZPD).
- **Structured Multimodal Scaffolding (Google & Khanmigo):** These modes prioritize Cognitive Load

Theory by decomposing complex problems into manageable, "bite-sized" steps.⁵ Google's focus on source-grounded reasoning (NotebookLM) directly addresses the 78% of students who cite information accuracy as a primary concern. Meanwhile, Khanmigo's curriculum-integrated hints provide the Behaviorist reinforcement necessary for mastery in structured subjects like math and coding.

6.2. Impact on Student [PM1]Learning and Metacognition

The long-term trajectory for students involves the systematic development of metacognitive awareness—the ability to plan, monitor, and evaluate one's own thought processes.

1. Retention and Mastery: Evidence suggests that students using these guided modes can see learning gains of approximately 20–30% compared to traditional instruction.
2. Intellectual Humility: Interaction with patient, corrective AI tutors has been shown to increase a student's awareness of their own cognitive limitations, making them more receptive to feedback and less prone to "hallucinating" knowledge (Chavez, 2025).
3. From Automation to Augmentation: The future of student work will be defined by the "Agentic Leap," where learners move from using AI to automate routine tasks to acting as "agent orchestrators" who direct portfolios of capable machines to solve complex, multi-step research problems.

6.3. The Future "Agentic" Horizon in Higher Education

By 2030, these learning modes will likely evolve into **Agentic AI**—self-contained, goal-based entities that operate with high degrees of autonomy and long-term memory. These agents will not just respond to prompts but will proactively identify a student's knowledge gaps, recommend microlearning modules, and schedule revision activities independently.

At the University of Economics Varna, our research initiatives are preparing for this shift by focusing on Human-Driven AI (HD-AIHED). This envisions the use of microcredentials to validate the collaborative AI literacy of our graduates, ensuring they possess the evaluative skills to assess AI performance and the ethical judgment to delegate authority responsibly. Ultimately, the vision is for AI to act as a force multiplier for human capability, preserving the irreplaceable elements of human judgment and creativity in the global labor market.

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Assessment of Engagement with Digital Educational Products (DEP) in Bulgarian Schools**Teodora DANEVA¹**¹ University of Economics - Varna, Varna, Bulgaria, teodora.daneva@ue-varna.bg

JEL: N3**Abstract**

Four hundred thousand years ago, humans discovered fire, and this has completely changed their way of living. The progress achieved by technology could be interpreted as an extension of that achieved by biology. Education is no exception. In the digital decade, learning programs, platforms are updated more frequently, and the adoption of immersive technologies and adaptive learning systems in school education has the capacity to increase student engagement. The study aims to assess children engagement level (aged 11-15) with DEP in Bulgarian lower secondary schools emphasizing its multi-dimensional aspect, as well as to identify its underlying factors through the application of Exploratory Factor Analysis (EFA). In view of that, the assessment of engagement with DEP is conducted through children's reported behaviour by their teachers, which could be influenced by social biases. Additionally, as the number and digital infrastructure of schools are limited, the results may potentially vary and change during different time periods. The EFA showed that student engagement is a complex construct, identifying one dominant factor. The survey results revealed that Bulgarian teachers implement such products confidently in their classes, confirming that children enjoy DEP sessions in various disciplines. Despite the limitations, the current study provides valuable insights for educational providers in Bulgaria, who can leverage by delivering sustained value through enhanced customer-driven products, while educational experts learn that the application of DEP in their teaching practices introduces new approaches to engage students and improve their learning experience.

Key words:

assessment, student
engagement, digital educational
products, school education

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1. Introduction

Four hundred thousand years ago, humans discovered fire, and this has completely changed their way of living. The progress achieved by technology could be interpreted as an extension of that achieved by nature and biology. Both moved in a chaotic manner. Biological evolution gave birth to life as we know it, and technological evolution could give rise to a new life and/or forms of intelligence that we might find difficult to accept, but which could surpass us as a species. The dynamics of long-term technological innovation resembles biological evolution in many ways. The design of new technologies is strongly influenced by existing ones, and both chance and right context are needed to bring about technological change. If we interpret technological evolution as an extension of biological evolution, the former is driven by humans and has the potential to be driven by artificial intelligence in the future. Linking the two types of evolution, the Czech philosopher Radovan Rihta (1967) introduced the term “technological evolution” to characterize the different states that humanity has passed through in history as a result of technological progress. Education is no exception. In the digital decade, learning programs and platforms are updated more frequently, devices are constantly being improved, while the adoption of immersive technologies and adaptive learning systems in school education not only has the capacity to increase student engagement, but to enhance their practical skills and develop the necessary competences for a better future. Concerning the rise of learning analytics and its potential advantages, a variety of scientific papers have been focused on implementation of DEP in

Bulgarian education (Nikolova, Evtimova, 2022; Byalmarkova, Petrov, 2024) social relationships (Valkov, Lavrentsova, 2019; Piu et al, 2024), student engagement with such technologies on a global scale (Henderson, Trupia-Melluish, 2025; Nkomo, Daniel, Butson, 2025; Bond, 2023), demonstrating traditional and innovative methods for assessing it. However, a few of the academic articles actually focus on student engagement with such products in Bulgaria's lower secondary schools. The study aims not only to assess teacher and children engagement level (aged 11-15) in Bulgarian lower secondary schools emphasizing its multi-dimensional aspect, but also to summarize prominent scientific theories concerning student engagement, as well as to identify its underlying factors through the application of exploratory factor analysis. This step would validate the methodological approach and verify the reliability and construct's validity. In view of that, the report accepts the following limitations - assessment of student engagement with DEP is conducted through children's reported behaviour and observations by their teachers, which could be influenced by social biases rather than genuine behavioral patterns. Second, as the number of schools is limited and their digital infrastructure differs, the results may potentially vary between lower or higher engagement. Third, engagement levels are dynamic, which excludes seasonal variations or long-term effects of current educational reforms. Finally, the scope of the report is limited to lower secondary education in Bulgaria, which restricts the generalizability of the results to other countries and educational levels. Thus, the current report provides practical contribution to the DEP market for children by providing information about the market opportunities, such as product adoption rate of DEP, product attributes, etc. Moreover, educational providers in Bulgaria can leverage by delivering sustained value through enhanced customer-driven products. Last but not least, the study ensures that educational institutions in Bulgaria have the knowledge and understanding that the application of DEP in their teaching practices presents new ways to engage students and improve their learning experience.

2. Literature Review

2.1. Theories of Student Engagement

Today's world is extremely dynamic. Schedules sometimes collide and require from students to juggle with many different tasks simultaneously - writing homework, submitting assignments, watching videos and/or using interactive platforms. While some of these learning activities are required to develop competences, doing them without efforts and/or involvement, combined with multitasking, affects negatively children's productivity. Moreover, the digital era leads to shorter attention spans (15 to 30 minutes) for students, aged 11-15, leaving an impact on their ability to stay focused on a specific task, filter distractions and learn effectively (High focus centers, 2025). One of the antidotes to the current challenges is to foster engagement in the learning process. However, we shouldn't review it as the one and only requisite for effective learning. If we consider the whole process as a sport contest, a marathon, autonomy and developing competencies are the main goals, the finish line, while engagement is the starting point, something as an entry to the contest. Thus, understanding the concept of engagement is vital to develop successful educational strategies for student retention.

Most researchers define student engagement as a complex, multi-dimensional construct, emphasizing students' feelings, reactions and actions while learning (Zepke, 2018). Thus, the definition emphasizes several important characteristics - engagement includes behavioral and emotional domains. It also requires a conceptualization of its opposite, defined by Skinner, Kindermann, Furer (2009) as alienation. Others expand the concept in terms of the quality of the interactions, regarding participation in the learning process, values, people and the community as a whole (Reeve et al, 2025). Contemporary research adds another layer – agentic engagement in terms of students' initiative to contribute to the learning atmosphere and improve the overall experience in the class room by taking proactive actions such as asking questions and stating preferences (Reeve, Cheon, Jang, 2020). This dimension is based on Finn's (1989) definition of behavioural

engagement. He divided participation into four levels ranging from responding to teacher's instructions to involving in extracurricular activities. Thus, student engagement encompasses behavioural, emotional and cognitive domain (Skinner, 2009; Fredricks, Filsecker, Lawson, 2016; Zepke, 2018). Therefore, the conceptualization of the concept is part of the broader model of human motivation, developed in recent decades (Connell, Wellborn, 1991; Deci, Ryan, 1985, 2000; Skinner, 1991). To summarise, we interpret student motivation and engagement as significant factors in increasing the value of education, but the characteristics of the learning environment also have an impact on the student activity (Kong, 2021; Derakhshan et al., 2021; Shernoff, 2017). Striving to find answers to the question "how" to engage effectively students in the learning process, educational experts spend a lot of time and effort analyzing the capabilities of digital educational products and exploring new ones that can facilitate the process.

One of the first scientists who established the foundations of the engagement theory was Ralph Tyler, illustrating the positive effects of time on task on learning (Merwin, 1969). Robert Pace (1984) also contributed to the field of research, developing the College Student Experiences Questionnaire (CSEQ) and emphasizing engagement's behavioral aspect – quality of effort. Much closer to the core of the behavioral aspect of engagement is the involvement theory, developed by Austin (1999, p.519), and defined as "the physical and psychological energy in a specific object". This definition resembles Freud's cathexis, where the three components of personality - the id, the ego, and the superego define, redirect and/or limit the psychic energy invested in an idea, object or a person (Lantz, Kaur, Ray, 2025). With the conceptualization of the student involvement, Austin (1999) connected two central disciplines - psychology and pedagogy. Moreover, he shifted the focus from teaching to learning design, emphasizing that students should be integrated as active participants in the process, not only passive receivers of content, previously confirmed also by Edgar Dale's (1969) pyramid of experience. Kuh (2009) went further and broadened the concept beyond efforts and energy in a specific activity to an interactive process between students and educational institutions, represented by teachers and peers as a whole community. Applying behavioral data he was able to analyze and suggest new ways to increase student learning outcomes, and defined the factors that influence student level of engagement as either student-based or institution-linked (Strydom et al., 2010). Thus, student behaviours which are linked to engagement include study habits, time on task, interaction with staff, peer involvement, and motivation as a driver for behavior. Therefore, if a student wants to accomplish the learning goals, a necessity is not only his/her formal presence and/or attachment but also persistence and active efforts in the activity - concrete actions such as studying, exercising, doing homework etc., arising from motivational states (Reeve, 2020).

Each of the existing domains has been strongly influenced by various theories from multiple disciplines in an attempt to explain the complex relationship between students and their involvement in the learning process. Gray's Reinforcement Sensitivity Theory (RST); (Gray, 2000), although indirectly, is part of the puzzle clarifying the initial triggers to approach or avoid a given task, an activity or a process as a whole, focusing mainly on the emotional dimension. Based on the theory, there are three systems underlying students' reactions. Depending on the motivational stimuli and personality sensitivity differences, the Behavioral Approach System (BAS) spikes interest, excitement and joy by producing dopamine, the Fight-Flight-Freeze (FFF) system is related to a fear of punishment causing withdrawal from specific activities while the Behavior Inhibition System (BIS) stimulates anxiety (Franchina, Klackl, Jonas, 2023). Therefore, pedagogical experts can use RST to design educational assignments that eliminate negative triggers and stimulate only positive ones – providing rewards and/or feelings activating the BAS system, as well as student motivation to persistence and completion of the required tasks. Another theory that successfully interprets student engagement in the educational process is the social exchange theory. It considers expected rewards as the main incentive for achieving student engagement. Such an example represents the platform Kahoot! where students pass different tests, as well as obtain badges, create avatars, etc.

In quest to explain how people regulate their behaviour Skinner (1938) was among the key researchers who studied the influence of external conditions through operant conditioning. He systematically demonstrated through series of experiments the capability of reinforcement scheduling and its frequency to shape persistence. In education his conclusions give answers to such questions as why students stop/repeat specific behaviours and when the provided feedback affects most their actions. Bandura (1977) continued research on the concept of persistence through his self-efficacy theory and linked two domains of engagement – cognitive and behavioral. In education, his theory explains how students' confidence influences their quality of efforts and perseverance. He argued that the existence of stimuli alone was not enough to provoke one's reactions and behavior as previously stated, differentiating outcomes from self-efficacy. According to the theory one's belief that certain actions will lead to a desired outcome is essential to regulate behavior. In other words, self – efficacy produces motivational stimuli to persist and the existence of doubts eliminates it. In education, Bandura's (1977) theory describes the psychological reasons leading to motivational stimuli to persist with specific activities. In simple words, if students do not believe they will cope with the assignments, they are not confident in themselves or that their actions will not lead to specific results, they would rather quit than pour efforts.

Deci and Ryan's (1985) self-determination theory extended the concept of persistence and classified motivation to extrinsic (due to external forces) and intrinsic motivation (self-regulated). As a main driver of human growth, intrinsic motivation requires three essential factors - competence, autonomy and relatedness, which aligns fully with Vigotsky's (1979) scaffolding technique. Educational institutions which strive to increase the level of authentic motivation for their students should provide rather supportive than controlling teachers, because intrinsic motivation thrives on autonomy and control undermines its levels. Second, for children is vital not only to feel competent, but self-determined. In other words, a necessary component is the locus of causality or that achievements and accomplishment of goals are due to students' efforts and competence, part of cognitive evaluation theory (CET). Another issue is the decision whether to provide various tangible rewards and/or elements of gamification as the existence of frequent tangible rewards such as badges would more often decrease intrinsic motivation than to raise its level due to the so-called crowded – out effect (Deci et al., 1999). To that end, educational institutions need to plan and design carefully their teaching methods in order to model effectively the behavior of their students. However, modern research argues that extrinsic rewards could be applied as a gate to engagement, through interest-based learning theory and activating the same learning - reward loop. Thus, scientists may have exaggerated the detrimental effect of extrinsic rewards on intrinsic motivation as both types of rewards are processed in the same brain chain and the impact is more or less subjectively interpreted based on particular differences in personality traits (Hidi, Renninger, 2010; Woolley, Fishbach, 2016; Bardach, Murayama, 2025).

Related to the second and third dimension - emotional and cognitive engagement is the optimal experience/flow theory which considers the focus and concentration in a given assignment as a state of flow - a desirable inner experience where people are excited and immersed in an activity regardless of date and time (Csikszentmihalyi, Csikszentmihalyi, 1988; Csikszentmihalyi, 1990). Flow is interpreted as a state of heightened concentration while performing an activity, ignoring external stimuli. Csikszentmihalyi (1990) also found that people who had a vivid imagination and rich internal world did not require numerous external stimuli from the environment to represent the reality in their consciousness. Thus, they are more autonomous, have higher control of their thoughts and are able to experience the state of flow more easily than the others. As stated by this concept, the most significant prerequisites for students to the state of flow require clear goals, feedback and activities they enjoy, but at the same time they are enough challenging to demand efforts and lead to real achievement.

In DEP there are two key concepts related to flow theory – immersion and presence. Presence is described as a “sense of being” (Makransky, Peterson, 2021, p.6), interpreted as a subjective sensation of activation of the proprioceptive and autonomic nervous systems in a manner similar to that in real life. It is

not related to one's literal presence in the environment, but to the users' perception of that environment. Immersion, on the other hand, is a fundamental state of human consciousness that arises from the desire to engage with a particular stimulus that attracts attention and arouses interest. Immersion is a psychological sensation, a subjective experience of participation in a total experience, where self-awareness and awareness of time fade away (Mystakidis, Vangelis, 2023). When immersion is combined with high levels of engagement, with a balanced ratio between competence and task difficulty, the feeling of flow can be facilitated. The lack of balance in the difficulty of performing the task causes negative emotions – boredom, indifference or anxiety and frustration.

2.2 Student Engagement in the Digital Era

As a result of pandemic COVID-19 online learning provided both new opportunities and challenges for students, while enabling inclusive education and supporting participation in the learning process regardless of differences in geographic location and socio-economic conditions. Students had the chance to connect, supporting collaboration and relatedness and thus influencing intrinsic motivation. In addition to that, the rise of state - of - the art technologies such as AR, VR, and agentic AI offers significant advantages for engaging students and enhancing their learning experience, based on personalization, sense of immersion and flow, integrating Piaget's (1929) and Vigotsky's (1978) constructivism theory with Kolb's (2008) experiential learning.

The use of DEP according to this concept facilitates the perception of information through sensory and visual stimuli, game simulations, contributing to easier assimilation (recognizing a specific object and associating new information with the category) and accommodation (the process of adding information and creating new schemes, categories). The implementation of VR provides learners with a holistic sensory experience through which they can virtually see, hear, manipulate physical objects and practice in real-life situations. In this way, they transit from observers to active participants by improving their concentration, while the role of the teachers is modified from content providers to guides and mentors. Thus, DEP assists educational experts in the application of the "scaffolding" technique, emphasizing the role of the tutor during student education (Wood, Bruner, Ross, 1976). The advantages are the presence of interactivity, the ability to perceive and understand complex concepts, and the higher degree of engagement of the learners, who are placed in different environments similar to real life and unattainable with basic learning resources (Palamarova, Kostov, 2019). Usually experiential learning stimulates sense of competence and autonomy as students build confidence in solving complex problems. Additionally, the application of machine learning algorithms and the development of adaptive learning systems ensures that students' progress in the learning process with their own pace, while emphasizing their sense of autonomy and competence. Moreover, adaptive learning systems deliver tailored personalized recommendations based on student's weaknesses and difficulties enhancing the level of sense of mastery over the academic studies. Typically, this transforms into intrinsic motivation and persistence, as learners believe they are able to cope with academic challenges and are more willing to take on new ones (Weidlich et al., 2024). All these features of DEP represent potential entry for increasing student engagement while the application of learning analytics helps educators to predict the possibility of a student dropout (Abuhassna et al., 2024).

3. Methodology

The current study adopted a quantitative research design, aiming to assess children (aged 11-15) engagement level with DEP among students in Bulgarian lower secondary schools (5th – 7th grades). The multi-dimensional aspects of student engagement were analysed through the observations and children's reported behaviour by their teachers. To reach the main goal of the study, the research includes the following objectives - to evaluate and examine the reliability of the sub-scales related to each attribute and the reliability of the overall instrument. Although factor analysis includes two types - EFA and confirmatory

factor analysis (CFA), the following survey applied EFA, as it focuses on the simplification of interrelated constructs and identifies the underlying factors of student engagement.

Based on the scales developed by O'Brien, Toms (2009) and the engagement scale developed by Skinner and Kindermann (2009), a self-constructed five-point Likert-type Student Engagement with DEP (SEDEP) Scale was used, ranging from 1 (strongly agree) to 5 (strongly disagree) to measure the respondents' evaluations. The questionnaire, comprising 40 items, organized in 3 modules, was constructed with the help of Alchemer software. A special survey link was generated and when respondents clicked on it they were taken to the first page of the survey. At the top of it there was an introduction with instructions, including explanations of all abbreviations. A progress bar was located at the bottom of the currently used page, which informed participants about the left number of pages they had to complete until the end of the questionnaire. Using the button "Next" respondents were able to navigate the whole content.

The survey was pretested with 2 teachers, who were being observed while completing their responses. Although not associated with the research, their provided feedback and verbal comments contributed to modifying and improving the survey's functionality and clarity. To collect the data, a non-probability purposive sampling technique was used. The research sample was recruited from various public schools in Bulgaria, both state and municipal, in cooperation with teachers in lower secondary education (5th-7th grades), who were invited to complete the structured online survey. The questionnaire was posted online for a month (July 1st – July 31st 2025). Target population is limited to teachers in lower secondary education in Bulgarian schools. A total of 177 individuals completed the survey with only 171 completing the demographic information and 170 sharing their age. There were 146 females (85.4 %) and 25 males (14.6 %). Respondents ranged in age from 24–29 (n=10, 5.9%); 30–34 (n=7, 4.1%); 35–39 (n=20, 11.8%); 40–44 (n=19, 11.2%); 45–49 (n=29, 17.1%); to 50–59 (n=65, 38.2%).

The first module consisted of 14 items. Its aim was to measure teachers' existing customer experience with DEP, such as the specific DEP type currently implemented in the teaching practices, frequency of usage, customer satisfaction, NPS, etc. Additional questions were raised regarding teachers' digital capabilities, competencies and their recent participation in trainings concerning digital technologies. To analyse the brand awareness of a specific DEP, respondents were asked additional questions using both unaided and aided recall and with regards to the top 3 DEP products from the category they have heard/known of.

The assessment of student engagement with DEP products was based on the observations of the teachers regarding students' behaviour, ranging from 1 (strongly agree) to 5 (strongly disagree) to measure the respondents' evaluation. The second module contained 51 items, covering behavioural, cognitive and emotional aspects such as focused attention, students' efforts, involvement, challenge, reward and aesthetics of DEP. The aforementioned items included statements with up to 6 dimensions concerning cognitive engagement (items Q15_1, Q15_2, Q15_3, Q15_4) and represented by focused attention and mental efforts.

Based on the theoretical frameworks of Fredricks, Blumenfeld, Paris (2004), Skinner, Furrer, Marchand, and Kindermann (2008), and user engagement with new technologies developed by O'Brien and Tomms (2010), the illustrated research model (Fig.1.) is used to determine the underlying factors of student engagement indicating a multidimensional construct comprising 3 domains: behavioural, emotional, and cognitive.

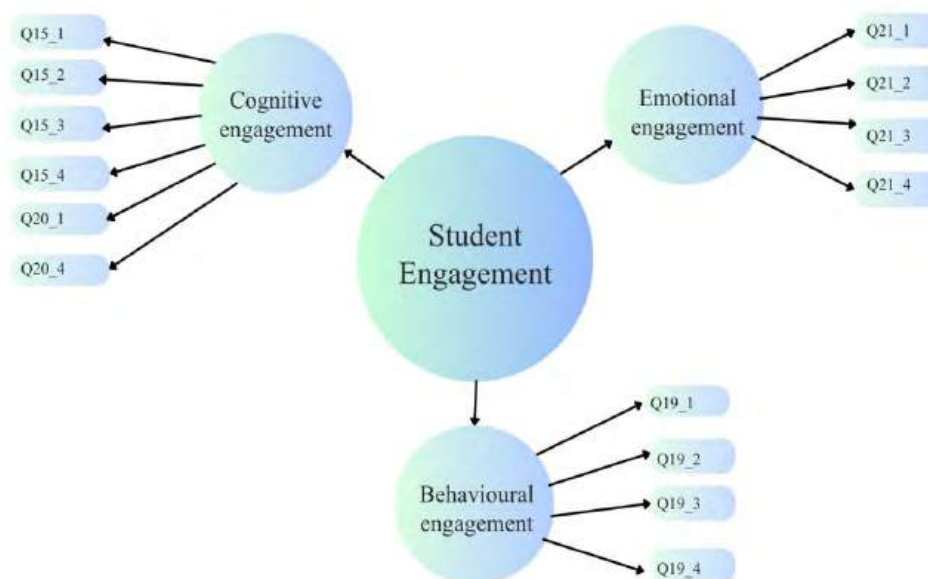


Fig. 1. Research model of student engagement with DEP

Source: Adapted from Vassileva (2017) Consumer Activities and Reactions to Social Network Marketing, Management, 12, 133-144.

Thus, based on the theory, cognitive engagement reflects focused attention, mental efforts, positive challenges and perceived time. Each dimension was measured through several observed variables included in the survey instrument.

Table 1.

Questions regarding cognitive engagement

Statements	1	2	3	4	5
Q15_1 Children focus without getting distracted.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
Q15_2. Children do not need frequent reminders to return to assigned tasks.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
Q15_3. While using DEP, children ignore other stimuli from the environment.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
Q15_4. I don't feel the time passing when I teach with DEP.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
Q20_1. Children must make efforts to use DEP effectively and complete the tasks.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
Q20_4. DEP provides challenges of an appropriate level of complexity that engages my attention as a teacher.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree

Source: Author's work

Behavioural engagement was represented by 4 items with regards to teachers' participation in creating new content with DEP, student involvement and agency including students' requests for additional tasks with DEP.

Table 2.

Questions concerning behavioural engagement

Statements	1	2	3	4	5
Q19_1. I participate actively in creating or adapting new content through DEP.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
Q19_2. Children participate with interest, even when the task is challenging.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
Q19_3. Children themselves are constantly looking for new ways to use the features of DEP.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
Q19_4. Pupils often raise questions or make requests about additional tasks with DEP.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree

Source: Author's work

The statements about emotional engagement (items Q21_1, Q21_2, Q21_3, Q21_4) included interest, pleasure, excitement. Perceived usability (items Q16_1, Q16_2, Q16_3, Q16_4, Q16_5, Q16_6) aimed to measure the considered advantages of DEP in comparison with other traditional products according to the TAM model (Rogers, 1971). Additional questions identified motivational aspects (items Q24_1, Q24_2, Q24_3, Q22_1, Q22_2, Q22_3, Q22_4) as a driver to engagement according to Deci and Ryan's work on Self-Determination Theory (1985).

Table 3.

Questions concerning emotional engagement and motivation in assessing student engagement with DEP

Statements	1	2	3	4	5
Q21_1 The use of DOP evokes positive emotions in students.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
Q21_2. After the end of the DEP session, children enthusiastically share what they have learned and/or experienced.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
Q21_3. Children are excited to share their experiences with DEP.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
Q21_4. Children demonstrate a strong desire to use DEP in subsequent lessons.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
Q22_1. I have full control over the learning process when using DEP.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
Q22_2. I can adapt DEP according to the needs of my students.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
Q22_3. Children successfully manage the functions of the ADI (e.g., navigation, selecting options, and using tools).	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree

Q22 4. I can adjust the teaching pace through DEP's functions.	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree

Source: Author's work

Module 3 consisted of 13 items and focused on demographic information concerning gender, teaching experiences, income, location, and type of school where the respondents teach (state or municipal), etc.

3.1.1. Data processing

The obtained research data was cleaned and analyzed using SPSS 19.0 and RStudio 4.1. All missing data was coded -9 and excluded from the survey. A reliability scale with a Cronbach's alpha coefficient of ≥ 0.7 was accepted as satisfactory and an item-total correlation coefficient of > 0.3 was adopted. To analyse the underlying factors of student engagement, an exploratory factor analysis (EFA) was conducted under the following requirements:

1. Factor loading > 0.5 ;
2. Kaiser – Meyer – Olkin (KMO) coefficient ranging between 0.5 and 1;
3. Bartlett's test for sphericity (Sig. < 0.05);
4. Percentage of total variance (percentage of variance $> 50\%$).

The aim was to analyse whether the items were clustered together around one or other latent constructs reflecting different dimensions of student engagement such as focused attention, perceived usability, aesthetics, endurability, involvement, challenge, emotional engagement, control, motivation, feedback, novelty, and perceived time.

4. Results and discussion

Online Survey

Results of the online survey revealed that 93.6% of teachers in Bulgaria have implemented various types of DEP in their teaching practices. Among the top-performers, used daily, are educational websites (82.9%) and digital educational platforms (81.1%). User experience with DEP is evaluated as strongly positive (7 out of 10) as teachers are eager to recommend them to their colleagues (51.4%). Considered as the most significant function of DEP is the capability to track children's progress in the learning process, preferred by 53.2% of the respondents. In addition to that, teachers interpret the use of DEP as a necessity in the 21st century and regarding the development of state-of-the-art technologies. Izzy is the educational platform, scoring with the highest rate of brand awareness, and selected by 54.1% of the participants in the survey.

As per the statements concerning engagement, particularly focused attention and aesthetics, teachers demonstrate moderate agreement (50%). More than 56.3% of them state that they will continue to use DEP in their classes, confirming that they manage to capture students' attention and foster creativity. However, only 34.0% of the teachers, participated in the survey, actually create new content with DEP despite the fact that 63.6% of them review themselves as digital competent and 40% - feel more motivated when using such products. Teachers' observations reveal that children are capable of dealing with such products and do not express any problems/difficulties; yet making efforts is a significant prerequisite for completing successfully the tasks. More than 53.1% of the teachers review DEP as a challenge to children, which evokes only positive emotions and makes the learning process more effective in comparison with traditional approaches.

Exploratory Factor Analysis

A thorough analysis of the variables was made in order to assess their relevance and suitability as well as to identify potential anomalies. As an essential step before proceeding with the EFA, a further examination of central tendencies was included with regards to means and standard deviation. Ranging from 1.70 to 2.76 the items demonstrated moderate levels of agreement. In addition to that, the standard deviations were within acceptable levels (0.7-1.10), confirming the adequacy of the responses' variability - a necessary requirement for EFA. Thus, the initial results of the descriptive statistics provided sound arguments and evidence of the empirical appropriateness of the data. The reliability analysis demonstrated a Cronbach's alpha of 0.975, exceeding the recommended level of 0.70 (Field, 2018) and the correlation coefficient of total variables (Item total statistics), demonstrating excellent consistency of the scale.

Table 4.

Reliability analysis and sample's adequacy

Indicator	Result
Cronbach's Alpha	0.975
N of Items	51
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.923
Bartlett's Test of Sphericity Approx. Chi-Square	5622.977
Df	1176
Sig.	.000

Source: Author's work

However, two items – Q16_7 (perceived usability) and Q20_1 (challenge) did not meet the reliability criterion, as their values were below 0.7 (Q16_7 – 0.380 and Q20_1 – 0.137). Thus, they were dropped prior to the EFA. Kaiser-Meyer-Olkin (KMO), which analyses the adequacy of the data, was 0.923, surpassing the necessary requirements and indicating good Bartlett's Test of Sphericity (Chi-square $X^2 = 5622.977$, $p < 0.001$), and confirming that the correlation matrix is appropriate for factor analysis. Additionally, the matrix also provided evidence of statistically significant ($p < 0.001$) moderate to high inter-item correlations, indicating good internal consistency. Some of the items related to constructs as Aesthetics, Perceived Usability, Emotional Engagement, Motivation and Endurability, even showed correlations between items above $r = 0.60$. For example, item Q16_3 within Perceived Usability had correlations exceeding $r = 0.6$ with items under this construct, confirming its reliability. The same conclusions were made about items under Emotional Engagement construct (Q21_4), which showed inter-item correlations above 0.70, supporting the use of EFA as a subsequent step of the study.

Principal Axis Factoring was chosen as an extraction method as more appropriate for identifying latent factors (Fabrigar et al., 1999).

Table 5.

Total variance explained

Factor	Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	23.247	47.443	47.443
2	1.859	3.795	51.237
3	1.839	3.754	54.991

4	1.493	3.048	58.039
5	.946	1.930	59.969
6	.875	1.786	61.755
7	.829	1.691	63.446
8	.745	1.521	64.967

Extraction Method: Principal Axis Factoring.

Source: Author's work

In Principal Axis Factoring method components having eigenvalues more than 1 are extracted, and the factor loadings of the item above 0.6 are rotated in order to explain the underlying construct. The correlation between each of the items and the construct is defined as factor loadings (Kedia, Lokanath, 2023). From the output in Tabl. 6. and according to Kaiser's rule (1960) initial eigenvalues showed 4 factors, explaining a total variance of 58.039 %.

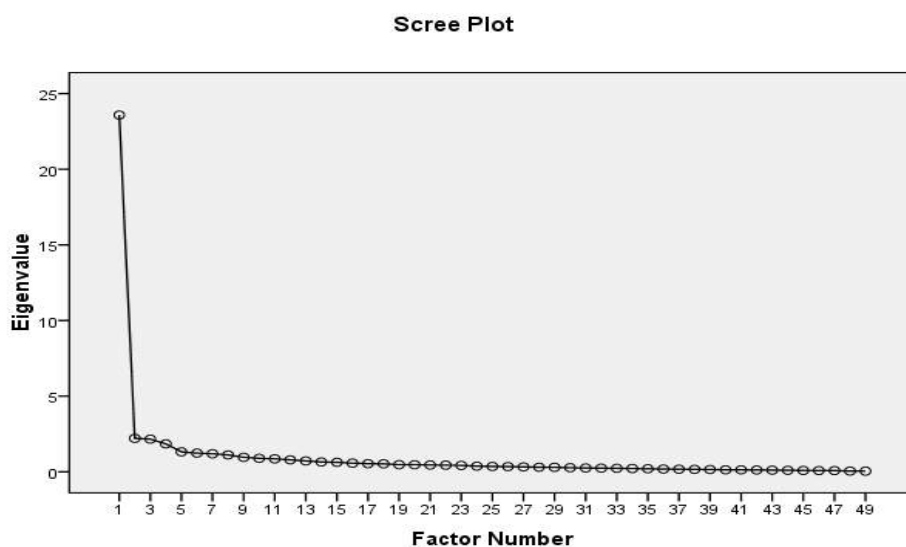


Fig. 2. Scree plot

Source: Author's work

The scree plot confirmed the eigenvalues, but showed a sharp decline between the first and the second factor, aligned with Cattell's (1966) scree criterion and Field's (2018) interpretations. Additionally, the factor matrix supported the statement that a strong dominant factor is responsible for approximately 47% of the variance. In summary, the results confirmed that student engagement is a complex, unidimensional construct.

5. Conclusion and implications for future research

The study focused on assessment of student engagement in lower secondary education (5th – 7th grades) in Bulgarian schools. The results showed that Bulgarian teachers use DEP confidently in their teaching practices and also confirmed that children enjoy DEP sessions. Pupils demonstrated strong interest, focused attention and involvement while using such products in various disciplines. The application of the EFA verified the research methodology and validated the reliability and internal consistency of the

construct, ensuring that the developed scale measures correctly student engagement with DEP. However, several topics remain open. Given the research limitations, future studies should broaden the scope of the investigated groups to analyse whether student engagement remains high despite the age differences. Second, while the current report applied EFA to identify the underlying factors of student engagement, a subsequent confirmatory factor analysis is required to verify the identified dominant factor and its robustness. Third, an analysis of the long-term effect of DEP on students' health is necessary, as various reports reveal the negative impact of such products if used recklessly. Thus, researchers should develop a unified framework and validate KPIs to evaluate and monitor DEP's effectiveness and its influence on students' results. Fourth, the examination of the mediating and moderating effects of learners' characteristics such as digital competency on engagement outcomes is another open venue. Last, but not least, the theoretical framework, representing models of behavioural and emotional engagement should be adapted to nowadays digital learning environments, including immersive, gamified, or AI-powered platforms. These directions will support the design of more engaging and pedagogically effective DEP on a global scale.

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Analysis of Student Satisfaction among Marketing Students at BSU "Prof. Dr. Asen Zlatarov" in the Course "Economic History"

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JEL: M30, M31

Abstract

The subject "Economic History" included in the curriculum of the "Marketing" major is intended to familiarize students with how people have provided themselves with food, shelter, clothing and other material benefits over the millennia. On the other hand, the subject under consideration also examines purely economic issues, such as: the role and place of money, labor markets and financial markets, taxes and their impact on the economy, the causes and consequences of economic and financial crises. This places the subject under consideration within the scope of the mandatory subjects for study by students of the "Marketing" major at the Bulgarian State University "Prof. Dr. Asen Zlatarov". In this regard, the main goal of this paper is to build a foundation of theoretical knowledge about the essence of economic history and to conduct a comparative analysis of the lecturers (of lectures and exercises) of the subject under consideration on it. For the purposes of the analysis, an empirical study was used, which was conducted using surveys distributed through the Google Forms system.

Keywords:

comparative analysis, student satisfaction, business history, Marketing major

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Introduction

The relevance of the research is determined by:

- the evolution of nations lies at the heart of the discipline of "Economic History" and should be considered as a dynamically developing branch of economic science;
- On the other hand, achieving customer satisfaction for students majoring in Marketing at BSU "Prof. Dr. Asen Zlatarov" is becoming the main task of the teaching team.

The thus presented **relevance of the present study** predetermines the research interest, which presupposes the scientific and applied focus of the studied issues.

➤ Tasks:

- To review the literary sources related to the issue under consideration;
- To develop a questionnaire;
- Conduct a survey among students;
- To process the data;
- To analyze the data obtained;
- To draw conclusions, generalizations and summaries.

The subject of this study are the students majoring in Marketing at the Bulgarian State University "Prof.

Dr. Asen Zlatarov".

The subject of this study is the user satisfaction of students in the taught discipline "Economic History".

The main objective of this study can be specified in the following areas:

- *First, to conduct a study on the specifics of the discipline "Economic History";*
- *Second, to explore the essence of customer satisfaction as an element of marketing;*
- *Third, to implement an empirical study related to student satisfaction with the taught discipline "Economic History".*

The research thesis is: the use of appropriate questions regarding the taught discipline, integrated into the questionnaire provided to the respondents, helps to draw conclusions, generalizations and conclusions about consumer satisfaction of students majoring in Marketing.

1. Review of literary sources and development of hypotheses

1.1. Specifics of the discipline "Economic History"

The main task of the discipline "Economic History" is to provide students of the specialty "Marketing" with knowledge, skills and experience in the economic development of society, from antiquity to the present day. In this regard, the discipline examines the development of production technologies, trade, consumer attitudes and economic systems during the different periods of development of society. From this point of view, it can be noted that the discipline under consideration is of significant importance for marketing, as it allows future specialists in this field to understand the context in which they can operate, and this, in turn, helps them in building more effective strategies based on historical examples and lessons. In the context of the argumentation presented in this way, we cannot but agree with the statement of **Lyuben Berov**, who notes that the product of economic history becomes as necessary for society and especially for the younger generation as it finds in the interpretation of the past given by its confirmation of its ideals and answers to its questions (Беров, 1999).

Developed by **Brian Jones & Eric H. Shaw** It is noted that economic history should focus on the analysis of historical structures and changes in society (JONES & SHAW, 2002). According to the cited specialists, this discipline examines not only the resources that are used, but also the technologies that are implemented, and this in turn means that it examines how production and trade practices evolve. A review of the economic literature shows that within the discipline of "Economic History" it is necessary to study the following stages of the development of society:

- **Ancient civilizations** – this suggests the need to study the development of trade networks and economic structures in ancient Mesopotamia, Egypt, India, China, Greece and Rome. The reason for studying these civilizations, economists find, is that in these societies, on the one hand, the initial trade practices were formed, and on the other hand, concepts of goods and exchange. Thanks to the theoretical overview of **Jared Diamond** can trace the development of individual cultures in the context of trade and marketing (Diamond, 1999). In his work, the author emphasizes the thesis that Mesopotamia can be considered the first known place where trade developed. The discovered written records of trade transactions can be defined as fundamental for economic history. The circumstances presented in this way give reason **Jared Diamond** to state that in Mesopotamia, city workers, thanks to a developed trade network, supported the country's complex economy. On the other hand, the cited work examines the trade in gold, flax and grain in Ancient Egypt, which shows how resources and geographical conditions shape trade practices. According to the expert, it was at this time that marketing communication was born thanks to the advertising of goods through the symbolism of deities and sacred rituals. Within the limits of his study, **Diamond** establishes that in Ancient India there was a complex trade network and various shopping

formulas, and this, in turn, attracts the attention of a large group of specialists in the field of economic history. **Diamond** finds that trade in India was based on various concepts of trust and consumer relations, which are still actively used today. To present the development of trade and marketing in Ancient China **Jared Diamond** emphasizes how this was realized along the Silk Road, and this in turn indicates the presence of cultural exchange. The cited work states that in both Egypt and China, trade was governed not only by economic, but also by moral and social codes. Looking at Greece and Rome as part of ancient civilizations, **Jared Diamond** emphasizes the *mise-en-scène* that the commercial practices and entrepreneurial strategies of these civilizations leave a deep imprint on modern economic theories and marketing strategies. In this regard, the expert in question finds that it was in Greece and Rome that merchants used various types of advertising, such as posters and word of mouth, to promote their products.

The study of ancient civilizations can be defined not only as interesting from a historical perspective, but also as necessary for the development of marketing strategies. By understanding the basics of trade and consumer behavior in antiquity, future marketing professionals can build a solid foundation for building their future approaches.

➤ **Middle Ages and Renaissance** – the transition to feudalism and the subsequent Industrial Revolution, which led to the rise of the bourgeois class and new economic ideas characterized by the Renaissance spirit of innovation. Courtesy of **Jim Manis** can be reviewed **Adam Smith's work**, namely "The Wealth of Nations" (Manis, 2005). This provides us with the opportunity to establish that the Middle Ages and the Renaissance represent two key periods in history that create the basis for many of the modern economic and marketing practices. The changes in trade, production and consumer behavior that occur during the periods under consideration have a profound impact on the way people interacted and did business. The findings thus drawn can change the understanding of future marketing specialists about the different marketing strategies. Based on **Adam Smith's reasoning**, the following conclusions can be drawn about the development of trade and marketing in the Middle Ages: *economic interactions are subordinated to local authorities and farmers; trade, at that time, can be defined as local, but with the development of trade routes and markets, there is an increase in exchange between different regions; during this period, associations of craftsmen are created that regulate production and trade; associations of craftsmen introduce standards for quality and protection of the interests of their members; this period can be defined as the beginning of the emergence of branding as an element of marketing communication; consumer attitudes begin to change with the passage of time: new goods, such as spices, fabrics and jewelry, become increasingly desirable, which causes the emergence of long-distance trade; the rise of urban culture leads to new consumer needs and desires that influence the production process.* The adopted principle statement of this study requires that the following presentation presents the conclusions about the development of trade and marketing during the Renaissance, which can be derived thanks to **Jim Manis**, namely: *this period should be perceived not only as a cultural and intellectual upsurge, but also a time of significant economic and commercial changes; the development of the printing press, new sea routes and ideas for exchange transformed trade and expanded markets; the existence of new financial instruments, such as credit and shares, facilitated business and increased investment in trade and industry; These innovations form the basis of the modern economic system and marketing practice; product personalization and increased competition among retailers lead to more developed marketing strategies; advertising becomes an important part of commerce; the emergence of new goods and styles emphasizes the need for uniqueness, which is the basis of modern branding principles.*

➤ **Industrialization** – countries undergo significant changes, as advances in technology and production processes change the way people work and live. In **Peter's theoretical development**

Marsh states that the following innovations were achieved during industrialization: *this period is associated with the introduction of new technologies, such as the steam engine, the emergence of mechanized tools and electricity, which significantly increased production; the mechanization of production allows for the mass production of goods, which reduces costs and increases the availability of products; the shift from agrarian to industrial economies not only changes the way work is done, but also creates new professions and class structures; changes in the form of work lead to new attitudes, needs and behaviors among workers and consumers; industrialization creates new trade networks and increases the importance of white and black markets, as well as global trade; this period leads to the specialization of production, which means that different companies and regions begin to focus on the production of a particular item; this diversity increases competition in the market and provides more options for consumers* (Marsh, 2012).

Industrialization is a key factor in the modern development of marketing. Technological innovations, changing labor structures, and new business models provide the basic principles of modern marketing. Understanding industrialization is essential for future marketing professionals who want to thrive in today's dynamic marketing environment.

- **Globalization and digitalization** – the development of the Internet and globalization are changing the ways of trading and marketing, creating new challenges and opportunities. A review of the economic literature shows that both processes are interconnected and significant. In turn, they change the way companies operate and interact with consumers. According to a number of specialists, these processes not only transform economic systems, but also change market conditions, affecting marketing strategies and practices. The starting point in **Dani's work Rodrik** is associated with the axiom that globalization should be considered in the following directions: *this process refers to the interconnectedness of countries and economies on a global scale, through trade, investment, technology and cultural exchange; it encompasses the economic, political, social and technological aspects leading to the creation of a global market; this process facilitates trade between countries, which leads to increased competitiveness of companies; communication and information technology allow businesses to more easily connect with consumers around the world; it leads to a mixing of cultures, which creates new consumer attitudes and expectations; companies must adapt their marketing strategies to reflect local cultural contexts* (Rodrik, 2011). The adopted principle statement of this study requires that the following section presents the directions related to digitalization: *digitalization refers to the process of converting information into a digital format, which facilitates the management and distribution of data; it changes the way companies interact with consumers, thanks to online platforms, social media and e-commerce; digitalization leads to the emergence of new business models, such as B2B, B2C and C2C, which change traditional trade structures; the existence of platforms such as Amazon, Alibaba and Uber demonstrate how technologies are changing traditional trade; the collection and analysis of large volumes of data allows companies to personalize their marketing strategies, to assess the effectiveness of companies; the digital environment offers new tools for monitoring consumer behavior and changing attitudes* (Chaffey & Ellis-Chadwick, 2019).

