

PROCEEDINGS

of International Scientific and Practical Conference

SUSTAINABILITY AND ECONOMIC RESILIENCE

in the context of global systemic transformations

4th EDITION

CHIȘINĂU, 2025

Academy of Economic Studies of Moldova

Department of Economic Theory and Policy

PROCEEDINGS

**International Scientific and Practical Conference,
4th Edition, March 27-28, 2025, Chişinău, Moldova**

**SUSTAINABILITY AND ECONOMIC
RESILIENCE IN THE CONTEXT OF GLOBAL
SYSTEMIC TRANSFORMATIONS**

Chişinău, 2025

CZU 3(082)

S 94

Proceedings of Scientific Articles Presented at the International Scientific and Practical Conference "Sustainability and Economic Resilience in the Context of Global Systemic Transformations", 4th Edition (March 27-28, 2025)

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Layout and technical editing: Tatiana BUCOS

**DESCRIEREA CIP A CAMEREI NAȚIONALE A CĂRȚII DIN REPUBLICA
MOLDOVA**

"Sustainability and Economic Resilience in the Context of Global Systemic Transformations", International Scientific and Practical Conference (4 ; 2025 ; Chişinău). Sustainability and Economic Resilience in the Context of Global Systemic Transformations : International Scientific and Practical Conference : 4th Edition, March 27-28, 2025, Chişinău : Proceedings / editorial board: Tatiana Bucos [et al.] ; scientific committee: Stratan Alexandru (Moldova), Topor Ioan Dan (România) [et al.]. – Chişinău : [S. n.], 2025 (SEP ASEM). – 395 p. : fig., tab. color.

Cerințe de system: PDF Reader.

Antetit.: Academy of Economic Studies of Moldova, Department of Economic Theory and Policy. – Referințe bibliogr. la sfârșitul art.

ISBN 978-9975-168-27-4 (PDF).

3(082)

S 94

ISBN 978-9975-168-27-4 (PDF).

DOI: <https://doi.org/10.53486/ser2025>

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The preparation of this proceedings volume was supported by the ASEM Scientific Library through UDC indexing, bibliographic editing, assignment of DOI identifiers, and coordination of indexing in international scientific databases.

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EDUCATIONAL RESILIENCE THROUGH E-LEARNING: HOW HIGHER EDUCATION ADAPTS TO GLOBAL CHALLENGES

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Abstract: In recent years, universities around the world have had to rethink how they operate, responding to major challenges such as the COVID-19 pandemic, armed conflicts, and economic instability. This study explores how online education has evolved from a temporary solution adopted during crises into a continuously applied instrument, capable of ensuring educational resilience through the structural transformations involved in integrating digital learning into higher education. The article examines academic literature, institutional best practices, and regulatory adjustments that have accompanied the accelerated adoption of digital technologies in education. Particular attention is given to essential elements of e-learning, such as student-centered teaching, the development of flexible digital infrastructure, and policy frameworks that allow for rapid adaptation. The findings indicate that, when properly implemented, digital education can reduce inequalities, maintain academic cohesion, and provide students with real autonomy in unstable contexts.

Keywords: Educational resilience, E-learning, Higher education, Digital transformation.

UDC: 378.018.43:004(100)

Classification JEL: I23, I28, O33.

1. Introduction

In a world marked by instability, higher education has been forced to adapt rapidly to unexpected pressures such as pandemics, conflicts, and economic crises. These challenges have demonstrated that ensuring the continuity of teaching and learning during times of crisis can no longer be addressed in isolation but instead requires a comprehensive vision capable of supporting institutional resilience.

Initially adopted as an emergency measure, e-learning platforms have become fundamental tools used by academic institutions to organize their daily activities. This article is grounded in the idea that digital transition is not merely a technological shift within universities, but a profound reorganization of educational processes. The study analyzes key elements that support this institutional transformation: digital infrastructure, pedagogical approaches, and regulatory frameworks.

2. Literature Review

The growing literature on digital education and resilience in higher education has coalesced around several key themes: the transformative potential of online learning, the necessity of institutional adaptability, and the complex interplay between student agency, pedagogy, and technological infrastructure during times of crisis.