In the work of **Robert C. Allen** it is noted that special attention should be paid to the Islamic world, which is characterized by certain specificities (Allen, 2012). The Islamic world encompasses a significant part of the global economy and culture, including many countries with diverse economic conditions and social structures. Understanding the Islamic context is essential for future marketers, as this society gives unique characteristics to the consumer behavior of the Islamic world and their significance for marketing. The main premise in the work of the research team led by **Jessen Floren** is associated with the theory that the Islamic world should be considered in the following ways: *it is not only a religion, but also a way of life that has a profound impact on the social, economic and political structures in Muslim-majority*

countries; the main elements of Islamic culture, such as halal (permissible) and haram (forbidden) food, play an important role in the daily lives of Muslims and require attention from businesses; Islamic economies vary greatly, from developing to highly developed, but they all share principles derived from Islamic teachings, such as the prohibition of interest (riba) and the encouragement of charity (zakat); the formulation of ethical business practices is a key aspect that marketers must consider; Islam encourages trade and entrepreneurship, and the word "protection" (baraka) is fundamental in economic relations; partnerships and transactions are often based on relationships of trust, which is important for successful business (Floren, Rasul, & Gani).

The review of economic literature shows that the discipline "Economic History" as part of the curriculum of the "Marketing" specialty has the following meanings:

- ***Understanding consumer attitudes*** – history provides information about how consumer behavior has changed over time. This allows future marketers to identify trends and predict future changes based on historical lessons.
- ***Lessons from successes and failures*** – historical examples provide valuable information about effective marketing and sales strategies, on the one hand, and the consequences of wrong decisions, on the other. Analyzing the failures of famous companies can inform future marketers on how to act to increase the likelihood of success.
- ***Strategy adaptations*** – knowledge of historical contexts can help future marketers adapt their marketing strategies to changes in the market. To confirm his thesis, the author of the study gives the following example – how different economic conditions, such as crises, growth and stagnation, affect marketing approaches.
- ***Market dynamics and competitiveness*** – business history provides a foundation for understanding competitive environments and market structures, which can be defined as critically important for developing successful marketing strategies (JONES & SHAW, 2002).

The review of the literature thus conducted allows us to draw the following **conclusion**: the study of economic history is not only useful, but also necessary for every marketing professional. It provides a deep understanding of changes in economic systems, consumer attitudes, and business practices, which leads to better informed decision-making and more successful marketing strategies.

1.2. Essence of customer satisfaction

Customer satisfaction should be considered a key aspect of a business's operations that significantly impacts its success. *It should* be viewed as a measure of how well a product or service meets customer expectations. Understanding *customer satisfaction* can be considered critical to a business because satisfied customers are more likely to repeat purchases and recommend the product or service to their friends and family.

In the context of the issues discussed above, it can be noted that *consumer satisfaction* as an element of marketing has been analyzed and discussed by a number of researchers. In this regard, as part of the subsequent presentation (see *Talb. 1.*), some of the definitions of the discussed concept included in the specialized literature are presented.

Table 1.

Author's views on the essence of customer satisfaction

Author	Definition
F. Kotler (Kotler, 2006)	<i>satisfaction</i> can be described as follows: "a person's feeling of pleasure or disappointment resulting from comparing the perceived performance (or outcome) of a product with his or her expectations."
O. Hansemark & M. Albinsson (Hansemark & Albinsson, 2004)	<i>Satisfaction</i> represents a consumer's overall attitude towards a product or service provider or an emotional reaction to the difference between what the consumer expects and what he receives, in terms of fulfilling some need, goal, or desire.
Svetla Panayotova & Anyuta Nikolova (Панайотова & Николова, 2009)	"Consumer satisfaction" is characterized (especially in marketing, respectively, psychology of commerce) as an abstract category in social research. Product quality and the availability of alternatives are essential for consumer satisfaction.
G. Mladenova (Младенова, 2000)	<i>Satisfaction</i> represents a general emotional reaction with varying degrees of intensity, which has a specific time of manifestation (determined in time according to the situation) and a limited change that is directed towards the main attributes of the offer/product (choice, purchase, consumption).
Magnus Söderlund & Mats Vilgon (Söderlund & Vilgon, 1999)	<i>Consumer satisfaction</i> should be viewed as a mental state that results from the consumer's comparison between <i>pre-purchase expectations</i> and <i>post-purchase perceptions of the product or service's performance</i> .

As a result of the review of the literature sources, the following definition of consumer satisfaction can be derived: *consumer satisfaction can be presented as an emotional reaction of the consumer as a result of his overall attitude towards the purchase made, which can be defined as positive or negative.*

A review of the economic literature shows that the study of *consumer satisfaction* requires analyzing *the factors influencing it*. In this regard, **Philip Kotler** notes that these should include: *product quality, customer service, and product price* (Kotler, 2006).

Product quality as a factor influencing consumer satisfaction is associated with the fact that products that meet or exceed consumer expectations lead to high satisfaction.

The next *factor influencing customer satisfaction* is presented by **Philip Kotler**, such as *customer service*. In this regard, the "father of marketing" points out that additional services, including after-sales service, play a significant role in determining *customer satisfaction*.

The final *factor influencing customer satisfaction*, examined by **Philip Kotler** is *the price of the product*. From this perspective, it can be emphasized that the quality-price ratio is of critical importance for consumer satisfaction. His satisfaction increases when he is sure that he is getting a better ratio.

3. Materials and methods

The following presentation examines the satisfaction of Marketing students with the course "Economic History" (lectures and exercises). The examination of economic history and consumer satisfaction serves as a starting point for the causal relationships between the two concepts.

The current part of the marketing research is aimed at analyzing and comprehensively evaluating the results of the empirical study conducted among 2nd year students, majoring in Marketing, full-time and part-time, who are graduates of the Bulgarian State University "Prof. Dr. Asen Zlatarov". The empirical study was conducted during the period September 2024 - May 2025 using surveys distributed through the **Google system**

Forms. 37.1% of men and 62.9% of women participated in the survey.

"Empirical research highlights the requirement for a specific organization of research work, in which certain empirical data are obtained, classification and comparison of facts revealing the actual state of the phenomenon or process under study. It is directed at the object and is based on the data obtained from the research work. The results are expressed in the form of empirical generalizations, which are a system of certain scientific facts (Дечев, 2022). "

4. Research results

The dynamic changes of the online environment and the possibilities of digital technologies form a new added value in the level of satisfaction and requirements of students as users of the university. The research results obtained as a result of the survey conducted show that modern students, along with traditional teaching methods, prefer more modern methods.

The information thus provided and due to the imposed restrictions, gives us the opportunity, within the framework of the subsequent presentation, to present a small part of the questions that make up the questionnaire provided to the students, related to the current marketing research.

The first question, the subject of the marketing research, can be presented as follows: ***"Do you attend lectures (exercises) in the discipline "Economic History"?"*** It should be noted that both lectures and exercises represent an important part of the educational process related to the theoretical and practical application of knowledge, skills and experience in the field of "Economic History" – see **Fig. 1.**

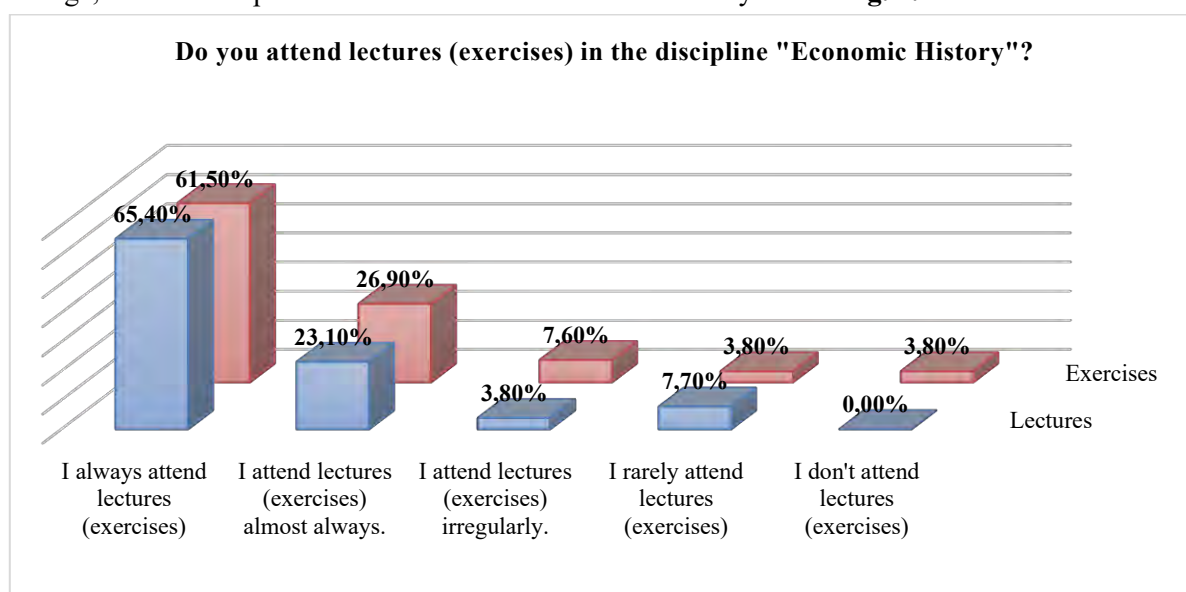


Fig. 1. Do you attend lectures (exercises) in the discipline "Economic History"?

Source: Conducted own survey

The data presented in **Fig. 1.** show that a large number of students attend both lectures and exercises in the discipline "Economic History", respectively 65.40% and 61.50%. Data analysis shows that 23.10% and 26.90% of respondents attend lectures and exercises almost always. Lectures and exercises provide an organized structure of the learning material, which facilitates the assimilation of information, which is the basis for the fact that there are no students who do not attend lectures and only 3.80% of respondents who do not attend exercises.

Within the scope of the information presented in this way, it can be summarized that students' attendance at lectures and exercises creates the prerequisite for good preparation for the exam session, as they have greater

access to the important information and resources indicated by the lecturers.

The next question, the subject of the survey, is **"Does the lecturer of lectures (exercises) in the discipline "Economic History" use interactive teaching methods?"** The use of interactive methods, within the framework of the students' classroom and extracurricular work, supports the emergence of discussions, group projects and role-playing games, and this, in turn, helps to maintain attention and interest in the learning process. The results of the survey can be illustrated by means of **Fig. 2**.

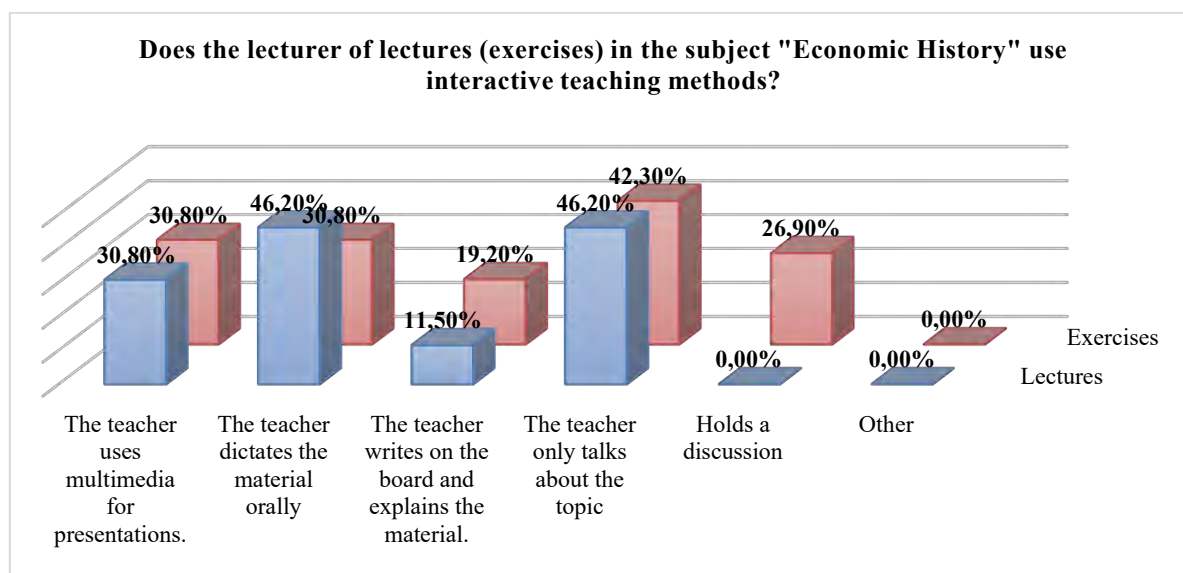


Fig. 2. Does the lecturer of lectures (exercises) in the subject "Economic History" use interactive teaching methods?

Source: Conducted own survey

The question presented in this way creates a prerequisite for indicating more than one answer, which can determine the different ways in which lectures and exercises in the discipline "Economic History" are conducted. The results obtained show that, according to 46.20% of the participants in the survey, the lecturer dictates the material orally and only talks about the topic. According to 42.30% of the respondents, the lecturer only talks about the topic. 30.80% of the respondents indicated that the lecturer uses multimedia for presentations during lectures and exercises. On the other hand, it can be noted that activities within the learning process can create a positive learning environment, which allows 26.90% of the students to note that discussions are held during the exercises.

The structure of the discipline "Economic History" creates the prerequisite for deriving the following interpretations: lecturers in lectures and exercises use different methods to provide knowledge about the analyzed discipline, which allows for easier perception of the material by students. On the other hand, the different teaching methods provide an opportunity to enrich the learning process, but also prepare students for their successful integration into the professional world.

Based on the information presented in **Fig. 2**, we cannot but agree with the statement of **Velika Bineva**, who emphasizes the proposition that new information technologies offer innovative solutions for addressing various challenges (БИНЕВА, 2023).

The present marketing research requires the following question to be analyzed and evaluated: **"How do you evaluate the teaching methods of the subject "Economic History" in lectures (exercises)?"**. In its essence, the present question can be defined as a question of essential importance for determining the satisfaction of students with the material provided both in lectures and exercises.

Based on the information presented in this way, the results obtained from the conducted survey can be illustrated by means of **Fig. 3**.

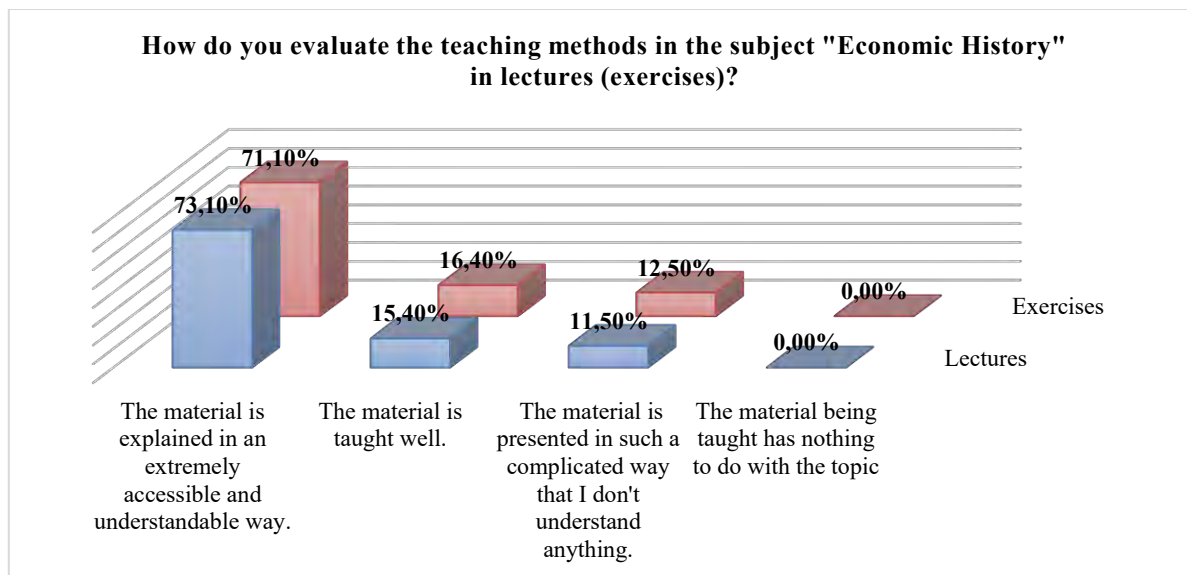


Fig. 3. How do you evaluate the teaching methods in the discipline "Economic History" in lectures (exercises)?

Source: Conducted own survey

In the basis of this question, it can be noted that in general there is a general positive assessment of the material provided. The analysis of the data shows that 73.10% of the students indicate that the lecture material is explained extremely accessible and understandable, and 71.10% indicate the same answer for the teacher of exercises. Only 11.50% of the respondents indicate that the material is provided so complicated that they do not understand anything when this applies to lectures, and when the question is related to exercises, this answer was indicated by 12.50%. The data presented in this way indicate the presence of high professionalism on the part of the teachers, both in lectures and exercises. Well-presented material contributes to easier assimilation by the students, which contributes to the achievement of higher results during the examination session.

The imposed principle statement of the present study requires the following question to be examined: ***"How do you evaluate, in general, the teaching of the lecturer of the discipline "Economic History" in lectures (exercises)?"*** Lectures and exercises in the discipline under consideration can be presented as a basic element of the educational process and an important factor for the successful mastering of the educational material, and the lecturer and the assistant of the exercises – as the face of the discipline, in the eyes of the students. In this regard, it is of utmost importance to note that the lecturers of "Economic History" play a significant role in the understanding, perspectives and satisfaction of the students from the educational process being conducted. It is for this reason that this question creates prerequisites for directing attention to the general assessment of the students to the quality of teaching and, respectively, to their satisfaction with the lecturers of the discipline under consideration. The constructiveness of the data obtained from the conducted questionnaire survey can be traced in **Fig. 4**.

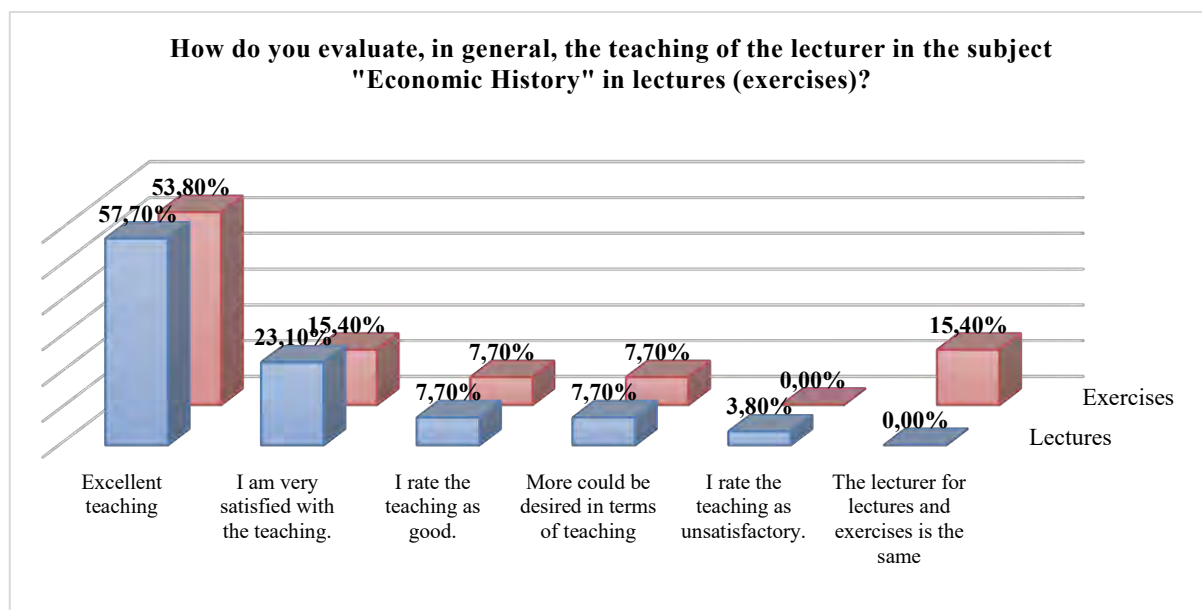


Fig. 4. How do you evaluate, in general, the teaching of the lecturer in the subject "Economic History" in lectures (exercises)?

Source: Conducted own survey

The data presented in **Fig. 4.** create a prerequisite for the following interpretations: for the most part, the participants in the survey rated the teaching of the lecturer in the discipline "Economic History" in lectures *as excellent* (57.70%). It can be noted that the respondents also gave the lecturer in exercises *an excellent rating*, with 53.80% marking the current answer. This, in general, speaks of the positive attitude that lecturers create in students. It is noted that a quarter of the participants in the survey marked that *they were very satisfied with the teaching*, with 23.10% and 15.40% for lectures and exercises, respectively. This, in general, indicates the high level of satisfaction and recognition, on the part of the students, for the quality of teaching. The conducted survey led the current research team to the finding that 3.80% of the respondents believe that the lecturer's teaching is *unsatisfactory*. 15.40% of the participants in the survey indicated that *the lecturer for lectures and exercises is the same*.

The data from the complex analysis of the current issue show that, to their great credit, lecturers in the disciplines under consideration enjoy the approval of their students in terms of teaching, which speaks of their high professionalism and competence.

The last question, the subject of this study, can be presented as follows: **"How do you assess the attitude of the lecturer in the subject "Economic History" towards the students, during lectures (exercises)?"** This question aims to determine interpersonal relations within the classroom environment. The lecturer's attitude towards the students can have a significant impact on the motivation, learning atmosphere and overall success of the learning process. The answers received to this question can provide valuable guidance on how students perceive the communication, attitude and support from the lecturer. The question formulated in this way creates a prerequisite for indicating more than one answer, which contributes to creating a more accurate picture of the lecturer-student relationship (see **Fig. 5.**).

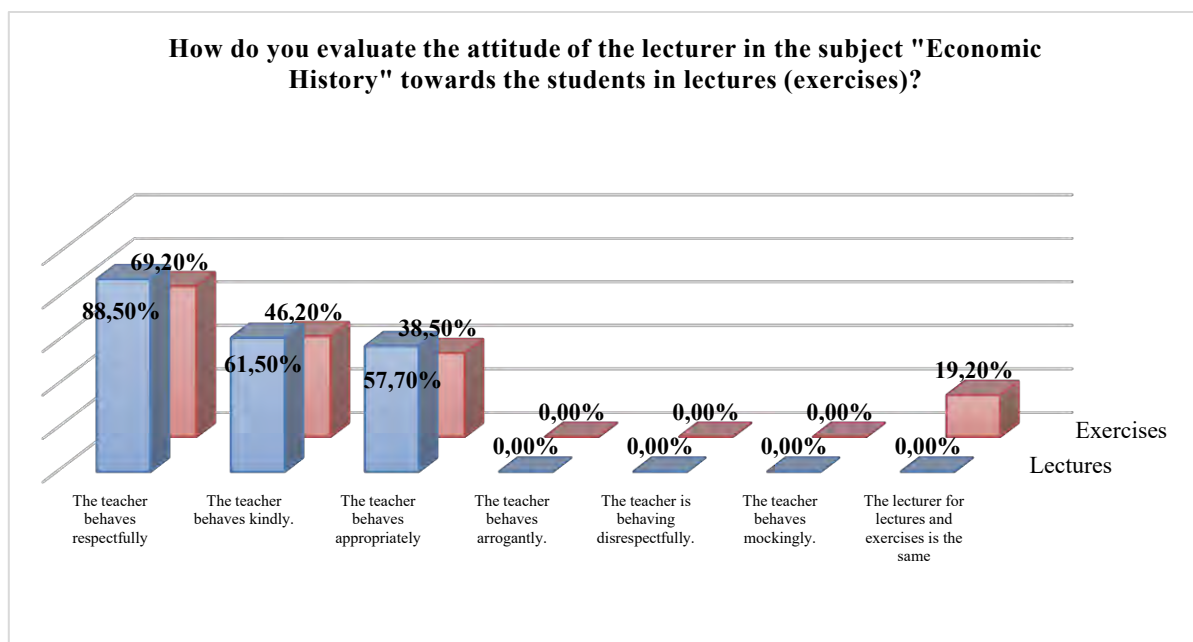


Fig. 5. How do you evaluate the attitude of the lecturer in the subject "Economic History" towards the students during lectures (exercises)?

Source: Conducted own survey

In the foundation of the question presented in this way, it can be noted that interpersonal relationships, within the classroom environment, are of essential importance for easier and faster assimilation of the provided material. In this regard, it is necessary to note that the data provided in **Fig. 5.** show that a significant part of the students indicated that the lecturers in the subjects under consideration behave *respectfully*, respectively by 88.50% and 69.20% for lectures and exercises. The analysis of the data shows that the students who participated in the survey noted as additional answers that their lecturers in the subject "Economic History" behave *politely*, respectively by 61.50% and 46.20% for lectures and exercises and *adequately*, respectively by 57.70% and 38.50% for lectures and exercises. The synthesis of the data provides the possibility of finding that for 19.20% of the respondents *the lecturer of lectures and exercises is the same*.

Based on the results presented in this way, obtained through our *own survey*, it can be summarized that the positive results with which the lecturers and assistants were evaluated are due to the high professionalism and competence of the lecturers. Based on the information presented in this way, we can refer to the marketing theory adopted by **Simeonka Petrova**, which is associated with the interpretation that in today's competitive business environment, the university is faced with the search for stable development tools in order to be able to meet the different, specific and diverse requirements of users (PETROVA, 2020).

5. Conclusions

Based on the analysis of student satisfaction with the teaching process presented in this way, the following conclusions can be drawn:

First, "Economic History" is a multi-layered and broad-ranging discipline that traces the evolution of nations and economic growth over time.

Secondly, based on the theoretical analysis of the author's views on the nature of consumer satisfaction, it can be defined as the consumer's emotional reaction as a result of his overall attitude

towards the purchase made, which can be defined as positive or negative.

Third, the conducted survey allows us to determine the degree of satisfaction of students majoring in Marketing at the Bulgarian State University "Prof. Dr. Asen Zlatarov" with the lectures and practical classes held.

Fourth, the results obtained show that a significant portion of students attend lectures and exercises and are satisfied with the way the lecturers conduct them.

*Based on the conclusions from the theoretical and empirical research results, **the research thesis is proven** that the use of appropriate questions regarding the taught discipline, integrated into the questionnaire provided to the respondents, helps to draw conclusions, generalizations and conclusions about consumer satisfaction of students majoring in Marketing.*

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8. PHD STUDENTS TRACK

Marketing Strategy Adaptations for Businesses during Bulgaria's Euro Adoption: Lessons from Croatia

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Abstract

This study examines the strategic marketing challenges facing Bulgarian businesses ahead of the country's planned euro adoption in January 2026, using Croatia's 2023 transition as a comparative case. Adopting a qualitative, theory-driven approach, it introduces a Strategic Marketing Framework for Euro Adoption (SMF-EA), which integrates communication design, pricing transparency, and consumer trust management. The analysis finds that Croatia's success was driven not only by legal compliance but also by proactive, emotionally resonant campaigns that combined institutional leadership with business engagement. In contrast, Bulgaria's preparations remain largely institutionally focused, with limited participatory outreach. The findings demonstrate that euro adoption is both an economic reform and a behavioural transformation, where marketing is critical for public acceptance. Practical recommendations are offered for businesses and policymakers, emphasizing early dual pricing, symbolic trust signals, and culturally adapted communication, supported by real-time consumer engagement and coordinated public-private action.

Key words:

euro adoption, marketing strategy, Bulgaria, Croatia, dual pricing, communication design, pricing transparency, consumer trust

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1. Introduction

The planned adoption of the euro in Bulgaria on January 1st, 2026 represents a major structural shift in the country's monetary and institutional framework. While the macroeconomic effects of eurozone integration—such as reduced currency risk, lower transaction costs, and increased investor confidence—have been extensively analyzed (Ferrari and Picco, 2022), the marketing and consumer-side implications remain underexplored. Research shows that among young Bulgarians, perceptions of euro adoption are strongly influenced by trust in institutions and perceived inflation risk (Ivanov and Petrova, 2023). Public opinion remains divided. According to Gerunov et al. (2024), attitudes towards the euro are shaped not only by economic considerations but also by generational identity, institutional trust, and perceptions of transparency. This is consistent with wider literature on currency substitution in emerging economies, where public confidence is critical to the success of monetary transitions (Albulescu et al., 2017).

The experience of Croatia, which joined the euro area in 2023, offers valuable lessons. Despite early concerns about inflation, public acceptance was strengthened through coordinated communication campaigns, mandatory dual pricing, and symbolic initiatives such as the “Euro on Wheels” programme (Vuldzhev, 2024). These measures illustrate how well-designed marketing can reduce uncertainty and foster public trust. For Bulgarian businesses, the challenge is twofold: ensuring compliance with legal and technical requirements while communicating effectively with consumers who may remain sceptical. Marketing strategies must therefore address shifts in currency perception, price sensitivity, and psychological readiness for change. As Hochreiter and Waldhauser (2014) note, culturally attuned communication during periods of societal transformation can reinforce trust and mitigate perceived risk.

This report examines how Bulgarian businesses can adapt their marketing strategies for euro adoption, using Croatia's experience as a benchmark. The analysis is built on a Strategic Marketing Framework for Euro

Adoption (SMF-EA)—a model developed by the author and inspired by established strategic marketing concepts (Kotler and Keller, 2016; Fill and Turnbull, 2019), and empirical research on communication in currency transitions (Stix, 2006; Hofmann et al., 2020). While not an official EU framework, the SMF-EA integrates guidance from European institutions on changeover communication, pricing practices, and public trust-building into five interconnected domains: communication design, pricing transparency, trust-building mechanisms, public engagement, and perceived inflation management. This framework offers a practical tool for navigating high-uncertainty monetary transitions, with particular relevance for small and medium-sized enterprises (SMEs), which often have limited marketing resources but are highly exposed to shifts in consumer sentiment.

2. Literature Review and Hypotheses Development

2.1. Euro Adoption and Public Sentiment

The process of euro adoption has been widely examined in Central and Eastern European (CEE) contexts, with particular attention to its social and behavioural consequences. Beyond macroeconomic considerations, the transition to a new currency influences consumer perceptions, spending habits, and trust in institutions (Mestre and Marqués, 2021; Wälti, 2012). Research in Slovakia and Slovenia shows that perceived inflation—often exceeding actual inflation—is largely driven by psychological pricing effects and media framing (Stix, 2006; Hobza and Zeugner, 2014). This “perceived inflation gap” is especially challenging for marketers in low-margin sectors such as food retail and utilities, where even minor shifts in perceived cost can significantly alter consumer behaviour.

In Bulgaria, Gerunov et al. (2024) finds that misinformation and institutional distrust are major drivers of scepticism, particularly among older and economically vulnerable groups. Comparable patterns were documented by Kallestrup and Martinsen (2019) during the Baltic States' euro transitions. These insights suggest that technical readiness is necessary but insufficient; successful adoption requires anticipating and addressing emotional and symbolic responses to currency change.

2.2. Marketing Strategies in Transitional Economies

Marketing research emphasizes that during periods of monetary or political transition, trust-building and informational clarity are essential (Chattopadhyay and Laborie, 2005; DelVecchio, Krishnan and Smith, 2007). Price transparency, brand empathy, and consumer empowerment form the core of effective transitional communication strategies.

The Croatian experience provides concrete examples of such approaches. Petrovic and Radic (2023) highlight pre-emptive dual pricing, dedicated consumer helplines, and in-store information kiosks as tools that facilitated price comparisons and reduced uncertainty. Symbolic branding—such as fairness-themed slogans and euro symbol integration—helped normalize the new currency on an emotional level. These findings align with Hofmann, Lohse and Reuter's (2020) comparative study of Austria and Finland, which found that firms emphasizing “price fairness” and corporate responsibility maintained stronger customer loyalty during currency reforms.

2.3. Cultural and Behavioural Framing

Cultural context plays a significant role in shaping public responses to euro adoption. Hofstede's cultural dimensions—particularly uncertainty avoidance and long-term orientation—help explain differences in resistance across Eurozone members (Hofstede, Hofstede and Minkov, 2010). In high uncertainty-avoidant societies like Bulgaria, early, clear, and consistent messaging becomes especially important.

Behavioural economics provides further insight: Ariely (2009) notes that unfamiliar pricing units can

trigger cognitive biases, leading consumers to assume higher costs, especially if price tags appear arbitrary or rounded upward. This means businesses must manage not only the technical conversion but also the cognitive adaptation process.

2.4. Hypotheses Development

The literature on euro adoption in Central and Eastern Europe underscores that successful transitions depend on addressing both the economic and psychological dimensions of change. Studies on perceived inflation (Stix, 2006; Hobza and Zeugner, 2014) show that transparent pricing mechanisms, such as dual currency displays, help narrow the perceived inflation gap and reduce consumer anxiety. Building on these findings—and considering that public scepticism towards the euro remains high in Bulgaria (Gerunov et al., 2024)—it is reasonable to expect that dual currency price displays (BGN and EUR) will increase consumer confidence and perceived transparency (**H1**).

Trust has emerged as a central driver of public sentiment in monetary reforms (Chattopadhyay and Laborie, 2005; Hofmann, Lohse and Reuter, 2020). Comparative evidence from Croatia shows that coordinated, trust-centred campaigns—combining fairness-oriented messaging, public engagement, and symbolic gestures—were effective in reducing resistance and fostering acceptance (Petrovic and Radic, 2023; European Commission, 2023). Consequently, trust-driven marketing campaigns are expected to reduce psychological resistance to euro adoption (**H2**).

Educational interventions also influence post-transition consumer behaviour. Hofmann et al. (2020) highlight that early, accessible information empowers consumers, mitigates misconceptions, and strengthens brand loyalty during systemic change. Croatia's "Euro on Wheels" mobile centre, in-store info kiosks, and starter coin kits illustrate how such initiatives can foster familiarity and confidence. This supports the expectation that firms engaging in pre-adoption educational marketing will experience stronger post-transition customer loyalty (**H3**).

Finally, cultural predispositions help explain variance in public responses to currency changeovers. Hofstede's uncertainty avoidance dimension (Hofstede, Hofstede and Minkov, 2010) suggests that in highly risk-averse societies—such as Bulgaria—even well-designed campaigns may be filtered through a desire for stability and predictability. Therefore, high uncertainty avoidance is expected to moderate the relationship between euro communication strategies and consumer trust (**H4**), shaping the overall effectiveness of marketing interventions.

3. Material and Methods

This study adopts a qualitative, theory-driven approach rooted in comparative case analysis. Rather than relying on primary data such as surveys or interviews, the research draws on **academic literature, institutional reports, public statements, media discourse, and policy documents** to synthesise strategic marketing insights relevant to Bulgaria's euro adoption.

3.1. Research Design

The methodological framework is grounded in two intersecting perspectives:

- Comparative case study analysis, focused on Croatia's euro adoption (2023) as a reference point for Bulgaria. Croatia's changeover process, approved following the *European Commission and European Central Bank Convergence Reports* (EC & ECB, 2022), provides institutional and marketing campaign data.
- Theoretical integration, based on concepts from behavioural economics, consumer trust theory, and marketing communication.

The Croatian case was selected due to its structural similarity to Bulgaria: both are post-socialist economies, EU members with relatively recent transitions, and countries with mixed public sentiment toward euro adoption. Croatia's experience is also recent enough (2023) to offer fresh data, campaign material, and institutional assessments (European Commission, 2023; SUERF, 2023).

For Bulgaria, the analysis draws on recent institutional milestones, such as the *European Commission* (2025) press release confirming Bulgaria's readiness to join the euro on 1 January 2026, the *ECB June 2025 Convergence Report*, and the Bulgarian National Bank's official planning documents.

3.2. Data Sources

Secondary data was collected from the following categories:

- Academic literature on euro adoption, pricing psychology, consumer behaviour, and crisis marketing (e.g., Stix, 2006; Hobza & Zeugner, 2014; Hofmann et al., 2020).
- Institutional documents – including *ECB and EC Euro Changeover Guidelines*, *European Commission Q&A on Bulgaria's changeover* (EC, 2025), *EU-Croatia Memorandum of Understanding on Coin Production* (2023), and publications from the Bulgarian National Bank and Croatian National Bank on public communication strategies.
- Eurobarometer surveys, *EC and ECB Convergence Reports* (2022, 2025), and media analyses from international news agencies such as *Reuters* (2025).
- Public campaign records – official materials from Croatian initiatives, including:
 - o *Euro on Wheels*: mobile educational exhibition visiting towns to explain euro features.
 - o Dual pricing enforcement campaigns with consumer helplines.
 - o Starter kits distribution allowing early handling of euro coins (Croatian National Bank, 2023).

These sources were analysed using qualitative content analysis, identifying recurring themes such as trust messaging, price transparency, and consumer response to communication formats.

3.3 Analytical Criteria

The study evaluates each country across three core dimensions:

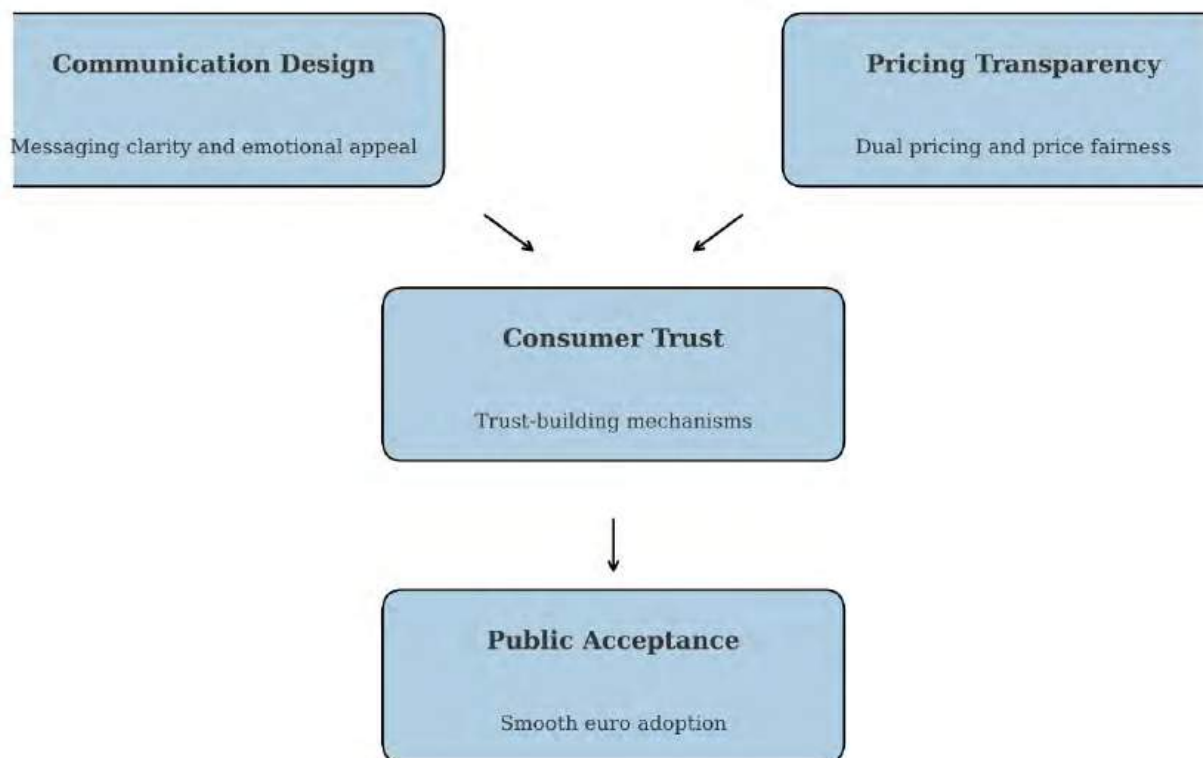
1. Communication Design – message clarity, emotional resonance, multi-channel engagement.
2. Pricing Transparency – visibility and enforcement of dual pricing, conversion tools, anti-inflation messaging.
3. Consumer Trust Management – addressing misinformation, building brand trust, and using symbolic gestures (e.g., leaders making first public euro purchases).

These criteria were applied to assess the strategic fit of campaigns, identify gaps, and suggest adaptations for Bulgaria.

3.4 Analytical Model

To support the analysis, the study applies a Strategic Marketing Framework for Euro Adoption (SMF-EA), shown in Figure 1. The model depicts how communication design and transparent pricing jointly influence consumer trust, which in turn drives public acceptance.

Figure 1. Strategic Marketing Framework for Euro Adoption (SMF-EA)



Source: developed by the author.

3.5 Limitations

As a theory-based study without primary data collection, findings are constrained by the availability and objectivity of secondary sources. Evaluations of Croatia's campaigns largely reflect institutional and media perspectives, which may have inherent biases. Bulgaria's transition is still evolving, and real-time events may alter communication patterns. Nevertheless, this approach offers a conceptual framework that can guide both practical marketing strategies and future empirical research.

4. Results

The transition to the euro is not only a technical and monetary process, but also a communication challenge where **public confidence, price perception, and institutional trust** play decisive roles (Wälti, 2012; Albuлесcu et al., 2017). By looking at Croatia's 2023 changeover and Bulgaria's ongoing preparations, we can draw practical lessons for marketing strategies and identify areas where the **Strategic Marketing Framework for Euro Adoption (SMF-EA)** can be most effectively applied.

4.1 Practical Case Examples

Croatia's euro adoption strategy combined institutional leadership, business-sector engagement, and public-facing events to convey a consistent, confidence-building message—that the euro is safe, pricing remains fair, and everyday life would continue uninterrupted (European Commission, 2023; Hofmann et al.,

2020). European Commission (2023) refers to the official assessment report of Croatia's euro changeover, which documents the campaign messaging and its public reception, while Hofmann et al. (2020) provides the theoretical basis for understanding how trust-based marketing supports such economic transitions.

- **Euro on Wheels** – a travelling mobile exhibition—visited 27 cities across Croatia between October and December 2022 as part of a government-run multi-channel communication campaign. It featured interactive displays, currency history exhibits, and staff-led Q&A sessions, which helped to demystify the euro by giving citizens a tangible and engaging experience. The campaign also included traditional media, brochures, televised spots, toll-free phone lines, and dual pricing information, aiming to reassure and inform. This initiative is documented in the European Commission's official assessment report of Croatia's euro changeover, which highlights its broad engagement and inclusive design (European Commission, 2023a; Petrovic & Radic, 2023).
- **Educational Seminars by HGK and HNB** – The Croatian Chamber of Economy (HGK) and Croatian National Bank (HNB) held a hybrid seminar "*Ready for the Euro?*" in October 2022, targeting both businesses and citizens. It explained legal obligations, conversion rules, and practical implications for contracts and payrolls (Croatian National Bank, 2023).
- **EU-Co-financed Multi-Channel Campaign** – Using television, radio, print, and digital media, this campaign delivered clear, repeated messages on prices, timelines, and consumer rights. Post-campaign surveys found 88% of Croatians felt well-informed, and 61% perceived the transition as smooth (European Commission, 2023).
- **Fair Price Commitment** – Retailers could display an official sticker if they pledged not to increase prices due to the euro changeover. Compliance was monitored by inspections and consumer reports, signalling accountability to consumers. According to the European Commission's 2023 assessment, this voluntary commitment, backed by enforcement, was an important trust-building mechanism during the transition (European Commission, 2023a; Croatian National Bank, 2023).
- **Starter Kits and School Programmes** – Coins were sold in low-cost kits weeks before adoption, enabling citizens to familiarise themselves with the euro. Schools integrated special euro lessons, ensuring younger generations acted as informed messengers within households. According to the Croatian National Bank (2023) and European Commission (2023), these initiatives increased familiarity with the new currency and contributed to smoother adaptation. From a behavioural perspective, such hands-on experiences reduce uncertainty and improve acceptance (Ariely, 2009), while in high uncertainty-avoidant societies structured and tangible demonstrations are particularly effective (Hofstede et al., 2010).

Bulgaria's preparations are more recent, and while several promising initiatives exist, they remain largely institution-driven with limited private-sector coordination compared to Croatia's approach (Gerunov et al., 2024).

- **Lidl Bulgaria Dual Pricing** – Since June 2025, Lidl has displayed prices in both BGN and EUR across all 137 stores, giving customers almost 18 months to adjust before the official mandate (Forbes Bulgaria, 2025).
- **National Information Campaign** – Launched by the Ministry of Finance in March 2025, this initiative aims to explain the changeover process, but has so far relied mainly on press conferences, brochures, and government website—channels with lower public engagement potential (Novinite.com, 2025).
- **Banking Sector Educational Initiatives** – The Association of Banks in Bulgaria (ABB), in cooperation with the Bulgarian National Bank and Ministry of Finance, launched an educational campaign to address common myths, focusing heavily on inflation fears (Forbes Bulgaria, 2025).
- **EY Bulgaria Advisory Services** – EY offers technical and communication workshops, gap analyses,

and operational planning for euro transition readiness (EY.com, 2025).

While these actions indicate readiness in specific sectors, they fall short of the emotional engagement, symbolic gestures, and broad-based community outreach that characterised Croatia's transition (Hofmann et al., 2020; Petrovic & Radic, 2023). Croatia's campaigns effectively combined institutional leadership with business-driven initiatives, embedding emotional and cultural resonance into their messaging. By contrast, Bulgaria's current initiatives—led primarily by large retailers, the banking sector, and consultancy firms—are promising yet remain fragmented. They could benefit from earlier strategic coordination, cross-sector partnerships, and more direct public interaction.

Survey data among Bulgarian youth further reveal that concerns over perceived inflation and the loss of national currency control remain widespread (Ivanov & Petrova, 2023). These perceptions underscore the importance of the Strategic Marketing Framework for Euro Adoption (SMF-EA), which emphasises the interplay between communication design, pricing transparency, and consumer trust. Applying the SMF-EA to Bulgaria's case suggests that campaigns must not only convey factual information but also proactively address emotional and psychological barriers. This alignment between practical measures and behavioural insights forms the basis for the hypotheses outlined in the next section.

4.2 Communication Design

Croatia employed a multi-tiered communication approach before its euro adoption in January 2023. A centerpiece of the campaign was the “Euro on Wheels” program—an interactive mobile information center targeting over 100 municipalities (Petrovic & Radic, 2023; European Commission, 2023). This initiative aligns with Chattopadhyay and Laborie's (2005) framework on brand experience and market contact auditing, which stresses face-to-face interaction as key during transitions. Similar mobile outreach models have been shown to increase trust and knowledge retention in public communication campaigns (DelVecchio, Krishnan & Smith, 2007; Hofmann et al., 2020). Additionally, the Croatian government coordinated national media messaging through television, digital platforms, and in-store signage, ensuring repeated exposure across multiple touchpoints—a strategy consistent with Stix's (2006) findings on perceived inflation mitigation through visibility and consistency. According to Hofmann, Lohse & Reuter (2020), trust-based marketing in economic transitions should combine rational information with symbolic reassurance, a balance successfully achieved in Croatia through co-branded government–business messages like “Your euro is safe” (European Central Bank & European Commission, 2022). The campaign's integrated approach mirrors lessons from earlier eurozone entrants, where visible retailer participation reinforced credibility (Hobza & Zeugner, 2014). In contrast, Bulgaria's efforts remain institutionally centered and limited in scale. The Bulgarian National Bank has published a dedicated euro transition Q&A on its website, but it lacks visual design, interactivity, and emotional framing—features highlighted in marketing literature as essential for engagement in high-uncertainty contexts (Hochreiter & Waldhauser, 2014; Hofstede, Hofstede & Minkov, 2010). As reported by Gerunov et al. (2024), passive communication channels in Bulgaria contribute to lower engagement—only 28% of Bulgarians feel well-informed. Similar trends were found in the Baltic States' transition, where Kallestrup & Martinsen (2019) observed that fragmented information reduced message credibility and participation.

4.3 Pricing Transparency

In Bulgaria, mandatory dual price display came into force on August 8th 2025, following amendments to the Euro Adoption Act, with a two-month grace period for compliance until October 8th 2025 and sector-specific deadlines, such as October 31st 2025 for taxi tariffs and January 1st 2026 for printed works (BTA, 2025). While the legislative framework aligns with European Commission guidelines on parallel pricing before euro introduction, its effectiveness will depend on consistent enforcement. Drawing on the broader findings of

Albulescu, Goyeau and Pépin (2017) regarding monetary transitions in Central and Eastern European economies, weak or uneven application of such measures can undermine policy credibility, which in turn risks reducing public trust. Without visible and proactive oversight, perceptions of opportunistic price increases may spread rapidly, amplified by social media narratives that turn isolated incidents into broader concern.

4.4 Consumer Trust Management

Trust is a critical factor in consumer acceptance during monetary transitions (Wälti, 2012). In Croatia, this was addressed through multi-level trust-building mechanisms: euro starter kits distributed by banks, public school euro lessons, and messaging by familiar public figures. The Croatian Chamber of Economy (CCE, 2023) reported that 71% of citizens considered the transition process transparent and fair. These findings are consistent with Ariely (2009), who emphasizes that experiential familiarity with new pricing systems reduces anxiety and fosters behavioral adaptation. Furthermore, Hofstede’s cultural framework (Hofstede et al., 2010) classifies Croatia and Bulgaria as high uncertainty-avoidant societies, where structured communication and tangible demonstrations (like starter kits) are especially effective. In Bulgaria, institutional trust remains fragile, especially after inflationary episodes in the 1990s (Vuldzhev, 2024). Despite formal price guarantees, consumers remain skeptical. A comparative study by Hofmann et al. (2020) shows that in such contexts, "empathy-based marketing"—including emotional appeals and community endorsements—is more effective than dry facts alone.

4.4 Summary Table

Table 1.

Comparison of Croatia and Bulgaria using the SMF-EA Framework

SMF-EA Based	Croatia	Bulgaria
Communication Design	Multi-channel campaigns (TV, radio, social media, “Euro on Wheels”), consistent branding, clear timelines.	Predominantly institutional communication, limited emotional engagement, fragmented messaging.
Pricing Transparency	Early and mandatory dual pricing with strong enforcement and public “Fair Price Commitment” campaign.	Dual pricing introduced later, less emphasis on enforcement and public pledges.
Trust-Building Mechanisms	Partnerships between the Central bank, the Government, and the retail sector; citizen-focused events; transparent reporting.	Primarily government-led messaging; weaker private sector involvement; trust hindered by perceived political instability.
Public Engagement	Interactive and mobile outreach (Euro on Wheels), high visibility in local communities.	Fewer interactive events; campaigns often top-down with limited two-way engagement.
Perceived Inflation Management	Public reassurance through monitoring, regular updates, and myth-busting materials.	Perception risks remain high among citizens.

Source: Author’s synthesis based on available data in public sources

5. Discussion and Practical Marketing Strategy Prescription

The comparative analysis indicates that while regulatory compliance is a necessary foundation for a smooth euro transition, it is insufficient on its own to ensure public acceptance. Croatia’s experience demonstrates that the integration of compliance measures with proactive, audience-oriented communication campaigns can mitigate uncertainty and support a more seamless adaptation. Initiatives such as *Euro on Wheels*, early dual pricing, and public commitments to fair pricing addressed both functional aspects of the

changeover—clarity on conversion rates and timelines—and the psychological aspects of consumer adaptation, including trust-building and perceived inclusion.

Bulgaria's current approach, while adhering to the legal requirements of the Euro Adoption Act, has so far been predominantly institutional in nature. This centralised approach may ensure formal compliance, but it carries the risk of lower public engagement if emotional and behavioural drivers of acceptance are not sufficiently addressed. Nevertheless, Bulgaria's preparation period offers scope to integrate multi-channel outreach, public-private partnerships, and community-based activities before the changeover date. These adjustments would strengthen **H1** and **H2**, which posit that dual currency price displays and trust-driven campaigns can boost transparency and reduce resistance.

From a business perspective—particularly for SMEs—the euro adoption process represents both a compliance challenge and a strategic opportunity. Regulatory alignment is unavoidable, but companies can go further by using the transition to reinforce brand reliability, position themselves as consumer advocates, and differentiate through clear, consistent, and empathetic communication. This supports **H3**, which anticipates that pre-adoption educational marketing fosters stronger post-transition loyalty. Periods of currency transition act as “brand system shocks” (Ferrari & Picco, 2022), prompting consumers to reassess their trust in institutions and businesses alike. Firms that engage actively in transparent, culturally attuned communication during this time can reinforce customer loyalty, strengthen competitive positioning, and mitigate perceived risks.

Finally, cultural context must be considered. Bulgaria's high uncertainty avoidance (Hofstede et al., 2010) means that unclear or inconsistent communication could amplify scepticism, especially in the context of inflation concerns. This aligns with **H4**, suggesting that communication effectiveness is moderated by cultural predispositions toward risk and uncertainty. Therefore, marketing strategies should blend factual clarity with symbolic reassurance to appeal to both rational and emotional dimensions of consumer behaviour.

Overall, the findings support a dual-track approach: maintaining rigorous compliance while proactively engaging with diverse consumer perspectives through transparent, culturally attuned marketing strategies. This balance can help mitigate resistance, enhance brand loyalty, and support a smoother transition for both businesses and the wider economy.

Drawing on comparative lessons from Croatia and Bulgaria—and grounded in behavioural and marketing theory—the following step-by-step strategy is proposed for companies, especially SMEs, navigating the euro transition. The actions map to the SMF-EA pillars (communication design, pricing transparency, trust-building, public engagement, perceived-inflation management) and to the study's hypotheses (H1–H4):

- **Step 1 — Start Early with Dual Messaging (H1; Pricing Transparency)**
Adopt dual price display (BGN/EUR) well before the legal deadline across all touchpoints (shelf labels, menus, e-shops, invoices). Use consistent formatting and the official conversion rate to reduce perceived inflation and increase transparency (cf. Hobza & Zeugner, 2014; Stix, 2006).
- **Step 2 — Public “Fair Price” Commitment (H2; Trust-Building)**
Publish and display a pledge not to round prices upward due to the changeover; back it with internal audits and spot checks. Make the pledge visible in-store/online and communicate breaches + remedies to signal accountability (Hofmann et al., 2020).
- **Step 3 — Educate and Empower at Point-of-Need (H3; Communication Design)**
Provide simple conversion guides, FAQs, and receipt-level cues (e.g., “BGN → EUR at 1.95583”). Train frontline staff for confident, empathetic answers; add QR codes linking to official guidance. Education reduces anxiety and strengthens loyalty (DelVecchio et al., 2007; Hofmann et al., 2020).
- **Step 4 — Use Cultural and Emotional Resonance (H2/H4; Public Engagement)**
Localize messages with familiar symbols, community ambassadors, and short “how we protect your wallet” stories. In high uncertainty-avoidant contexts, tangible reassurance and repeated, human-

centred communication improve acceptance (Hofstede et al., 2010).

- **Step 5 — Coordinate with Peers (H2; Trust-Building/Public Engagement)**
Join chamber/industry initiatives to align wording, visuals, and timing (e.g., shared icon for dual pricing and fair-pricing). Co-host info days or webinars to extend reach and credibility.
- **Step 6 — Monitor, Correct, and Adapt in Real Time (H2/H3; Perceived-Inflation Mgmt.)**
Track customer questions, social chatter, and complaints; correct misinformation quickly with short, visual explainers. Update in-store scripts and website banners as questions evolve.
- **Step 7 — Make Readiness a Brand Asset (H3; Communication Design/Trust-Building)**
Publicize on-time readiness, smooth transactions, and price stability in newsletters, receipts, and social posts. Close the loop with brief post-purchase surveys to evidence satisfaction gains.

Suggested timeline:

- **T–6 months:** Steps 1–3 live; publish pledge; begin staff training.
- **T–3 months:** Scale community events/co-ops (Step 5); boost media frequency.
- **T–0 to T+3 months:** Maintain dual pricing; intensify monitoring and rapid response (Step 6).
- **T+6 months:** Gradually phase out BGN display; continue trust messages where questions persist.

Minimal KPI set: Dual-pricing compliance rate; percentage of customers noticing the “Fair Price Commitment” pledge; top three customer concerns (tracked monthly); complaint rate related to pricing; Net Promoter Score (NPS) and Customer Satisfaction Score (CSAT) change from baseline; refund/adjustment rate linked to conversion errors.

In this context, NPS refers to the likelihood of customers recommending the business, scored on a –100 to +100 scale, while CSAT reflects the proportion of customers reporting satisfaction, typically measured on a 1–5 scale. The delta vs. baseline indicates the variation in these metrics compared to the pre-transition benchmark, enabling businesses to assess whether euro adoption communication and trust-building measures are improving customer sentiment (Reichheld, 2003; Morgan & Rego, 2006).

This integrated approach aligns with the Strategic Marketing Framework for Euro Adoption (SMF-EA) and the study's hypotheses—particularly **H1** (dual pricing builds transparency), **H2** (trust-driven marketing reduces resistance), and **H3** (educational engagement strengthens loyalty). By treating the euro transition as a strategic branding opportunity rather than a compliance burden, Bulgarian businesses can mitigate uncertainty, strengthen customer trust, and position themselves competitively in the post-adoption market.

The comparative analysis between Croatia and Bulgaria reveals a critical gap between technical compliance and strategic communication in the context of euro adoption. While both countries implemented dual pricing and legal frameworks, the difference in public engagement and trust-building measures significantly shaped the quality of the transition.

Croatia's success was not merely a result of regulatory compliance but a product of proactive marketing strategies, which addressed cognitive and emotional concerns among consumers. The country's adoption of multi-channel messaging, symbolic campaigns (e.g., starter kits, "Fair Price" tags), and community-based education created a sense of inclusion and transparency. This aligns with DelVecchio et al. (2007), who emphasize that consumer perceptions of fairness and predictability are often more important than price levels themselves.

Bulgaria's reliance on one-way communication (official websites, infographics) without participatory engagement may result in long-term brand erosion, especially for retailers directly interfacing with the public.

For Bulgarian businesses—especially small and medium-sized enterprises (SMEs)—this presents both a challenge and an opportunity. Without the capacity to launch national campaigns, SMEs can adopt localized marketing tactics inspired by the Croatian case:

- Clear in-store signage explaining the dual pricing process
- Visual symbols of “price commitment”
- QR codes linking to simplified euro information
- Staff training for customer communication during transition

Moreover, businesses can collaborate through chambers of commerce to issue voluntary codes of conduct, ensuring shared standards of communication and fairness.

Another critical insight from the Croatian case is the importance of timing. Early engagement allows businesses to stabilize consumer expectations before legal mandates take effect. In Bulgaria, compressed timelines risk leaving SMEs unprepared and consumers suspicious.

Finally, the findings confirm that marketing is not a peripheral concern in economic transitions, but rather a core mechanism for managing change.

6. Conclusions

This study examined the strategic marketing dimensions of Bulgaria's planned euro adoption, using Croatia's 2023 transition as a comparative benchmark. The analysis applied the Strategic Marketing Framework for Euro Adoption (SMF-EA), focusing on three interrelated domains—communication design, pricing transparency, and consumer trust management.

The comparative evidence indicates that Croatia's relatively smooth transition was not solely the result of legal compliance but of proactive, multi-channel campaigns that combined factual information with symbolic reassurance. Initiatives such as early dual pricing, the “Euro on Wheels” programme, and the “Fair Price Commitment” fostered both transparency and emotional acceptance, reducing perceived risks and normalising the new currency in daily life.

In contrast, Bulgaria's preparations to date, while meeting institutional and legislative milestones, remain fragmented in public outreach and limited in emotionally resonant engagement. Without a more coordinated approach—integrating business participation, community-level interaction, and consistent trust-building messages—there is a risk that citizens will remain susceptible to misinformation, perceived inflation, and reduced confidence in market fairness.

The study contributes to the literature by positioning euro adoption as a socio-behavioural transition in which marketing strategy is not peripheral but central to success. The proposed SMF-EA framework offers both a diagnostic and prescriptive tool that can be adapted to other emerging eurozone candidates.

Practical implications for Bulgarian businesses, particularly SMEs, include early adoption of dual pricing, public commitments to fair pricing, active participation in joint campaigns, and culturally attuned messaging. For policymakers, collaboration with marketing professionals, educators, and business associations can enhance the credibility, inclusiveness, and reach of national communication efforts.

Future research could employ consumer sentiment tracking, behavioural experiments, or longitudinal studies to evaluate how public perceptions evolve during the dual-currency phase. As Bulgaria approaches its planned 2026 adoption date, continuous monitoring and adaptive communication will be essential to maintaining public trust and ensuring a credible, well-managed transition.

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Households' Inflation Expectations: A Behavioural Lens for Measurement and Policy Communication

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Abstract

Households' inflation expectations shape consumption, saving, wage setting, and the credibility of monetary policy. This report synthesizes evidence on expectation formation, reading the literature through a behavioural lens-information design, cognitive shortcuts, affect, and social context-alongside the rational-expectations benchmark. The analysis is conceptual and integrative; no econometric estimation is undertaken. Two operational domains follow. For measurement, the report reviews direct (surveys and survey-embedded experiments) and indirect (markets, behavioural traces, text, modelling) approaches, recommending light safeguards to limit framing, anchoring, and salience while preserving comparability. For policy communication, it proposes information design that prioritizes signal over noise: lead with a stable medium-term anchor, contextualize volatile components, disclose uncertainty ranges and base rates, use neutral tone and consistent sequencing, and evaluate releases as policy. The contribution is pragmatic: align conventional tools with documented behavioural regularities to improve interpretability, tighten anchoring of expectations, reduce overreaction to transitory shocks, and strengthen institutional credibility over time.

Key words:

inflation expectations,
households, behavioural
economics, expectations
measurement, policy
communication

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1. Introduction

Inflation expectations occupy a central position in modern macroeconomic theory and policy. They underpin the transmission of monetary policy, condition central-bank credibility, and shape consumption, saving, and wage bargaining. When households expect higher inflation, they may accelerate purchases or demand higher wages, potentially reinforcing price pressures. Conversely, when expectations are stable, monetary authorities can manage shocks more effectively and sustain economic confidence. Yet despite their centrality, expectations remain among the most complex and elusive phenomena to capture empirically.

Traditional models treat expectations as rational forecasts, formed through optimal use of information and consistent with the underlying economic model. The rational-expectations hypothesis (Muth, 1961; Lucas, 1972) has yielded powerful insights into credibility, time consistency, and policy effectiveness. However, it does not fully capture the realities of household behaviour. Survey evidence shows that households often overestimate inflation, overweight salient price changes, and update slowly in response to new information (Carroll, 2003; Coibion & Gorodnichenko, 2015). These patterns suggest that expectations are shaped by bounded cognitive capacity, affective responses, and social context rather than by flawless calculation.

Behavioural economics deepens this perspective. From the seminal work of Kahneman and Tversky (1974) to research on choice architecture and institutional design (Thaler & Sunstein, 2008), decision-making is shown to rely on heuristics, framing, and social cues. Expectations emerge not as disembodied forecasts but as products of environments marked by uncertainty, influenced by emotions, and stabilized-or destabilized-by social interaction. Treating the rational and behavioural traditions as substitutes risks missing their complementarities: the former emphasizes forward-looking consistency and credibility; the latter illuminates how cognition, affect, and institutions shape expectation formation.

This conference report adopts that complementary perspective to motivate an applied analysis of household inflation expectations and to draw implications for measurement and policy communication. It emphasizes the practical channels through which informational design, heuristic processing, affective responses, and social and institutional context shape beliefs and their persistence. A formal integrative framework that organizes these behavioural channels forms part of my ongoing doctoral research. The analysis centers on evidence and policy-relevant implications-particularly for measurement and communication-and shows how behavioural mechanisms can be accommodated within model-consistent analysis, with formal development deferred.

2. Literature Review

2.1. From Classical Insights to the Rational-Expectations Benchmark

Theories of inflation have long grappled with expectations, though their prominence has varied across paradigms. Early monetary thought-Fisher's Purchasing Power of Money (1911) and The Theory of Interest (1930)-linked money, credit, and prices but treated expectations as secondary. Keynes (1936) brought uncertainty and sentiment to the fore, and Hicks (1937) and Samuelson (1948) formalized these insights around rigidities and effective demand; expectations were acknowledged but not modeled systematically (Bronfenbrenner & Holzman, 1963).

The monetarist turn placed expectations at the core. Friedman (1968) introduced adaptive expectations to explain the Phillips curve, while Phelps (1968) incorporated them into wage setting and long-run equilibrium. Cagan's (1956) analysis of hyperinflations showed how self-reinforcing beliefs can destabilise economies. Subsequent surveys (e.g., Totonchi, 2011) documented how expectations moved from the margins to a central determinant of inflation and policy effectiveness.

The rational-expectations hypothesis (REH), formalised by Muth (1961) and extended by Lucas (1972), culminated this trajectory. By positing model-consistent forecasts and instantaneous adjustment, REH implied that systematic forecast errors cannot persist, anticipated policies are ineffective, and credibility is pivotal for monetary governance.

Yet REH's elegance rests on restrictive assumptions. Cognitively, it presumes computational abilities real agents lack; households rely on salient price signals such as food and fuel (D'Acunto et al., 2021). Informationally, it assumes complete and symmetric knowledge, while in practice households update slowly and selectively (Carroll, 2003; Binder, 2017). Heterogeneity further strains the representative-agent view: education, income, and demographics shape inflation forecasts (Malmendier & Nagel, 2016). Institutionally, trust and social interaction affect whether expectations remain anchored or drift (Candia, Coibion, & Gorodnichenko, 2021; Kuchler & Zafar, 2019).

These insights do not render REH obsolete but reveal its incompleteness. As a benchmark, it disciplines forward-looking analysis; as a description of household behaviour, it must be enriched with behavioural, affective, and social mechanisms that capture how people process information under uncertainty. The task here is integration rather than replacement: this report systematises evidence on attention frictions, salience, heterogeneity, and institutional context and derives applied implications for measurement and policy communication, while the formal integrative model is developed outside this report.

2.2. The Case for a Behavioural Turn

The limitations of rational expectations motivate behavioural approaches that foreground cognitive, emotional, and social constraints. Simon's (1955) bounded rationality addresses the cognitive critique: agents economize on attention and computation rather than processing all data with unlimited precision. Kahneman's dual-process view (2011) further distinguishes fast, intuitive judgments from slower, deliberative reasoning,

implying that expectations often arise from heuristics rather than exhaustive calculation.

Behavioural research also tackles the informational critique. While REH presumes complete and symmetric information, evidence shows partial and selective updating: households overweight salient categories such as food and energy and underreact to aggregate statistics (Carroll, 2003; Armantier et al., 2016; D'Acunto et al., 2021). These patterns are not mere errors but adaptive strategies under complexity-attention flows to what is visible, recent, or emotionally resonant.

Heterogeneity reinforces this view. Surveys document systematic differences in forecasts by income, education, gender, and age (Malmendier & Nagel, 2016), reflecting variation in price exposure, financial literacy, and interpretive frames-features abstracted away by representative-agent models. Institutional context matters as well: affective states shape risk perception (Loewenstein, 2000), narratives coordinate beliefs (Shiller, 2019), and trust in central banks conditions whether communication anchors or is discounted; peer effects can stabilize or destabilize expectations (Binder, 2017; Candia, Coibion & Gorodnichenko, 2021).

Taken together, behavioural mechanisms should not be viewed as isolated corrections to rational expectations but as interdependent processes that shape how households perceive and respond to economic signals. Expectation formation is dynamic and multi-layered: information is filtered by its presentation, interpreted through shortcuts, colored by affect, and stabilised-or destabilised-through social and institutional context. What is often missing in the literature is a structured account of how these forces interact to produce the observed persistence, dispersion, and sensitivity of household inflation beliefs. In the broader project, I formalize this interaction in an integrative framework; here it serves only as a guiding lens to interpret the evidence and derive implications for measurement and policy communication. The key takeaway is complementarities: a rational benchmark disciplines forward-looking consistency, while behavioural channels explain how real households process information under uncertainty and why expectations sometimes drift from model-consistent paths.

2.3. Behavioural Channels Shaping Households' Inflation Expectations

Households do not meet prices in a vacuum; what they see first is an informational environment that highlights some cues and downplays others. The design and presentation of information-choice architecture-therefore matters: benchmarks such as the HICP often act as implicit defaults, framing ("temporary adjustment" vs. "loss of purchasing power") tilts interpretation, salient items like energy and food loom large, and the order of presentation gives extra weight to what comes first or last (Thaler & Sunstein, 2008; Thaler & Benartzi, 2004; Tversky & Kahneman, 1981; Bordalo, Gennaioli & Shleifer, 2012; Hogarth & Einhorn, 1992). In short, the information setup is not neutral-well-designed communication can stabilize expectations, while poor design can unsettle them.

Given this setup, the next question is how people process what they see. In practice, three shortcuts often work together. Availability gives outsized weight to recent or vivid prices (fuel, groceries); anchoring turns salient figures-round numbers, headlines, official projections-into sticky reference points; and representativeness encourages pattern-matching, so a jump in a symbolic price (e.g., gasoline) is read as typical for the whole economy. Working in tandem, these tendencies elevate volatile categories, sustain beliefs even as fundamentals improve, and help explain persistence and dispersion in household expectations (Tversky & Kahneman, 1974; Coibion & Gorodnichenko, 2015). Crucially, which cues become "available," which numbers serve as anchors, and which stories feel representative all depend on the upstream information design.

Processing is not purely cognitive. Emotion filters the same signals and changes their impact. People often lean on a felt response-the affect heuristic-so tone and imagery guide attention and color interpretation; headlines stressing "price shocks" produce sharper updates than neutral wording, and negative media tone raises perceived inflation even when official data are steady (Slovic et al., 2002; Levin et al., 1998; D'Acunto et al., 2019). Social platforms accelerate emotional contagion, turning private unease into a shared climate,

which helps keep expectations elevated and slows adjustment to new information (Kramer et al., 2014; Binder, 2022).

Finally, social and institutional context decides whose signals are believed and how strongly. Households with stronger economic literacy aggregate across categories more accurately and are less prone to overreact to salient items (Bruine de Bruin et al., 2010; Lusardi & Mitchell, 2014). Exposure matters too: low-income budgets concentrate on frequently purchased essentials, creating “personal inflation” that can diverge from official indices (Eurostat, 2024; Brachinger, 2008). Above all, credibility calibrates every channel: when central banks and statistical agencies are trusted, households can “delegate” expectations and the noise from shortcuts and affect diminishes; when trust is low, headlines and rumors substitute, amplifying swings (van der Crujisen et al., 2015; Ehrmann, Pfajfar & Santoro, 2017). Media agenda-setting and framing supply durable stories—“cost-of-living crisis,” “energy shock”—that structure attention and tone, while close-circle conversations translate those stories into everyday judgments and reinforce them through repetition (McCombs & Shaw, 1972; Kramer et al., 2014).

Putting the pieces together: information design shapes what stands out; cognitive shortcuts determine how it is read; emotion amplifies or tempers the reading; and social credibility decides whether the message sticks. This sequence explains why identical price shocks generate different expectations across groups—and why stabilizing beliefs requires not only accurate statistics, but also clear design, credible messengers, and engagement with the channels through which people actually talk and think about prices.

2.4. Measurement of Households' Inflation Expectations (Direct and Indirect)

This subsection uses the behavioural discussion above strictly as a guiding lens to interpret existing practice and to draw modest implications for how expectations are measured. Two complementary approaches dominate. Direct measures elicit beliefs through surveys that ask households for short- and medium-term inflation expectations and, in modern implementations, also collect uncertainty via intervals or histogram bins (pre-defined outcome intervals for allocating probabilities); this evolution from qualitative “up/same/down” questions to quantitative and probabilistic formats improves comparability and econometric use while preserving transparency about who expects what (Bruine de Bruin et al., 2017; ECB, 2021). Experiments—whether laboratory, field, or survey-embedded—also belong to the direct family because they elicit expectations under controlled information or framing and thus identify limited causal channels relevant for communication (Coibion, Gorodnichenko & Kumar, 2018). The advantages of direct approaches are clarity and segmentation; their weaknesses are sensitivity to wording and ordering, occasional round-number clustering, and the risk that reported beliefs track salient news rather than stable views (Tversky & Kahneman, 1974; Coibion & Gorodnichenko, 2015).

Indirect measures infer beliefs from actions, prices, and text. Market-based indicators—breakeven inflation from indexed bonds and inflation swaps—provide high-frequency signals, while option prices around CPI releases inform tail risks; all require adjustments for risk premia and liquidity and careful interpretation (Gürkaynak, Sack & Wright, 2010; Kitsul & Wright, 2013). Behavioural and observational traces—purchase acceleration, trading down to cheaper brands, portfolio shifts—capture revealed preferences in real time but demand identification strategies to separate expectations from constraints (Seiler, 2022). Text-based measures quantify media tone, salience, and framing, offering context about the informational environment in which beliefs form (D'Acunto, Malmendier & Weber, 2019). Modelling approaches (factor, state-space, SEM) combine surveys, markets, and behaviours to extract latent drivers such as trust or perceived uncertainty (Andrade & Le Bihan, 2013; Kapetanios & Yates, 2008). Indirect measures are timely and rich but can measure correlates of beliefs rather than beliefs *per se*.

Read through the behavioural lens, these approaches are complementary rather than competing: direct measures provide levels and dispersion by group, while indirect measures supply timing and narrative context.

The lens does not replace the toolkit; it suggests light safeguards that improve interpretation. On the survey/experiment side, affect-neutral wording, rotation of examples, and separation of official benchmarks from the elicitation screen help limit framing, salience, and anchoring; routine collection of uncertainty clarifies confidence around reported means (Levin et al., 1998; Bruine de Bruin et al., 2017). On the inference side, market movements should be read alongside simple diagnostics of media tone and a small set of behavioural markers to distinguish sentiment-driven spikes from fundamentals (Gürkaynak et al., 2010; D'Acunto et al., 2019). Used in tandem and interpreted through this lens, direct and indirect measures yield a coherent, policy-relevant picture of what households expect and why those expectations move.

2.5. Implications for Policy Communication

In most jurisdictions, policy communication follows a relatively standard template: periodic press releases and reports that lead with the latest headline inflation; a short explanation of drivers (often emphasising energy and food); a point forecast; and a policy stance paragraph, with supporting speeches and social-media excerpts that recycle the same figures. While this approach is transparent, its structure can unintentionally heighten salience, invite anchoring on round numbers or recent headlines, and transmit anxiety through tone-mechanisms documented in the literature on attention, heuristics and affect (Tversky & Kahneman, 1974; Levin et al., 1998; Slovic et al., 2002; D'Acunto, Malmendier & Weber, 2019). Read through the behavioural channels discussed earlier, three implications follow.

First, information design should prioritise signal over noise. Rather than opening with volatile categories or a single-point nowcast, communications ought to lead with a stable benchmark (e.g., medium-term objective, trend/core indicator), then situate current movements relative to that benchmark, with clearly labelled sections for transitory drivers. Consistent ordering across releases-benchmark, then drivers, then uncertainty, then household-relevant clarifications-operates as a light-touch nudge in the choice-architecture sense, directing attention away from salient but ephemeral items and reducing primacy/recency distortions (Thaler & Sunstein, 2008; Hogarth & Einhorn, 1992).

Second, to mitigate cognitive shortcuts, salient statistics should be paired with base rates (for example, comparisons to multi-year medians) and presented with ranges/fan charts rather than single numbers. Brief historical references to post-spike reversion counter representativeness and round-number anchoring, while affect-neutral wording limits framing effects (Tversky & Kahneman, 1974; Bruine de Bruin et al., 2017; Levin et al., 1998).

Third, because affect conditions reception, tone and narrative coherence matter. Neutral language that acknowledges uncertainty without dramatization reduces the translation of identical facts into elevated perceived inflation; alignment of press, web and social summaries to a common vocabulary limits narrative drift that otherwise arises from media amplification (Slovic et al., 2002; D'Acunto, Malmendier & Weber, 2019).

Finally, credibility and lived experience determine whether messages anchor beliefs. Transparent methods and revision policies, a regular release cadence, and concise, basket-relevant explainers (e.g., utilities, food) help audiences whose “personal inflation” differs from headline indices to interpret official numbers, thereby improving delegation to institutions (van der Cruysen et al., 2015; Ehrmann, Pfajfar & Santoro, 2017).

The anticipated results of these adjustments are tighter anchoring of short- and medium-term expectations around policy-consistent benchmarks, lower dispersion and reduced over-reaction to transient shocks, and stronger trust in official statistics and monetary guidance-outcomes directly aligned with the behavioural channels shaping household inflation expectations.

3. Conclusion

This report examines household inflation expectations through two lenses: a classical, forward-looking benchmark and a behavioural lens. The first disciplines analysis—especially on credibility and model-consistent behaviour - yet it struggles to account for the persistence, dispersion, and sensitivity to salient prices seen in household data. The second, emphasising attention, heuristic processing, affect, and social and institutional context, explains these regularities while preserving the benchmark's normative role. Together, the analysis yields a structured synthesis of cognitive, informational, and social channels - an original consolidation not previously articulated in this form—which underpins the guidance that follows.

Two practical implications emerge. First, for measurement, direct and indirect approaches are jointly necessary. Survey elicitation—preferably with simple uncertainty measures—identify the level and distribution of beliefs across groups, while market indicators, behavioural traces, and text-based signals supply timeliness and narrative context. Modest design safeguards (affect-neutral wording, separation of official benchmarks from elicitation, brief diagnostics on salient prices considered and on institutional trust) improve interpretability without altering the established toolkit. Second, for policy communication, information design should prioritise signal over noise: begin from a stable medium-term anchor, contextualise volatile components, present ranges and base rates rather than single-point figures, maintain neutral tone and consistent ordering, and evaluate releases as policy interventions through pre-tests and post-release monitoring.

Implemented together, these adjustments are expected to tighten the anchoring of short- and medium-term expectations, reduce overreaction to transitory shocks, and strengthen the credibility of official statistics and monetary guidance, thereby aligning empirical practice and communication with the documented mechanisms by which households form and update their views.

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ESG as a Tool for Sustainable Governance and Financial Stability in the Banking Sector

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Abstract

Key words:

ESG, environmental, social, governance, commercial banks, green deal, sustainable banking, risk management, corporate sustainability, financial stability, communication, Bulgaria

This report examines the role and significance of ESG (Environmental, Social, Governance) factors in the operations of commercial banks in Bulgaria in the context of the European Union’s Green Deal and the increasing regulatory requirements. The main ESG components and their intersections with banking activities are analyzed, as well as their impact on financial stability, risk management, reputation, and trust in the banking sector.

The report systematizes key principles of sustainable governance and stakeholder communication strategies, with a particular focus on practical steps for the effective integration of ESG into banking policies and processes. The conclusions indicate that sustainable ESG management is a dynamic and continuous process and represents an important prerequisite for the long-term stability and competitiveness of commercial banks.

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1. Introduction: ESG and the Role of Commercial Banks

The reason for the growing focus of commercial banks on the Green Deal in recent years is that it represents an essential part of the overall ESG concept (Council of the EU, 2024). ESG has become a core element of banks’ corporate social responsibility, as well as of their risk management strategies, investment planning, and the development of long-term client relationships. This engagement has positioned commercial banks as one of the key communication channels regarding emerging business-related issues associated with the Green Deal.

It can be argued that commercial banks’ understanding of ESG characteristics and their incorporation into banking policies, rules, procedures, and regulations play a critical role in determining the long-term financial stability and success of the banking system. This process not only contributes to the reduction of operational risks but also strengthens banks’ reputations by fostering trust among clients and investors.

2. ESG Factors and Banking Activity

ESG factors have increasingly become an integral part of banking activity, influencing not only regulatory compliance but also strategic decision-making, risk management frameworks, and stakeholder relations. In the banking sector, ESG considerations extend beyond internal operations and affect credit policies, investment decisions, and the assessment of long-term financial sustainability. Understanding the specific dimensions of environmental, social, and governance factors and their interaction with banking activities is therefore essential for evaluating their overall impact on commercial banks.. Table 1 below presents the author’s attempt to illustrate the intersections between the main characteristics of the ESG components and banking activities.

Table 1

ESG factors in banking activities

ESG	Environmental Factors	Social Factors	Governance Factors
Definition	Cover the way organizations impact the environment. This includes, for example, greenhouse gas emissions, waste management, biodiversity protection, and the sustainable use of natural resources.	Encompass the organization's relationships with its employees, suppliers, customers, and local communities. Key aspects include workers' rights, health and safety in the workplace, supply chain management, and corporate social responsibility.	Focus on transparency and accountability through audits, internal controls, ethical codes, as well as risk management and the protection of shareholders' rights.
Areas of Influence in the Banking Sector			
Financial Stability	The integration of ESG factors can help commercial banks identify and manage environmental and social risks, which in turn may affect their financial stability. For example, investments in sustainable projects may reduce exposure to regulatory fines and long-term transition risks.		
Reputation and Trust	The adoption and implementation of ESG principles can significantly influence public perception of commercial banks. Banks that actively demonstrate commitment to environmental and social objectives, as well as transparency in governance, are perceived as more reliable partners. This leads to increased trust among clients and investors, which is fundamental to the long-term success of any financial institution.		
Regulatory Requirements	There is increasing global pressure on financial institutions to integrate ESG standards into their operations, reflected in a growing number of regulatory requirements. Commercial banks that effectively integrate and report on their ESG practices are better positioned to meet these requirements and avoid potential sanctions.		

Source: Developed by the author

At present, ESG characteristics can be said to have the greatest impact on regulatory requirements and the reputation of commercial banks. Business benefits and the long-term financial stability outlook are not yet as strongly affected; however, they demonstrate significant development potential and are closely linked to the principles of sustainable governance in the long term. Sustainable governance is the foundation of successful and responsible business practices, particularly in the banking sector, whose activities exert substantial influence on the economy, society, and the environment. In this context, the growing relevance of ESG factors suggests that their role will expand beyond compliance and reputational considerations toward a more direct influence on business performance and strategic resilience. As regulatory expectations and market pressures intensify, ESG integration is likely to become a core component of banks' value creation and risk mitigation strategies. Consequently, the alignment of banking activities with sustainable governance principles will be increasingly critical for ensuring long-term competitiveness and stability.

3. Sustainable Governance in Commercial Banks

Examining the principles of sustainable governance helps commercial banks address the complex challenges of the modern world and thereby generate long-term value for both shareholders and society as a whole. Effective corporate sustainable governance in commercial banks requires the integration of principles such as transparency and accountability, ethical conduct and integrity, risk management, and effective oversight. Table 2 below outlines some guidelines for integrating these principles into the operations of commercial banks.

Table 2.**Key principles of sustainable governance in commercial banks**

Transparency and Accountability	Establishing clear processes and procedures for reporting and communication with shareholders, employees, and all other stakeholders.
Ethical Conduct and Integrity	Defining ethical standards and corporate values that promote responsible behavior among bank employees.
Risk Management	Developing strategies for identifying, assessing, and managing risks related to financial operations, as well as the psychological and social impacts associated with them.

Source: Developed by the author

It is important to note that, in order to have real impact, it is not sufficient for these principles to be merely incorporated into internal regulatory banking documents. They must be clearly communicated to all stakeholders so that cooperation in their implementation and supervision can be achieved, thereby helping commercial banks remain aligned with their chosen path of sustainable governance.

Communication between commercial banks and stakeholders—including clients, employees, investors, regulatory authorities, and local communities—plays a key role in sustainable governance. Table 3 below presents some of the main communication strategies that commercial banks should apply in this regard.

Table 3.**Communication strategies between commercial banks and stakeholders**

Open and Transparent Communication	Developing channels for regular and open communication with all stakeholders to ensure transparency regarding corporate activities, policies, and outcomes.
Stakeholder Dialogue	Creating forums and platforms for dialogue where stakeholders can express their views and concerns, while the bank presents its strategies and actions related to sustainable governance.
Collaboration for Sustainable Development	Working in partnership with communities, non-governmental organizations, other corporations, and governments to identify and develop initiatives that support sustainable development.
Reporting and Feedback	Providing detailed reports on ESG activities and outcomes, as well as establishing mechanisms for responding to stakeholder inquiries and feedback.

Source: Developed by the author

In summary, principles require the development of strategies, and strategies require plans consisting of consistent and concrete steps. In this specific case, such steps may include:

Comprehensive coverage of all aspects of banking activities through the introduction of sustainable policies and clear procedures. Each document should be clearly regulated and described in an understandable manner for all banking units. The regulatory framework should be easily accessible, with the possibility of contacting a specialized unit in case of questions;

Building a culture of sustainable business practices among employees through personal example and the introduction of training programs. This implies that commercial banks incorporate ESG topics into periodic training sessions while simultaneously committing to reducing their carbon footprint across all possible activities—less paper usage, reduced electricity consumption, green transportation, use of recyclable materials, digitalization of processes, etc.;

Transparent reporting through the establishment of an ESG monitoring system, involving regular reporting on sustainability performance alongside financial reports. This enables stakeholders to observe progress and commitment. Accountability provides a reference point for necessary changes while also offering

feedback on the level of monitoring and engagement by commercial banks;

Introducing a system for rapid adaptation to the evolving ESG regulatory environment in order to maintain current and effective banking practices. The dynamic nature of EU directive updates related to ESG requires the creation of a flexible administrative and internal communication environment within commercial banks. Such an environment should enable both the timely updating of regulatory documents and their effective communication across all affected banking units.

Based on the above, it can be concluded that sustainable management of ESG implementation processes in banking activities is not static, but rather involves continuous improvement and adaptation to emerging challenges and opportunities. Commercial banks that succeed in integrating sustainability across all organizational levels are better prepared to address future challenges, generate long-term value for all stakeholders, and contribute to the achievement of global sustainable development goals. In this context, sustainable governance principles are fundamental to building a more resilient and responsible banking—and, consequently, financial—sector.

4. Conclusion

The analysis demonstrates that the integration of ESG factors into the activities of commercial banks in Bulgaria is a key element of the transition toward sustainable governance and long-term financial stability. At present, ESG exerts its strongest influence on regulatory compliance and banks' reputations, while business benefits and the impact on long-term returns are still in a developmental stage.

Sustainable governance in the banking sector should not be viewed as a one-time process or a formal fulfillment of regulatory requirements, but rather as a dynamic system of policies, practices, and organizational culture. The effective application of ESG principles requires transparency, accountability, ethical conduct, and active communication with stakeholders.

Commercial banks that succeed in integrating sustainability at all organizational levels will be better positioned to adapt to future regulatory and market challenges and to generate long-term value for both their shareholders and society as a whole.

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Resistance to Imposed Organizational Change: Diagnosis, Appearances, and Management Approaches for Its Mitigation

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Abstract

Changes in organizations often generate ambivalent reactions in employees and significantly affect work motivation and engagement, especially when imposed unilaterally. The paper aims to highlight the main manifestations of hidden resistance and how it affects labour efficiency and loyalty attitude. The research focuses on the difference between obvious and hidden forms of resistance when analysing the dual dynamics of acceptance and resistance. The objective is to identify the main forms and dominant patterns of change-resistance attitudes among the workforce to provide basic recommendations for company leadership. Resistance to change needs to be recognized not as an obstacle to be eliminated, but as a diagnostic indicator to be constantly monitored. The findings suggest that resistance can be anticipated, measured, and effectively managed if recognized on time.