Several studies have examined how universities worldwide responded to the COVID-19 pandemic by rapidly transitioning to e-learning. Wang (2024) underscores that fostering digital communities, offering personalized support, and embracing inclusive design are vital in enhancing educational resilience during crises [1]. Similarly, Aggarwal et al. (2021) identify faculty engagement and pedagogical innovation as decisive factors in facilitating successful transitions to digital formats [2].

Eri et al. (2021) provide student-centered insights, noting that learners from Australia and Asia demonstrated varying levels of digital resilience, with institutional support playing a critical mediating role [3]. Complementing this perspective, Kumalasari and Akmal (2020) emphasize that online learning satisfaction is directly linked to academic resilience, particularly when students are equipped with the necessary readiness for digital study [4].

Beyond the pandemic, broader discussions highlight the strategic imperative for universities to embrace digital transformation. Lane et al. (2014) argue that institutional flexibility and technological innovation are fundamental for higher education to remain competitive in a knowledge-driven economy [5]. Karim et al. (2024) extend this argument by documenting the expansion of blended learning and virtual collaboration tools as mechanisms to address socio-economic disparities in access [6].

From a pedagogical lens, Motz et al. (2023) and Bozkurt (2022) underscore the role of digital systems in fostering inclusive and adaptive learning environments [7], [8]. These systems, they argue, must be embedded in broader efforts to promote quality and equity in education, reinforcing digital competencies as a core dimension of institutional strategy. Sánchez Ruiz et al. (2021), examining a blended learning model in Spain, confirm that hybrid formats and digital tools significantly enhance students' adaptability, especially in technical disciplines [9].

Importantly, the literature also draws attention to the emergence of new student identities and forms of agency within virtual spaces. The work of Motz et al. (2022) highlights how digital communities, forged during times of isolation, became channels for collective resilience and protest, reshaping the dynamics of engagement and participation in higher education [10].

In synthesis, the reviewed studies converge on a shared conclusion: e-learning is no longer an auxiliary option, but a strategic platform for educational resilience. Its effectiveness depends on multidimensional readiness - pedagogical, technological, and institutional - supported by continuous innovation, equity-driven policy, and responsiveness to learner needs.

3. Methodology

This study applies a qualitative research design, relying primarily on document analysis to explore how digital education contributes to institutional resilience in higher education. The research synthesizes relevant academic literature, policy documents, institutional reports, and international frameworks to identify patterns, challenges, and emerging strategies.

Sources were selected from peer-reviewed journals, policy databases, and global educational organizations such as UNESCO, OECD, the European Commission, and the World Bank. Emphasis was placed on recent publications (2020–2024) that examine the intersection between digital transformation and crisis response in academic settings.

The methodological approach aims to offer a comparative lens across diverse higher education contexts. The selection of examples and policies spans institutions and systems from both developed and developing countries, allowing for a broader understanding of how resilience manifests under varying structural and socioeconomic conditions.

The analysis does not seek to produce statistical generalizations but rather to highlight key features and strategies that support adaptability and continuity in digital learning. Where applicable, the study also draws from case studies and strategic education recovery plans published in response to the COVID-19 pandemic and ongoing systemic disruptions.

This approach ensures that the findings are grounded in documented practice and policy, while also providing conceptual insights that may guide future educational planning and implementation.

4. Results and Discussion

Learner Resilience and the Democratization of Access Through E-Learning

The growing complexity of global systemic challenges - from the COVID-19 pandemic and regional conflicts to climate-induced displacement and economic instability - has intensified the urgency of ensuring inclusive, continuous, and adaptable access to education. In such conditions, e-learning has emerged as more than a digital alternative; it now serves as an instrument for educational justice and personal resilience.

Learner resilience in this context refers to the capacity of students to pursue and sustain education despite external disruptions. E-learning supports this capacity by offering geographic flexibility, asynchronous availability, and scalable cost-efficiency, thereby reducing dependence on vulnerable physical infrastructures. For learners located in remote or conflict-affected regions, or for those facing economic hardship or forced migration, digital education becomes a critical gateway to continuity and progression.