Key words:

organizational change,
acceptance of organizational
change, resistance to change,
sources of resistance, types of
resistance, limiting resistance

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1. Introduction

The problems accompanying organizational change are particularly relevant in the context of the high adaptability and strategic flexibility required in the current accelerated economic, digital, and social transformations. Organizational change can be defined as a **purposeful, systematic, continuous, and manageable transition of organizations from one state to another, in which structures, processes, resources, and technologies are transformed to achieve balance, higher efficiency, sustainability, and adaptability to a dynamic environment.**

The change is, by its nature, a **risky and uncertain** intervention. Leaving a stable state always introduces uncertainty into the results, as during transformation, the organization is vulnerable, and risks are multidimensional. In addition to operational and financial risks, serious reputational risks arise from adverse reactions from customers, partners, and the public. The socio-psychological risks of loss of trust, decline in commitment, and the departure of key people should not be underestimated. Every change generates resistance to it.

Resistance to change is an inevitable and complex phenomenon, stemming from a variety of personal, social, and organizational sources. Managing it requires not just suppression, but understanding, engagement, and strategic participation. Successful organizations do not impose change, but create the conditions for it to be accepted through communication, participation, training, and a supportive environment. Using appropriate tools to measure and monitor resistance contributes to a more effective transition, turning resistance into a resource rather than just an obstacle.

The research methodology includes theoretical summaries of resistance to change in organizations and an independent survey conducted by the author. The survey was conducted between 2022 and 2024 among 131 respondents aged 21 to 35. It examined the main reasons for employee resistance to organizational change and the most common manifestations of this resistance.

The aim of the study is to identify the main sources of resistance and to distinguish risky changes that

require preventive management actions to limit potential resistance, based on a study of attitudes towards change acceptance. The survey seeks to identify risky areas with a very high potential for resistance. The focus of the study is on examining resistance as a source of information about internal threats and a tool for predicting reactions.

2. Research on the causes and sources of resistance to organizational change

Resistance to change in management theory is perceived as an individual or group reaction to a change in the status quo, expressed through behaviour, attitudes, or emotions that hinder or delay it. It arises from the failure to meet the objective need for change identified by managers and from employees' internal attitudes toward accepting this change (Mladenova, 2022). Resistance is perceived as a natural human reaction aimed at preserving the current state of affairs and, as such, should be expected and anticipated.

Burnes (2004) defines resistance as the outcome of a confrontation between two forces—the status quo and the new—which produces signals of imbalance and communication deficits. In an organizational context, resistance to change is expressed through social dynamics—changes in roles, power structures, status, security, and relationships. A relatively new focus in resistance management is on transformational leadership, which holds that resistance should not be suppressed but transformed into energy for development (Mladenova, 2022). In this sense, resistance can also be seen as a "driving force" for improving management style, making it softer, more sensitive, and more flexible.

Resistance manifests itself throughout the entire transformation process, but is most pronounced in the initial phase of change. The sources of uncertainty and fear arise not from the nature of the expected changes, but from uncertainty about the consequences for each individual and anxiety about how the change will affect them personally. In this sense, people resist not the change in the organization, but their position and role in it.

Contemporary management theory has not extensively studied methods for identifying, measuring, and realistically predicting resistance. The study identifies the facts and circumstances most likely to cause disobedience and focuses management efforts on addressing them.

Respondents rated the strength of the influence that each factor has on their overt or covert resistance to imposed change on a scale of 1 to 5, where 1 reflects the respondent's indifference to the factor in question, and 5 indicates the strongest degree of influence, at which the individual certainly expects to show resistance: (1) - I don't think it matters, I'll accept the change without any real discomfort; (2) - I won't like it, but I'll go along with the changes without messing up my performance; (3) - It'll make me uncomfortable and I'll probably show some hidden resistance; (4) - It will definitely have a negative impact on my motivation, I will express my opinion; (5) - Totally unacceptable, I will protest openly or leave.

When interpreting the results, the natural tendency of workers not to freely share negative attitudes or admit to bad habits and behaviour should also be taken into account. The results are presented in Table 1 below.

Table 1

Factors leading to resistance to organizational change and the degree of influence on employees

	Factors	Average score
Personal (individual) reasons	Fear of the unknown and of losing control over what is happening; fear of losing one's job, status, role, privileges, etc.	4,54
	Understanding the reasons, but deep distrust of what has been promised, especially individual benefits.	4,10
	Fear of uneven distribution of the burden of change – people expect key tasks to be delegated to conscientious workers, while mediocre ones will not be burdened with additional work.	3,95
	Scepticism about the realism of the targeted positive results.	3,84
	Emotional state – increased anxiety, inability to work under pressure and stress, sensitivity of the individual, and inability to "see" oneself in the new environment.	3,80
	Lack of understanding of the reasons and goals of the change, and scepticism.	2,45
	Doubts about one's own ability to cope satisfactorily, lack of confidence, fear of exposure, etc.	1,95
	Inertia – people tend to stick to their routines and habits, fear of being outside their comfort zone, etc.	1,52
Organizational reasons	Bad experiences from previous changes.	4,62
	Insufficient communication and participation; employees are not involved in the diagnosis and planning process, but only in the implementation, without knowing why the changes are necessary.	3,80
	Difficult reorientation of thinking due to established social norms and groups.	2,56
	Conflicts between old and new power structures, roles, and responsibilities.	2,25
	Expectation of overspending of resources and time, resistance to real future constraints.	2,10
	Organizational culture unprepared for change: lack of flexibility, lack of synchronization between systems.	1,26

Source: Author's research.

The reasons for resistance were studied in two categories: personal, arising from the individual, and organizational, depending on the corporate culture and management capacity. There is a clear predominance of individual reasons for resistance, with a sensitivity (3.27) higher than that for organizational reasons (2.76).

To a large extent, respondents admit that they will show resistance in some form due to fear of the unknown and loss of control, fear of losing their job, status, role, privileges, etc. (4.54 or almost certain resistance). Secondly, a circumstance likely to cause resistance is the expected uneven distribution of the burden of change, with people expecting key tasks to be delegated to conscientious workers and mediocre workers to be spared additional work (3.95). The weakest factor is sensitivity to one's own skills and confidence in one's competencies and potential – a lack of understanding of the reasons behind it, fears of failure or poor

performance, etc. Emotional state is also a high-risk factor for resistance (rating 3.8), indicating the high degree to which young workers value their psychological comfort at work and the microclimate within the organization. Emotional reactivity and anxiety are also cited as risk factors by Edmondson, who talks about "psychological safety," in which employees do not actively engage with change but sabotage it (Edmondson, 1999).

A similar study from 2025 (Anvarovich, 2025) indicates that the behaviour of millennials and Gen Z employees is most influenced by the fear of losing social identity, as they have a specific need for role and group belonging.

Regarding reasons arising from organizational characteristics and culture, the greatest rejection is observed in cases where workers have had negative experiences with prior changes (4.6). Once they have experienced changes without the promised results, without any obvious improvement in working conditions and remuneration, mistrust borders on an almost certain refusal to participate in the changes. Analysis of results by organizational cause shows a significant difference in sensitivity to the various imperfections across companies. The results show that employees are less interested in the mechanisms within the organization, their synchronization, and other circumstances related to the company's results than they are in their personal results. This observation supports the concept of "organizational cynicism" (Dean et al., 1998), which holds that employees who have experienced unfulfilled promises develop lasting distrust.

3. Research on the causes and sources of resistance to organizational change

Fear of the unknown and a sense of loss of control are among the most powerful catalysts for resistance. Similar conclusions are drawn by Oreg (Oreg, 2006), according to whom people with a high degree of resistance to change react with anxiety and withdrawal when the established order is disrupted. Oreg measures individual capacity for resistance by predicting employee behaviour using a resistance-to-change index. He concludes that those most sensitive to change are practically the safest, as their expected behaviour is withdrawal and a quiet departure, which are relatively predictable and measurable, and sabotage and entrapment of other workers are not expected.

Resistance is expected and should be managed. Management can identify areas of risk for expected resistance and direct prevention measures more effectively.

In addition to the causes, it is important to be aware of the specific manifestations of resistance, which vary in degree and intensity. Resistance to organizational change in this study is considered to be overt or covert, and at the same time, in all cases, it can be conscious or unconscious.

3.1. Overt resistance

Overt resistance is characterized by open and visible opposition to change. It is easy to identify because it is expressed through behaviour, words, or actions that directly sabotage or attack the change process. Practical manifestations of this type of resistance include open criticism, complaints, sarcasm, or mockery of the idea of change. Informal coalitions against change are formed, and overt pressure groups, disobedience, etc., are organized. As an open form of protest, workers often deliberately reduce their performance and limit their productivity. Open resistance also takes the form of boycotting training sessions, company events and celebrations, team building activities, etc. Overt resistance is often a sign that communication about the change is insufficient or that employees are not represented in the process. Due to its visibility, it can be managed relatively easily through dialogue, training, and participation (Kotter and Schlesinger 2008).

3.2. Hidden resistance

Hidden (secret) resistance is the most dangerous type because it does not manifest openly but undermines the process of change from within, as it is not limited in time – it is not an initial protest but a monotonous,

secret sabotage of micro processes. It is often the result of unconscious fears, lack of trust, or feelings of powerlessness. This type of resistance often manifests after initial overt resistance, when the individual has openly opposed and argued against the change or parts of it, but has been unheard and ignored. Hidden resistance is the most predictable result of anger. Characteristics of hidden resistance are:

- Pseudo-acceptance - formal agreement without real commitment;
- Passive behaviour - apparent busyness without the usual quality, non-participation in discussions and meetings, delays, omissions, apathy in communication with customers and colleagues, emotional distancing from the company, etc.
- Deterioration of the microclimate - spreading negative rumours, intrigues, creating conflicts, demotivating colleagues
- "Quiet" quitting - performing tasks qualitatively and on time, but only the minimum duties described in the job description, not taking any initiatives or additional tasks.

Hidden resistance is common in cultures with low levels of trust and strong hierarchies. It is difficult to detect, but can be recognized through indirect signals: a decline in initiative, avoidance of responsibility, and a lack of feedback. Armenakis and Harris (Armenakis & Harris, 2009) emphasize that hidden resistance is most effectively overcome through active listening, creating space for expressing doubts, and providing support during the adaptation process.

Recognizing the forms of resistance helps managers choose the right approach—rational, emotional, or cultural. While overt and conscious resistance allows for direct dialogue, hidden and unconscious resistance requires patience, observation, and empathy. As Kuzmanova points out (Kuzmanova, 2012), "the manager's ability to distinguish between types of resistance largely determines the success of the change itself."

3.3. Conscious resistance

Conscious resistance is a deliberate, considered, and reasoned opposition to change. The individual understands the goals of the change but, due to disagreement with them or incompatibility with their personal interests or beliefs, chooses to oppose it. Conscious resistance includes reasoned criticism and rational objections; expressing disagreement at meetings and in official communications; attempting to influence decisions through dialogue or pressure, etc.

Kuzmanova emphasizes that conscious resistance can also serve a constructive purpose, as it often reveals gaps in the analysis of change and can help improve it when addressed correctly.

3.4. Unconscious resistance

According to Levin and later Argyris (1990), unconscious resistance is part of the internal tension between the need for stability and the need for adaptation. It manifests itself when an individual feels a threat to their identity but cannot clearly articulate it.

Unconscious resistance manifests itself when a person does not feel or fully understand the reasons for their own unwillingness to accept change. It is the result of unconscious fears, personal defence mechanisms, and internal conflicts. This type of resistance is most often emotional rather than rational in origin. It manifests as procrastination, delays, or the avoidance of tasks, with irrelevant and irrational excuses. The employee's work shows a lack of energy and motivation, anxiety, irritation, distraction, and passive aggression on topics related to change. Unconscious resistance is most susceptible to transitioning from one type to another, as it can quickly and easily transform into overt or covert, hidden resistance. This type of resistance often goes unnoticed by managers, but it has the strongest impact on team motivation and culture.

Unconscious resistance is the most difficult type because its manifestations cannot be predicted or controlled, are difficult to recognize, and require an empathetic, individualized approach.

Table 2 summarizes the main characteristics of the different types of resistance and suggests a successful management approach.

Table 2

Key characteristics of the various types of resistance and approaches to overcome it

Type of resistance	Type of appearance	Reasons	Typical appearance	Approach to limiting
Conscious resistance	Usually overt, sometimes deliberately hidden	Rational disagreement, protection of interests or values; assessment of the risk of change	Reasoned opposition; critical statements; active attempts to influence decisions	Dialogue and involvement in the change process; discussion of arguments; participation in working groups; adaptation of change according to real objections
Unconscious resistance	More often hidden, emotional	Unconscious fears, anxiety, cognitive dissonance, loss of sense of security or control	Procrastination, passivity, increased irritability, lack of motivation without apparent reason	Individual approach and support; empathetic communication; coaching and psychological assistance; gradual introduction of the new
Overt resistance	Visible, direct	Reaction against a threat to status, role, or workload; search for influence	Refusal to participate, boycott, criticism, conflicts, sabotage	Direct communication; participation in discussions; demonstration of benefits; training; clear leadership presence
Hidden resistance	Difficult to see, indirect	Distrust, fear of punishment, low psychological safety; passive disagreement	Apparent agreement, but lack of real commitment; delaying; informal complaints and rumors; apathy	Creating a trusting environment; informal conversations; active listening; encouraging feedback; cultural change and support

Source: Author's summary.

Resistance is almost always a combination of its types, shifting from one form to another and changing in intensity. The resisting individual combines their discontent, expressing some openly while keeping some hidden, and this proportion is constantly changing. Heterogeneous resistance is the most difficult for managers to notice and limit. Another approach (Kuzmanova, 2011) is used to group manifestations of resistance. It divides resistance symptoms into verbal and nonverbal. Each type can be both active and passive resistance.

Manifestations of **active** resistance can be verbal (debate, counterarguments, reproaches, threats) and nonverbal (tension, rumours, intrigues, etc.). **Passive** resistance is associated with nonverbal symptoms such as silence, apathy, absenteeism, lack of interest, indifference, and demonstrative fatigue.

Other researchers broaden the spectrum of resistance by adding a new level of "lack of resistance" or passive acquiescence, (Stoyanova, 2014). According to Stoyanova, lack of resistance to change includes enthusiasm, cooperation (due to personal conviction or pressure), and active and passive agreement. Although "lack of resistance" can help an organization analyse its readiness for change, cooperation under pressure and passive consent cannot be called "lack of resistance" (compliance). We define the described behaviour of those who "do not resist" as disinterest in what is happening or unwillingness to resist, but not as a lack of resistance.

Distinguishing between types of resistance allows managers to select an appropriate management strategy. While conscious and overt resistance can be addressed through rational arguments and participation

in the process, unconscious and covert resistance requires a more subtle, psychological approach based on trust, empathy, and gradual adaptation. As Kuzmanova (Kuzmanova, 2012) notes, effective change management requires "the ability to distinguish when resistance is a sign of miscommunication and when it is a natural defensive reaction of people."

Each type of resistance to change involves different dynamics and requires a specific approach that combines communication, psychological, and organizational tools. Conscious resistance is most successfully managed through transparency and participation (constructive feedback). In cases of overt resistance, where tension is visible, dialogue and leadership by example (demonstrating commitment, calmness, and confidence) play a key role.

In cases of unconscious and hidden resistance, however, the approach must be more delicate. These forms require attention to employees' emotional states, building trust, and creating an environment where fear and insecurity can be shared without the threat of sanctions. This is where the importance of empathetic leadership, coaching practices, and psychological support comes into play, as it is precisely the restoration of an individual's sense of control and belonging that is the factor that transforms resistance into cooperation.

3.5. Assessment of resistance tendencies during organizational transformations

In management's attempts to study the genesis of resistance and predict its manifestation, it is necessary to clearly understand the phases through which change passes.

Elizabeth Kübler-Ross developed a five-stage model (Kübler-Ross, 1969), known as the "change curve," that tracks an individual's emotional trajectory when faced with unexpected loss or transition. The stages are: 1) denial, 2) anger, 3) bargaining, 4) depression, and 5) acceptance. Initial denial is a defence mechanism against uncertainty; anger is a reaction to loss of control; bargaining is an attempt to preserve part of the old; depression reflects a moment of helplessness, and acceptance is the result of a new balance between expectations and reality. This model is widely used in human resource management and organizational development because it describes the internal psychological dynamics of resistance. The Kübler-Ross model shows that resistance has an emotional rhythm that cannot be bypassed by rational arguments. It must be "experienced" in order to transform into a willingness to cooperate.

The second part of the study examines employees' attitudes toward specific organizational changes and their willingness to accept and participate in change. The aim of the study is to identify types of change with a high or very high risk of employee resistance.

Table 2

Attitudes toward accepting or rejecting imposed organizational change, accept/reject tendency

Type of change	I would accept the change very easily	I would accept the change relatively easily	I would accept the change with difficulty	I would not accept the change	It will not affect me	Risk of resistance
A change in your job responsibilities that requires you to upgrade your qualifications.	23%	35%	18%	4%	20%	Low
A change in your working hours and break schedule.	4%	22%	34%	9%	31%	Moderate

A change in your place of work (being relocated without your agreement)	9%	15%	38%	12%	26%	High
Type of change	I would accept the change very easily	I would accept the change relatively easily	I would accept the change with difficulty	I would not accept the change	It will not affect me	Risk of resistance
An increase in your workload for the same pay.	3%	7%	36%	40%	14%	High
Increased quality control of the product/service you produce/offer.	14%	27%	11%	3%	45%	Low
Change in the managers' management style.	6%	25%	27%	4%	39%	Moderate
Change in the team you are used to working with.	8%	12%	48%	7%	25%	High
Change in the microclimate of your workplace - teamwork, mood, gossip, and communication styles, etc.	6%	15%	39%	19%	21%	High
Change in the system of bonuses, social benefits, vacations, etc.	11%	20%	32%	15%	22%	High
Change in career development opportunities.	12%	29%	27%	13%	19%	Moderate
Risk to your power, prestige, reputation, and social interaction.	7%	13%	25%	28%	27%	High
Short-term poor financial results of the company.	5%	18%	33%	11%	33%	Moderate
Change in ownership of the company.	11%	12%	13%	7%	57%	Low
Reorientation of the company towards the production of a product/service that is incompatible with your moral sensibilities and values (production of harmful foods, sales based on lies, sale of blatantly poor-quality goods, unfair practices in customer service, etc.).	2%	9%	24%	39%	26%	High

Source: Author's research.

The analysis of the results shows that the strongest resistance is observed to changes that increase the

volume of work without a corresponding increase in remuneration. This change is perceived as unfair and, for the majority of respondents, represents a threat to their sense of balance between effort invested and remuneration received. 76% of respondents say they would not accept the change or would find it very difficult to do so. This convincingly confirms the thesis that changes affecting the assessment of personal contribution and corresponding bonuses are risky for organizations.

A change in the microclimate, associated with deterioration in teamwork and the presence of gossip and intrigue, is a circumstance that 58% would not accept.

An interesting observation is the high sensitivity of employees to changes in the team they are used to working with: 48% of respondents say they would find it very difficult to accept this change, but only 7% are firmly convinced they would not accept it. This shows that social dynamics and the microclimate should be kept stable or changed in a smooth, careful manner.

Employees show the greatest understanding and potential for acceptance regarding changes that increase control over the quality of work and rest periods, while the greatest indifference is observed regarding changes in company ownership.

Managers' management style also shows little sensitivity toward workers—nearly 40% say that a change in management style will not affect them.

The change expected to be accepted most easily and therefore provoke the least resistance is the change in requirements for upgrading qualifications, nearly 60% would accept it easily or very easily.

It is also worth noting that respondents disapprove of changes incompatible with their personal moral sensibilities and values as 63% would not accept such a change.

4. Limiting resistance to organizational change

4.1. Management approaches to limiting resistance, early diagnosis, and prevention

In management practice, there are many approaches to limiting resistance to change, which vary depending on the nature of the organization, the depth of the change, and employees' emotional readiness.

The choice of approach is a strategic management decision, as it determines whether the change will be perceived as an opportunity for development or as a threat to the status quo. Although all methods of limiting resistance are intended to facilitate adaptation, there are significant differences among them in terms of their moral acceptability and organizational consequences. While education, participation, and support are grounded in trust, openness, and mutual respect, manipulation and coercion call into question the ethical standards of leadership.

The use of force or covert mechanisms may ensure short-term success, but in the long run, it leads to the erosion of organizational culture and loss of loyalty. Therefore, management choices should be guided not only by effectiveness but also by ethical responsibility towards people and organizational identity.

Table 4 below presents the main management methods for overcoming resistance, along with their advantages and disadvantages, adapted to the specifics of the Bulgarian organizational environment and contemporary requirements for ethics and sustainability.

Managing resistance to organizational change is not a reactive but **primarily a preventive process**. Successful modern organizations realize that resistance rarely arises suddenly; it builds gradually from uncertainty, mistrust, poor communication, or a lack of meaning. This underscores the importance of managers' ability to diagnose early signs of tension for the sustainability of the transformation.

Early diagnosis is a systematic and behavioural approach based on an analysis of the combination of **objective organizational indicators and subjective attitudes**. Kuzmanova (Kuzmanova, 2011) emphasizes that managers should observe not only the results of the work but also changes in employee behaviour, looking for signs such as decreased engagement, isolation, cynical comments, and increased formalization in

communication.

Table 4

Methods for limiting resistance

Methods	Suitable application for	Advantages	Disadvantages
Education and communication	Lack of information, communication crises	Improves cooperation and sense of significance, reduces insecurity	It takes a significant amount of time
Participation and engagement	Misunderstanding or disagreement with objectives, bottom-up approach	Increases motivation and sense of belonging; creates "internal ambassadors" of change	The process is slow and depends on many factors, including leadership and group dynamics
Facilitation and support	Restructuring, layoffs, and unpopular changes	Reduces tension and stress, increases trust in leadership	High financial and human costs due to the scale of the changes and the need to bring in external specialists, consultants, coaches, etc.
Negotiation and agreement	When personal or group interests are seriously affected	Reduces the risk of serious conflicts, creates a sense of fairness and dialogue	Requires concessions and compromises, may set precedents
Manipulation and co-optation (involving opponents in decision-making)	When other methods have failed, when time is very limited and urgent	Quick effect, neutralizes resistance by changing its direction	Risk of mistrust, need for covert actions, demotivation upon disclosure, and high ethical and reputational risk
Overt or covert coercion	When resistance needs to be neutralized urgently, in crisis situations	Ensures control and timely action	Reputational risk, risk of fines and sanctions from external institutions, and risk of losing key personnel; creates fear and alienation
Support for personal development (training, mentoring, therapy)	When there is low confidence and a lack of competence to work in the new conditions	Increases self-esteem and readiness for change; develops long-term sustainability	Requires time and financial resources; the effect is gradual but lasting, an investment for all future changes
Empathetic leadership and a supportive environment	When there are high levels of anxiety, emotional resistance, and exhaustion	Reduces psychological resistance; builds trust and loyalty	Requires mature and competent leadership; difficult to measure effect
A series of micro-changes (gradual approach)	When there is cultural resistance or fear of radical change	Reduces fear and facilitates adaptation; higher resilience	Slower achievement of goals; risk of loss of focus and momentum
Positive modeling (behavioral example)	When role models for the new behaviour and examples to emulate are needed	Increases the persuasiveness of change; demonstrates consistency	Highly dependent on the authenticity of leaders; difficult to maintain

Source: Synthesis by the author based on Kotter, J.P. & Schlesinger, 2008; Armenakis & Harris, 2009; Zafirova, 2014, and Kuzmanova, 2011

One effective tool for this is the so-called **organizational barometer** - short, regular surveys of team morale. This practice is used by companies such as Google and Unilever, which measure their employees' "emotional temperature" monthly through anonymous digital surveys. This data is analysed by internal HR teams and serves as an indicator of potential pockets of resistance.

An important source of information is also **informal communication networks**, which often precede official channels. Their analysis identifies informal leaders and influencers who can both drive and brake change (Zafirova, 2014). At *IBM*, for example, managers use so-called network mapping to track how information spreads and identify informal centres of resistance.

In addition to quantitative tools, qualitative methods (individual interviews, focus groups, observation) also play a crucial role. Change is only as successful as the quality of feedback from the people who experience it (Burke, 2018). Listening, not just communicating decisions, is a practical form of prevention.

Another mechanism is the **assessment of organizational readiness for change**, recommended by Armenakis & Harris (Armenakis & Harris, 2009). It includes five key dimensions: awareness, desire, knowledge, ability, and support (based on Prosci's ADKAR model). Through it, managers can determine at what stage of change acceptance each department or employee is at and adapt their approach accordingly.

The best way to prevent resistance is **to build a culture of transparency and participation**. As Kotter points out, "every sustainable change begins with a sense of meaning and ends with a sense of belonging." When employees are involved in the diagnosis and planning process, they do not feel like objects of change, but rather its authors and agents (Kotter, 1996).

Practical mechanisms can include:

- Regular feedback meetings between managers and teams (as at *Toyota* through the "Gemba Walks" system, where managers regularly visit workplaces to hear about the real problems of employees);
- Open communication forums where issues and upcoming changes are discussed publicly and without repercussions;
- Internal training sessions that translate the meaning and purpose of change from a strategic to a human level.

These mechanisms not only prevent mistrust, but also strengthen organizational commitment—one of the key protective factors against resistance.

Even with the best preparation, any change causes **emotional stress and cognitive dissonance**. Research by Lewin and later by Schein shows that in the process of "unfreezing" old habits, individuals experience anxiety and a temporary loss of control. Therefore, organizations must provide **support structures** to stabilize people during this transition. Examples of such support structures could be:

Working groups for change are interdepartmental teams that assist with implementing new practices, identify problem areas, and serve as mediators between different levels of management. At *Siemens*, for example, every major change is accompanied by so-called Change Ambassadors. These are representatives from different departments who monitor the mood, translate ideas into the language of reality, and help their colleagues adapt.

The advantage of this approach is its dual function of **control and support at the same time**. It reduces feelings of pressure and strengthens a sense of belonging and commitment.

Internal consultants serve as **psychological translators** of change. They combine organizational knowledge and emotional sensitivity, helping managers recognize hidden sources of tension. At *Philips Electronics*, for example, HR specialists are trained as internal change management consultants to mediate tensions between management and employees.

This approach is more cost-effective than hiring external consultants and ensures a longer-term impact

by keeping knowledge and experience within the organization, reducing the risk of sensitive information leaking.

Change leaders and change ambassadors are influential individuals within the organization who have authentic influence over their colleagues. They act as emotional anchors, stabilizing teams in times of uncertainty. Their role is to "translate" strategy into behaviour and model desired attitudes through personal example (Armenakis and Harris, 2009).

An example of this is *Procter & Gamble*, where every major change project is accompanied by a network of internal change leaders who have undergone specialized training in communication, empathy, and team-meeting facilitation.

Many organizations are already implementing **targeted stress management programs**, individual coaching sessions, group resilience training, awareness programs, and emotional check-in meetings. At *Microsoft* and *Deloitte*, for example, there are permanent employees appointed to be responsible for workers' well-being who monitor employees' psychological state during large-scale transformations.

These practices have a proven impact on motivation and productivity. According to research by Harvard Business Review (2021), companies that invest in psycho-emotional support during organizational change reduce turnover by up to 40% and increase employee loyalty.

4.2. Reversibility of resistance, reframing

Methods for countering resistance result in reduced resistance, softened resistance, or, in the best-case scenario, complete elimination. However, turning its direction from negative to positive is a supreme management skill. The ability to turn opponents of change into its proponents is possibly the most useful move in change management. Turning resistance from a threat into a resource is the highest form of managerial maturity. Interventions on resistance should not eliminate it, but redirect it.

Transparent communication and employee involvement in change planning are cited as key tools for mitigating or even reversing resistance (Divya & Christopher, 2026). Kotter and Schlesinger, however, suggest involving only the most vocal opponents of change in the decision-making process, not everyone. They are expected to "infect" the rest (Kotter & Schlesinger, 2008). The inclusion of the biggest sceptics in change management should be smooth and almost invisible – not as formal leaders, but as advisors and coordinators. This would create a culture of unity and provide psychological security for the "renegades" by giving them a symbolic share of the success.

Another tool for overcoming resistance is publicly acknowledging mistakes and accepting criticism. When management openly acknowledges that objections have value, publicizing its mistakes has a powerful effect on its direction.

In 2018, during a large-scale internal technological transformation at *Siemens*, a group of engineers in influential positions openly opposed the digitization of production, fearing they would lose expertise. Management included them as facilitators in pilot automation projects, where they began using their skills to develop their own digital solutions and incorporate them into the pilot changes. The company reports that within six months, the resisters became the strongest advocates of change and drew almost everyone into psychological involvement in the transformation. To effectively counter resistance, it is necessary to clearly understand and operationally apply the following practices:

- Resistance as part of the change process signals weaknesses, ambiguities, or unpreparedness and is used as an appropriate indicator for monitoring and evaluating change. (Kuzmanova, 2011).
- Changes must be conscious, visible, and have short-term wins.
- The introduction of change must take into account cognitive, emotional, and social aspects.
- Leaders must maintain sustained dialogue and space for sharing fears and concerns to counter silent

dissent.

- Change must be integrated into everyday life; if it remains "at the top" without becoming part of daily rituals and practices, resistance will continue.

Even if the desired effect of reversing the direction of resistance is not achieved, these techniques can dramatically accelerate its reduction.

5. Conclusion

The mechanisms for early diagnosis and prevention of resistance represent an **integrated management system** that combines organizational analysis, human sensitivity, and strategic communication.

When change is managed not only through plans but also through empathy, participation, and trust, it ceases to be a threat and becomes a **project of mutual growth**. In this sense, an effective organization is not one that has no resistance, but one that knows how to **read, anticipate, and transform it into cooperation**.

There is no universal solution to overcoming resistance; each organization should choose a combination of approaches that aligns with its culture, resources, and human potential. The combination of measures must inevitably be tailored to the nature of the specific resistance. Successful resistance management requires a balance between rational and emotional tools, including transparent communication and participation, empathetic leadership, and a supportive climate. It is important for managers to realize that resistance is not an obstacle but a natural indicator of the system's response to change, and that correctly interpreting it can yield valuable feedback and organizational learning.

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Integrating Quality Management Indicators into Market Sustainability: A Case Study of Ceramic Tiles

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Abstract

Background and aim: Market sustainability is gaining importance even in traditionally stable industries such as the ceramic tile sector, where product renewal cycles are accelerating due to design trends, technological innovation, and evolving customer expectations. Although ceramic tiles generally exhibit longer life cycles than most consumer goods, increasing market saturation and competition require continuous innovation and quality improvement. This study aims to develop and test a methodological framework for assessing the market sustainability of ceramic tiles from the perspective of quality management.

Scope: The research in progress is based on internal company data from two of the largest ceramic tile factories in Bulgaria, covering the period 2019–2025. It focuses on product clusters derived from EN 14411:2016 groups, further differentiated by size categories. Social and ecological dimensions are not included at this stage.

Methods: A Market Sustainability Index (MSI) is constructed using eight indicators—Complaints, First Quality, Technical Parameters, Customer Satisfaction, Compliance with Standards, Production Frequency, Product Variation, and New Model Development Requests. Data normalization, statistical methods, and validation criteria such as life cycle length, sales dynamics, and geographic reach are applied.

Results: Preliminary findings indicate the index differentiates product groups, identifies weaknesses, and highlights stable, long-life models.

Conclusions: Market sustainability can be operationalized through measurable quality and performance indicators.

Originality: The novelty lies in integrating quality management indicators into a Market Sustainability Index (MSI), bridging operational control and strategic market analysis.

Practical implications: The index provides managers with a diagnostic tool for portfolio optimization, product improvement, and informed strategic decisions.

Key words:

market sustainability,
composite index, quality
management, ceramic tile
industry, performance
indicators.

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1. Introduction

Market sustainability assessment can be regarded as an analytical framework applied in contemporary research, reflecting ongoing efforts to operationalize sustainability within market and quality contexts. The conceptual basis of this approach builds on Porter's (1985) theory of competitive advantage, which established the foundations for understanding how firms sustain long-term market presence through strategic resource allocation and value chain optimization. This foundation was extended by Barney's (1991) Resource-Based View (RBV), emphasizing internal resources and capabilities as sources of enduring competitive advantage. The theoretical framework adopted in this study further integrates the Dynamic Capabilities model (Teece, Pisano & Shuen, 1997; Teece, 2007), multi-dimensional performance assessment tools such as Kaplan and Norton's Balanced Scorecard (Kaplan & Norton, 1992), and composite index methodologies developed for sustainability evaluation (Nardo et al.,

2005; OECD, 2025). The conceptual alignment between market sustainability and quality management draws on Kaplan and Norton's (2004) framework for translating intangible assets into measurable performance outcomes. As noted in their later research, value creation does not reside in individual assets but emerges from the integration of interrelated capabilities and the strategic coherence that binds them. (Kaplan & Norton, 2010). Accordingly, the Market Sustainability Index (MSI) developed in this study functions as a measurement mechanism linking quality management dimensions to market sustainability outcomes through strategic alignment.

There is no unique definition for market sustainability. Market sustainability, as conceptualized by Voronin et al. (2020), refers to the ability of a product, service, or organization to maintain its market presence and competitive position over time through strategic adaptation to changing conditions and effective resource management. They define this as "the stability of the firm in market conditions determined by the ability to optimally manage available resources, effective planning for timely promotion of new products, and the ability to adequately respond to challenges posed by sudden changes in market conditions" (p. 12). In this context, market sustainability can be interpreted as the capacity of a product, service, or organization to maintain competitiveness despite internal or external fluctuations, shaped by factors such as consumer preferences, technological innovations, and regulatory requirements.

Quality management has emerged as a fundamental driver for the long-term competitiveness and sustainability of industrial enterprises. In a rapidly changing economic environment characterized by technological advancements, market volatility, and evolving customer expectations, organizations must adopt robust analytical approaches to evaluate and enhance their market position. This report explores widely adopted quantitative and qualitative methods for analyzing market performance and sustainability, emphasizing their application in the context of quality management within the ceramic industry.

Both market sustainability and quality management place product and process quality at the heart of their strategies, recognizing quality not only as an operational metric but as a key driver of long-term competitiveness. In market-sustainability theory, quality is viewed as the foundation of enduring demand, customer loyalty, stable market share, and low complaint rates – all essential for maintaining a product's relevance over time. This aligns with Porter's value-chain model, quality functions as both a strategic resource and a source of competitive differentiation, driving uniqueness that raises buyer satisfaction and meets evolving needs (Porter, 1998, pp. 124, 132).

This methodology aims to address the complex interplay between internal quality management processes and external market performance indicators in manufacturing environments where quality consistency directly impacts competitive positioning. The proposed framework can support managerial strategic planning while also serving as a prognostic tool for assessing future market behavior.

Despite extensive research on sustainability assessment, the majority of existing studies concentrate on environmental and social dimensions, often operationalized through ESG frameworks or life-cycle analyses. These approaches, while valuable, provide limited insight into the economic and quality-related mechanisms that determine a product's sustained market presence. Within manufacturing sectors particularly the ceramic tile industry, characterized by standardized production, long product life cycles, and high quality dependence, there is a notable lack of methodological tools for assessing market sustainability using internal performance indicators. Previous studies (Teece et al., 1997; Kaplan & Norton, 1992; Ferrer Lorenzo et al., 2018) have conceptually linked resource capabilities, quality management, and competitive advantage, yet few have quantitatively integrated these dimensions into a composite index capable of diagnosing product-level market sustainability. Furthermore, most sustainability indices are designed for macro-level comparisons between firms or industries, overlooking the micro-level dynamics that determine the longevity of individual product models within a competitive market. This methodological and contextual gap justifies the development of the present MSI, which

bridges quality management metrics and strategic sustainability assessment through a unified analytical framework tailored to the manufacturing context.

The OECD's (2025) analysis of ESG rating products reveals gaps in measuring economic and quality-related sustainability indicators. Winston (2022) argues that ESG terminology is “fairly meaningless” as it represents merely “an acronym for categories of things companies should work on” rather than providing concrete direction for sustainability efforts.

Recent studies emphasize potential trade-offs between sustainability and profitability, including inconsistencies between financial performance and sustainability outcomes (Kim et al., 2024). Although the present study does not encompass environmental and social aspects, it focuses on market sustainability indicators that indirectly reflect these dimensions through customer satisfaction and regulatory compliance metrics.

Also, there is a dearth of literature on the application of composite index methodologies for manufacturing sector sustainability assessment, particularly in industries with standardized products and long lifecycle characteristics. Against these backdrops, this study raises the following research questions:

1. What is the relationship between quality management indicators and market sustainability in ceramic tile manufacturing?
2. How can internal production metrics predict long-term market presence and competitive position?
3. What is the effectiveness of Market Sustainability Index (MSI) methodology in capturing multi-dimensional aspects of market sustainability?

2. Literature Review and Hypotheses Development

2.1. Market Sustainability Index (MSI) Development

A Market Sustainability Index (MSI) integrates multiple indicators into a single composite measure that captures complex, multidimensional constructs (Nardo et al., 2005). In market sustainability research, composite indices enable the aggregation of diverse quality metrics such as first-quality production rates, complaint frequencies, internal production heterogeneity, regulatory compliance, customer satisfaction, production frequency, and technical parameters into an overall value that can be statistically validated for predictive relevance.

Voronin et al. (2020) operationalize this approach by modeling nonlinear interactions among key indicators, demonstrating that a properly weighted composite index can effectively forecast a firm's ability to maintain market stability amid fluctuating conditions.

Stricter regulatory requirements such as those found in construction product regulations (Regulation 305/2011, Regulation 2024/3110), CE marking mandates, and the forthcoming digital product passports reduce buyer (B2B) sensitivity to price and increase the importance of quality and compliance as verified by MSI indicators. This perspective aligns with Porter's theory of differentiation and competitive advantage through quality management and product attributes.

Recent research further emphasizes the strategic role of quality management in sustainable development. Savastano et al. (2022) find that quality-related principles continuous improvement, effective leadership, people-centered management, fact-based decision making, and customer focus positively influence organizational sustainability. Similarly, Aigboje (2025) highlights how systematic quality management practices significantly enhance competitive advantage and support sustained market positioning.

Ferrer Lorenzo, Maza Rubio, and Abella Garcés (2018) demonstrate that quality management and its various dimensions positively impact firms' competitive advantage, emphasizing how resources, capabilities, and strategies combine uniquely across companies to shape this advantage. Although Jamil, Tahir, and Neelab (2024) report a negative regression coefficient for quality control certifications in relation to market share,

their ANOVA findings show ISO 9001-certified firms achieving superior market performance and reputation, reaffirming the importance of formalized quality frameworks, customer orientation, and product quality for long-term competitive success.

Furthermore, the relationship between quality management and sustainability is well documented; quality is not merely a mechanism for customer satisfaction but a key contributor to organizational sustainable development (Siva et al., 2016). Nonetheless, challenges arise when balancing quality with other priorities like waste reduction and cost efficiency, particularly within Lean and related methodologies (Longoni et al., 2013).

2.2. Quality Management Indicators

In ceramic tile manufacturing, quality management indicators fall into two categories: process metrics (e.g., first-quality production rate, defect ratio per batch) and outcome metrics (e.g., customer complaint frequency, compliance with regulations). The robust quality systems, as measured by mentioned specific indicators, constitute valuable, rare, and inimitable organizational resources aligning with concept of RBV of Barney when these resources are sensed, seized and reconfigured through dynamic capabilities they sustain long-term competitive advantage (Barney, 1991; Teece et al., 1997)

The MSI methodology aligns with Kaplan and Norton's (1992) Balanced Scorecard framework, which demonstrates how internal capabilities drive external performance outcomes through interconnected cause-and-effect relationships. The four BSC perspectives: financial, customer, internal process, and learning & growth partly mirror the structure of this study's market sustainability measurement approach, where quality management capabilities (learning & growth) enhance production parameters (internal process), improve customer satisfaction (customer perspective), and ultimately sustain market presence through sales volume, product life cycle duration, and territorial reach (financial perspective).

Hence, hypotheses are formulated to assess: the impact of individual quality indicators on the composite market sustainability index and the influence of the index on the verification criteria.

H1: The composite market sustainability index has a positive effect on sales volume.

H2: The composite market sustainability index has a positive effect on product life cycle duration.

H3: The composite market sustainability index has a positive effect on territorial distribution breadth.

3. Material and Methods

3.1. Theoretical Framework

This study integrates the Resource-Based View (Barney, 1991) and Dynamic Capabilities theory (Teece, Pisano and Shuen, 1997) to explain how quality management capabilities drive market sustainability. This integration is particularly relevant because "the possession of strategic resources is not sufficient, and it is only by being able to deploy these that competitive advantage can be attained" (D'Oria et al., 2021, p. 1385). Moreover, "recognizing DCV as an extension of RBV highlights its importance in helping manufacturing firms align their resources with market demands, thereby fostering competitive advantages in volatile settings" (Hoang et al., 2025, p. 3).

Within this study, the relationships between internal resources (quality, innovation, efficiency), external factors (market demand, competition, regulation), and results measured by market behavior and customer satisfaction are considered key determinants of market sustainability. By integrating the perspectives of Porter's value chain, RBV, DCV, and BSC, this study conceptualizes market sustainability as the result of cumulative quality management capabilities that generate and maintain competitive advantage.

The integrated theoretical framework is presented in Fig. 1.

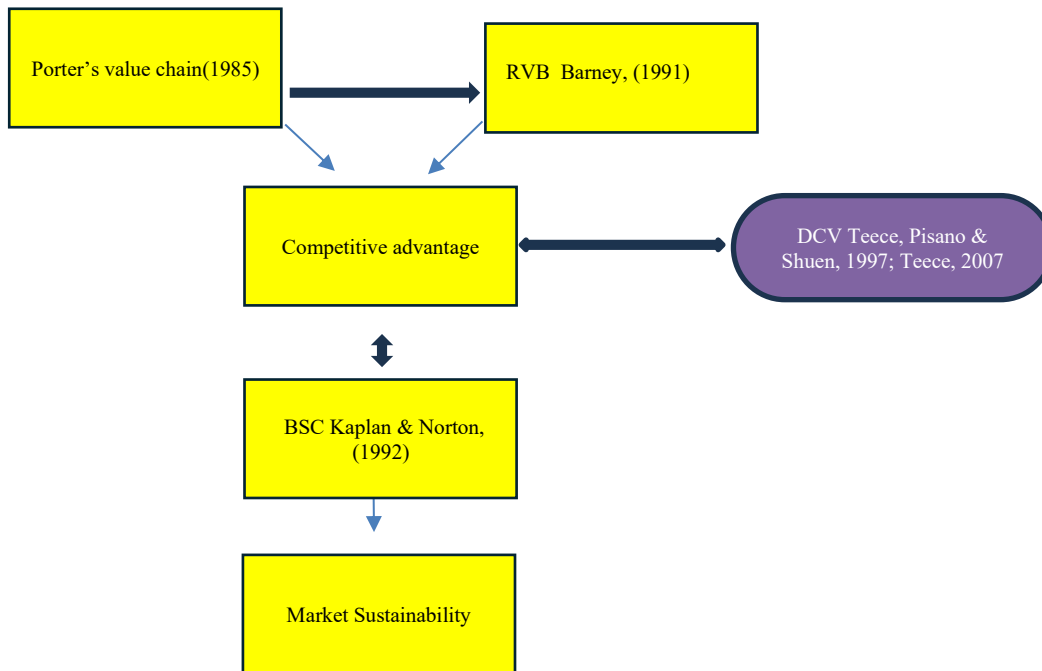


Fig. 1. Theoretical framework of the study

Source: Author's elaboration (2025).

3.2. Development of Market Sustainability Index (MSI)

$$MS_s = \sum_{j=1}^{\{n\}} w_j \cdot x'_{\{sj\}}$$

We recognized market sustainability as the study's dependent variable at first stage and independent at second stage. In developing the market sustainability index, we will use seven indicators and one additional only for new models.

Table 1:

Measure of variables

Variable	Role	Measurement	Source
First-quality production rate	Quality indicator (X ₁)	% of units meeting quality standards on first pass	Internal data
Technical parameters	Quality indicator (X ₂)	% units classified in different classes based on international standards for testing	Internal data and external laboratory results
Complaint frequency	Quality indicator (X ₃)	Complaints per 10,000 sqm sold	Internal data
Production frequency	Quality indicator (X ₄)	How often is the product produced	Internal data

Internal heterogeneity	Quality indicator (X ₅)	Variation of models in each group and size	Internal data
Customer satisfaction	Quality indicator (X ₆)	Signals by customers for problems per 10,000 sqm sold	Internal data
Compliance with regulation	Quality indicator (X ₇)	% of units meeting voluntary quality standards	Internal data, Certificates issued by third party
Developed by customer request- additional indicator for new models	Quality indicator (X ₈)	% of units developed by customer request	Internal data
Composite Market Sustainability Index	Dependent (stage 1) / Independent (stage 2)	derived weighted aggregate of indicators	Authors' calculation
Sales volume	Dependent (stage 2)	Annual units sold	Company reports
Product life-cycle duration	Dependent (stage 2)	Years from launch to discontinuation	Company databases
Territorial distribution breadth	Dependent (stage 2)	Number of regional markets served	Sales records

Source: Authors' Compilation, 2025.

The purpose of this study in progress is to develop and validate a composite index methodology for measuring market sustainability in ceramic tile manufacturing through quality management indicators. The selection of analytical variables was guided by their relevance to Garvin's (1987) eight dimensions of quality, the Balanced Scorecard framework of Kaplan and Norton (1992), their interrelationships within quality management systems, as well as their consistency over a defined time period and suitability for statistical analysis.

To achieve a balance between granularity and manageability of the analysis, an aggregation of model indicators within a product line is applied. In order to ensure both analytical generalizability and the validity of the conclusions at a lower level of disaggregation, a combined approach is applied in the study. The main analysis will be conducted by groups according to product type and size, which cover the entire product range and allow to identify structural dependencies between market sustainability and key indicators for a period of 7 years. In addition, a representative sample of individual models (several from each group) will be analyzed, which allows validation of general trends and a more in-depth interpretation of behavioral patterns at the product level for a period of 2 years.

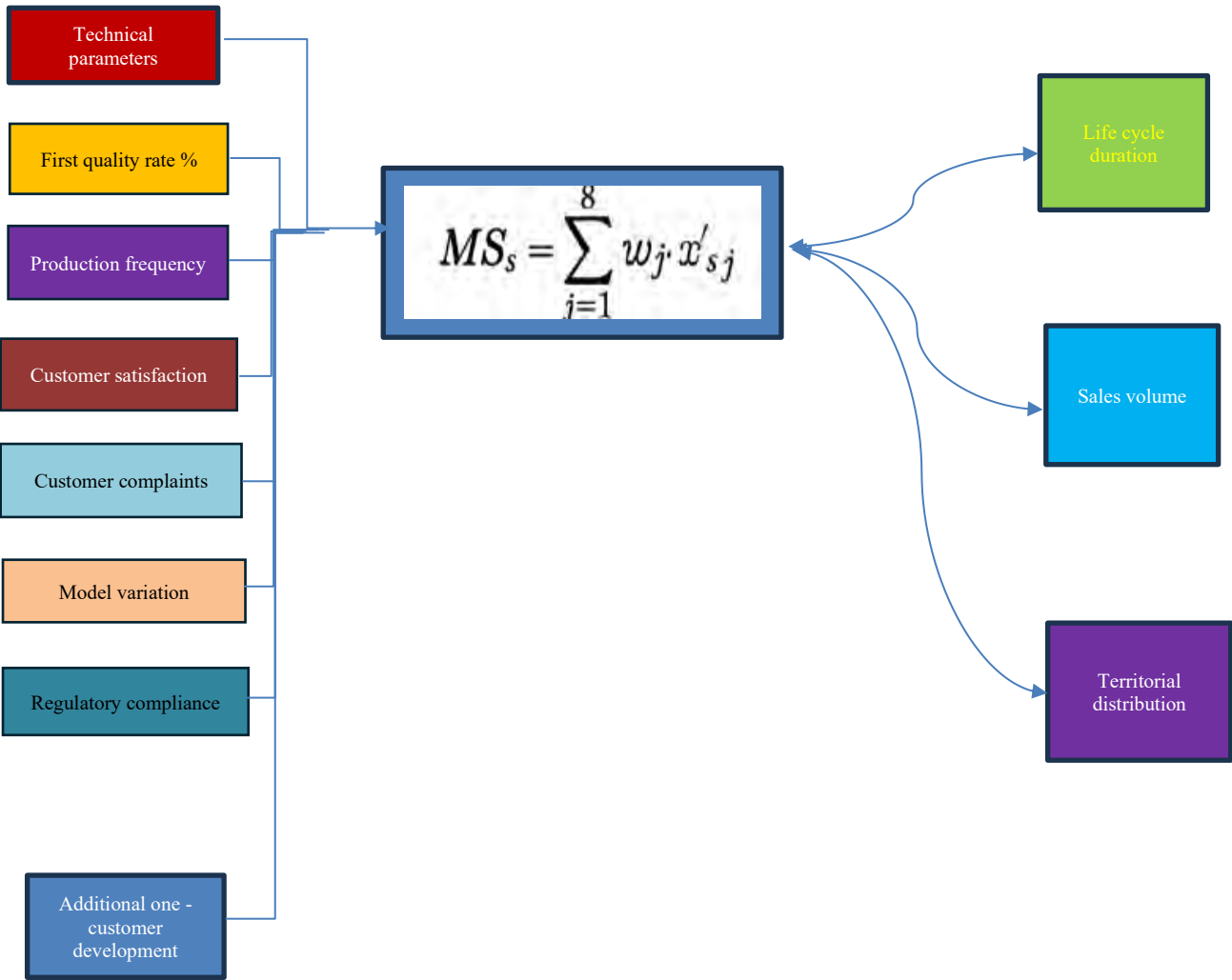


Fig. 2. Construction of the MSI
Source: Author (2025).

According to the requirements of the BDS EN 14411 standard and the EN 10545 series of standards, the following technical parameters are applied:

Tiles intended for use as floor coverings:

- Slip coefficient (for floor tiles only - safety) ☐
- Abrasion resistance coefficient (floor tiles - durability) ☐
- Stain resistance (cleaning) ☐
- Chemical resistance (cleaning and durability) ☐
- Scratch coefficient on the MOHS scale (durability)

Tiles intended for use as wall coverings: ☐

- Stain resistance (cleaning) ☐
- Chemical resistance (cleaning and durability)
- Scratch coefficient on the MOHS scale (durability)

3.3. Stages of research

Data were collected from 2 ceramic tile manufacturers in Bulgaria during 2019-2025 with annual production capacity 28 millions sqm. Selection criteria included: minimum 20 years of operation, complete quality records availability, and more than 50 % of total industry production in Bulgaria. As the research is still in progress (stage 3), empirical validation for the whole range of more than 2000 products is still not provided.

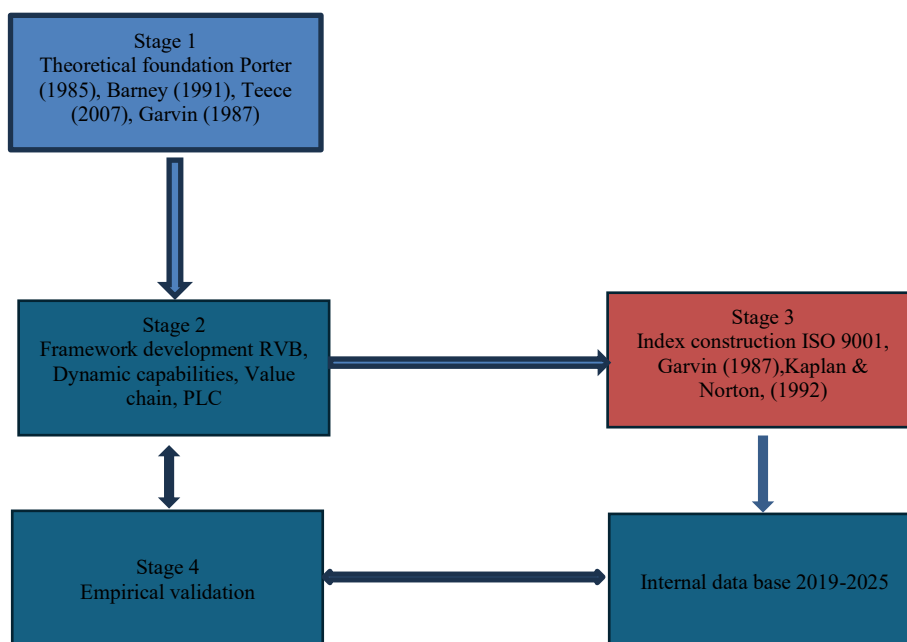


Fig. 3. Theoretical framework of the stages

Source: Author's elaboration (2025).

4. Conclusion

In conclusion, market sustainability is the ability of a company to adapt to market turbulence, maintain market share and customers, and sustain competitiveness over the long term. While corporate sustainability encompasses economic, managerial, market, and social aspects, market sustainability can be viewed as a critical subcomponent focused on long-term business viability.

The composite Market Sustainability Index (MSI) developed in this study serves as a predictive and operational tool, incorporating quality, demand stability, and internal product positioning indicators. Firms with higher MSI scores likely exceed buyer expectations, attracting and retaining valuable customers. This index functions not only as an internal capability metric but also as a means to segment buyer groups, facilitating strategic market positioning.

Competitive positioning within the study is assessed through internal company comparisons across ceramic tile types, models, and size groups according to EN14411 standards. This allows analytics of product groups for customer base growth potential without requiring external competitive data.

The MSI operationalizes market sustainability by reflecting product adaptability and stability through indicators such as life cycle length, sales volume, and market coverage, criteria that also serve as strategic objectives for competitive advantage and effective resource management.

Aligned with Kaplan and Norton's Balanced Scorecard framework, this index quantifies how internal quality management, customer satisfaction, and product attributes jointly drive long-term market sustainability. This integration creates a feedback loop between "Internal Processes" and "Customer" perspectives, linking quality metrics to strategic objectives and value creation.

Although this study focuses on quality-focused indicators and excludes social and environmental dimensions, future research can extend the MSI to include such factors and explore applications in other industries and market contexts.

This research contributes to academic discourse by bridging quality management theories with practical market sustainability measurement, providing managers with a diagnostic tool for portfolio optimization, product life cycle extension, and strategic decision-making.

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Rising Techno-Nationalism and Innovation Rivalries: Bulgaria in the Unknown Future of Global Value Chains

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JEL: F02; O31; O33; O38

Abstract

The global economy is undergoing structural change. Competition for resources persists within conventional value chains, while innovation leaders redirect the frontiers of rivalry. These dynamics are altering how GVCs operate. When access to key technologies becomes contested, states increasingly securitize and restrict exchange. This tendency, rising across economies, is described as techno-nationalism. It now converges with the sustainability transition to redefine the functioning of GVCs. Today's dependencies on semiconductors, data processing, biotechnologies, new energy vehicles (NEVs), and new materials generate defensive reflexes and accelerate systemic fragmentation.

This study reviews strategic initiatives such as *Made in China 2025* (2015), the *CHIPS and Science Act* (2022), and the EU's *Critical Raw Materials Act* (2023/24) as evidence of how states institutionalize control points in emerging industries. It identifies policy pathways through which international innovation and technology transfer can support Bulgaria's navigation of transforming GVCs and argues that success must be reframed as the attainment of competitive advantage under systemic uncertainty.

Key words:

techno-nationalism, innovation rivalries, global value chains (GVCs), international innovation and technology transfer, strategic technologies.

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1. Introduction

The global economic system is entering a period of structural turbulence shaped by rising techno-nationalism, intensifying competition for innovation leadership and the reconfiguration of global value chains (GVCs). Technologies that once diffused through open markets—such as semiconductors, artificial intelligence, advanced materials and clean-energy systems—are increasingly embedded in geopolitical agendas and national strategies for technological sovereignty. As major powers adopt defensive industrial policies, impose export controls and invest heavily in domestic innovation ecosystems, the global distribution of technological capabilities is being realigned with lasting implications for economic development and international cooperation.

These dynamics create an environment in which the future architecture of GVCs becomes fragmented, uncertain and more difficult for smaller economies to navigate. The predictable, rules-based global system that previously facilitated technology diffusion through trade, foreign investment and multinational production is giving way to competing strategic blocs and rival technological standards. The strategic contest between the United States, China and the European Union has evolved beyond traditional market competition into a struggle for control over technological “chokepoints” that shape future economic and geopolitical influence. For latecomer economies, this transformation restricts access to frontier technologies precisely at a moment when technological upgrading is essential for competitiveness, resilience and participation in emerging industrial paradigms.

For Bulgaria, these shifts constitute a structural challenge. The country enters this new technological architecture with modest domestic R&D capacity, fragmented innovation institutions and limited integration

into knowledge-intensive GVC segments. Despite the advantages of EU membership, Bulgaria remains exposed to external technological dependencies and supply-chain vulnerabilities. Global uncertainty—combined with domestic capability gaps—magnifies the risk of long-term peripheralization in the emerging technological order.

In this context, international innovations and technology transfer (IITT) becomes a central mechanism for strategic adaptation. Unlike earlier phases of globalization, where technology transfer operated largely through market-driven channels, the current environment requires a deliberate, institutionally coordinated and strategically aligned approach. Effective IITT enables economies with constrained R&D systems to access advanced technologies, participate in European industrial transformations and build the internal capabilities needed to remain competitive in an era of securitized technological assets. For Bulgaria, IITT also offers a pathway to embed national development priorities within broader EU technological and industrial strategies—from clean-energy transitions and circular materials to digital infrastructures and advanced manufacturing systems.

This paper situates IITT within the wider structural shifts generated by techno-nationalism and global innovation rivalries. It argues that these forces fundamentally reshape the conditions under which Bulgaria must pursue economic modernization and technological upgrading. The analysis examines how emerging technological blocs redefine access to strategic technologies, how GVC fragmentation alters upgrading prospects for peripheral economies, and why Bulgaria must adopt a strategic rather than transactional approach to technology transfer. The introduction therefore establishes the conceptual foundations for the sections that follow, which explore the drivers of techno-nationalism, compare the strategic models of major economies and assess the implications for Bulgaria's positioning within an increasingly uncertain technological landscape.

2. Literature Review and Hypotheses Development

2.1. Techno-Nationalism in Contemporary Research

The emergence of techno-nationalism as a central analytical category reflects a fundamental restructuring of the global technological order. Contemporary scholarship increasingly defines techno-nationalism as the renewed primacy of the nation-state in governing technological assets, standards and innovation pathways (Breznitz & Murphree, 2013). This shift marks a departure from the liberal paradigm of open innovation and market-mediated technology diffusion that prevailed during the late twentieth century. Current analyses emphasize that techno-nationalism is driven by strategic concerns over supply-chain vulnerabilities, asymmetric technological dependencies and the geographic concentration of critical capabilities within rival geopolitical blocs.

Techno-nationalism is conceptualized simultaneously as a protective mechanism—intended to safeguard industrial competitiveness and national security—and as an outward-facing mechanism through which states seek to expand influence across international technological domains. In this literature category, technology is reframed from a neutral production input into a strategic resource embedded in questions of sovereignty, security and systemic rivalry. The export-control regimes of the United States, China's dual-circulation strategy and the European Union's pursuit of open strategic autonomy exemplify how techno-nationalist logic increasingly shapes industrial and innovation policy.

A key insight in this research stream is that techno-nationalism alters the architecture of international cooperation itself. Channels of technology transfer such as foreign direct investment, licensing, joint ventures and participation in global innovation networks are now conditioned by political risk assessments and geopolitical alignment. For small economies, this evolution signifies a structural constraint: access to frontier technologies is no longer mediated primarily by market capacity but by the ability to position

themselves within emerging geopolitical and technological blocs. Consequently, the securitization of innovation and the pursuit of technological sovereignty reshape the environment in which IITT must operate.

2.2. Innovation Rivalries and Strategic Technological Competition

In parallel with the rise of techno-nationalism, the literature identifies a marked intensification of innovation rivalries among major economic powers. Innovation rivalries are understood as system-level competitions in which states attempt to secure control over strategic value chains, frontier knowledge domains and the industrial ecosystems that underpin long-term economic growth (Aghion & Howitt, 1998; Mazzucato, 2021). This competition unfolds across critical technological domains—including artificial intelligence, quantum computing, biotechnology, advanced materials, clean-energy systems and semiconductor manufacturing—that function as global “control points.” Dominance in these domains shapes not only technological leadership but the future direction of economic development.

The literature also documents the coexistence of competing industrial-technological models. The United States increasingly frames innovation as a security asset, adopting policies that restrict the diffusion of advanced technologies and reinforce domestic industrial capacity. China follows a state-led model that prioritises indigenous innovation, long-term industrial upgrading and strategic self-sufficiency. The European Union pursues strategic autonomy through regulatory power, mission-oriented innovation and the development of resilient regional value chains. These models collectively contribute to a growing fragmentation of global innovation flows, reducing cross-border openness and facilitating the emergence of regionally anchored innovation ecosystems.

A recurring theme is that innovation rivalries influence not only the distribution of technologies but also the distribution of developmental opportunities. For countries with limited domestic R&D capacity, intensified rivalry reduces the pathways through which advanced technologies can be accessed. This reinforces the strategic importance of IITT as a mechanism through which latecomer economies can integrate into high-value technological trajectories while navigating increasing geopolitical constraints.

2.3. The Future of Global Value Chains Under Systemic Uncertainty

A third major strand of research examines the systemic uncertainty affecting the future of global value chains (GVCs). Building on foundational frameworks (Gereffi, 2018; Humphrey & Schmitz, 2002), recent scholarship shows that technological competition, geopolitical fragmentation and recurring global disruptions are reshaping production networks. The shift away from globalised, efficiency-driven structures towards regionalised, security-oriented configurations reflects broader political and technological trends.

Current research highlights several structural transformations. First, GVCs are increasingly reorganising around regional clusters, where political trust, strategic alignment and industrial resilience play central roles. Second, technological change—particularly digitalisation, automation and the green transition—is redistributing value creation towards upstream, knowledge-intensive stages, undermining development models reliant on low-cost assembly. Third, the volatility of global shocks illustrates that GVC stability can no longer be taken for granted; disruptions propagate more rapidly and more widely than in previous decades. Finally, access to GVCs is progressively conditioned by regulatory compliance, environmental standards, data governance requirements and geopolitical affiliations.

The literature converges on the conclusion that peripheral economies must reposition themselves within these reconfigured value chains to avoid long-term marginalization. Traditional upgrading avenues are narrowing, and integration increasingly depends on institutional readiness, technological alignment and participation in regionally defined industrial ecosystems.

2.4. Implications for IITT and Small Economies (Bulgaria)

Taken together, techno-nationalism, innovation rivalries and GVC reconfiguration redefine the strategic role of IITT for small and late-developing economies. The literature identifies three broad implications.

First, IITT becomes more difficult. Technology transfer is increasingly mediated by security considerations, intellectual-property restrictions and geopolitical filtering mechanisms. Access to frontier technologies is no longer frictionless.

Second, IITT becomes more necessary. Economies with limited indigenous research capacity—such as Bulgaria—cannot rely solely on endogenous innovation to remain competitive or to align with European digital and sustainability targets.

Third, IITT becomes more strategic. Successful technology transfer depends not only on participation in global networks but on institutional coordination, long-term capability building and alignment with regional technological missions, particularly within the EU.

The literature thus converges on a central insight: in an international system structured by techno-nationalism and innovation rivalries, technological sovereignty becomes the new benchmark for development, and IITT emerges as the primary pathway through which peripheral economies can pursue it.

2.5. Hypotheses Development

Based on the reviewed literature, the paper formulates the following conceptual hypotheses:

H1: *Rising techno-nationalism reduces the accessibility of frontier technologies for small and latecomer economies.*

H2: *Intensifying innovation rivalries reshape the conditions under which peripheral economies can integrate into strategic technological domains.*

H3: *GVC fragmentation increases the dependence of small economies on structured, institutionally coordinated forms of technology transfer.*

H4: *For Bulgaria, IITT constitutes the most viable mechanism for achieving technological upgrading and aligning with European technological priorities.*

3. Methodology and Conceptual Framework

The methodological foundation of this study combines comparative analysis and systemic-structural reasoning to capture the complexity of contemporary technological transformations. Since techno-nationalism, innovation rivalries and the restructuring of global value chains (GVCs) constitute overlapping geopolitical, economic and institutional processes, a single-method design would be insufficient; the paper therefore adopts an interdisciplinary analytical approach.

The empirical component begins with a comparative examination of the major industrial and technological strategies of the United States, China and the European Union. Analyzing the CHIPS and Science Act, Made in China 2025 and the EU's technological sovereignty agenda provides insight into how leading technological powers reinterpret technology as a strategic asset and restructure innovation systems around security-driven logics. This comparative lens helps identify the mechanisms through which global technological competition is institutionalized and how it shapes the operational environment for smaller economies such as Bulgaria.

Complementing this, the research applies a systemic-structural methodology inspired by the literature on national innovation systems and global value chains. This perspective treats technological development not as a linear progression but as the product of dense interactions among firms, institutions, regulatory regimes and geopolitical dynamics. Within this framework, IITT is conceptualized as a dynamic, path-dependent process conditioned by domestic absorptive capacity, institutional coherence and the ability of national economies to align with evolving regional technological ecosystems. This approach emphasizes the

asymmetries between core technological blocs and peripheral economies, focusing on how smaller states internalize external knowledge under conditions of heightened uncertainty.

The study utilizes a conceptual framework to capture the recursive dynamics underpinning emerging interdependencies in international innovation and technology transfer. The model is based on the understanding that scarcity in key technological domains—such as semiconductors, artificial intelligence, advanced manufacturing and clean-energy systems—has become a systemic feature of the global economy. Scarcity spans design capabilities, research infrastructures, specialized labor and the knowledge required to advance frontier technologies. This scarcity intensifies innovation rivalries, prompting major powers to deploy large-scale industrial and regulatory initiatives aimed at reducing dependencies, securing domestic capabilities and gaining leverage over strategic technological sectors.

As these rivalries escalate, states increasingly turn to techno-nationalist industrial policies. Export controls, investment-screening mechanisms, reshoring initiatives, critical-materials strategies and mission-oriented innovation programs have become central tools for managing technological dependencies. These measures narrow the openness of global innovation flows and place geopolitical alignment alongside market criteria in determining access to strategic technologies.

Such policies contribute to the fragmentation and regionalization of global value chains. Production networks that once operated on principles of cost efficiency now reconfigure around trusted alliances, technological control points and industrial resilience. High-value segments consolidate within leading technological blocs, while peripheral economies face shrinking upgrading opportunities and heightened exposure to supply-chain disruptions. This creates a self-reinforcing dynamic in which scarcity strengthens rivalry, rivalry intensifies techno-nationalist responses and these responses further fragment GVCs—deepening the very scarcity that initiated the cycle.

Within this recursive system, IITT emerges as a strategic mechanism through which smaller economies attempt to navigate structural constraints. As access to frontier technologies becomes increasingly conditional and geopolitically mediated, the ability to secure and internalize external knowledge becomes a decisive factor for long-term competitiveness. For Bulgaria, this involves both overcoming domestic structural limitations—such as limited R&D capacity and fragmented innovation institutions—and leveraging EU membership to participate in mission-oriented programs, regional innovation initiatives and knowledge-intensive value chains.

The methodological approach therefore links global technological dynamics with national-level capability and institutional conditions. By combining comparative policy analysis with systemic-structural reasoning, the study provides a basis for assessing Bulgaria's strategic options within a fragmented and evolving global technological environment, and for understanding why IITT constitutes a critical pathway for technological upgrading and long-term resilience.

4. Comparative Analysis of Techno-nationalist Models and Global Technological Rivalries

The intensification of global technological competition has revived and expanded analytical frameworks long developed in the fields of innovation studies, industrial policy and international political economy. Analysts of techno-nationalism such as Adam Segal (2020) argue that advanced technologies have become core instruments of geopolitical influence, prompting states to securitize innovation and restrict cross-border technological flows. This transformation aligns with the logic described by Farrell and Newman (2019) in their concept of “weaponized interdependence,” wherein technologically dominant states leverage systemic chokepoints to shape industrial outcomes beyond their borders.

Within this evolving environment, the United States has adopted a model centered on defensive technological supremacy. As noted by Bremmer (2021), U.S. industrial and technological policy increasingly merges innovation leadership with national security objectives, culminating in initiatives such as the CHIPS

and Science Act that consolidate domestic capabilities while restricting the transfer of critical technologies to strategic competitors. Frey (2025) further illustrates how U.S. industrial strategy emphasizes the protection of frontier technological domains as a means of preserving long-term competitive advantage.

China pursues a markedly different trajectory grounded in capability accumulation and state-led industrial transformation. Barry Naughton (2021) highlights how China's long-term planning—embodied in Made in China 2025 and subsequent initiatives—aims to internalize strategic segments of global value chains and reduce dependence on foreign technologies. Nolan and Zhang (2010) document the mechanisms through which Chinese firms have leveraged state support, learning processes and integration into global networks to reposition themselves within advanced manufacturing sectors, challenging established technological leaders and altering global competitive dynamics.

A third strategic model is visible in the European Union, which seeks to construct technological sovereignty through regulatory integration, coordinated investment and mission-oriented industrial policy. Mario Draghi's (2023) report on European competitiveness identifies the need for resilient value chains and strategic autonomy as preconditions for preserving Europe's technological position. This approach aligns with the systems-of-innovation framework articulated by Freeman (1987) and Lundvall (1992), who emphasize the role of institutional coherence, cross-sectoral coordination and long-term innovation investment in shaping technological trajectories. EU instruments such as the Critical Raw Materials Act and Horizon Europe reflect these principles by coupling regulatory power with strategic technological missions.

Although the U.S., Chinese and EU models differ in institutional design—security-driven restriction in the United States, capability-driven self-reliance in China, and regulatory–mission-oriented integration in the EU—they converge around the pursuit of technological sovereignty. This convergence intensifies the structural dynamics described by Rodrik (2004), who argues that contemporary industrial policy increasingly reshapes technological landscapes rather than merely correcting market failures. It also resonates with the evolutionary perspective of Nelson and Winter (1982), according to which industrial leadership depends on continuous adaptation within shifting institutional and technological environments.

The implications for global value chains are profound. McKinsey Global Institute (2019) documents the shift toward regionalized, politically aligned production systems centered around strategic technologies. Ivanov, Dolgui and Sokolov (2019) demonstrate how systemic shocks propagate unevenly across global networks, exacerbating vulnerabilities for economies located in peripheral or low-value segments. These processes reinforce the hierarchical distribution of value creation described by Porter (1990), wherein high-value, knowledge-intensive segments increasingly concentrate within technologically leading blocs.

For smaller and latecomer economies, these developments significantly reshape the strategic landscape for international innovations and technology transfer. Radosevic (1999, 2002) emphasizes that countries with limited domestic innovation capacity cannot rely solely on endogenous processes of capability accumulation; instead, they must embed themselves within the technological ecosystems of larger blocs to avoid structural stagnation. In an era where major powers actively restrict access to frontier technologies, the ability to align with regional technological priorities becomes a decisive dimension of competitiveness.

Taken together, the comparative analysis shows that global innovation rivalries are not simply contests among technological leaders but structural forces that redefine the opportunities and constraints facing all economies. For smaller states, the ability to navigate between these competing models, position themselves within regional technological strategies, and deploy IITT as a deliberate mechanism for capability-building is central to achieving technological upgrading and sustainable long-term development.

5. Implications for Bulgaria

The restructuring of the global technological landscape has direct and far-reaching consequences for Bulgaria, a small latecomer economy whose development trajectory is strongly influenced by external

technological forces. The rise of techno-nationalism and the securitization of innovation—highlighted internationally by Segal (2020) and Bremmer (2021)—increasingly shapes the analytical work of Bulgarian researchers as well. Scholars such as Stoyanova (2021) and Chobanova (2016) argue that Bulgaria's technological and economic security is inseparable from the broader geopolitical transformation of the global economy. As international technological flows become conditioned by rivalry, security assessments and strategic control points, the space within which Bulgaria can pursue modernization narrows.

Bulgarian research on innovation and technology transfer provides an important complement to these global debates. Authors such as Georgieva (2016) and Yalamov, Zhelev, Toshkov and Nikolova (2014) consistently identify institutional fragmentation, weak innovation governance and insufficient absorptive capacity as core constraints that limit the ability of Bulgarian firms to transform external technologies into productive capabilities. Their work aligns with international perspectives such as Cohen and Levinthal (1990), who emphasize that absorptive capacity depends on accumulated knowledge, learning processes and institutional coordination—not merely R&D expenditure. Under conditions of global technological fragmentation, these internal weaknesses become even more consequential.

The transformation of global value chains (GVCs) poses additional risks. Gereffi (2018), the McKinsey Global Institute (2019), and Ivanov, Dolgui & Sokolov (2019) document the shift toward regionalized, politically aligned production systems that prioritize resilience and technological control. Bulgarian scholars arrive at similar conclusions. Hristov and Marinova (2019) find that Bulgaria remains concentrated in low- and medium-technology segments of European production networks, where competitiveness is increasingly undermined by automation, digitalization and the rising importance of sustainability criteria. Yotzov (2021) further warns that without substantial upgrading of national technological capabilities, Bulgaria risks reinforcing long-term dependency as the EU deepens its industrial strategies around strategic autonomy.

At the same time, the Bulgarian literature emphasizes that IITT remains the primary mechanism through which the country can overcome its structural constraints. Chobanova (2013) and Tsanov (2020) argue that meaningful technological upgrading requires not only access to foreign knowledge but alignment with European innovation missions, regulatory standards and institutional practices. This perspective resonates with the systems-of-innovation frameworks developed by Freeman (1987) and Lundvall (1992), though the institutional gaps identified in Bulgaria make such alignment more demanding and more urgent.

In this context, participation in EU-led technological initiatives becomes critical. Draghi (2023) and related EU strategic analyses show that technological sovereignty is increasingly pursued through mission-oriented programs, industrial alliances and coordinated investment platforms. For Bulgaria, these initiatives offer structured opportunities to integrate into higher-value segments of regional value chains. However, benefitting from them requires substantial domestic institutional modernization, enhanced absorptive capacity and the ability to meet advanced technological and regulatory thresholds.

The securitization of global technological flows further limits Bulgaria's room for diversification. Export-control regimes, investment-screening mechanisms and restrictions on sensitive technologies make the EU not only Bulgaria's primary technological ecosystem but, in many domains, the only viable one. This increases the importance of policy coherence, regulatory alignment and long-term capability building within the Bulgarian national innovation system.

Taken together, the literature converges on a clear insight: Bulgaria's future technological and economic competitiveness depends on its ability to govern IITT strategically, strengthen domestic absorptive capabilities and integrate into European technological ecosystems at higher levels of sophistication and value creation. In a global environment characterized by rivalry, security-driven policy and regionalization, IITT becomes not an auxiliary mechanism but the central pathway through which Bulgaria can avoid long-term peripheralization and pursue sustainable technological advancement.

6. Policy Directions for Bulgaria

The restructuring of the global technological system requires Bulgaria to adopt a policy framework that reflects the realities of techno-nationalism, intensifying innovation rivalries and the regionalization of global value chains. Bulgarian scholars—most notably Chobanova (2016), Georgieva (2016), Yalamov et al. (2014) and Hristov & Marinova (2019)—emphasize that the country cannot rely on spontaneous technological diffusion or passive integration into low-value segments of European production. Instead, Bulgaria must pursue a coordinated strategy that strengthens domestic capabilities, improves institutional coherence and aligns national priorities with the evolving technological agenda of the European Union.

A first policy direction concerns the reinforcement of institutional capacity for IITT. The literature consistently shows that effective technology transfer depends on robust intermediaries—technology transfer offices, sectoral innovation centers, research–industry collaboration mechanisms and public agencies capable of supporting firms in adopting advanced technologies. Bulgarian analyses indicate that the fragmentation of these institutions weakens national absorptive capacity. Addressing this requires an integrated national framework linking universities, research institutes, businesses and ministries into a functional innovation ecosystem. This approach reflects the systems-of-innovation principles outlined by Freeman (1987) and Lundvall (1992), while acknowledging the more significant institutional gaps that persist in Bulgaria.

A second policy priority involves positioning Bulgaria within the EU's technological sovereignty initiatives. The EU's evolving strategic direction—outlined in Draghi (2023) and supported by instruments such as the Critical Raw Materials Act, the Net-Zero Industry Act and Horizon Europe—creates opportunities for Bulgaria to participate in high-value technological domains. Active engagement in European Industrial Alliances on semiconductors, batteries, green hydrogen, circular materials and advanced manufacturing should become a national objective. Realizing this requires strengthened co-financing mechanisms, improved administrative capacity for large-scale projects and a strategic mapping of Bulgarian sectors with realistic integration potential.

A third policy direction focuses on building targeted industrial and technological capabilities. As noted by Shinohara (2022), Aghion and Howitt (1998) and numerous Bulgarian authors, technological upgrading requires purposeful interventions in areas of strategic importance. For Bulgaria, this includes sectors aligned with European priorities—renewable energy technologies, digital infrastructure, materials engineering, sustainable agriculture and advanced manufacturing. Developing these capabilities requires sustained public–private investment, human capital development and institutional support for applied research. Without such measures, Bulgaria risks being excluded from technological domains that will define future European competitiveness.

A fourth direction concerns leveraging IITT as a catalyst for Bulgaria's green and digital transformation. The literature on GVC restructuring demonstrates that participation in future value chains depends on the ability to absorb technologies related to clean energy, automation, digital services and artificial intelligence. National strategies must therefore integrate IITT into green and digital transition agendas, with regulatory reforms, firm-level incentives and infrastructure investments aligned with EU climate and digital objectives. Radosevic (1999, 2002) and Yotzov (2021) stress that for latecomer economies, technology transfer must generate domestic capability rather than reinforcing dependency.

A fifth policy direction involves strengthening human capital and overcoming structural skills gaps. The transition toward knowledge-intensive production requires a workforce capable of adopting, adapting and utilizing advanced technologies. Bulgarian researchers such as Georgieva (2016) identify persistent STEM shortages, weak integration between research and higher education and insufficient incentives to retain skilled professionals. Policy action is needed to modernize curricula, expand vocational and technical education, support lifelong learning and promote collaboration between universities and businesses.

Finally, Bulgaria must establish a strategic governance approach to IITT that reflects the increasing

securitization of technological flows. Export controls, investment-screening regimes and restrictions on sensitive technologies make the EU the primary technological ecosystem for Bulgaria. Navigating this environment requires long-term coordination across ministries, agencies, business associations and research institutions. Technology transfer must be treated not only as an economic instrument but as a component of national security, industrial policy and regional integration. Strengthening governance structures will reduce fragmentation, accelerate capability-building and ensure alignment with Europe's technological sovereignty agenda.

Taken together, these policy directions outline a coherent strategy for Bulgaria's response to global technological shifts. They position IITT as a central pillar of national development policy and underscore that Bulgaria's future competitiveness hinges on its ability to integrate into European innovation ecosystems, build domestic capabilities and modernize its institutional architecture. In a global environment defined by rivalry, security-driven policy and regionalized value chains, Bulgaria's technological future depends on deliberate, coordinated and forward-looking action.

7. Conclusion

The transformation of strategic policy approaches to global technology-transfer interdependencies introduces a new set of constraints and opportunities for small and late-developing economies. Within a global environment shaped by techno-nationalism, concentrated innovation power and the restructuring of global value chains, access to advanced technologies increasingly depends on strategic alignment and institutional preparedness rather than market openness alone. The analysis presented in this paper shows that these dynamics fundamentally redefine the conditions under which Bulgaria must pursue technological upgrading and long-term competitiveness.

The analysis highlights that international innovations and technology transfer represent the primary mechanism through which Bulgaria can navigate this reconfigured environment. Strengthening absorptive capacity, improving institutional coordination and reinforcing the linkages between research, industry and public policy emerge as essential conditions for benefiting from IITT. Bulgaria's position within the European Union provides a unique advantage, but also a clear responsibility: alignment with EU technological, digital and green priorities is now central to sustaining relevance within emerging regional value chains.

At the same time, the paper underscores that internal structural constraints—limited domestic R&D intensity, uneven technological capabilities, and fragmentation within the national innovation system—remain significant barriers. Addressing these requires a strategic transition from passive integration into global production networks toward deliberate participation in those segments of European technological ecosystems where Bulgaria can develop and accumulate capabilities.

Overall, the findings point to a clear conclusion: Bulgaria's future technological and economic trajectory will depend on its ability to position itself within the evolving European technological architecture, govern IITT strategically and invest consistently in the institutions and skills that enable the absorption and productive use of external knowledge. In a global context characterized by uncertainty and accelerated technological competition, the capacity to internalize and operationalize international innovation will determine whether Bulgaria secures a resilient, upward-moving role in the next phase of economic transformation.

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The Productivity Paradox and Qualified Workforce Deficit in Latvia's ICT Sector: A Theoretical and Empirical Diagnosis

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Abstract

Latvia's Information and Communication Technology (ICT) sector faces a dual challenge: a persistent productivity paradox, lagging the EU average, and a critical shortage of a qualified workforce. This lack of skilled labour reinforces the emigration of top professionals, creating a significant barrier to innovation and competitiveness. This paper provides a foundational theoretical framework and an empirical diagnosis of this interconnected problem. Using a bibliographic research method, it synthesizes theories of endogenous growth and intellectual capital mobility to model a negative feedback loop where low productivity, and the deficit of a skilled workforce reinforce each other. The findings offer an evidence-based diagnosis of the structural barriers, establishing the critical link between productivity and the dynamics of the qualified workforce.

Key words:

productivity paradox, ICT sector, qualified workforce, labour mobility, brain drain, Latvia

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1. Introduction

The information and communication technology (ICT) sector is widely recognized as a key driver of economic growth, innovation, and competitiveness in a globalized world. For the Member States of the European Union, a dynamic ICT sector is not only an economic resource but also a strategic prerequisite for achieving long-term prosperity and integration. However, the potential of this sector can be significantly limited by structural barriers that reduce productivity and drain the human capital necessary for its development. The relevance of the study rises from challenges at the national level in Latvia:

1. Lack of qualified workforce in the ICT sector.

2. Low productivity in the ICT sector compared to the EU average (Ministry of Economics, 2024) (LV PEAK, 2025).

This lack of qualified specialists creates a significant barrier to innovation, hinders the introduction of the latest technologies, and ultimately reduces the overall competitiveness of the industry. Recent data underscores the reality of this situation, which reveals a productivity gap in Europe. In 2021, the average value added per employee in ICT enterprises in Western Europe was approximately EUR 135,512, whereas in the Central and Eastern European (CEE) region, this figure stood at a mere EUR 45,351 (PwC, 2024). This threefold difference highlights structural economic imbalances and underlines the urgency of Latvia's case.

Although the symptoms of low productivity and "brain drain" are well documented, the underlying mechanism that triggers them in a self-sufficient cycle is less well understood. This publication attempts to address this gap by providing a basic theoretical framework and empirical diagnosis for this interrelated problem. Using a bibliographic research method, this study synthesizes recognized endogenous growth theories, which postulate that human capital is the main driver of economic development, with models of intellectual capital mobility (OECD, 2022).

It leads to the following research questions:

- How relevant is the productivity paradox in the ICT sector in the age of technology?

- What is the critical link between low labour productivity and the dynamics of the skilled labour?

The main thesis is that low productivity and a shortage of skilled labor are not independent variables, but rather components of a strong negative feedback loop, in which each factor continuously reinforces the other, resulting in persistently lower economic performance.

The publication is structured into five distinct paragraphs. Following this introduction, the second paragraph will outline the bibliographic research methodology used to compile and synthesize theoretical and empirical evidence. The third paragraph will establish the theoretical framework, drawing connections between the productivity paradox, endogenous growth theory, and the dynamics of intellectual capital. The fourth paragraph will present the results of the analysis, diagnosing the structural barriers within Latvia's ICT sector and examining the critical role of skilled labour migration. Finally, the fifth paragraph will offer a conclusion, synthesizing the findings to provide an evidence-based diagnosis of the problem and its implications for policy and future research.

2. Methodology

The research integrates a literature review with a comparative analysis of statistical and documentary evidence, providing a comprehensive understanding of the research issue from theoretical perspective. The literature review was conducted using the bibliographic method, to critically evaluate, compare, and synthesize existing theories to address the research question. The review process was structured in four distinct stages, ensuring a robust and replicable selection of relevant academic sources.

1. Identification phase was carried out using the EBSCO, Scopus, Web of Science, and Google Scholar databases. The search was based on key terms such as “productivity paradox,” “Solow paradox ICT,” “endogenous growth theory,” and “intellectual labour migration”. This initial search yielded around 26,000 results. To refine the search, two filters were applied: the publication time frame was limited to 2017–2025 (except for original theory publications and reports).

2. Screening process was performed, during which the titles, abstracts, keywords, and conclusions of the identified articles were reviewed for relevance. This stage narrowed the pool of potential sources to 92 studies.

3. Eligibility phase, the full texts of the remaining 74 studies were thoroughly evaluated to determine their suitability for the research. After this comprehensive assessment, 39 studies were deemed eligible for inclusion.

4. Inclusion stage involved a final critical review, resulting of 16 studies that form the core of the literature review for this paper.

To supplement the theoretical findings, a comparative analysis of statistical and documentary evidence was conducted. This analysis focused on diagnosing the structural factors shaping the productivity and workforce challenges in Latvia's ICT sector. The data were sourced from reputable national and international institutions. The statistical analysis is based on data collected from *Eurostat*, the *Central Statistical Bureau of Latvia (CSP)* and various report. To provide a deeper understanding of the national context, the study incorporates an analysis of key national policy documents, including the *Latvian Productivity Report (2024)* and the *RIS3 Monitoring Report (2024)*.

3. Literature Review and Theoretical Framework

In order to obtain a scientific explanations of why the productivity of skilled labor is declining today and what factors influence it, especially at the national level in Latvia, as well as the lack of intellectual human capital in the ICT sector, it is necessary to have a clear understanding of the development of theory and its significance today, taking into account the continuity of research and the future development of the theo-

ry. Nobel Laureate economist Robert Solow came up with claim that investments in Information Technologies do not yield returns in productivity, calling it the “productivity paradox” (Brynjolfsson, 1993). Since that, several other studies have used this model to examine technological progress over different time periods and developed theories that look at economic growth in the long term.

3.1. The relevance of Productivity Paradox

According to Eric Brynjolfsson’s research, there are three best potential explanations for the mismatch between technological development and labour productivity growth: mismeasurement, concentrated distribution of productivity gains and implementation lags (Brynjolfsson et al., 2017). In more detail, mismeasurement of correct and interrelated outputs and inputs. It is believed that traditional economic indicators, such as gross domestic product (GDP), are insufficient to fully reflect the benefits of ICT, which often manifest themselves in improvements in product quality, customer service, or significant consumer value from services whose market price is close to zero. (Derviş & Qureshi, 2016). Several other publications in the 1990s argued that the return on investment in IT is long-term, as claimed, for example, growth requires a significant period of time and organizational learning and adjustment (Kraemer, 2001). In addition to the above, other studies emphasize another aspect- technology alone is not enough to generate productivity. The return on ICT investment is highly dependent on additional investment in intangible assets such as new business processes, organizational structures, and human capital (Brynjolfsson & Hitt, 2000). Research shows that when ICT investments are combined with organizational changes, productivity gains are significant and substantial, suggesting that the paradox may be related not so much to the technology itself as to the inability of organizations to adapt (Bjerke-Busch & Thorp, 2023). The persistent disconnect between technological potential and economic performance appears to be a symptom of underlying structural rigidities within an economy, such as inflexible market regulations, low business dynamism, and deficits in intangible assets like managerial expertise and workforce skills (Trpeski et al., 2021).