Moreover, by enabling access to structured learning environments even during global emergencies, e-learning contributes to psychological stability and long-term academic identity. It allows displaced or marginalized students to maintain a sense of direction, agency, and belonging - essential attributes of resilience.

E-Learning Platforms Addressing Educational Resilience Challenges

Digital platforms have become essential instruments for supporting educational resilience by ensuring continuity, accessibility, and adaptability. Beyond their use in traditional classrooms, many e-learning solutions have been designed to address structural inequalities and respond to the needs of specific vulnerable groups.

The table below presents a comparative overview of several prominent platforms developed to ensure educational continuity during times of crisis or for marginalized populations. These initiatives exemplify how digital infrastructure can be leveraged to address geographic displacement, incarceration, disability, and other forms of exclusion.

Table 1. E-Learning platforms addressing specific educational resilience tasks

Platform	Country / Sponsor	Primary Function	Target Group	Access Features	Official Link
All-Ukrainian Online School	Ukraine / Ministry of Education	National e-learning during war and displacement	Displaced students, secondary level	Asynchronous, multilingual, mobile-optimized	lms.e-school.net.ua
DIKSHA	India / Ministry of Education	Public e-learning aligned to national curricula	School learners, teachers	Multilingual, low bandwidth, adaptive modules	diksha.gov.in
Learning Passport	UNICEF & Microsoft	Curriculum-aligned digital education for crisis settings	Refugees, migrants	Web and mobile, offline-first capability	www.learningpassport.org
Recomeçar Platform	Brazil / Ministry of Education	E-learning platform aligned with national curriculum targeting socially vulnerable groups	Economically disadvantaged learners	Modular courses, mobile access, free certification	avamec.mec.gov.br
Rumie LearnCloud	Rumie Initiative (Global)	Microlearning via low-data mobile platform	Marginalize, low-connectivity	Mobile-first, offline support, community-tailored	rumie.org

Source: Developed by author

Each platform highlighted above addresses an education continuity gap with e-learning infrastructure tailored to meet contextual needs. The All-Ukrainian Online School enables nationwide curriculum access for displaced students affected by war. DIKSHA powers national digital education in India through mobile-friendly, multilingual platforms for both learners and educators. Kolibri and Rumie offer solutions for areas where internet access is unreliable or unaffordable - turning mobile phones and offline servers into pathways to structured learning.

The Learning Passport, developed with support from Microsoft, is a relevant example of how digital platforms can address the educational needs of children in crisis situations. Designed to function even in environments with limited internet access, it offers tailored, curriculum-aligned content that can be deployed quickly in emergencies.

What makes these platforms effective is the way they combine thoughtful content design with robust technological infrastructure. Their role goes beyond simply maintaining continuity - they actively widen access to education for learners in marginalized or hard-to-reach contexts.

E-learning today is no longer about simply moving lessons online. It is about meeting real educational challenges: offering continuity for children displaced by conflict, reaching students in remote regions, supporting those with disabilities, and ensuring learning continues even in places like detention facilities. Each of these platforms was created with a clear understanding that educational resilience must be planned in advance and shaped according to the type of disruption it seeks to address.

In Ukraine, for example, the All-Ukrainian Online School allowed students to continue following the national curriculum even while living in shelters or across borders. Platforms like DIKSHA and Kolibri have proven essential in reaching rural students with poor connectivity. Meanwhile, initiatives like Recomeçar or the Prison Education Project tackle some of the least visible forms of exclusion - those related to disability or incarceration. The Learning Passport, coordinated by UNICEF, addresses the needs of displaced children in humanitarian contexts.

Together, these examples show that the true strength of e-learning lies not just in its technological sophistication, but in how well it adapts to real-world conditions. Digital education, when used thoughtfully, becomes a flexible tool for restoring, sustaining, and expanding access to learning where it is most at risk.

This role - supporting equity and empowering learners - is at the heart of a broader discussion on how digital education systems should be designed to serve students during and beyond times of crisis.

Methodological Design for Student-Centered E-Learning

To build a resilient digital learning environment, it is essential to focus not just on content, but on the path each student takes through their education. A learner-centered system offers more than access - it creates space for autonomy, flexibility, and steady engagement over time.