In 2025, we are living in an era of rapid development of artificial intelligence and machine learning alongside pervasive intelligent automation and advanced digitalization this puzzle persists, now frequently termed the “modern productivity paradox” (Capello et al., 2022). While the fundamental tension remains the same - a clash between high expectations regarding economic and social gains and statistics showing weak productivity growth - the modern paradox carries heightened relevance due to the complexity and heterogeneity of the technologies involved and the increased subtlety required to measure its sources. This heterogeneity means that the general explanations for the initial paradox (implementation lags, concentrated distribution of gains, and mismeasurement) must now be re-evaluated, as each new technology is likely subjected to different paradoxical mechanisms (Capello et al., 2022). The persistent disconnect between technological potential and economic performance appears to be a symptom of underlying structural rigidities within an economy, such as inflexible market regulations, low business dynamism, and deficits in intangible assets like managerial expertise and workforce skills (Trpeski et al., 2021).

Consequently, explaining the modern paradox requires isolating sources tailored to specific technologies and sectors. The technological landscape today is composed of multiple, heterogeneous technologies, primarily divided into intelligent automation (proxied by robot stock) and advanced digitalization (proxied by online sales). For example, For advanced digitalization, the expectation is that the market enlargement effect (increasing value added) and the labour expansion effect could offset each other, potentially leading to negligible or negative aggregate productivity growth (Capello et al., 2022). A.Barros in his research about education in ICT sector points out that communication technology does not always lead to improved labor productivity, including in a context where working hours, labor, and tasks are held constant. Rather, they point to disruptive effects, as workers struggle to adjust to a new technology at least in short term (Barros, 2023).

Part of the answer might be in the market-based way we measure innovations and productivity growth, given the low market price of most of the benefits we get from the ICT revolution, as well as the massive externalities. As well automation moved many of those who lost middle-level productivity employment in manufacturing and clerical work into low measured productivity employment in so-called low-skilled service sectors, damping productivity growth in consequence (Soskice, 2022).

3.2. The Endogenous growth

The theoretical foundation for diagnosing the productivity paradox and qualified workforce deficit in the ICT sector rests upon Endogenous Growth Theory (EGT), which provides a fully specified model of long-run growth by assuming that knowledge is an input in production that has increasing marginal productivity (Romer, 1986). The historical persistence of the productivity paradox – the observation that huge investments in technology do not translate into a corresponding increase in overall productivity – requires a theoretical framework that models technology and human capital not only as investments, but as endogenous drivers of economic change. The classical exogenous growth model (Solow/Swan) fails this test, attributing the majority of long-run productivity growth to unexplained technical progress. Conversely, Endogenous Growth Theory (EGT), pioneered by Paul Romer and Robert Lucas, offers a superior foundation for diagnosing the current predicament in Latvia's Information and Communication Technology (ICT) sector, which faces simultaneous stagnation in productivity alongside a deficit of qualified labour (Fine, 1998).

EGT fundamentally reconceptualizes the sources of long-run economic growth by making both the rate of technological progress and the rate of economic growth determined by choices made within the economic system. This contrasts sharply with old growth theory, where the growth rate was considered fixed (exogenous). Long-term growth in the EEA is sustained by mechanisms that prevent a decline in the return on capital, often achieved through the continuous creation of new knowledge, technological variations, or human capital. These mechanisms include market imperfections, in particular the presence of positive effects or externalities arising from investments in knowledge (Fine, 1998).

The model structure for the ICT sector is the R&D-based variety expansion model. This structure involves three key sectors, which can be analogized to the modern digital economy:

1. Final Goods Sector- Produces output using labour and intermediate goods.
2. Intermediate Goods Sector- Produces capital inputs (monopolies).
3. R&D Sector- Employs labour to produce new designs or *knowledge* (new intermediate good varieties). This is the engine of endogenous growth, as the creation of new designs prevents the long-run erosion of the growth rate (Hamaguchi, 2021).

4. Results

The theoretical frameworks of the productivity paradox and endogenous growth coincide in the central importance of human capital. The mobility of this intellectual capital, embodied in skilled professionals, is a primary mechanism that can either accelerate or impede economic development. The EU operates as a highly competitive single market for skilled labour, with a particularly acute demand for ICT specialists. Between 2014 and 2024, the number of employed ICT specialists in the EU grew by 62.2%, a rate nearly six times higher than for total employment (Eurostat, 2024). Despite this growth, demand consistently outstrips supply, with 57.5% of EU enterprises reporting difficulties in filling ICT vacancies in 2023 (Eurostat, 2024).

In the context of ICT graduates as a percentage of all degree graduates, Latvia show significant contributions at 5% in 2021. These figures, surpassing the EU average of 4.2%, suggest that certain Central and Eastern European nations are fostering substantial ICT talent, potentially driving digital innovation and growth in the region (PwC, 2024). In the following years, the number of ICT graduates in Latvia increased even more, reaching an average of 7% of all graduates in the country (see Table 1).

Table 1

ICT graduates in Latvia

Students / Year	2020	2021	2022	2023	2024	% of total in 5 years
Doctorate (ISCED level 8)	18	26	30	43	50	3%
Master's degree (including professional); second-level professional higher education with a duration of 5 years (ISCED level 7)	282	307	265	272	381	27%
Bachelor's degree (including professional); second-level professional higher education with a duration of 3-4 years (ISCED level 6)	532	581	586	708	780	56%
First-level professional higher education (college) (ISCED level 5)	121	153	185	175	153	14%

Source: Authors' Compilation based on data from the Latvian Central Statistical Bureau, 2024. Available: (CSP, Oficiālās Statistikas Portāls, 2024)

Latvia's integration into this common labour market has been characterized by a significant and sustained net emigration of its skilled workforce, a phenomenon commonly termed "brain drain" (Hazans, 2016). This outflow has disproportionately affected tertiary-educated professionals, particularly those with qualifications in STEM fields, including ICT (Hazans, 2018). Research confirms this loss of skilled labour is largely permanent, with the probability of return diminishing as the level of education increases (Hazans, 2018). The primary drivers for this emigration are significant wage differentials compared to more developed EU economies and greater opportunities for professional development (European Commission, 2021).

From the perspective of endogenous growth theory, the sustained emigration of skilled ICT professionals constitutes a direct depletion of the primary asset required to generate long-term productivity growth: human capital (Fine, 1998). This outflow cripples the key mechanisms of knowledge diffusion, particularly the knowledge spillovers that occur through the mobility of skilled labour between firms (Agrawal et al., 2003). When this mobility is predominantly outward, the domestic ecosystem for knowledge transfer is broken, innovations fail to circulate, and the national capacity to absorb and apply new knowledge is diminished (Sanders, 2019).

The outflow of intellectual capital provides the critical link that forges a self-reinforcing negative feedback loop. The emigration of ICT specialists systematically strips the economy of the essential complementary asset - skilled human capital - required to realize returns from ICT investment (Brynjolfsson & Hitt, 2000). This skills shortage constrains the ability of firms to innovate, leading to low productivity growth. Low productivity, in turn, limits opportunities for high-value work and suppresses wage growth relative to other EU countries, further incentivizing skilled professionals to emigrate and deepening the initial workforce deficit (OECD, 2025). While "brain circulation" is often proposed as a remedy, empirical evidence for Latvia suggests that return migration is frequently unsuccessful. Returnees face significant reintegration challenges, including a different work culture and a perception that skills gained abroad are not fully valued, leading to underemployment and high rates of re-emigration (Melke, 2024; Mierina & Bela, 2021). This reinforces the permanence of the human capital loss and ensures the negative feedback loop remains intact.

A rapid increase in the available labour force is problematic, but it is still possible to increase the productivity of existing employees, as one ICT specialist in Latvia generates an average of EUR 49,000 per year, which, although 144% of the national average, still lags behind European indicators (around EUR 100,000 per year in Germany, Finland, and Sweden, and around EUR 50,000 per year in the Czech Republic, Slovenia, and Estonia) (LIAA, 2021). Based on these 2021 data, a profound labour productivity gap exists within the European ICT sector. This significant disparity highlights a structural economic imbalance, indi-

cating that CEE countries, including Latvia, face substantial challenges in competitiveness and value creation.

5. Conclusions

In conclusion, the modern productivity paradox is more relevant than its Solow predecessor not merely because it recurs, but because it is driven by a heterogeneous set of powerful technologies requiring the detailed disentanglement of complex mechanisms—compensation, reallocation, and quality effects—that were hidden or less pronounced during the initial ICT era. The persistent aggregate failure despite measurable sectoral success makes the origins of the modern paradox urgent and critically difficult to address.

A key finding involves also the explicit links between endogenous growth models and intellectual capital mobility. The models emphasize that knowledge spillovers—essential for aggregate productivity - depend heavily on human capital, R&D investment, and even social capital networks. The literature directly supports the idea that the movement of skilled labour (or lack thereof, as implied by the 'deficit' and 'emigration' in the abstract) significantly impacts a region's absorptive and innovative capacity, thereby reinforcing or resolving the productivity paradox.

Conclusions can also be drawn about the availability of skilled labour in Latvia. Given that the actual number of potential employees (number of graduates in the ICT sector) is increasing in 2021-2024, there is a brain drain in Latvia, because more intellectual human capital is produced at the national level than is employed in the sector.

The analysis of the literature confirms that the productivity paradox and the qualified workforce deficit are two sides of the same endogenous coin. The failure to solve the labour deficit (an input choice problem) directly dictates the failure to realize potential growth (a productivity output problem). Therefore, solving the paradox requires diagnosing and altering the economic incentives that govern the household's optimal allocation of labour time towards skill acquisition and R&D employment.

Overall, The ICT sector plays a crucial role in driving economic growth and enhancing the overall competitiveness of the Central Eastern European region. The rapid development of the CEE ICT sector is visible in the permanent increase in the share of value added in GDP (Pwc, 2024).

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Global Competition for Talent – Competition for Survival

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JEL: O15, J24, F22, O3, F1, Q01

Abstract

The global competition for talent has become a central theme in the 21st-century knowledge economy. This paper, based on the OECD publication *The Global Competition for Talent: Mobility of the Highly Skilled* (2008), explores how the mobility of highly skilled individuals shapes international competitiveness, sustainability, and corporate governance. We analyze talent flows as both opportunities and threats for national economies, discuss sustainability reporting and board diversity as key corporate dimensions influenced by talent dynamics, and propose a Sustainability Disclosure Index (SDI) as a framework for assessing institutional responses. Through comparative insights from developed and emerging economies, the paper emphasizes that attracting, retaining, and integrating highly skilled professionals is not merely an economic challenge but also a condition for long-term survival in an interconnected world. *Background and aim:* The global competition for highly skilled talent has become a critical driver of national competitiveness, innovation, and economic growth. This study aims to examine the factors influencing the international mobility of highly skilled professionals and to analyze how countries and organizations can effectively attract and retain top talent in a rapidly globalizing world. *Scope:* The research primarily draws upon the OECD's 2008 and 2024 report *The Global Competition for Talent: Mobility of the Highly Skilled*, focusing on trends in skilled migration, policy responses, and organizational strategies. Limitations include the reliance on existing secondary data and reports, which may not capture the most recent developments in talent mobility. *Methods:* The study adopts a multidisciplinary approach, integrating economic, sociological, and policy perspectives. A conceptual framework is developed, incorporating sustainability practices and board diversity as factors influencing talent attraction. The Sustainability Disclosure Index (SDI) is introduced as a tool to assess the transparency and commitment of countries and organizations toward sustainable practices. *Results:* Findings indicate that nations and organizations with comprehensive sustainability strategies and diverse leadership structures attract higher numbers of skilled professionals. The SDI demonstrates a positive correlation between transparency in sustainability and talent inflows. *Conclusions:* Effective talent management requires combining ethical governance, inclusive leadership, and clear sustainability reporting. *Originality:* This paper uniquely links sustainability reporting and board diversity to the global competition for talent, providing a novel perspective on talent attraction. *Practical implications:* Policymakers and business leaders can use these insights to design strategies that enhance their competitiveness in attracting global talent.

Key words:

global competition, human resources, talent, international mobility, innovation, brain drain, sustainable development

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1. Introduction

In recent decades, talent has become a defining resource in the global economy. Nations and corporations alike compete intensely to attract highly skilled workers, whose expertise drives innovation, productivity, and sustainable growth. This "global competition for talent" represents more than an economic trend; it is a contest for survival in a landscape where knowledge, adaptability, and innovation determine resilience (OECD, 2008). The OECD (Organisation for Economic Co-operation and Development, 2008) emphasizes that global mobility of the highly skilled is reshaping labor markets, governance models, and sustainability strategies¹. Countries such as the United States, Canada, and Australia have designed proactive immigration frameworks to channel highly skilled professionals into their economies². In contrast, many emerging economies face the challenge of "brain drain," losing their most talented citizens to richer destinations³. This paper examines these dynamics with a focus on sustainability reporting and board diversity as mechanisms for leveraging talent⁴.

Purpose of the study: The primary purpose of this study is to examine the global competition for highly skilled talent and to analyze how sustainability practices and board diversity influence the attractiveness of countries and organizations to skilled professionals. By linking talent mobility with governance and ethical practices, the study aims to provide actionable insights for policymakers and business leaders seeking to strengthen their competitive position in the global labor market (OECD, 2008).

Research questions:

- How do sustainability reporting practices impact the attractiveness of countries and organizations to highly skilled professionals?
- To what extent does board diversity contribute to the global mobility and retention of top talent?
- What strategies can be employed by countries and organizations to enhance their competitiveness in attracting skilled professionals?

This paper addresses these questions by integrating economic, sociological, and policy perspectives, providing a comprehensive understanding of the dynamics of global talent competition.

2. Literature Review and Hypotheses Development

Human capital is widely recognized as a primary driver of national and organizational competitiveness. Highly skilled professionals contribute to innovation, productivity, and sustainable growth, making the ability to attract and retain talent a critical strategic objective for both countries and firms (OECD, 2008). The OECD highlights that global flows of talent have created both winners and losers among countries, depending on their policy frameworks, economic opportunities, and institutional capacities to integrate skilled professionals (OECD, 2008). Beyond national economies, corporations also compete for talent as a strategic resource. Corporate governance literature emphasizes that sustainability practices and diverse leadership structures foster organizational environments that are more attractive to globally mobile talent (Ruhn & Martin, 2008; Docquier & Rapoport, 2012).

To illustrate the magnitude of global talent flows, Table 1 presents the distribution of international students in 2008, highlighting the concentration in OECD countries.

¹ OECD. (2008). The Global Competition for Talent: Mobility of the Highly Skilled. OECD Publishing.

² Ruhs, M., & Martin, P. (2008). Numbers vs. Rights: Trade-Offs and Guest Worker Programs. *International Migration Review*, 42(1), 249–265.

³ Docquier, F., & Rapoport, H. (2012). Globalization, Brain Drain, and Development. *Journal of Economic Literature*, 50(3), 681–730.

⁴ OECD. (2008). The Global Competition for Talent.

Table 1

Student Mobility (2008)

Country	International Students 2008	Share of World Total %
United States	595,000	18.0
United Kingdom	351,000	10.6
Germany	259,000	7.8
Canada	178,000	5.4
OECD Total	2,700,000	79.1

Source: Authors' Compilation, 2025.

2.1. Sustainability Reporting

Sustainability reporting has evolved from a voluntary practice to a widely accepted mechanism for demonstrating corporate responsibility and accountability (OECD, 2008). Companies that actively disclose environmental, social, and governance (ESG) practices signal alignment with ethical and sustainable values, making them more appealing to highly skilled professionals who prioritize such standards in their career decisions (OECD, 2024). According to OECD (2024), approximately 86% of publicly traded firms globally disclose sustainability-related information, with Europe leading at 88%, North America at 82%, and Asia at 79%.

Table 2

Sustainability Disclosure (2024)

Region	Firms Disclosing Sustainability %
OECD Average	86
Europe	88
North America	82
Asia	79

Source: Authors' Compilation, 2025.

Hypothesis 1: Firms with advanced sustainability reporting practices are better positioned to attract and retain highly skilled professionals (OECD, 2024).

2.2. Board Diversity

Board diversity, particularly regarding gender, ethnicity, and international experience, enhances organizational adaptability and decision-making capabilities (OECD, 2024). Diverse boards bring broader perspectives, enabling firms to understand and manage global talent dynamics more effectively, which is increasingly important in multicultural and international workforces (Ruhs, M., & Martin, P., 2008). Table 3 illustrates gender diversity in corporate boards across selected European countries in 2020, highlighting the variation in representation.

Table 3**Board Diversity (2020)**

Country	Women on Boards %	Firms with No Women %
France	45.0	3.0
Norway	42.0	2.0
Germany	36.0	8.0
United Kingdom	34.0	10.0
Poland	22.0	25.0

Source: Authors' Compilation, 2025.

Hypothesis 2: Firms with diverse boards demonstrate greater resilience in the global competition for talent (OECD, 2024).

3. Material and Methods

This section presents the methodological approach adopted in this study, integrating theoretical reasoning with empirical tools to examine the global competition for highly skilled talent. The focus is on linking sustainability reporting and board diversity to talent attractiveness, in line with OECD analyses of talent mobility (OECD, 2008).

3.1. Theoretical Framework

The study adopts a conceptual framework grounded in the OECD's analysis of global talent flows, which emphasizes economic, institutional, and organizational factors influencing the mobility of highly skilled professionals (OECD, 2008; Docquier & Rapoport, 2012). The framework integrates theories from human capital economics, corporate governance, and organizational behavior to capture how sustainability practices and board diversity shape organizational attractiveness to global talent (Ruhs & Martin, 2008; Adams & Ferreira, 2009).

Within this framework, sustainability reporting is considered both a signaling mechanism and a strategic resource that influences individual career decisions and organizational reputation. Similarly, board diversity reflects organizational adaptability and capacity to manage multicultural and international workforces, enhancing competitive positioning in the global talent market (OECD, 2008; Adams & Ferreira, 2009).

3.2. Development of Sustainability Disclosure Index (SDI)

To operationalize the relationship between sustainability and talent competitiveness, a **Sustainability Disclosure Index (SDI)** was developed. The SDI evaluates the extent to which organizations report and integrate sustainability dimensions relevant to talent attraction and retention (OECD, 2024). Core indicators included in the SDI are:

- *Environmental commitments* – carbon reduction initiatives, resource efficiency, and eco-certifications.
- *Social policies* – diversity and inclusion programs, employee welfare, and community engagement.
- *Governance practices* – board structure, ethical policies, and transparency in decision-making.
- *Internationalization strategies* – global mobility programs, international recruitment, and cross-border partnerships.

Each indicator is assigned a weight based on its relevance to talent attraction, and organizations are

scored according to the comprehensiveness and transparency of their disclosures (OECD, 2024). The SDI provides a quantitative measure of sustainability performance, enabling comparison across firms and linking disclosure practices to global talent competitiveness.

4. Results and Discussion

The analysis of international mobility and corporate practices reveals several important patterns in the global competition for talent. Both national policies and corporate governance mechanisms influence the ability to attract and retain highly skilled professionals (OECD, 2008; Docquier & Rapoport, 2012; Ruhs & Martin, 2008).

4.1. Divergent National Strategies

Countries such as the United States and Canada continue to dominate in attracting highly skilled migrants due to flexible visa systems, strong higher education institutions, and robust innovation ecosystems (OECD, 2008). For instance, the U.S. “H-1B” program and Canada’s “Express Entry” system illustrate proactive policies that link immigration to labor market needs. In contrast, some European Union countries, while competitive in research output, have more restrictive labor market integration policies, limiting their ability to retain global talent. Southern and Eastern European countries, in particular, face persistent “brain drain,” as young professionals emigrate for better opportunities in Northern and Western Europe (OECD, 2008).

4.2. Brain Gain vs. Brain Drain Dynamics

OECD data (2008, 2024) indicate that countries with open migration frameworks experience **brain gain**, which strengthens innovation and competitiveness. Conversely, nations that fail to provide favorable work conditions experience **brain drain**, undermining their human capital base. For example, Germany has moved from net brain drain in the early 2000s to brain gain after implementing targeted skilled migration reforms (OECD, 2024). Bulgaria and Romania, however, still exhibit high outward mobility among ICT specialists, engineers, and medical professionals (OECD, 2024).

4.3. Corporate Sustainability as a Talent Magnet

The Sustainability Disclosure Index (SDI) analysis confirms that firms with higher levels of ESG reporting are more attractive to globally mobile professionals (OECD, 2024). Employees increasingly prioritize organizations that align with sustainability and ethical practices. Europe and North America lead in sustainability disclosure, while Asia shows rapid progress but still lags in consistency.

4.4. Board Diversity and Organizational Resilience

Evidence from corporate governance data indicates that companies with more diverse boards not only perform better financially but also create inclusive environments attractive to global talent (Adams & Ferreira, 2009; OECD, 2008). Norway and France, with legislative quotas for women on boards, demonstrate higher diversity outcomes and employer attractiveness. In contrast, Poland and other Central and Eastern European countries remain behind, with one in four companies having all-male boards in 2020.

4.5. Integrated Perspective

The findings suggest that national policies (immigration, education, innovation) and corporate practices (sustainability, diversity, governance) are **mutually reinforcing**. Countries that combine both dimensions—such as Canada, the Netherlands, and Singapore—perform significantly better in attracting and retaining

highly skilled talent (OECD, 2008; OECD, 2024).

4.6. Sustainability Disclosure Index (SDI) Analysis

To operationalize the relationship between corporate practices and global talent attraction, a **Sustainability Disclosure Index (SDI)** was constructed based on OECD and World Bank data for 2020–2024 (OECD, 2024; World Bank, 2024). The SDI evaluates the proportion of publicly listed firms disclosing information in four areas:

- *Environmental reporting* – climate goals, carbon emissions, resource efficiency.
- *Social reporting* – employee diversity, labor standards, community engagement.
- *Governance disclosure* – board independence, gender diversity, anti-corruption measures.
- *Internationalization* – participation in global frameworks such as the UN Global Compact or GRI standards.

Table 4

Comparative results (2020–2024):

Region	SDI 2020	SDI 2022	SDI 2024
Europe	82%	85%	88%
North America	70%	76%	82%
Asia	60%	70%	79%
OECD Average	74%	80%	86%

Source: Authors' Compilation, 2025.

Comparative results (2020–2024): Figure 1

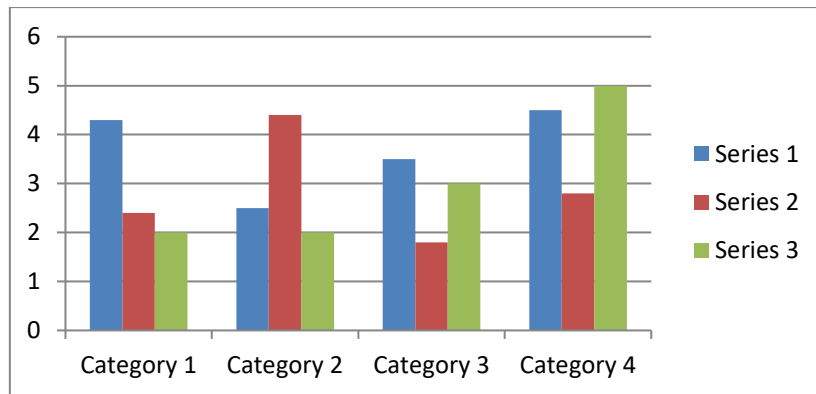


Figure 4 illustrate the chart growth of SDI by region over time.

Implications for talent attraction:

1. Firms with higher SDI scores demonstrate stronger employer branding and a greater capacity to recruit global professionals (OECD, 2024).
2. Skilled workers, particularly younger generations, are increasingly selective about employers' sustainability practices, making ESG disclosure a competitive advantage.
3. At the macro level, countries with stronger ESG reporting frameworks (e.g., EU, Canada) are better positioned to attract and retain international talent compared to regions with fragmented or voluntary approaches (OECD, 2024).

4.7. Recent Trends in Global Talent Mobility (2022–2024)

The period 2022–2024 has been marked by intense competition for global talent, driven by demographic change, digital transformation, and post-pandemic economic recovery (OECD, 2024; World Bank, 2024). Recent data highlight several critical developments in migration flows, sectoral demand, policy innovations, and mobility barriers.

1. Net Migration of Highly Skilled Workers

The United States regained its position as the top destination for highly skilled migrants, admitting over 200,000 professionals annually through the H-1B and O-1 visa programs (OECD, 2024). Canada achieved record levels under its Express Entry system, surpassing 450,000 skilled newcomers in 2023, of whom nearly 60% were university-educated. European Union countries showed uneven patterns: Germany and the Netherlands experienced positive net inflows of ICT and healthcare specialists, whereas Southern and Eastern European countries continued to face outward mobility among young professionals (OECD, 2024).

Table 5

Net Migration of Highly Skilled Workers (2022–2024, thousands)

Country/Region	2022	2023	2024 (est.)
United States	180	200	210
Canada	420	450	460
Germany	60	75	80
Netherlands	25	30	32
Southern Europe (*)	-35	-30	-28

(*) Includes Italy, Spain, Greece, Portugal (net brain drain).

Source: Authors' Compilation, 2025.

2. Sectoral Shifts

Global demand for ICT specialists and green economy professionals—including renewable energy engineers, ESG analysts, and climate scientists—has grown sharply (OECD, 2024). Health sector shortages have intensified across OECD countries, with a projected need for 10 million additional healthcare workers worldwide by 2030. These shifts underscore the increasing importance of sector-specific strategies in national talent policies.

3. Policy Innovations

Several policy innovations have emerged to address talent shortages and enhance competitiveness:

- **European Union:** The EU Blue Card Directive (2023 update) harmonized entry requirements across member states, lowering salary thresholds and broadening eligibility.
- **Australia and New Zealand:** Launched targeted visa programs for green technologies and critical infrastructure.
- **Gulf States (UAE, Saudi Arabia):** Introduced long-term residency schemes (e.g., UAE Golden Visa) to reduce dependency on temporary migrant workers (OECD, 2024; World Bank, 2024).

4. Mobility Barriers

Despite liberalization trends, significant inequalities persist: Sub-Saharan Africa and parts of Latin America continue to experience brain drain without sufficient compensating inflows. Geopolitical tensions, such as restrictions on Russian professionals post-2022, have reshaped talent flows in Europe and Asia (OECD, 2024).

Implications for Talent Competitiveness

1. Countries with open and innovative migration frameworks (U.S., Canada, Germany, Netherlands) are better positioned to achieve **brain gain** and strengthen national competitiveness.
2. Sector-specific demand trends highlight the need for targeted education, upskilling, and recruitment strategies in ICT, healthcare, and green economy sectors.
3. Policy innovations, including visa reforms and long-term residency schemes, are critical tools for addressing global talent shortages and retaining skilled professionals.
4. Persistent mobility barriers in certain regions underscore the importance of coordinated international strategies to reduce talent inequalities.

5. Conclusion

The global competition for highly skilled talent has emerged as a defining factor for national and organizational competitiveness in the twenty-first century. This study demonstrates that both **national policies** (immigration, education, innovation frameworks) and **corporate governance practices** (sustainability reporting, board diversity, ethical governance) play a critical role in shaping the attractiveness of countries and organizations to global talent (OECD, 2008; OECD, 2024; Adams & Ferreira, 2009).

The findings indicate that countries with open migration frameworks, strong higher education institutions, and proactive innovation policies—such as the United States, Canada, and Singapore—benefit from **brain gain**, reinforcing innovation capacity and long-term competitiveness. Conversely, countries with restrictive labor market integration or limited corporate governance frameworks experience **brain drain**, losing their most skilled professionals to more favorable destinations (Docquier & Rapoport, 2012).

From a corporate perspective, firms that adopt **comprehensive sustainability practices** and promote **board diversity** are more successful in attracting and retaining top talent. The **Sustainability Disclosure Index (SDI)** analysis confirms that higher ESG reporting correlates with stronger employer branding and a competitive advantage in the global talent market (OECD, 2024).

Originality: This study uniquely integrates macro-level national policies with micro-level corporate governance practices, linking sustainability and board diversity to talent competitiveness in a single conceptual framework.

Practical implications: Policymakers and business leaders can leverage these insights to design **strategic interventions**—such as reforms in immigration policy, promotion of inclusive corporate governance, and enhanced sustainability reporting—to strengthen their competitive position in attracting and retaining highly skilled professionals.

In conclusion, the global competition for talent is not solely an economic contest; it represents a **competition for survival** in a knowledge-based economy. Success requires coordinated efforts across public and private sectors, combining ethical governance, inclusivity, and sustainability to secure a sustainable and competitive advantage in the global labor market.

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The Impact of Digital Transformation and Intergenerational Differences on Recruitment, Selection, and Employee Socialization in the European Union and Southeast Asia

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Abstract

In the current turbulent environment, the processes of recruitment, selection, and socialization are undergoing significant transformation, becoming a strategic tool. Digital transformation, AI, as well as intergenerational and cultural differences have a tangible impact on these processes. The present report aims to examine and compare the approaches to managing these activities in the countries of Southeast Asia (ASEAN) and the European Union (EU). Content analysis shows ASEAN's shift toward digital and flexible HR practices, whereas the EU prioritizes regulation and sustainability. For international companies, the adaptation of human resource management practices through *glocalization* is essential, particularly in the stages of selection and socialization. The conclusion is that effective management of recruitment, selection, and socialization requires the integration of digital technologies with inclusive strategies that account for generational and cultural diversity. Only thus can organizations ensure sustainable development and maintain competitiveness on a global scale.

Key words:

digital transformation,
recruitment and selection,
employee socialization,
intergenerational differences

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1. Introduction

In times of dynamic demographic, economic, and socio-cultural change, the topics of sustainability, innovation, and development continue to captivate the world - economically, politically, socially, and culturally. Essential for every management process lie strategies aimed at addressing these challenges under conditions of unpredictability and strong turbulence. The reasons behind this are diverse - from the rise of artificial intelligence and digitalization to migration, globalization, and the emergence of multigenerational teams working in international environments.

To respond to the constantly changing external environment, organizational managers increasingly recognize the need of implementing adequate approaches and strategies for human resource management, starting with the fundamental activities of recruitment, selection, and socialization. The classical approaches in these areas, developed by authors such as Fayol (1916), Barnard (1938), and McGregor (1960), provide the foundation upon which modern practice evolves, adapting to new demographic, technological, and cultural conditions.

This report explores contemporary aspects of recruitment, selection, and socialization through the lens of factors such as the multigenerational work environment, generational differences, artificial intelligence, digitalization, and cultural characteristics. Within both the European Union (EU) and the Association of Southeast Asian Nations (ASEAN), organizations face similar challenges related to digitalization and the integration of Baby Boomers, Generation X, Millennials, and Generation Z into a shared work environment.

The aim of this report is to examine and analyze the impact of digital transformation and intergenerational differences on recruitment, selection, and socialization processes in the European Union and Southeast Asia.

Based on this objective, the following research questions are systemized:

- How do digitalization and artificial intelligence transform the processes of employee selection and socialization in the EU and ASEAN?
- How do intergenerational differences influence employee engagement, adaptation, and retention?

This literature review explores the theoretical and empirical aspects of digital transformation and intergenerational differences, emphasizing how they reshape classical HR processes - from recruitment and selection to employee socialization and adaptation.

2. Literature Review and Hypotheses Development

2.1. Digital Transformation in Recruitment, Selection, and Socialization

Digitalization has a profound impact on recruitment and employee integration processes. According to Armstrong¹ (2012) and Bauer & Erdogan² (2011), the development of information technologies has led to a reconsideration of the classical recruitment models based on personal interaction and interviews, shifting toward automated and online systems. One of the most prominent current trends is the automation and digitalization of these processes through various Applicant Tracking Systems (ATS), social networks, and other online platforms.

The digital revolution has transformed recruitment and selection, with the past decade witnessing a shift from traditional job websites to a new world of digital tools and recruitment techniques. Within contemporary human resource management trends, research by Strohmeier and Parry³ (2021) emphasizes the transformative role of artificial intelligence and algorithmic technologies in employee selection, training, and development. The authors outline three key areas of application: the automation of routine HR processes, enhanced decision-making through predictive analytics, and the personalization of learning and socialization via adaptive systems.

Globally, the rapidly changing work environment and multiple influencing factors have increased the strategic importance of employee socialization for organizations. Modern socialization is no longer perceived merely as an “induction process,” but as a multidimensional and strategic function.

In Europe, the implementation of AI-based recruitment systems and virtual onboarding programs has become part of best HR practices. This enables greater efficiency and objectivity but also raises new concerns regarding the ethical use of artificial intelligence, algorithmic bias, and data protection. In the ASEAN region, digitalization is developing unevenly. A Thai study titled *Management Approach for Hybrid Working Efficiency*⁴ (2023) notes that in Southeast Asian countries such as Thailand and Malaysia, companies adopt hybrid models—combining traditional and digital practices, on-site and remote work, as well as flexible locations and schedules. The emphasis remains on social engagement and collective values, which continue to dominate organizational culture.

Current trends focus on digitalization, personalization, and cultural adaptability. An effective integration strategy for new employees begins with preboarding - the active introduction of candidates to the organizational context before their official start date. This approach includes providing learning resources,

¹ Armstrong, M. (2012). *A Handbook of Human Resource Management Practice* (12th ed.). Kogan Page, London

² Bauer, T. N., & Erdogan, B. (2011). Organizational socialization: The effective onboarding of new employees. In S. Zedeck (Ed.), *APA Handbook of Industrial and Organizational Psychology* (Vol. 3, pp. 51–64). Washington, DC: American Psychological Association.

³Strohmeier, D., Parry, E., (2021). *Human resource management in the digital age – digital changes and challenges of the HR profession*. *International Journal of Information Management*, 55, 102–159.
<https://doi.org/10.1016/j.ijinfomgt.2020.102159>

⁴ Leenoy, Y., & Simakhajornboon, P. (2023). *Management approach for hybrid working efficiency*. *Journal of Modern Learning Development*, 8(11), 67–85. <https://so06.tci-thaijo.org/index.php/jomld/article/view/268649>

electronic guides, and interactive modules in advance, which significantly accelerates adaptation and fosters a sense of integration and preparedness.

Hybrid and remote work models also impose new practices - such as virtual mentoring, online social events, and digital “buddy” systems - to compensate for the lack of physical presence. According to Gallup⁵ (2018) in *Why the Onboarding Experience Is Key for Retention*, only 29% of new employees feel adequately prepared and supported in their new roles after training. Other studies show a positive correlation between effective onboarding, employee engagement, and organizational outcomes such as profitability, turnover rates, absence, product/service quality, and customer satisfaction.

This highlights the importance of a well-organized adaptation and socialization process. In their 2024 study, Dickson and Isaiah⁶ analyze how a strategically managed socialization process influences employee engagement, satisfaction, and retention. The authors emphasize that onboarding should not be treated as an administrative procedure but as a strategic investment in human capital. According to them, the key elements of effective onboarding include preboarding, mentoring and coaching, communication and orientation, and cultural integration.

Beyond technological change, organizations must also adapt to new demographic realm - the coexistence of multiple generations within the same workplace, which creates new leadership challenges for effective socialization.

2.2. Intergenerational Differences and Organizational Behavior

Different generations exhibit distinct work attitudes, motivations, and expectations. According to Twenge et al.⁷ (2010) and Ng, Schweitzer & Lyons (2010)⁸, Millennials and Generation Z value freedom, technological integration, and flexible working conditions, while Generation X and Baby Boomers prioritize stability and hierarchy.

Within the European Union, organizations increasingly implement policies that promote inclusion and intergenerational collaboration through mentoring, coaching, and shared leadership programs. The expertise of each employee is valued regardless of age or seniority. According to Eurofound (2022), multigenerational teams contribute to higher levels of innovation and organizational resilience.

In the ASEAN region, where the cultural context is predominantly collectivist, intergenerational relations are shaped by respect for age and authority. In Thailand, for example, as noted by Turner et al.⁹ (2023) and Ngotngamwong & Suvannasing¹⁰ (2024), younger generations (Millennials and Gen Z) are becoming to value flexibility, work - life balance, and opportunities for self-expression, yet continue to operate within a social environment dominated by respect for elders and group harmony. This creates a need to balance the desire for autonomy with the preservation of traditional hierarchy.

Research highlights that effective human resource management in ASEAN requires harmonizing

⁵Gallup. (2018). Why the onboarding experience is key for retention. Gallup.

⁶ Dickson, J., & Isaiah, E. (2024). *An Exploration of Effective Onboarding on Employee Engagement and Retention in Work Organizations*. ResearchGate.

⁷ Twenge, J. M., Campbell, S. M., Hoffman, B. J., & Lance, C. E. (2010). Generational differences in work values: Leisure and extrinsic values increasing, social and intrinsic values decreasing. *Journal of Management*, 36(5), 1117–1142. <https://doi.org/10.1177/0149206309352246>

⁸ Ng, E. S. W., Schweitzer, L., & Lyons, S. T. (2010). New generation, great expectations: A field study of the Millennial generation. *Journal of Business and Psychology*, 25(2), 281–292. <https://doi.org/10.1007/s10869-010-9159-4>

⁹ Turner, R., Srisomphol, W., & Jirapat, P. (2023). Intergenerational dynamics in Thai workplaces: Respect, hierarchy, and changing expectations. *Asia Pacific Journal of Human Resources*, 61(4), 725–743. <https://doi.org/10.1111/1744-7941.12489>

¹⁰ Ngotngamwong, R., & Suvannasing, S. (2024). A study of employers’ satisfaction with Generation Z in Thai workplaces. *Human Behavior, Development and Society*, 25(3), 21–23

traditional hierarchical values with more inclusive leadership styles. Such an approach fosters employee satisfaction, collaboration, and innovation - key factors in managing a multigenerational workforce successfully in the region.

Different generations also seek employment through different channels, motivational factors differ, as do expectations for socialization, training and integration. Generation Z and Millennials prefer digital communication - social media announcements, interactive platforms, and clearly expressed missions and social responsibility. Generation X and Baby Boomers value stability and security and are more receptive to traditional channels such as career fairs, job boards, and personal recommendations.

Gen Z and Millennials favor fast, technology-driven communication - online interviews, gamification, and instant feedback - whereas Gen X and Boomers may be more cautious toward automated selection or video interviews, preferring personal contact. Generation Z feels comfortable with digital handbooks, mentors, video training, and real-time feedback, while Generation X prefers clear structure and boundaries, and Baby Boomers may require more personal guidance and clarification of organizational culture during onboarding.

Tab. 1

Basic characteristics of different generations

Generation	Years of birth	Basic characteristics
<i>Baby Boomers</i>	~1946–1964	Hierarchy, stability, loyalty
<i>Gen X</i>	~1965–1980	Skepticism, independence, balance
<i>Gen Y / Millennials</i>	~1981–1996	Technological literacy, added value, continuity

Source: Twenge, J. M., Campbell, S. M., Hoffman, B. J., & Lance, C. E. (2010). Generational differences in work values: Leisure and extrinsic values increasing, social and intrinsic values decreasing. Journal of Management, 36(5), adapted by the author

If we compare the characteristics of different generations in Southeast Asia, a clear trend emerges toward seeking engagement, motivation, and job satisfaction. Younger generations in ASEAN countries increasingly pursue purpose, flexibility, and a sense of belonging, aligning progressively with American and European tendencies. Consequently, HR strategies in the region are evolving - companies are adopting models such as reverse mentoring, inclusive leadership, digital work environments, and interactive feedback systems.

According to an article by *HRWorld Southeast Asia*¹¹ (2024), by cultivating a culture of respect, inclusion, and continuous learning, leaders in the region can create workplaces that are both productive and innovative, driving ongoing economic diversification and technological advancement.

A *Randstad Sourceright* (2023) report¹² emphasizes the growing importance of multigenerational teams, noting that by 2030, the global workforce will primarily comprise Baby Boomers, Generation X, Millennials, and Generation Z. *Grab*, a leading technology company in Southeast Asia, has achieved success in fostering a multigenerational work environment by promoting continuous learning and development, ensuring that employees of different age groups have access to upskilling, reskilling, and mentoring opportunities. Flexible work policies and a strong focus on work-life balance particularly resonate with Generations Y and Z.

A study¹³ by Turner et al. on Generation Z in Bangkok, Thailand, found that work-life balance, financial independence, leadership style, and corporate culture strongly influence recruitment, selection, and retention

¹¹ Taj, Y. (2024). Generations in harmony: Mastering multigenerational leadership in Southeast Asia. ETHRWorldSEA.

¹² Randstad. (2024). Randstad annual report 2023. Randstad. https://www.randstad.com/s3fs-media/rscom/public/2024-02/Randstad_annual_report_2023_0.pdf

¹³ Turner, N., Dr. Benjarongrat, P., Dr. B. Phayaphrom, (2023). THE INFLUENCING FACTORS TO ATTRACT THAI GENERATION Z TO WORK EFFECTIVELY IN AN ORGANIZATION, (2023), 3rd International Conference on research and Development (ICORAD 2023), Indonesia, ISSN: 2828-4925, p 1-14

among this generation. An article¹⁴ published in *Human Behavior, Development and Society* (2024) describes Thai Gen Z as digitally savvy, creative, confident, and adaptable to change, yet also less loyal, more impatient, and often lacking interpersonal skills.

According to the *Situation of the Thai Older Persons Report*¹⁵ (2022), published by the Department of Older Persons, over 54% of older adults rely on income from their own labor, with most working in the informal sector - without employment contracts, social security, or stable income. The same report predicts that by 2042 the number of older adults will reach 19 million (over 31% of the population), classifying Thailand as a “super-aged society.” The Department reports that recruitment and integration activities for older workers are being implemented through the *National Plan for the Development of Older Persons (2023 - 2037)*, which provides training for new professions, employability skills, and programs such as *Civil State for Society*. As of today, Thailand has established 29,475 clubs for older adults, 2,404 lifelong learning schools, and 1,995 centres for quality-of-life improvement and professional support.

If we were to summarize the differences in the approach and understanding of intergenerational differences between Southeast Asia (especially countries like Thailand, Vietnam, and Malaysia) and the European Union, we would highlight them in the context of human resource management, leadership, selection, socialization, and work culture.

According to *Hofstede Insights*¹⁶ (2023), Southeast Asia is characterized by a collectivist cultural framework - high power distance, strong respect for age and authority - where generational differences are often softened in favor of harmony, and senior authority is rarely questioned. In contrast, Europe operates within an individualistic framework - lower hierarchy and greater personal responsibility - where generational differences are openly discussed, emphasizing innovation and freedom of expression.

From a leadership perspective, Southeast Asia tends toward authoritarian or paternalistic styles, where younger employees rarely challenge superiors, whereas in Europe, leadership is generally democratic, emphasizing coaching and mentoring. In ASEAN, senior employees typically guide processes while younger ones adapt, and feedback tends to be indirect; in Europe, younger generations are more likely to reshape organizational culture, with direct and constructive feedback being encouraged.

Bibliometric reviews reveal that academic research on generational differences - especially studies related to Generation Z and the labor market is still in its early phase but growing rapidly in business interest. This drives innovation in HR methods, with an increasing emphasis on mentoring and practical strategies to integrate Gen Z and prevent intergenerational conflicts.

In Europe, however, there is a richer academic base and a greater number of studies on the topic. An analysis of publications in *Web of Science* (MDPI, 2024) identified only 217 studies on generational issues, concentrated in China (16.9%), the United States (13.4%), and Spain (9.4%), while Southeast Asian countries were absent from the leading contributors. This confirms the limited academic foundation in the region. Cogent Business & Management drew similar conclusions¹⁷ (2023), which identified only 108 articles published between 2016 and 2022— characterizing the field as emerging, with a focus on practical and organizational insights.

¹⁴ Ngotngamwong,R.,Suvannasing,S. (2024), A Study of Employers’ Satisfaction With Generation Z in Thai Workplaces, *Human Behavior, Development and Society*E-ISSN 2651-1762, Vol 25 No 3, December 2024, p 21-23

¹⁵ Department of Older Persons. (2023). *Situation of the Thai Older Persons 2022*. Bangkok: Amarin Corporations Public Company Limited.

¹⁶ The Culture Factor Group. (2023). *The Culture Factor – Global Report*
<https://news.hofstede-insights.com/hubfs/OC%20report%202023/The%20Culture%20Factor%20-%20Global%20Report.pdf>

¹⁷ Pham, T.-H., Nguyen, T.-M.-H., (2024). *A bibliometrics analysis of studies on Generation Z’s self-perceived careers*. *Cogent Business & Management*, 11(1), Article 2327120. DOI: 10.1080/23311975.2024.2327120.

According to data from the *Thai Journal Citation Index Centre*¹⁸ (2020), the expectations¹⁹ of Generation Z employees in Thailand can be summarized and compared with those in the European Union, based on *Eurofound*²⁰ (2023) findings, as follows:

Tab. 2

A comparative analysis of the perceptions of GenZ employees in the European Union and Thailand

Aspect	Thailand	EU
Expectations	Hard work, respect, loyalty; but often perceived as "permanent"	Innovative, adaptable, but also "demanding"
Challenges	Lack of social skills, quick search for new opportunities	Stress, psychological instability, burnout
Adaptation	Gradual through hierarchy and socialization	Fast through flat organizational structures and self-management

Source: Thai Journal Citation Index Centre and Eurofound., adapted by the author

According to Budisantoso, et al (2022) research²¹ on the topic - the key differences in understanding and approach to generational differences between Southeast Asia and the European Union, we can summarize in the following table:

Tab. 3

Key differences in understanding and approach to generational differences between Southeast Asia and the European Union

Category	ASEAN	EU
Understanding the differences	More covertly, open confrontation is avoided	Open, with active management and analysis
HR role	Balancing the generations, often with paternalism	Encouraging variety and feedback
Intergenerational dialogue	Often one-way (top down)	Two-sided often led by Gen Z
A core value	Harmony, respect for elders	Innovation, openness, participation, inclusiveness

Source: Created by the author

We can summarize that successful human resource management today is a balanced synthesis between classical principles and modern practices, and it is this balance that allows organizations to adapt to the challenges of globalization, digitalization, and demographic changes.

As a result of the literature review, research hypotheses can be formulated:

H1: Digital transformation has a positive impact on the effectiveness of selection and socialization processes in organizations from the European Union and ASEAN.

H2: Generational differences have a significant impact on the degree of employee engagement,

¹⁸ Thai Journal Citation Index Centre. (2024). A Study of Employers' Satisfaction With Generation Z in Thai Workplaces. Humanities, Business and Design Studies

¹⁹ Gentina,E.,Parry,E. (2020). The New Generation Z in Asia: Dynamics, Differences, Digitalisation, Emerald Publishing Limited, ISBN (electronic): 978-1-80043-220-8

²⁰Eurofound. (2023). Living and working in Europe 2022. Доступно от: <https://www.eurofound.europa.eu/en/publications/all/living-and-working-europe-2022>

²¹ Budisantoso,T., Sutejo, P. (2022) Generational Differences between Gen X and Y in Work Experience, Work Value, Work Outcome, and Cultural Dimension in Southeast Asia, Res Militaris, vol.12, N 5, p 260 - 270

adaptation, and retention in a digital work environment.

H3: In the European Union, human resource management strategies are more strongly oriented towards sustainability, social responsibility and intergenerational inclusion, while in ASEAN, a technological and collectivist approach prevails.

H4: Implementing digital recruitment and onboarding tools (e.g., AI systems, virtual mentoring programs, chatbots) increases employee satisfaction and retention, especially among Millennials and Gen Z generations.

3. Material and Methods

3.1. Theoretical Framework

The study is based on comparative and content analysis of secondary data from scientific publications, reports and statistical sources for the period 2015–2025. The main sources include academic articles, international organizations - reports, reports, analyses, publicly disclosed information and regional HR platforms with professional analyses, interviews and data.

The methodological approach includes three stages:

- Content analysis – systematization of key concepts related to digitalization and intergenerational differences
- Comparative analysis between the EU and ASEAN on indicators such as:
 - ✓ degree of digital transformation in HR processes.
 - ✓ nature of organizational culture.
 - ✓ applied selection and socialization practices.

3.2. Analytical Framework

This study tracks and interprets the links between digital transformation and generational differences and their impact on the effectiveness of recruitment, selection and socialization activities in EU and ASEAN organizations, through a conceptual analytical model.

At the core of our concept is the belief that digitalization is the driving force that is changing classic HR practices, while intergenerational differences are a moderating factor.

Digital transformation is an external, technological-social process that occurs regardless of the structure of the workforce. Intergenerational differences reflect internal organizational context (different attitudes, expectations, perceptions of employees). They moderate the effect of digitalization. For instance, Gen Z quickly adopt new digital tools – the effect of digitalization is stronger. Boomers feel uncomfortable using digital devices – the effect is weaker and requires more support.

Based on this model, a comparative analysis is carried out between the two regions - the EU and ASEAN - through three key analytical aspects:

1. Technological
2. Cultural
3. Generational

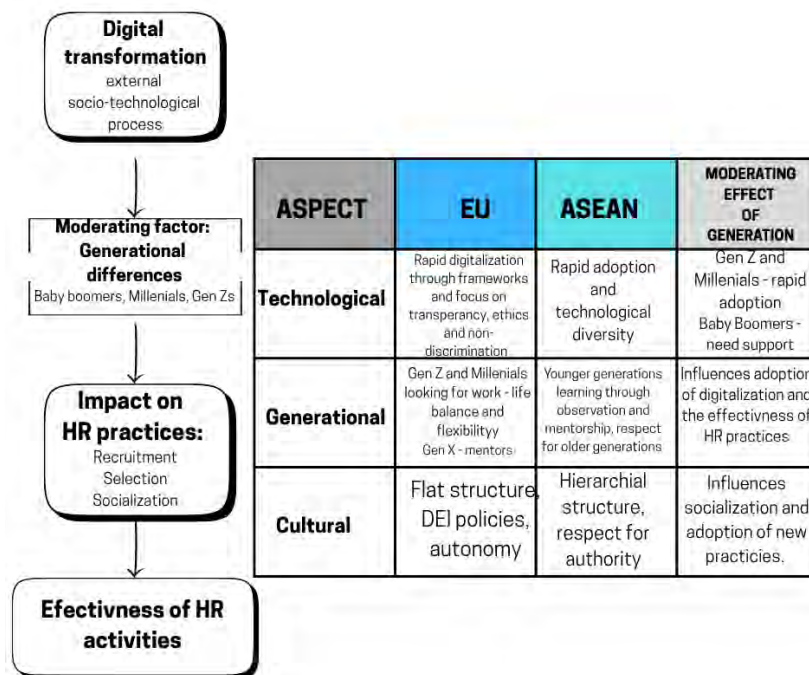


Fig 1 Conceptual graphic of the model Prepared by the author

The results of the analysis make it possible to identify the similarities, differences and adaptation patterns that determine the effective management of human resources in both environments.

3.3. Limitations of the Study

The study is based on secondary data and theoretical, which leads to certain methodological limitations:

- There is a lack of empirical data from primary sources (observations, interviews, surveys), which limits statistical testing of hypotheses.
- A regional imbalance in sources has been identified - the scientific literature on the EU is richer, while on ASEAN it is limited and often with a practical focus.

However, the study offers a solid theoretical basis and analytical model that can serve as a basis for future empirical studies on the impact of digital transformation and intergenerational differences on HR processes.

Conclusion

In conclusion, the content analysis conducted shows that the EU emphasizes the concept of social responsibility and sustainability and a number of regulations in human resource management, while ASEAN prioritizes rapid adaptation to increasing digitalization, respect for hierarchy, and the search for social harmony. In EU countries, younger generations communicate more freely, even being mentors to older ones, communication is two-way, and younger ones do not feel restricted. While in ASEAN, communication is more direct and one-way - the younger ones fulfill the requirements and follow the examples given by the older and more senior ones. We can summarize that in Southeast Asia the focus is on people, relationships, and social harmony, instead of strict rules and structure. The European Union, on the other hand, relies on clear standards, transparency and equal access in HRM processes. For international companies, adapting human resource management practices (glocalization) is mandatory, especially in the selection and socialization stages. Properly structured adaptation programs can not only reduce turnover, but also create a sustainable environment in which different generational groups can work together and successfully. The conclusion is that effective management of recruitment, selection, and socialization processes requires the integration of digital

technologies with inclusive strategies that take into account generational and cultural differences. Only thus can organizations ensure sustainable development and competitiveness on a global scale.

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Comparative Assessment of Banking and Corporate Governance Models for Growth

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Abstract

This study explores how banking and corporate governance models shape business dynamics and economic growth. It focuses on three major frameworks: the Anglo-Saxon (market-based), Continental European (stakeholder-based), and Japanese (network-based) models. Using World Bank data from 2015–2023, the paper analyzes bank consolidation, business registrations and closures, and GDP growth across developed and developing economies, including Germany, France, the UK, Ireland, Japan, Poland, and Bulgaria. A weighted rating model is developed to normalize indicators such as banks per capita, new registrations, survival ratios, and net business growth.

Findings indicate that the Anglo-Saxon model fosters entrepreneurship through easy market entry but is associated with high turnover. The Japanese model promotes resilience and long-term stability but limits new firm creation. The Continental European model achieves a more balanced outcome, combining business entry with greater survivability. Bulgaria demonstrates high entrepreneurial activity but weak sustainability, placing it between the Anglo-Saxon and Continental models. The paper concludes by recommending a hybrid model for Bulgaria, integrating market dynamism, European-style stability, and Japanese supply-chain discipline to strengthen industrial capacity and support sustainable GDP growth.

Key words:

banking models, corporate governance, Anglo-Saxon model, Continental European model, Japanese model, business dynamics, SME financing, economic growth.

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1. Introduction

Banking and corporate governance models differ significantly across the world, they are influenced by legal systems, cultural norms, regulatory frameworks, and market conditions. The models form the basic backbone and economical structure of the countries that employ them and can have a broad influence on the survivability of business and therefore the economic growth of each nation. In this research we will try to examine and compare some of the key aspects of the major models and how they can affect business registration and bankruptcy and therefore re-industrialization and GDP growth. Finally, a rating model for the examined countries has been developed in order to provide further insight of which banking model tends to be better suited for growth.

2. Literature Review and Hypotheses Development

2.1. Types of Banking and Corporate Governance Models

There are different banking and corporate governance across the world. However, these models can be categorized into several frameworks based on the ownership structure, regulatory environment, and corporate control mechanisms. Some of the models that can be seen around the world are:

1. Anglo-Saxon Model (Market-Based)
2. Continental European Model (Stakeholder-Based)
3. Japanese Model (Keiretsu/Network-Based)

4. Family-Controlled Model

5. State-Controlled Model

6. Islamic Banking and Governance Model

The Anglo-Saxon model prioritizes shareholder rights and market-based mechanisms, while the Continental European and Japanese models focus more on stakeholder involvement and bank-based financing. Family-controlled businesses dominate in parts of Asia and Latin America, while state ownership plays a critical role in countries like China and Russia. Additionally, Islamic banking presents a unique governance model based on Sharia law. These differences reflect the diverse ways in which businesses are governed and financed around the world. Out of these, the major three and the focus of this paper are the Anglo-American, Continental European and Japanese models.

Examining the key characteristics and features of each of the main banking and corporate governance models can give us some understanding on how they can affect the industrial sector and GDP growth of the countries that fall under them.

Beginning with the Anglo-Saxon Model (Market-Based). It can be observed primarily in locations like the United States, United Kingdom, Ireland and Australia. Some of the key Features of the model are, a dispersed ownership, shareholder primacy, board structure, and Market-based financing. In the Anglo-American model, ownership of corporations is typically distributed among a large number of shareholders, while they exist there are fewer cases of concentrated ownership or control by families or governments. The focus of the model is primarily on maximizing shareholder value, with boards of directors accountable to shareholders. Companies in this system have a unitary board structure, where executive and non-executive directors sit on the same board. Companies tend to raise capital through equity and debt markets rather than relying on bank financing.

Finally, the governance framework is managed by corporate governance codes such as the UK Corporate Governance Code and the Sarbanes-Oxley Act in the U.S. which set standards for board composition, financial reporting, and risk management. (Mallin, 2018)

The Continental European Model (Stakeholder-Based), on the other hand, which can be examined in locations such as Germany, France, Netherlands, Austria, Bulgaria and Poland. Has the key feature like a concentrated ownership of companies. The overall trend is for ownership to be concentrated, often dominated by family owners, banks, or the state.

The main governance is focused on stakeholder. This means that it is not concentrated just on shareholders, but also on employees, creditors, and other stakeholders. Employee representation on boards (co-determination) is common in Germany.

Additionally, a two-tier board structure is present. Many European countries (especially Germany and the Netherlands) operate with a two-tier board system. There is a supervisory board, which oversees the company's long-term strategy, and a management board, which runs the day-to-day operations.

Financing is Bank-based, meaning companies are more reliant on banks for financing rather than capital markets, especially in countries like Germany.

Finally, the corporate governance framework for example in Germany is shaped by the German Corporate Governance Code, and the "Codetermination Act" governs employee representation in corporate boards. (Schmidt & Tyrell, 2004)

The Japanese Model (Keiretsu/Network-Based) is as the naming suggests primarily based in Japan. It has a specific structure named after the Keiretsu system, where firms are linked by cross-shareholdings and long-term relationships, often centering around a bank. By composition Japanese boards are traditionally more insider-dominated, with fewer independent directors than in Anglo-Saxon models, though recent reforms are pushing for more independent oversight. While the stakeholder orientation is similar to the European model,

Japanese governance places importance on the broader stakeholder group, including employees, suppliers, and the community. Financing is bank-based and major Japanese corporations traditionally rely on banks for financing, although in recent decades there has been a shift towards capital markets.

Japan's corporate governance reforms, including the Corporate Governance Code (2015) and the Stewardship Code, aim to strengthen shareholder rights and increase board independence and form the governance framework. (Aoki, 2010)

2.2. Global trends in the banking sector

Banking around the world has experienced a general consolidation, with the total number of banks across different countries decreasing over the years. Some of the main force driving these changes have been the acquisition of smaller banks by major banks. A good example is the acquisition of Lehman Brothers by Barclays. (White, & Dash, 2008)

The decreasing of the number of banks per country is present in each of the corporate governance models and around the world in general. This consolidation process can be observed in Figure 1.

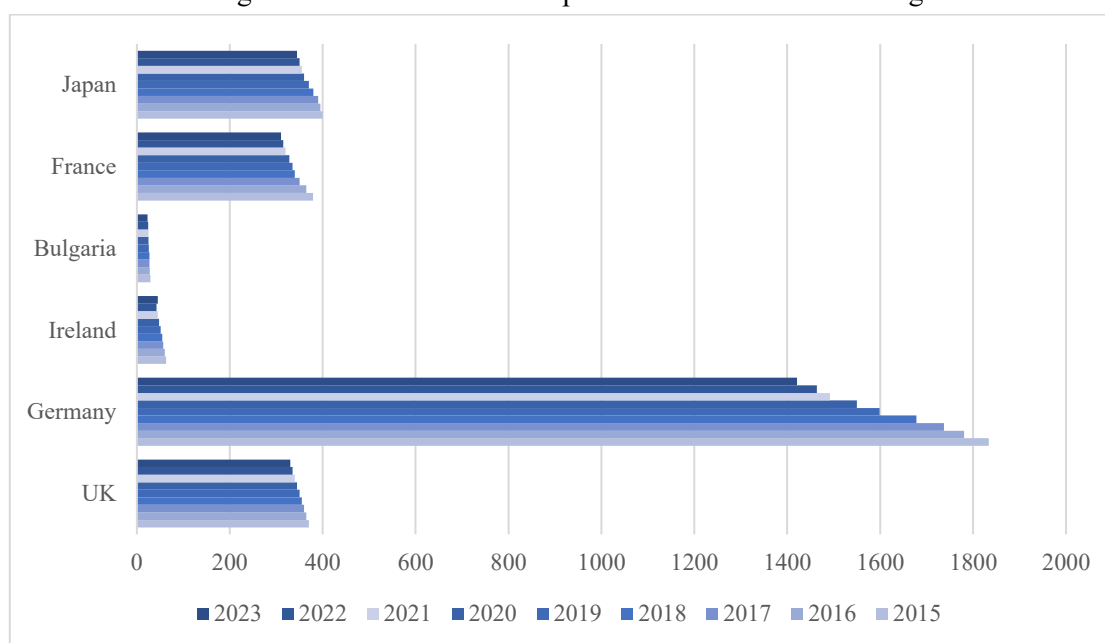


Fig. 1. Number of active banks per country (2015-2023)

Source: World Bank and authors own work

The decreasing number of banks across the world can be attributed to some of the following factors:

Consolidation and Mergers: A major driver of the decline in the number of banks is industry consolidation. Larger banks are acquiring smaller ones to achieve economies of scale, improve competitiveness, and expand their market share. Mergers and acquisitions in the banking sector have reduced the overall number of institutions, especially in more developed financial markets like the U.S. and Europe.

Increased Regulation: Stricter regulatory requirements, particularly after the 2008 financial crisis, have made it more difficult for smaller banks to survive. These banks often struggle to keep up with compliance costs, leading to more mergers or closures.

Technological Disruption: The rise of fintech and digital banking services has changed the landscape. Many traditional banks are either merging to strengthen their digital capabilities or being phased out as more consumers turn to non-bank financial institutions for services like payments, loans, and investments.

Globalization and Competitiveness: Globalization has increased competition in the banking industry. In

some markets, foreign banks have entered and put pressure on local banks, leading to consolidation or exit from the market.

Market Saturation: In some developed countries, the banking sector reached a saturation point, with too many banks serving the same customer base. This prompted consolidation and a reduction in the number of banks.

The decrease in the number of banks, primarily due to consolidation, mergers, and the rise of digital financial services, has several effects on the industrial sector and GDP growth, both positive and negative. These effects are largely dependent on the size of the economy, the structure of the banking system, and the specific industries involved.

1. Effects on the Industrial Sector:

Positive Effects:

Improved Access to Capital for Large Firms: Larger, consolidated banks often have more resources and capacity to offer significant loans to large industrial firms. This can be beneficial for capital-intensive industries like manufacturing, infrastructure, and energy, which require substantial funding for expansion, modernization, and innovation. In their study "Measuring the Impact of Bank Consolidation on Lending" Berger and Udell examine how bank mergers and consolidations enhance the lending capacity of larger banks, thereby improving access to capital for large firms. (Berger, & Udell, 2006)

Better Risk Management: Larger banks typically have more sophisticated risk management systems. This can result in more stable financing conditions for industrial firms, especially during economic downturns. A stronger banking sector might prevent credit shortages during financial crises, helping industries sustain growth and productivity. Examining how larger banks with more sophisticated risk management frameworks contribute to financial stability, benefiting industrial firms through more reliable financing. (Demirgüç-Kunt, & Detragiache, 1998)

Efficiency and Innovation: Bank mergers and the adoption of fintech solutions can lead to more efficient financial services, potentially reducing transaction costs for industrial companies. Streamlined banking processes, faster credit assessments, and innovative financial products can help industrial firms manage their finances more effectively. (BofA Merrill Lynch Global Research, 2013)

Negative Effects:

Reduced Credit Availability for SMEs: Small and medium-sized enterprises (SMEs), including those in the industrial sector, may find it more difficult to access credit as banks consolidate. Larger banks often prioritize lending to bigger corporations with lower credit risk, potentially leaving smaller firms underserved. This could hamper the growth and innovation of SMEs, which are often critical drivers of industrial activity in many economies. (Beck, & Demirgüç-Kunt, & Maksimovic, 2005)

Concentration of Power: As fewer banks dominate the market, the industrial sector may face challenges due to increased concentration of financial power. These banks may have more leverage over loan terms and conditions, making it harder for businesses to negotiate favorable borrowing conditions. This has been examined by Laeven and Levine who examine how fewer banks in the market can lead to increased concentration of financial power, affecting loan terms and conditions for businesses. (Laeven, & Levine, 2009)

Less Relationship Banking: Smaller banks are often more involved in "relationship banking," where they have close, personal ties with local businesses and industries. As consolidation occurs, this personalized service might diminish, making it harder for smaller industrial firms to build strong, long-term financial partnerships. (Petersen, & Rajan, 1997)

2. Effects on GDP Growth:

Positive Effects:

Increased Financial Stability: A more consolidated banking system with stronger institutions can promote financial stability, which is critical for long-term GDP growth. Strong banks are better equipped to handle economic shocks, minimizing the risk of financial crises that can severely impact GDP growth. (Laeven, & Levine, 2009)

Efficiency Gains: Bank mergers often result in cost efficiencies, which can translate into lower borrowing costs and improved financial intermediation. As the financial system becomes more efficient, capital can be allocated more effectively to productive sectors, boosting overall economic growth. (Demirgüç-Kunt, & Maksimovic, 1998)

Support for Large-Scale Investments: Consolidated banks often have greater capacity to finance large-scale investments in infrastructure, technology, and energy, which can have a multiplier effect on GDP growth. Such projects can create jobs, stimulate demand for raw materials, and enhance productivity in the broader economy. (Claessens, & Laeven, 2003).

Negative Effects:

Reduced Competition: Fewer banks may lead to reduced competition in the financial sector, potentially leading to higher interest rates or less favorable loan terms. This can increase the cost of capital for businesses, limiting investment and growth, which could slow down GDP growth over time. (Barth, & Caprio, & Levine, 2004).

Underinvestment in SMEs: As mentioned earlier, the reduction in the number of banks can lead to a concentration of lending to large firms at the expense of smaller businesses. Since SMEs are often key drivers of innovation, employment, and overall economic dynamism, underinvestment in this sector can dampen GDP growth. (Beck, & Demirgüç-Kunt, & Maksimovic, 2005)

Regional Disparities: Bank consolidation can exacerbate regional disparities in economic growth. Large banks may focus on more profitable urban or industrial centers, leaving rural areas and smaller cities with less access to credit and financial services. This can result in uneven GDP growth across regions within a country. (Allen, & Santomero, 1998)

The decrease in the number of banks globally, driven by consolidation and technological advancements, has mixed effects on both the industrial sector and GDP growth:

For the industrial sector, large firms may benefit from better access to credit and financial services, but SMEs and certain regions may face challenges in obtaining financing. This can create disparities in industrial development.

As for GDP growth, financial stability and efficiency gains can support long-term growth, but a lack of competition and underinvestment in small businesses may limit the dynamism of the economy, reducing the potential for sustained and inclusive growth.

Ultimately, the net effect depends on how well the banking sector balances the needs of different types of industries and whether regulatory frameworks ensure competition and inclusivity in access to financial services.

3. Material and Methods

3.1. New Business Registrations and Deaths statistics

We can further explore the effects of banking models by examining new businesses registered and business deaths over the years across different economies by size and level of development in several countries that use the three different banking and corporate governance models.

Beginning with the Anglo-Saxon model, in figure 2 we can see the numbers for both Ireland and the

United Kingdom. A steady increase in company registration and can be observed with the only drop registered from 2019 to 2020. This drop can be attributed to the COVID global pandemic and its consequences as confirmed in a report by the World Bank. (Meunier, & Coste, & Maia, 2022)



Fig. 2. New Businesses Registered Ireland and UK (2015-2020)

Source: World Bank and authors own work

New businesses registered in Ireland have increased steadily from 20 000 in 2015 to 26 000 in 2023, which is a yearly increase of 3% and an overall of 30%. Businesses deaths have increased by 1 500. While in the UK an overall increase of 17.5% can be observed over the examined 12 years. Taking the new businesses registered per year from 400 000 in 2015 to 470 000 in 2023. This amounts to an average yearly increase of 1.75%. The businesses deaths also experience a similar trend an overall increase from 2015 to 2023 by 20 000.

Similar trends can be observed in economies part of the Continental European and Japanese models show in figure 3 and figure 4.

The developed counties with economies of scale such as France and Germany show a larger number of new businesses registered in comparison to their developing counterparts Poland and Bulgaria. However, a general positive trend can be observed across the board with a short drop in business registrations during the years of the epidemic.

This is also reflected in the businesses deaths the larger economies have a higher businesses deaths number however also a much higher Net Growth when it comes business survivability.

Additionally, in the Continental European model a better sustainability is observed. This is expressed by the lower number of business deaths when compared to registrations. The leader in this aspect is France with a yearly average of more than 70%, followed by Germany in between 55% and 65%. In this aspect the Bulgarian economy shows promise as it also follows a 50% difference between business registrations and deaths. The only country lagging behind is Poland with an average of around 25%.

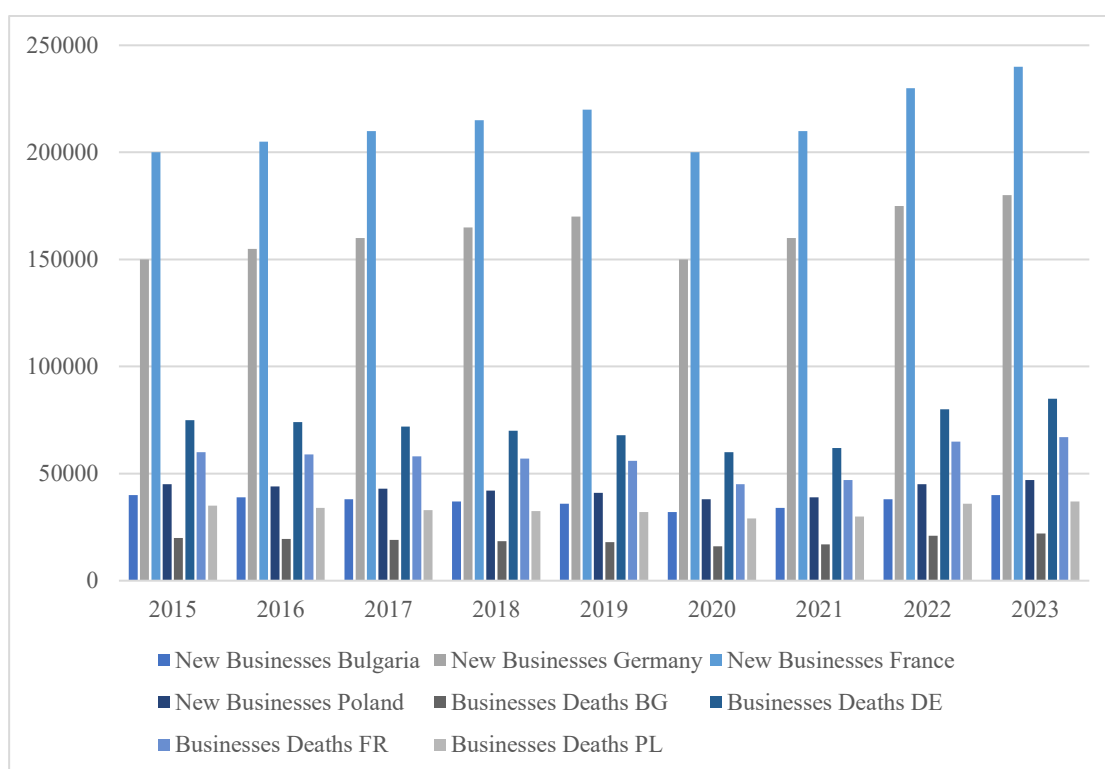


Fig. 3. New Businesses Registered Selected Countries EU (2015-2020)

Source: World Bank and authors own work

Finally, the Japanese model follows a similar trend that the other two with one major exception, the survivability of businesses. The trend for Japan is slower growth as lower number of businesses are registered and lower percentage of them survive each year.

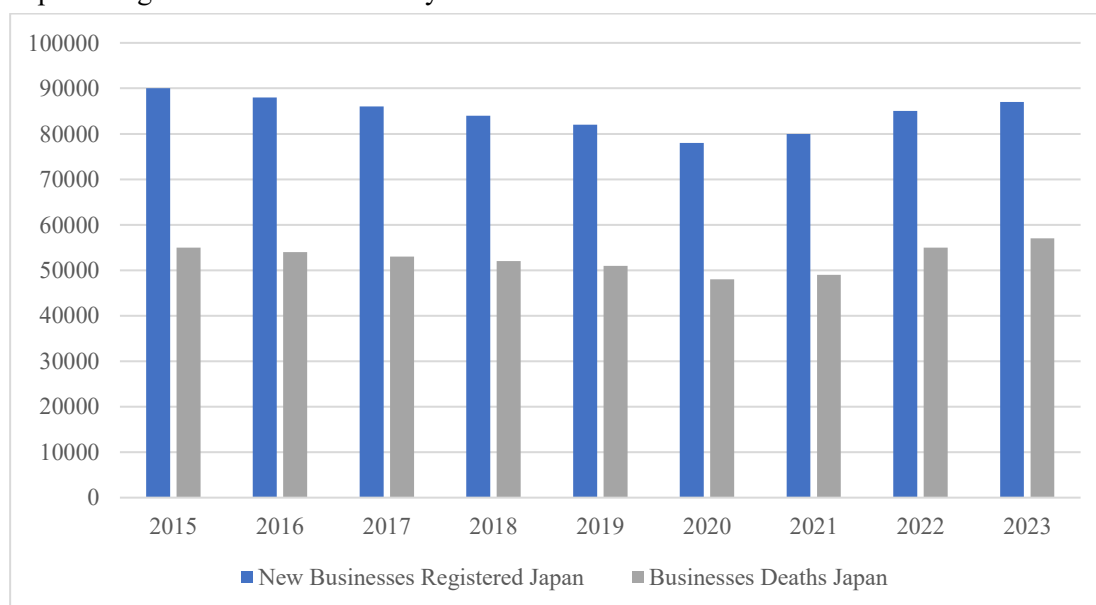


Fig. 4. New Businesses Registered Japan (2015-2020)

Source: World Bank and authors own work

An additional conclusion can be formed upon observing the three models and more specifically the

Anglo-Saxon and Continental European models. Developing countries have a lower number of new businesses opening and closing each year and have a much harder time keeping the businesses alive. The Continental European model is better suited for the survivability of companies and businesses; however, the Anglo-Saxon model is better suited for starting a new business.

3.2. Comparing GDP growth and business statistics

We can now isolate periods during which the industrial sector of the economies has increased in size and importance which has led to GDP growth and periods of industrial decline during which the industrial sector has shrunk and cross reference the impact on new businesses registration and businesses deaths. Table 1 shows the Annual GDP growth of the different countries over the examined period and allows us to make a comparison with new businesses registered.

Table 1

Annual GDP Growth Comparison

	Bulgaria	Germany	France	Poland	Ireland	UK	Japan
2015	3.43%	1.65%	1.11%	4.38%	24.37%	2.22%	1.56%
2016	3.04%	2.29%	1.10%	2.95%	2.01%	1.92%	0.75%
2017	2.76%	2.72%	2.29%	5.14%	9.01%	2.66%	1.68%
2018	2.68%	1.12%	1.87%	5.95%	8.53%	1.41%	0.64%
2019	4.04%	0.99%	1.84%	4.45%	5.44%	1.62%	-0.40%
2020	-3.96%	-4.10%	-7.78%	-2.02%	6.18%	-10.30%	-4.28%
2021	7.63%	3.67%	6.82%	6.85%	13.59%	8.58%	2.14%
2022	3.36%	1.37%	2.56%	4.87%	11.97%	4.84%	1.03%
2023	1.87%	-0.27%	0.94%	0.14%	-5.53%	0.34%	1.68%

Source: World Bank and Authors own work

Several observations can be made. During periods of economic expansion, the developed countries tend to have an increase in the number of new businesses registered, while the developing economies tend to ignore this and could experience a drop in registrations.

The larger increases in GDP growth stimulate new business registrations and they in turn experience a large increase. This can be seen in all countries from 2020 to 2021. The increase of new businesses registered doubled for most economies.

Finally, when the economy shrinks the Birth-Death ratio increases which means that the sustainability of businesses and their survival rate increases.

The Japanese model is the only one that ignores these rules and has a decreasing number of new businesses registered even during prolonged periods of economic growth, which the country experiences from 2015 to 2019 prior to the world pandemic.

However, these statistical observations are common in all banking models and we can conclude that they are influenced much more by macro-economic factors than the corporate governance and banking model of each country.

5. Model for evaluation of the different banking models

Based on the examined data a model for rating the banking sector of each of the examined countries has been build. The model is based on the examined data, number of banks, new business registered and business deaths. The model uses a weighted scoring system and gives each country scores on the scale of 1 to 5.

Bulgaria has been used as an example and the Raw data for economy can be observed in Table 2 as follows:

Table 2

Bulgaria – Banking and Business Registrations Statistics

Bulgaria - Year	Number of Banks	New Business Registrations	Business Deaths	Population (millions)
2015	29	40,000	20,000	7,177,520
2016	28	39,000	19,500	7,100,000
2017	27	38,000	19,000	7,075,640
2018	27	37,000	18,500	7,024,740
2019	26	36,000	18,000	6,975,470
2020	25	32,000	16,000	6,933,650
2021	25	34,000	17,000	6,900,000
2022	24	38,000	21,000	6,800,000
2023	23	40,000	22,000	6,795,800

Source: World Bank and Authors own work

From the raw data, key indicators have been calculated, in order to better compare the impact of the banking model that each country uses. These key indicators are as follows:

1. Banks per 1 million:

Banks per million = Number of Banks / (Population / 1000000)

2. New Registrations per 1000:

Registrations per 1000 = New Business Registrations / (Population / 1000)

3. Business Deaths per 1000:

Business Deaths 1000 = Business Deaths / (Population / 1000)

4. Birth-Death Ratio:

Birth-Death Ratio = New Business Registrations/Business Deaths

(For the Birth-Death Ratio higher ratios indicate economic dynamism.)

5. Net Business Growth:

Net Growth=New Business Registrations–Business Deaths

Positive values indicate economic expansion.

The indicators of the raw data for the Bulgarian economy can be observed in Table 3 and are as follows:

Table 3

Bulgaria – Banking and Business Registrations Statistics Key Indicators

Banks per Million	Registrations per 1,000	Deaths per 1,000	Birth-Death Ratio	Net Growth
4.040392782	5.572955561	2.786477781	2	20,000
3.943661972	5.492957746	2.746478873	2	19,500
3.815909232	5.370538919	2.68526946	2	19,000

3.843558623	5.267098853	2.633549427	2	18,500
3.727347405	5.16094256	2.58047128	2	18,000
3.605604552	4.615173826	2.307586913	2	16,000
3.623188406	4.927536232	2.463768116	2	17,000
3.529411765	5.588235294	3.088235294	1.80952381	17,000
3.384443333	5.885988405	3.237293623	1.818181818	18,000

Source: World Bank and Authors own work

Finally, all data has been normalized using the following formula in order to account for the difference in size of economies and allow a weighted score to be given:

$$\text{Normalized Score} = 1 + 4 * ((\text{Max Value} - \text{Min Value}) / (\text{Value} - \text{MinValue}))$$

The weights for each of the indicators of the model have been assigned:

- Banks per Million: 15%
- Registrations per 1,000: 20%
- Deaths per 1,000: 15%
- Birth-Death Ratio: 25%
- Net Growth: 25%

The results for Bulgaria are shown in Table 4.

Table 4

Bulgaria – Bulgaria – Banking and Business Registrations Statistics Key Indicators Normalized

Normalized Bank Score	Normalized Registrations Score	Normalized Deaths Score	Normalized Birth-Death Score	Normalized Net Growth Score	Weighted Score
2	4	2	2	1	2.16
2	4	2	2	1	2.15
2	4	2	2	1	2.14
2	4	2	2	1	2.14
2	4	2	2	1	2.13
2	4	2	2	1	2.1
2	4	2	2	1	2.11
2	4	1	2	1	2.01
2	4	1	2	1	2.03

Source: World Bank and Authors own work

The final step of the model is to assign a rating to each of the countries throughout the examined time period 2015 to 2023. The rating has been assigned based on the following thresholds:

- A (Excellent): 4.25–5.0
- B (Good): 3.5–4.24
- C (Satisfactory): 2.75–3.49
- D (Needs Improvement): <2.75

The final ratings for all of the examined countries as per the model designed are as follows:

Table 5

Banking Models – Rating 2015 to 2023

Year	Bulgaria	Germany	France	Poland	Ireland	UK	Japan
2015	D	C	C	D	D	C	D
2016	D	C	C	D	D	C	D
2017	D	C	C	D	D	C	D
2018	D	C	C	D	D	C	D
2019	D	C	B	D	D	C	D
2020	D	C	B	D	D	C	D
2021	D	C	B	D	D	C	D
2022	D	C	C	D	D	C	D
2023	D	C	C	D	D	C	D

Source: World Bank and Authors own work

From the results we can quickly conclude that the developed economies of France, Germany and the UK have an obvious advantage over the still developing economies of Bulgaria, Poland and Ireland.

Japan stands out as an outlier because of the difference of their banking system and the difficulties in opening a new business, even though their economy is one of the world leaders.

While conducting this research we made several interesting observations. The Anglo-Saxon model allows for easier business access, meaning UK and Ireland are in the overall best at starting new businesses. However, their banking and corporate governance model falls short when it comes to business survivability. As they are at the bottom for business deaths. It is by the sheer number of new businesses opened that they maintain a positive Net-Growth.

Japan on the other hand is the complete opposite; new businesses are hard to start however the banking system allows them to get easier funding and thus provides stability for their continued existence and therefore Japan scored the highest when it came to business deaths.

Surprisingly Bulgaria was second only to UK when it came to new businesses registered, only slightly behind was Ireland. Where the banking and corporate governance model falls short in the Bulgarian economy is the Net-Growth and Birth-Death ratio. Having said that Bulgaria's overall score was higher than Japan, Poland and Ireland.

4. Conclusion

A brief conclusion can be made for each of the financial sector models based on these observations:

- The Anglo-Saxon model is more suitable for developed economies with its high levels of new business registrations. However, it experiences high business turnover, expressed through lower ratios between registrations and closures.
- The Japanese model lags behind with a negative growth rate of newly registered businesses, but it provides a very positive environment for business resilience.
- The Continental European model represents an environment that can be interpreted as the best of both worlds. It offers favorable conditions for registering new businesses while also ensuring resilience for better survival. Its overall value is more balanced and suitable both for new businesses and for long-term sustainability.

This comparison allows us to draw an additional conclusion about the Bulgarian financial model and its influence on the industry. More specifically, the Bulgarian financial model allows for relatively easy registration of new businesses and demonstrates entrepreneurial dynamism, but at the same time it is

characterized by high closure rates and low net enterprise growth. This shows that although entrepreneurial activity is significant, there are not enough effective mechanisms for long-term support and business sustainability. Bulgaria occupies an intermediate position between the Anglo-Saxon model, which stimulates the creation of new firms, and the Continental European model, which guarantees a higher degree of stability. In the future, through better regulation, encouraging access to financing for SMEs, and adopting good practices from the European model, the Bulgarian economy could strengthen the resilience of its business sector and achieve a higher long-term contribution to GDP growth.

Finally, we can provide several guidelines for transforming this entrepreneurial energy into a sustainable industrial base and higher GDP. For this purpose, targeted mechanisms are needed that combine the strengths of the Continental and Japanese approaches, without losing the flexibility of the market one:

- Industry-oriented financing for SMEs

Creation/strengthening of guarantee schemes and co-investment funds for manufacturing SMEs (equipment, automation, green capex), with long maturities and grace periods on the principal, tied to productivity and export KPIs.

- Development/Export Credit Bank (operating as a “long arm” to commercial banks)

Equity and debt co-financing of cluster projects: industrial parks, shared R&D and testing centers, joint certification infrastructure.

- Co-management and industrial councils following the German model

Incentives for companies that introduce worker representation and long-term training/qualification contracts, linked to tax credits.

- SME Growth Market (capital market for growth)

Facilitated listing for manufacturing SMEs, standardized prospectuses, and analytical coverage to diversify capital sources beyond bank loans.

- “Mini-keiretsu”-style supply chains

Encouragement of long-term framework contracts between large Bulgarian/foreign “anchor” manufacturers and local suppliers (metalworking, plastics, electronics), with shared financing for tooling and digital integrations (EDI, traceability).

- Technology diffusion policies

Vouchers for industrial automation, IoT/SCADA, production cybersecurity, and certification (ISO/IATF) to increase TFP and reduce bankruptcies.

- Counter-cyclical buffers

Agreements with banks for supporting credit lines during shocks (energy, logistics), conditional on maintaining employment and investing in efficiency.

Brief assessment of models for Bulgaria

- What to take from the Continental model: long-term banking relationships, co-management, cluster policies, and export tools — for industry stability and lower closure rates.

- What to retain from the Anglo-Saxon model: easy entry, fast procedures, and access to venture/growth capital — for high innovation dynamics.

- What to adapt from the Japanese model: deep supplier relationships and shared investments in quality and equipment — for resilient, highly reliable production chains.

Summary

The most suitable direction for Bulgaria is a hybrid model: flexible market mechanisms for creating new industrial firms, reinforced by Continental tools for long-term sustainability and clustering, and Japanese

discipline in supply chains and quality. This way, entrepreneurial activity is transformed into lasting industrial capacity, higher productivity, and accelerated, more sustainable GDP growth.

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Developing the Corporate Identity of Science & Research at the University of Economics - Varna through NLP Analysis

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Abstract

In the context of digital transformation and increasing competition in higher education, the development and management of the corporate identity of research institutions is becoming a strategic issue. The aim of this report is to analyze the corporate identity of Science & Research at the University of Economics – Varna by applying Natural Language Processing (NLP) methods, assessing how the institution is presented and perceived in the academic and business environment. The scope of the study is limited to the analysis of text data from scientific projects and official communication materials, without including visual or multimedia elements, which is a major research limitation. The research design combines theoretical analysis of corporate identity with empirical research based on an NLP approach. The methodology includes the use of BERT models for emotional and value tone analysis and LDA for identifying the main thematic directions. The results show that linguistic formulation has a significant impact on the perceived institutional identity, with even minimal linguistic changes leading to a significant change in assessments. The main conclusions point to a dominant technological orientation and insufficiently expressed value and humanitarian aspects in communication. The originality of the study lies in the application of NLP as an objective tool for analyzing corporate identity in an academic environment, and its practical implications are expressed in the possibility of optimizing institutional communication and the strategic positioning of research organizations.

Key words:

corporate identity; Natural Language Processing (NLP); BERT and LDA models; communication; digital transformation.

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1. Introduction

The twenty-first century is characterized by intense technological changes, digital transformation, and continuous innovation, which are radically changing the way we live, communicate, and work. Technologies are becoming a key factor in socio-economic development, providing unprecedented access to information and accelerating the processes of global integration. In the context of the digital age, access to information and innovation is a key condition for efficiency and competitiveness. For organizations and academic institutions, building a sustainable corporate identity is becoming a strategic necessity. It determines how the institution is perceived by its internal and external audiences and influences its ability to attract partners, researchers, and funding. This report examines the possibilities of natural language processing (NLP) as a method for studying perceptions and public attitudes towards a given organization. NLP is an artificial intelligence approach to extracting, classifying, and interpreting linguistic data, through which opinions and assessments in text sources can be analyzed. The focus of the study is on Science & Research at the University of Economics – Varna. The aim is to analyze the corporate identity and positioning of the institution in relation to the academic and business environment, using NLP methods to track how the institution is perceived and presented to its students, doctoral students, researchers, and partners.

2. Evolution of the CI concept

Corporate identity (CI) is a concept with deep historical roots. Its earliest forms are associated with trademarks and visual symbols (e.g., the Bass Brewery trademark registered in 1876 in the United Kingdom). The introduction of the term corporate identity by Lippincott and Margulies (1957) marked the beginning of a systematic understanding of identity as an organizational tool. In the 1970s and 1980s, it took shape as a strategic business category, and according to Balmer (1995) and Melewar & Saunders (2000), as a multidisciplinary framework combining culture, communication, behaviour, and visual design. Thus, corporate identity established itself as a strategic resource for trust, reputation, and competitive advantage (Dowling, 1986; Olins, 1989). According to Balmer's (2001) definition, corporate identity is "a set of characteristics that make an organization unique, authentic, and consistent." It includes visual elements, communication practices, cultural values, and organizational behaviour.