Modern online education often uses modular structures, breaking down courses into smaller learning units. This makes it easier for students to manage their time, revisit material when needed, and fit their studies around personal or professional responsibilities. Such organization helps avoid overwhelming learners and allows them to move through content at a rhythm that suits their circumstances.

To keep learning consistent, many platforms blend live sessions with recorded content and asynchronous activities. This is particularly valuable for students working

jobs, living in different time zones, or caring for family members. Recorded lectures, discussion forums, and adaptive tests help them stay connected and involved.

Digital tools also make it easier to understand how students are doing. Learning platforms now monitor engagement levels and activity data, allowing universities to spot students who may be struggling and offer timely support. These features, built on feedback and data, help learners stay motivated and feel confident in their progress.

The use of multimedia - like videos, interactive exercises, or even virtual and augmented reality - can also make lessons more engaging. These tools support different learning styles and help create inclusive spaces where students with varied needs can thrive.

Finally, support systems embedded within platforms - like chat help, peer forums, or automated reminders - give students a sense of presence and support. Whether it's a quick answer to a technical issue or encouragement through peer collaboration, these tools humanize the learning process and remind students they're not alone.

Together, these elements constitute a methodological ecosystem designed to cultivate learner resilience in an unpredictable world.

Technical solutions and the architecture of student-centric e-learning

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Taken together, these elements form a well-rounded digital approach that helps students learn effectively, even in unpredictable or difficult situations.

The global shift to e-learning in higher education during crises

The COVID-19 pandemic catalyzed an unprecedented and nearly universal shift in higher education delivery. According to UNESCO, over 1.6 billion learners worldwide were impacted by institutional closures in 2020, leading to the rapid adoption of digital learning environments (UNESCO, 2021). E-learning, once seen as complementary, became the primary – often sole – mode of educational continuity.

This transition was reflected in the explosive growth of major digital learning platforms:

- Moodle reported a 145% increase in new installations during March-June 2020, and a 500% rise in global traffic during the first half of the pandemic (Moodle Statistics, 2021).
- Google Classroom's user base surged from 40 million to over 100 million by April 2020 (Google for Education, 2020).
- Microsoft Teams for Education reached 270 million monthly active users by early 2022 (Microsoft, 2022).

According to a joint World Bank, UNESCO, and UNICEF report, over 90% of higher education institutions in high-income countries transitioned to online instruction within the first two months of the pandemic (World Bank, 2021). Even in lower-income regions, many institutions rapidly adopted hybrid or asynchronous learning models, leveraging platforms such as Zoom, Canvas, and Google Meet, often with support from international donors and private sector initiatives.

This global shift marked not only a logistical adaptation, but also a pedagogical and institutional transformation. Universities invested in digital infrastructure, faculty training, and student support systems at an unprecedented rate, laying the foundation for more resilient and inclusive education systems moving forward.

In addition to the COVID-19 pandemic, several other global crises have significantly accelerated the integration of e-learning into higher education systems.

For instance, the war in Ukraine has led to the displacement of more than 5 million people, including tens of thousands of university students. In response, Ukrainian universities transitioned to digital platforms such as the All-Ukrainian Online School and adapted Moodle environments to sustain academic programs remotely (European Commission, 2022).

Climate-induced disasters are also increasingly shaping the need for resilient digital education. According to the Internal Displacement Monitoring Centre (IDMC), over 32 million people were displaced by natural disasters in 2022 alone – many from countries with fragile education infrastructure. Universities in regions prone to wildfires, floods, or droughts (e.g., California, Bangladesh, the Philippines) have adopted hybrid and cloud-based e-learning systems to prevent academic disruption (IDMC, 2023).

In contexts of economic crisis and austerity, such as Lebanon or Venezuela, universities have resorted to low-bandwidth platforms, including mobile-based learning and asynchronous content delivery, to address tuition affordability and digital access (UNESCO GEM Report, 2023).