Table 1

Corporate identity concepts

Definition	Author
"A strategic resource for building trust and support among stakeholders and gaining competitive advantage"	Dowling (1986)
Identity reveals the "philosophy, personality, and behavior of the organization"	Olins (1989)
"Strategically planned and operationally implemented internal and external self-representation"	Van Riel (1995)
"Strategic tool and source of competitive advantage"	Bickerton (1999)
"Corporate identity consists of four constructs: visual identity, behavior, corporate culture, market conditions"	Melewar & Saunders (2000)
Identity is "shrouded in fog"	Balmer (2001)
"A visual representation of the real essence of the company through its name, its logo, motto, products, services ... and other tangible evidence created by the organization"	Ardjenti (2003)

Source: Author's work

3. Models and dimensions

Balmer and Soenen (1999) developed the well-known ACID test, according to which identity is analysed through four dimensions: Actual, Communicated, Ideal, and Desired. This typology allows for the diagnosis of discrepancies between reality, perception, and the vision of the institution—particularly useful in rebranding or strategic reformulation of identity—and can identify discrepancies between the real values and the perceived image of the organization. Van Riel and Balmer (1997) add three key dimensions of corporate identity—behaviour, communication, and symbolism—which function as an interdependent system.

4. Measuring identity

According to Vasileva, Palamarova, and Ivanov (2023), the measurement process goes through four steps:

- The process of analyzing and assessing corporate identity goes through several consecutive stages. First, a problem analysis is carried out, the purpose of which is to determine the need for an identity assessment and to identify the main challenges facing the organization. This is followed by a positioning assessment, which is

carried out using strategic analytical tools such as SWOT, PESTEL or Porter's analysis, which allow the organization to track its place in the external and competitive environment. The third stage includes a gap analysis, in which the previously set goals are compared with the existing state, in order to identify discrepancies between the real, desired and communicated identity. On this basis, the identity is adapted, in which, depending on the results, guidelines for change, optimization or rebranding are formulated.

In international practice, three methods are established as leading empirical approaches to studying corporate identity. The Laddering Technique allows for the identification of key values through in-depth interviews, the Balmer Affinity Audit examines the socio-psychological factors that shape identity, and the Rotterdam Organizational Identification Test (ROIT) measures the degree of employee identification through a standardized questionnaire with 225 indicators. Measuring corporate identity according to its main types – real, ideal, desired and communicated – requires the application of different research approaches, including qualitative interviews with management, strategic analyses to formulate guidelines, and analysis of media and communication content to assess the public image.

5. Identity in higher education

In the context of universities, corporate identity plays a dual role: 1. Internal (organizational) – it creates a culture of belonging, motivation, and shared values among teachers and researchers. 2. External (communication) – builds a public image that positions the institution in the academic and international space. According to Melewar et al. (2018), academic identity is a combination of mission, values, and strategic communication that builds academic brand and cultural capital. Higher education institutions are increasingly seen as brands that position themselves as communication ecosystems through digital communication and visual consistency (Holland, 2012). The lack of a strategic digital presence can call into question academic identity and international authority.

5.1 Research methodology

1. Conceptual model. The methodology is a combination of comparative analysis and empirical research using NLP. Three leading Bulgarian universities—Sofia University, UNWE, and Veliko Tarnovo University—were analysed to outline models of academic identity. The criteria include: name, visual identity, mission and vision, organizational structure, public behaviour, and strategic positioning.

2. NLP approach NLP combines artificial intelligence, computer science, and linguistics, using automated models for text recognition, classification, and interpretation. According to Verspoor and Cohen (2013), NLP analysis examines linguistic data through computational methods – documents, publications, social media opinions, etc. Feuerriegel et al. (2025) add that in a digital society, text communications are the main vehicle for perceptions, which makes NLP extremely valuable for institutional analysis. The empirical part uses BERT and LDA models to analyse texts from Science & Research scientific projects.

BERT (Bidirectional Encoder Representations from Transformers) analyses the emotional tone of the texts (Manuel-Ilie et al., 2023). BERT is a deep learning-based architecture used to analyse sentiment and semantic context, going through two stages: pretraining and fine-tuning.

LDA (Latent Dirichlet Allocation) identifies hidden thematic structures (Blei et al., 2003) by discovering hidden (latent) themes in texts through the distribution of words into thematic groups.

The analysis was performed in Anaconda Navigator using Spyder IDE and Streamlit for visualization.

The code models were developed using ChatGPT, and the data was processed in English for better linguistic consistency.

Research results

1. Analysis with the BERT model

2. Two experimental variants were conducted:
3. Variant 1: direct use of the original project descriptions.
4. Variant 2: reworking the texts while preserving the meaning, but with more natural and human expression.

The results show that in variant 1, all corporate elements (communication, culture, strategy, design, structure, behaviour, and industrial characteristics) were rated negatively, with an average confidence level above 0.95.

After linguistic editing (option 2), six of the seven elements shift to a positive tone, with confidence values remaining high (0.87–0.98). This confirms that linguistic formulation and communication context directly influence identity perception, especially in automated linguistic analysis.

Analysis with the LDA model

The LDA model identifies the main themes in the project descriptions.

Option 1 highlights topics such as the development of analytical templates for problem solving and prototyping of automation software.

In option 2, flexible solutions for organizational efficiency and institutional application templates are highlighted.

The most common thematic matches are with the corporate elements of design, behaviour, and strategy, which shows that the research is highly technology-oriented but with a limited social and communication focus.

6. Conclusions:

The combined analysis demonstrates that:

1. BERT reflects the emotional and value aspect of corporate identity, with linguistic formulations setting the tone of perception.
2. LDA shows the thematic depth and strategic priorities of the institution.
3. The lack of humanitarian vocabulary (values, ethics, culture) in academic texts limits the perception of a positive identity.

The conclusion for Science & Research is that it has significant digital and communication maturity, but needs to strengthen the humanities and value aspects of communication.

7. Conclusion

The Science and Research Institute has a recognizable identity based on scientific competence and partnership. There is a lack of linguistic consistency and human dimensions in project communication; in order to strengthen the effect of identity, it is necessary to introduce a clearer communication framework based on values, innovation, and culture.

The NLP models BERT and LDA prove that even small linguistic changes can alter the way an institution is perceived by the public.

Therefore, the task of modern university research structures is not only to communicate effectively, but also to embody their values in the language they use.

Corporate identity in the digital age is a dynamic system of values, communications, and behaviour in which technology can serve as a tool for optimization, but not as a substitute for human meaning. True identity is created by the interaction between technology and humanity – where "innovation meets meaning, and technology meets humanity."

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Challenges and Perspectives for Entering the Electric Vehicle Market in India**Danika LECHEVA¹**¹ University of Economics - Varna, Varna, Bulgaria, d.lecheva@ue-varna.bg

JEL: M31**Abstract**

This research explores the most effective approach for entering the Indian EV market, analyzing the challenges and opportunities using Tesla's case study as an example. The purpose is to evaluate the market attractiveness and identify a suitable entry mode for international investors in the EV sector. The research is limited to an analysis of macroeconomic factors, consumer behavior, government incentives, and competitive dynamics specific to India. A theoretical framework for international marketing planning is applied to assess market potential, analyze the consumer base, and evaluate entry strategies including exports, franchising, joint ventures, and wholly owned subsidiaries. The study finds that Tesla's or another business's successful market entry depends on the alignment with India's localization requirements, navigating regulatory challenges, and responding to infrastructural constraints. Government incentives and growing environmentally conscious consumer base offer potential advantages for entering the market. Joint venture appears to be the most suitable entry mode for an entrant, given India's policy landscape and market dynamics. This research uniquely combines market attractiveness analysis with an evaluation of Tesla's global strategy to derive insights applicable to other international EV companies. The findings of this study are relevant to automotive firms, investors, policymakers and researchers, offering strategic insights into electric vehicle market entry and growth opportunities in emerging economies like India.

Key words:

marketing planning, entry
modes, electric vehicles,
market attractiveness, India.

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1. Introduction

Electric vehicles (EVs) are a highly topical subject because of people's concerns about air pollution, climate change, and the need for cleaner resources. The World Health Organization's (2024) report states that in 2019, outdoor pollution is said to cause the death of 4.2 million people worldwide. Approximately 89% of the deaths in the world were in the Western Pacific Region and Southeast Asia. In 2021, 70% of Chronic Obstructive Pulmonary Disease (COPD) deaths in India were because of air pollution. Every year more than 2 million deaths are linked to air pollution in India (Statista, 2025). Due to the growing population, increasing pollution, and decreased air quality, transitioning to EVs in India has the potential to bring about a significant change in the country's future. The interest of the people is rising fast by many government incentives, technological innovations, and shifting consumers preferences towards EVs. On the other hand, there are many challenges like problems with charging infrastructure, finances, and people's attitudes. Many factors influence customers' buying behavior such as range, affordability, cars' overall performance, and beliefs. A real-world example is how the global giant Tesla is trying to enter the EV market in India navigating and changing the tariff policies and market dynamics. From a business perspective, India is one of the fastest developing countries which sets many opportunities for companies to establish manufacturing focused on EVs. The position of India as a major driver of global growth is kept in 2025 as it is reported that up to the moment the growth is 6.8% (The Economic Times, 2025). This study focuses on the marketing planning process by analyzing all the obstacles, perspectives, restrictions, cultural differences, etc., to develop an effective market entry strategy for EVs in India, despite the entrance barriers. The subject of the research is the market

attractiveness of EVs market in India, Southeast Asia for new market entrants, what are the customers' attitudes towards EVs and their experiences with the greener alternative. The research aims to analyze the challenges and opportunities for entering the EV market in India by exploring key factors such as infrastructure readiness, political factors and incentives, customers' attitudes towards EVs, the competitive landscape, and setting a strategic framework for a new market entry based on the case of Tesla's current situation providing up-to-date practical implementation.

2. Literature Review

2.1. Marketing planning

The marketing planning process is an essential part of the marketing management, as an organized process, resulting in a marketing plan, which helps companies to examine market opportunities, set objectives and create strategies for entering and competing in domestic or international markets. Central to the marketing concept is the idea that marketing is a matching process between a company's capabilities and the factors of the environment. A variety of definitions, frameworks and methods for comprehending the marketing planning process are provided by marketing experts including McDonald (2007), Scott and Davis (2008), Marian Burk Wood (2013) Kotler and Keller (2016), Pearson and Malthouse (2024) and others.

Malcolm McDonald (2007) approached that the marketing planning is structured step-by-step process aligning marketing strategies with the organization's objectives. The planning is kept internal, but external analysis such as SWOT and PEST(EL) analysis are also important. The key steps for conducting the marketing planning are Situational analysis, Objectives, Strategy, Budgeting, and Control and Implementation phases. McDonald (2007) provides a classic business model that could be very practical and structured, valuable for more stable and well-known markets.

Scott and Davis (2008) emphasize that entities are open systems that should adapt their operating system to the influence of the external factors as well as the internal. The marketing planning should be an adaptive process as the environment is central. No defined steps are defined as the planning should constantly adapt to changes not dependent on the inner structure of the company. It is very useful for markets that are fluid and very politically dependent, such as the EVs market in India.

Marian Burk Wood (2013) contributed to the evolution of the marketing planning process by setting a highly structured framework focused on internal business processes and customers' values. It is designed to show the importance of market research, segmentation, targeting, positioning, and marketing decisions in evaluating an effective marketing plan. Her model is valuable for small businesses and educators, who seek immediate application.

Strategic and tactical marketing management play a vital role in establishing the Kotler and Keller's (2016) approach by explaining how the development of strategies together with marketing programs can make a strategic marketing planning process. It highlights the focus on customers that align with the values of the business organization using tactics such as the 4Ps analysis (Products, Price, Place, Promotion). In this process of marketing planning, we can observe a well-defined structure. After identifying the business mission and conducting the SWOT analysis, the goal and the strategy should be formulated. The program formulation and the implementation are significant for the success of the process as well as the controlling and checking afterwards.

In the paper Fifth Generation Integrated Marketing Communication (IMC), Stewart Pearson (2024) and Edward Malthouse (2024) propose a new model that focuses on the expansion of the marketing planning process including the people and the planet to the profit. Their paper highlights the importance of building long- term trust and transparency across the ecosystem involving the employees, regulators, customers, and communities, etc. Pearson and Malthouse (2024) state that the marketing planning should adapt to the big

crises worldwide such as COVID- 19, environmental changes that have a huge impact on society. Their research contributes to the marketing planning evolution as it adds values to the already established planning models.

After reviewing various marketing planning approaches, the author adopts McDonald's (2007) framework for its clarity, structure, and usefulness in guiding market expansion into emerging sectors such as India's EV market. The framework begins with a situational analysis of internal and external factors influencing performance and incorporates Scott and Davis's (2008) open systems approach to highlight interactions with external forces. Overall, McDonald's model provides a clear, step-by-step method for developing effective entry strategies in complex markets shaped by government policies, infrastructure, and competition.

2.2 International markets entry modes

In today's economy, which is highly globalized, businesses seeking international expansion must adopt a strategic approach to market entry. The marketing planning process is essential for ensuring that companies successfully manage their businesses, adopting consumer demand and gaining competitive advantage. The connection between marketing strategy and business success in international markets has been explored in depth by scholars. Cavusgil and Zou (1994) contribute to the idea of success in export ventures when company's marketing strategies are similar with what they are offering domestically and internationally. This idea is beneficial when entering fast-changing markets but could be a failure if the target market's environment is completely different from the domestic one in terms of infrastructure, government policies, etc. (Hollensen, 2017). The well-known types of entry modes such as exporting, licensing, franchising, joint ventures, subsidiaries, and foreign direct investment (FDI) (Brouthers et al., 2022; Canabal & White, 2008; Elia et al., 2019; Ngoasong et al., 2021) form the final outcomes of the entrance. Each of the options has its own pros and cons (Table 1) that should be very carefully evaluated in the process.

Table 1

Characteristics of main international markets entry Modes

Entry Mode	Definition	Advantages	Disadvantages	Best For
Exporting	Selling ready products from the home country to a foreign market	Low risk & cost Fast entry Control over production	Less control High logistics cost Trade barriers	Testing new markets; limited international experience
Licensing	Allowing a local firm to use intellectual property (IP) such as trademarks and patents in exchange for royalties	Minimal investment Quick access Good for IP-based products	Less control IP misuse risk Lower returns	Firms with strong tech/brand but limited resources
Franchising	Granting rights to operate under brand & format	Rapid expansion Risk is on franchisee Local partner knowledge	Brand inconsistency Requires strong business systems	Retail, food, service industries with standardized models
Joint Venture	Partnership with a local firm to create a new, shared entity	Shared risk/cost Local expertise Political legitimacy	Conflict risk Shared profits Complex management	Regulated/high-barrier markets; need local insight

Foreign Direct Investment (FDI)	Direct investment in facilities or operations abroad.	Full control Long-term integration Strategic presence	High financial risk Complex legal & regulatory compliance	Large firms with long-term strategic market interest
Subsidiary	A company established and controlled by a parent company in a foreign country.	Maximum control Brand consistency IP protection	High operational costs Cultural/managerial challenges	Firms committed to full-scale operations and market ownership

Source: Author's work based on Cateora (2020), Cavusgil (2022), Hollensen (2017), and others.

2.3. Research Statements

The reviewed literature highlights the importance of structured marketing planning frameworks, such as McDonald's (2007), in guiding market entry decisions. Studies further emphasize that entry mode selection is influenced by multiple factors, including market conditions, government policies, and competitive dynamics. However, limited empirical evidence exists on how these factors specifically affect entry strategies within emerging sectors like India's EV market. To address this gap, the present research employs hypothesis testing to examine the relationship between key market variables and the choice of entry mode. This approach allows for a systematic analysis of the factors that determine the most effective strategy for market entry. The main issues to be considered in this journey are:

Research statement 1: The development of the EV market in India is significantly influenced by infrastructure challenges, policy inconsistencies, and cost barriers, but is supported by rising environmental awareness and government incentives.

Research statement 2: Indian consumers generally view EVs positively due to environmental concerns about charging infrastructure, range limitations, and trust in brands reduce willingness to adopt.

Research statement 3: Strategic partnership or joint ventures are the most suitable entry modes for international EV firms entering India, as they help navigate regulatory challenges, share risk, and leverage local market knowledge.

3. Material and Methods

The literature review is based on the examination of existing reports, studies, papers, and books with additional personal insights. A market analysis is constructed based on current market situation, macro environmental factors affecting business's operations such as competitor evaluation and industry reports. The market attractiveness is evaluated by setting KPIs for assessment. A choice for potential target market and entry mode is made based on Tesla's case study. Recommendations are proposed for further implementation. For the identification of the challenges and opportunities for foreign EVs manufacturers to enter the Indian market, market analysis and customer experience evaluation, quantitative research was conducted between April and May 2025. The study is inductive and cross-sectional providing a snapshot of Indian people's current concerns, attitudes, motives for purchasing and overall mindset toward EVs. The research is based on qualitative data gained using a snowball sampling between 42 respondents living in different locations, having different age and driving experience with EVs to ensure a diverse combination of demographics. The initial participants were identified through online communities and friends' contacts. A structured online questionnaire was created using Lime Survey, consisting of 5 sections and 22 questions, including open-ended and close-ended questions. Each section had the aim to mark main elements of the study such as demographic background of the respondents, ownership and usage of EVs through Indians, satisfaction with EVs' performance and features, charging infrastructure

readiness and accessibility, and main challenges and concerns surrounding the electric vehicle. The survey was anonymous and no sensitive data was used.

3.1. Methodological Framework

This study hinges mainly on McDonald's (2007) marketing planning process vision to analyze the macro environment of the Indian EV market and choose the best entry mode. The adopted theory is McDonald's as the aim of it is clear, structured and is beneficial for companies that look for market expansion into an emerging market such as the EV market in India and need an effective entry strategy. McDonald's (2007) approach provides a structured way for evaluating an effective marketing planning process easier. It offers a step-by-step roadmap integrating the open system approach from Scott and Davis (2008) stating the relationship between the company and the outside dynamic forces. The marketing planning framework of McDonald (2007) offers clarity when making decisions on entering new consumer market such as India because it is shaped by many government policies, infrastructure gaps, local competitors, etc.

Thus, the methodological framework (Fig. 1.) is based primarily on the literature review chapter, showing the importance of the connection between the marketing planning process and marketing strategies for the contribution of a successful assessment of a market. The market attractiveness together with understanding of attitudes (identified by additional research) will lead to implementing the right international marketing strategy. In this way, the right entry mode can be chosen and further examined considering many important factors that are significant in the formulation and implementation of an entry strategy for a new market.

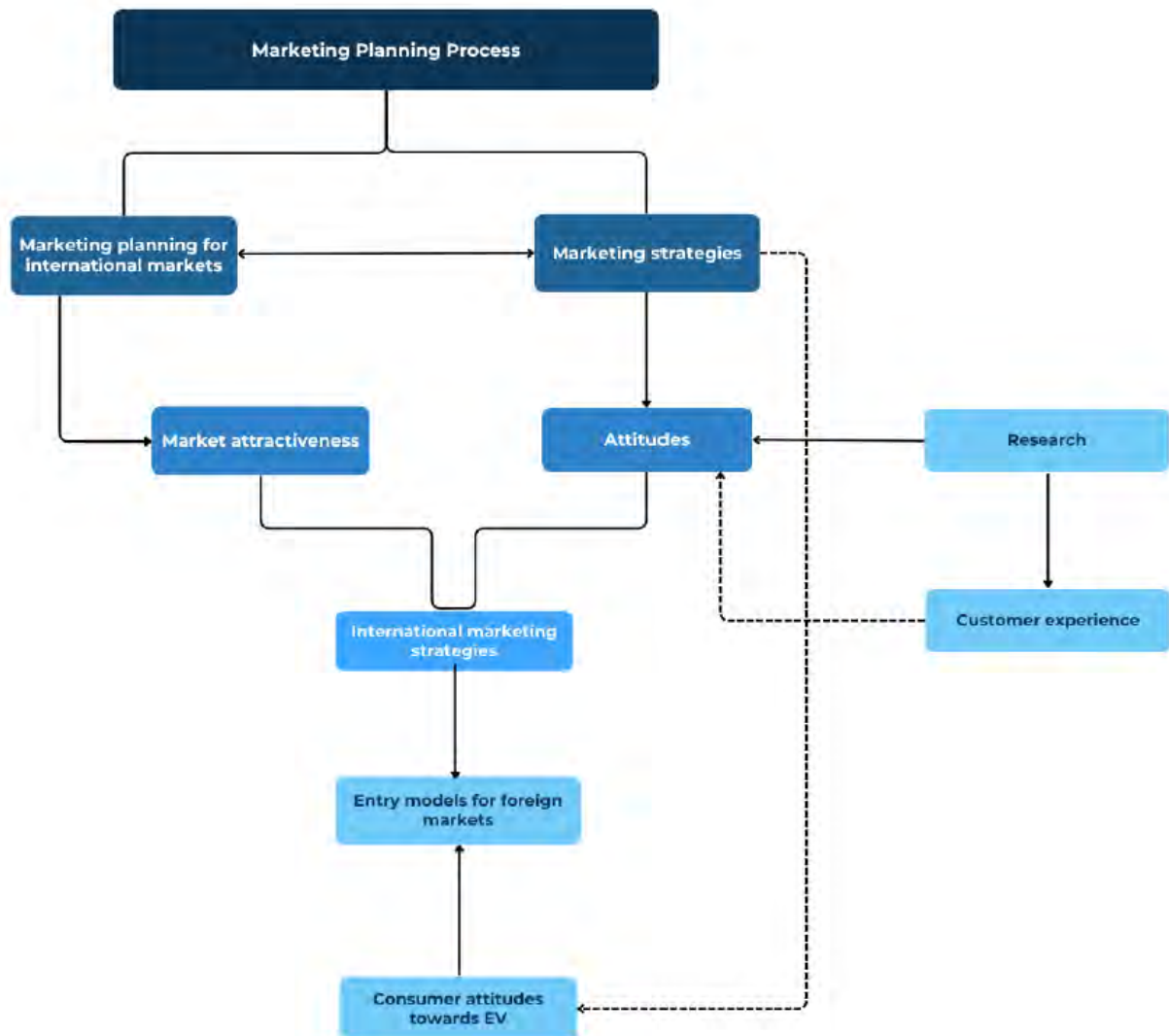


Fig. 1. Conceptual model of the paper

Source: Made by the author

3.2. Selection of an entry mode

3.2.1. Market Assessment

For a successful and reliable assessment of the market attractiveness of the India EV market several frameworks are applied:

Porter's Diamond Analysis

Factor conditions include that India is a country famous for its technical specialist and many significant R&D investments in EV and battery innovations, but the inadequate charging infrastructure sets challenges for the adoption and the supply chain of EVs.

Demand conditions are expressed by the rising number of the middle-class people and environmental concerns of the Indian population. The growing prices of fuel drive and many government incentives further stimulate the demand for greener transport.

The industries that are related and support are mainly part of the technology sector such as telecommunications companies, IT specialists and many automotive suppliers.

A firm's strategy, structure and rivalry play key roles in shaping the place in competition. In the Indian EV market there is strong competition faced by domestic companies such as TATA Motors and Mahindra which is encouraging for new entrants to be more innovative and provide more affordability. BYD and MG, foreign competitors operating on the Indian market, provide competitive landscape persuading new entrants to better services and higher product quality.

Additional factors that influence and fasten the transition to green alternatives are the many governmental incentives and EV policies which further contribute to the market attractiveness.

Porter's Diamond Model shows how dynamic and promising is the market for electric vehicles in India. The most valuable factors that improve the EV industry are human resources development, government support, and increasing consumer demand. However, companies should take into consideration the infrastructural unreadiness, potential supply chain problems, and regulatory challenges. At the same time, India offers a growth market for electric vehicles that has a great potential in the long-run.

PESTEL Analysis

India is a leading democratic country which has a diverse culture and is in the 1st place by population with approximately 1.438 billion people. The country's GDP is growing constantly, seeking new investors. For better analysis of the current macro environment a PESTEL analysis is conducted:

India is *politically* stable overall, though tensions in Jammu and Kashmir risk supply chain disruptions. Bureaucracy is slow, raising costs and delays, while corruption (index score 38 in 2024) often requires unofficial payments despite gradual improvements. The 2017 Goods and Services Tax simplified taxation, shaping financial planning. Strong ties with Europe also support investment in the country.

India's *economy* is strong and growing, ranked fifth globally with GDP projected to reach USD 7 trillion by 2030 (Statista, 2025). Rising GDP boosts consumer spending, while inflation has eased to 4–5% and unemployment has dropped to 4.2% (World Bank, 2025). Exchange rate fluctuations affect trade, but fiscal policies and infrastructure investments create opportunities for businesses. EV growth is supported by charging infrastructure and policies like the SPMEPCI, which ties imports to local manufacturing investment. The government is also working to reduce import barriers, attract foreign automakers, and promote sustainability, boosting consumer confidence and expanding the EV market.

India's *social* environment is shaped by its large and youthful population, with a significant share in the working-age group. Urbanization, rising education levels, and an expanding middle class are driving demand for a wide range of products and services, though low-income groups remain important. Growing environmental awareness, driven by severe pollution, is encouraging adoption of EVs and other green products. Changing lifestyles, globalization, and higher female workforce participation are boosting household incomes and spending. Widespread internet and smartphone use support the growth of e-commerce, while migration from rural to urban areas is increasing demand for better infrastructure and opportunities.

India is emerging as a *technology* leader, driven by its strong IT sector, achievements in space exploration, and ongoing 5G network expansion. Growing internet, mobile, and social media usage support the rapid rise of e-commerce, offering businesses access to wider audiences. Government support for research and development further encourages innovation and strengthens India's position as a hub for technological growth.

India faces major *environmental* challenges, including air and water pollution, climate change, and frequent natural disasters. The government is addressing these issues through stricter regulations, anti-pollution campaigns, and incentives to reduce reliance on fossil fuels. Urban and rural populations rely on different water sources, making water scarcity a critical concern. Rising environmental awareness and sustainability initiatives are increasing demand for eco-friendly products and pushing companies to adopt greener

technologies, though this can raise costs. India also seeks to strengthen its role in the global clean energy chain by boosting battery production and EV component exports, despite limited reserves of key resources like lithium and cobalt.

India has a strong *legal* framework covering labor, environmental, and corporate laws. Recent changes, such as stricter recycling rules and higher minimum wages, have increased business costs and affected financial planning. Compliance is essential to avoid penalties and ensure smooth operations. Key protections include foreign exchange, consumer rights, data privacy, intellectual property, and sector-specific regulations.

After careful evaluation of the trends and setting an assessment for each of them, the following weight evaluation table (Table 2) is constructed:

Table 2**Factors' Weights Evaluation Indicator Weight Assessment**

Indicator	Weight	Assessment	Quota
Political factors			
Political stability	0.2	3	0.6
Bureaucracy	0.1	2	0.2
Corruption	0.1	2	0.2
Trade policies and taxes	0.3	5	1.5
European union (EU) relationship	0.3	5	1.5
Total:			4
Economic factors			
Economy	0.1	5	0.5
GDP growth	0.05	5	0.25
Inflation rate	0.2	4	0.8
Unemployment	0.05	5	0.25
Exchange rate fluctuation	0.1	4	0.4
Fiscal policy	0.2	5	1
Government incentives	0.3	5	1.5
Total:			4.7
Social factors			
Environmental awareness	0.3	4	1.2
Population	0.1	5	0.5
Population growth rate	0.05	3	0.15
Age distribution	0.2	4	0.8
Education level	0.1	4	0.4
Lifestyle	0.15	4	0.6
Internal migration	0.1	4	0.4
Total:			4.05
Technological factors			
IT sector	0.3	4	1.2
Mobile network adoption	0.3	4	1.2
R&D sector	0.4	4	1.6

Total:			4
Environmental factors			
Air pollution	0.2	4	0.8
Water pollution	0.2	3	0.6
Waste disposal	0.2	3	0.6
Natural disasters	0.3	1	0.3
Sustainability	0.1	5	0.5
Total:			2.8
Legal factors			
Labor law	0.5	3	1.5
Environmental law	0.5	3	1.5
Total:			3
Total assessment:			23/6=3.83

Source: Author's work

All weights are based on their effects on the success of business operation in the Indian EV market:

Political factors: The EV sector is strongly influenced by government policies and institutional processes. Corruption can affect operational efficiency and investment, while trade policies and taxes impact purchasing, ROI, and revenue. Positive relations with the EU reduce trade barriers, lower taxes, and provide incentives such as the FAME II and FAME III schemes, promoting EV adoption.

Economic factors: India's growing economy and GDP support new business opportunities. Declining inflation and unemployment increase consumer purchasing power and incomes. Exchange rate fluctuations can raise international trade costs, but supportive fiscal policies and government incentives create favorable conditions for businesses.

Social factors: Rising environmental awareness is shaping consumer mindsets, with EVs seen as a way to reduce environmental impact. India's large, youthful population creates strong demand, particularly among younger consumers. High education levels, especially in IT, support innovation, while lifestyle changes and urban migration drive the need for affordable, sustainable transport.

Technological factors: India's advanced IT sector and space achievements strengthen its position as a tech leader. Expanding mobile networks enhance connectivity and business operations. Government-backed R&D drives innovation, improving quality of life and creating opportunities for new solutions.

Environmental factors: Environmental challenges remain significant, with pollution, natural disasters, and waste management issues posing risks. Stricter disposal rules and sustainability initiatives, however, build consumer trust and encourage businesses to innovate eco-friendly products.

Legal factors: India's strong legal framework requires compliance, particularly for EV entry, which demands high initial manufacturing investments. At the same time, government incentives such as FAME schemes and tax reductions encourage EV adoption and foreign investment.

The result of the analysis of the macroenvironment indicates that India has overcome the neutral zone with an assessment of 3.83 as it position it as a country with more opportunities than risks. Overall, India's macroenvironment shows more opportunities than risks, positioning it as an attractive market for EVs. Favorable demographics, supportive policies, and growing environmental awareness drive long-term growth and profitability. Short-term challenges like infrastructure gaps, price sensitivity, and safety concerns remain, but the outlook for the EV industry is highly positive.

Porter's Five Forces Analysis

Competitive rivalry: Medium to high

The Indian EV market has several well-established players, both domestic (TATA Motors and Mahindra Electric) and foreign (MG, BYD, and Hyundai). Competition is intense, driven by product variety, pricing, and government policies that stimulate EV adoption and investment.

Threat of new entrants: Medium to high

Government incentives like FAME II and "Made in India" support new entrants, but high initial investment, R&D costs, regulatory requirements, and limited charging infrastructure pose significant barriers.

Bargaining power of buyers: High

Consumers are increasingly eco-conscious but remain price-sensitive, often preferring cheaper ICE vehicles. B2B buyers favor greener alternatives for cost efficiency and customization. Limited charging infrastructure also influences purchase decisions.

Bargaining power of suppliers: Low to medium

Battery supply is critical, with most high-capacity cells imported from China, though local manufacturers are growing. Other vehicle components are readily available domestically, keeping supplier power moderate.

Threat of substitutes: High

ICE vehicles remain the main substitute due to affordability and variety. Public transportation options such as buses, trains, and metros also provide alternative mobility solutions.

Key Performance Indicators for Market Attractiveness Assessment

For making the right strategic decisions for expansion the following key indicators for assessment of the market attractiveness are being explored:

Market size and growth rate

The EVs industry in India is rapidly growing, promoted by government incentives, environmental concerns and technology innovations. The country has an aim to achieve more than 80 million electric vehicles for different purposes by 2030. Also, with the "Made in China" initiative, the government wants to improve the EV manufacturing industry as well. The Indian EV market is assessed at \$3.21 billion for 2022 potentially to grow to \$113.99 billion by 2029, growing at a compound annual growth rate (CAGR) of 66.52% (Fortune Business Insight, 2023). This indicates expansion opportunities in the Indian EV sector.

Regulations

The regulation policies in India are strong but at the same time improve the entry as it filters the entering players. Government EV policies enhance the transparent business processes for one less corrupt country.

Infrastructure readiness

The charging infrastructure is also very needed for charging the increasing number of electric vehicles as it is a key determinant for the accessibility of the electric vehicles. Instead of the government incentives for improving the charging infrastructure, other companies like Hyundai Motor India are also making investments in increasing the number of charging stations.

Consumer adoption rates

The level of adoption of the EVs among Indians is rising very fast as from 0.7% in 2020 it went to 6.3% in 2024. This is around 5 million vehicles, which indicates the strong demand and market readiness (World Resource Institute, 2025).

Financing accessibility

The subsidies, loans and many other leasing options are favoring the EV market. These are influencing the demand, purchasing power and the level of adoption.

Market entry barriers

The market barriers can be described as medium level as the government sets requirements for entering the market such as investing in the manufacturing industry to support domestic production.

Customer Experience

Understanding customer experience is crucial for evaluating the attractiveness of India's EV market. In an emerging market like India, consumer preferences are shaped by concerns, attitudes, and environmental awareness. A survey of 26 existing and potential EV users was conducted to assess satisfaction, key purchase motivators, readiness of charging infrastructure, main competitors, and customer concerns, providing insights into areas needing improvement.

Demographic questions

Most of the respondent of the survey are young and middle-young people, almost equally distributed between males (60%) and females (40%). Most of them live in urban areas and earn middle income, well-educated open for transition to greener alternatives.

EV ownership and usage

Only 1/3 of all researched people have ever owned or driven an EV and almost half of them used the strongly identified competitor on the EV market- TATA Motors (Fig.2.). Most people shared their considerations on the purchasing of an electric vehicle in the future.

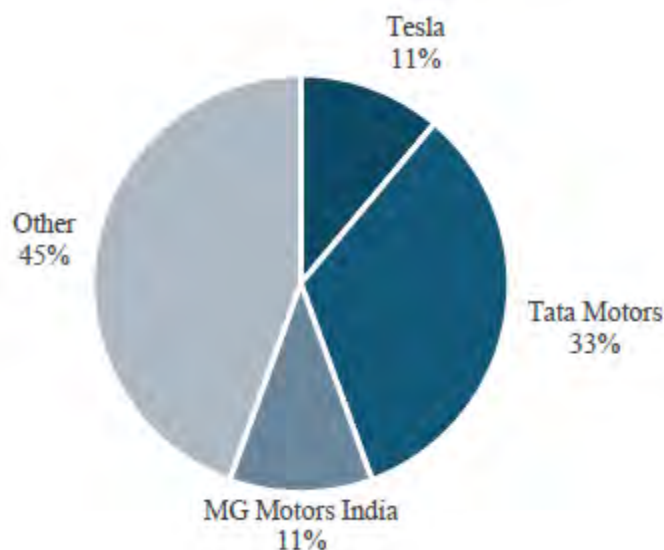


Fig. 2. Preferred brands of EVs by the respondents

Source: Made by the author

Satisfaction of EV's performance and features

Most of the users of EVs are relatively satisfied with their purchases as the average satisfaction score of the people surveyed is 2.4 (1-completely satisfied; 5- completely dissatisfied), which is below even the middle of the scale indicating relatively low satisfaction with the usage of EVs. There is still a gap for improvement of the services and infrastructure readiness to stimulate the promotion of EVs.

Charging infrastructure, accessibility and costs

Based on the answers of the surveyed people, half of them is experiencing charging infrastructure issues in their areas in terms of availability, which shows negative impacts on the customers' experience. They describe them as very limited. The average score of the importance of cost in purchase decisions is 4.15 out of

5 showing the high impact of price sensitivity in the buying process. Most of the Indians find the prices of an EV as somewhat reasonable compared to traditional ICE vehicles but almost 1/3 of them argue that they are unjustified further expanding the price sensitivity as a challenge for better customer satisfaction.

Key motivators for a purchase decision

Tax breaks, subsidies and other governmental incentives (Table 3) are key motivators for the purchase decision. This was further examined in the survey, as the respondents chose the cost savings with an average score of 4.26 and environmental concerns with a score of 4.11 as top motivators when deciding on buying an electric vehicle. Regarding the government incentives (3.74), the lowest driver, can be improved by decreasing the period for implementation. The technological interest (3.89) can be described as moderate, lacking the appeal for innovation.

Table 3

Motivators for a purchase decision

Motivators	Average Score (1-5)
Cost savings	4.26
Environmental concerns	4.11
Technological interest	3.89
Government incentives	3.74

Source: Made by the author

Challenges and concerns

Indians pointed out that the charging stations are the biggest challenge that they face with the usage of electric vehicles. The attitudes towards the environmental impact of electric vehicles are different, but most people have positive opinions towards EVs. Not all people see the EV as a social status improver, but this can be changed as their perceptions also change.

3.2.2. Tesla's Entry into the Indian EV Market: Strategic Analysis

Selecting the right entry mode is crucial for businesses entering foreign markets. This analysis examines Tesla's potential entry into India's EV market, considering market potential, customer segments, and strategic recommendations.

Tesla Inc., founded in 2003, is a global leader in electric vehicles (EVs) and renewable energy solutions. Its mission, "to accelerate the world's transition to sustainable energy," and vision, "to create the most compelling car company of the 21st century," highlight its focus on innovation, sustainability, and customer-centric products. Tesla's business model emphasizes vertical integration, controlling everything from battery production to software updates and direct sales, ensuring high quality and operational efficiency. Its brand identity combines technological innovation, minimalistic design, and autonomous driving capabilities.

India, the world's fifth-largest automobile market, offers high growth potential for EVs but presents several barriers. High import duties (up to 100%) make foreign vehicles expensive, with a recently reduced tariff of 15% requiring a \$500 million local investment. Tesla's products, positioned as premium, face a cost-conscious consumer base. Underdeveloped charging infrastructure, strong domestic competitors (Tata Motors 62%, MG Motor 22%, Mahindra 7%), and regional regulatory variations further complicate entry. Policies like FAME II favor domestic manufacturers, and geopolitical tensions may influence consumer perceptions of U.S. tech.

3.2.2.1. Entry Mode and Strategy

Kotler and Keller's (2015) framework identifies multiple entry strategies: exporting, joint ventures, licensing, and FDI. Tesla initially employed limited direct exports but aims for long-term local manufacturing to lower costs and access incentives. A joint venture could ease regulatory challenges but conflicts with Tesla's control-oriented philosophy. Tesla's differentiation strategy emphasizes product quality, superior battery performance, innovative features, and aesthetic designs, supporting premium pricing. For India, adaptation to price sensitivity and functional needs is critical. Market entry should start in affluent urban regions like Mumbai and Delhi, gradually expanding with models tailored to local preferences.

Market Potential and Projections

To find the estimate Tesla's future market share in the Indian EV sector, a review of factors such as current automotive dynamics, prices, competitors and consumer behavior is made. In 2024, 4.3 million vehicles were sold with 5% growing rate from 2023 (The Economic Times, 2025; Fortune India, 2025). The EVs' number is also growing as in 2024 the EV were 1.9 million of all vehicles sold having 27% growth regarding to 2023 (Carboncopy, 2025). The country has a goal to reach by 2030 as 30% of all vehicles sold to be electric ones, which equals approximately 1.3 million EVs annually. Tesla can possibly achieve 5-7% market share (60 000-90 000 units sold annually) in 5 years after entry, if it localize production facilities and price its products competitively. This will position Tesla as a premium EV company between foreign and domestic competitors. If Tesla do not localize the production and set a price that is appealing to the Indian customers, it may face only 1-2% of market share having only customers from high-end urban class. The brand equity of Tesla will help, but if its operations are not adapted, Tesla's influence will stay symbolic rather than structural. The last entrant of the EV market in India is VinFast, a Vietnamese company, which invested \$2 billion for establishing a manufacturing plant in Tamil Nadu, India, but still hasn't made the first sale due later in 2025 (The Economic Times, 2025). Citroen India started operating on the market in 2023 and has a current market share of 2.53% but is still the last market entrant with measurable market presence (Oorja, 2023).

The whole Indian EV market is projected to grow to 3 million units by 2030 and if Tesla is focused on the premium segment as their cars are prices around \$30 000. This segment represents about 8-10% of the total EV market which gives the company a potential target market of 240 000 to 300 000 vehicles per year (The Economic Times, 2024). The Serviceable Obtainable Market (SOM) is the part that Tesla can realistically reach if it considers factors like pricing, production, competition, etc. and if it manages to succeed in localizing the production to avoid the high import tariffs. Based on the performance of the competitors like BYD and Citroen, a business that is in the state of Tesla can expect to reach 2-3% of the total EV market within the first years of entrance (Ajit Dalvi, 2023). If Tesla manages to align its business operation with local conditions and start the production inside the country, it can achieve in selling 40 000 to 60 000 vehicles annually by 2030. This represents 5-7% of the premium EV segment and around 2% of the overall EV market. The SOM for Tesla in India is based on secondary data and for more precisely calculations in real should be used also the brand- switching behavior among EV customers. According to a survey by Deloitte (2025) 72% of the owners of EVs are willing to switch to another brand. This indicates the opportunity for Tesla to capture new customers who are not satisfied with their current EV brand. Starting with the SAM for this segment, which is 240 000 to 300 000 vehicles annually by 2030, and applying the 72% brand- switching rate it equals 172 800 to 216 000 consumers that are able to use Tesla. From this group the company's actual SOM will be based on the pricing strategy, production, competitive positioning, etc. If Tesla thrive to appeal to at least 25% of the switchers, the obtainable market will be approximately 43 000 to 54 000 vehicles annually.

These calculations are based on the theory available and for further and more valuable and realistic result, primary data, conducted surveys and behavioral data regarding Tesla's brand in the Indian context should be used. The available studies such as those by Frost & Sullivan (2024) and The Economic Times (2024) show

that Tesla can realistically achieve 2% market share in the first years based on the models of the last market entrant Citroen and cannot surpass its market share. This is an ambitious goal but an achievable one also, motivated by Tesla's strong brand reputation and India's fast growing environmental concerns and interest in green mobility (Sathyanarayana Kabirdas, 2025; BBC News, 2024).

Strategic Opportunity

India's young, urbanizing population and growing environmental awareness position it as a strategic market. Government incentives, increasing infrastructure, and rising R&D investment enhance potential. A "glocal" approach—combining Tesla's global technology with local customization—can maximize market penetration, offering high-quality, durable, affordable, and climate-adapted vehicles. Successful entry requires careful alignment with local regulations, pricing strategy, and customer expectations.

4. Conclusion and implications for future research

The global shift from traditional ICE vehicles to EVs offers both challenges and opportunities, especially in emerging markets like India. This analysis of India's EV market, using theoretical models, consumer surveys, and macro-environmental assessment, highlights rapid growth driven by government incentives, technological innovation, changing consumer preferences, and rising environmental awareness. Key challenges include limited charging infrastructure and high vehicle costs, though public-private initiatives are addressing these barriers. While adoption is currently low, it is expected to rise with urbanization, as consumers increasingly seek sustainable, affordable, and innovative solutions—factors critical for any business entering the market.

After reviewing the entry modes characteristics, the joint venture is chosen because it offers shared risks, investments costs, and experienced partnership with an already established business which understands the Indians' behavior and legal procedures. This entry mode is benefited by its connection with one of the primary incentives in India- "Made in India", through which the government wants to grow the manufacturing sector in the country.

For improving the level of demand and spread more awareness of EV's characteristics, the private companies and the government can start campaigns and promote events for physical contact thus increasing people's interest. For larger audience, social media publications can be created as well as persuasion of different target groups.

Overall, the paper identifies the main challenges and perspectives that the EV market in India offers to foreign investors by exploring Tesla's case study to gain current insights from a real-world example. The market possesses all opportunities for sustainable growth and further innovations. India has the potential to become a global leader in the electric automotive industry, considering the target market, strategies and policy alignment. The research presents a framework for a promising EV market entry, focusing on the increasing demand for local manufacturing, many R&D investments, and supported collaborations further ensure the long-term growth and success of the Indian EV market.

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