In Iran, political instability and suppression of academic freedom have spurred underground digital classrooms supported by international partnerships, where scholars in exile offer online courses through VPN-secured LMS platforms (Scholars at Risk Network, 2022).

These cases highlight how universities have used e-learning not only reactively but proactively – in response to both global and regional disruptions – to redesign their institutional models to withstand geopolitical, environmental, and socioeconomic stressors.

From emergency digitalization to strategic transformation

The strategic embrace of e-learning by higher education institutions has been significantly influenced by measurable shifts in global student behavior and institutional investment following the COVID-19 crisis. According to Statista (2023), the number of global users of e-learning platforms increased by over 200% between 2019 and 2021. In the United States, the National Center for Education Statistics (2022) reported that more

than 60% of students were enrolled in at least one online course in 2021, up from 37% in 2019. The number of students studying entirely online more than doubled—from 3.3 million in 2019 to 7 million in 2021. Similarly, a Eurostat survey (2022) found that over 50% of university students in the European Union participated in online learning during the pandemic, and 32% continued to engage in hybrid or fully online education in 2022.

In the aftermath of crisis-driven digital transitions, many universities have deliberately reoriented their institutional strategies to place e-learning at the core of their long-term development plans. This strategic transformation reflects a growing recognition that digital education is not merely a reactive solution, but a proactive lever for academic resilience, scalability, and inclusivity.

The University of Maryland Global Campus (UMGC) in the United States exemplifies this vision, operating entirely online and serving over 90,000 students across 20 countries. Its mission focuses on accessible education for adult learners and working professionals, supported by a comprehensive digital infrastructure.

Southern New Hampshire University (SNHU), also in the U.S., has built one of the largest online student bodies in the world - more than 135,000 learners - through a flexible, student-centered model. Its programs integrate adaptive learning technologies and emphasize affordability, modularity, and learner autonomy.

In Canada, Université TÉLUQ stands out as a francophone institution committed entirely to distance education. As part of the Université du Québec network, it serves underserved and geographically dispersed populations, using online modalities to uphold curriculum alignment and academic integrity.

The UK's Open University stands as a longstanding model of fully online higher education, enrolling over 170,000 students annually. Its sustained investment in initiatives such as AI-assisted tutoring systems and virtual laboratory environments reflects a proactive approach to maintaining quality and relevance in a digital context.

In Spain, the Open University of Catalonia (UOC) has furthered its digital trajectory by embedding artificial intelligence tools and modular learning formats that allow for greater flexibility and personalization. With a student body exceeding 85,000, UOC illustrates how digital models can be scaled without compromising pedagogical depth.

Athabasca University in Canada has institutionalized its digital direction through the strategic plan "Imagine: Transforming Lives, Transforming Communities," emphasizing online education as a vehicle for equity and institutional outreach. Similarly, Germany's FernUniversität in Hagen, serving more than 70,000 learners, is recognized for advancing adult and lifelong learning through blended and online modalities.

Taken together, these examples show that universities are not merely preserving emergency measures adopted during times of crisis. Instead, they are actively reimagining their organizational missions through the lens of digital education - building systems that are adaptive, student-oriented, and resilient to future disruptions.

Regulatory infrastructures for scalable and trustworthy e-learning in higher education

A coherent and supportive legal and policy framework is essential for embedding digital learning in a sustainable way within higher education. Both institutions and national authorities have faced the complex task of adapting regulations to meet the rapid uptake of technology, while also preserving academic integrity, safeguarding student data, and ensuring consistent quality standards.

Many countries have recently introduced regulatory frameworks connected to e-learning. In the United States, new Department of Education rules (2026) will require institutions to report outcomes for fully online programs as distinct compliance units.

Canada's Ontario region enforces mandatory web accessibility in higher education through its Accessibility for Ontarians with Disabilities Act (AODA). The UK's Data Protection Act 2018, alongside GDPR, reinforces protections for student data, while Germany's copyright reform (2018) expanded permissible educational uses of third-party content online, aligning with broader EU data rules. Australia embedded online education directly into its 2021 Higher Education Standards Framework, enforcing technology-neutral compliance obligations. Estonia legislated quality standards for digital education in its Higher Education Act (2019). South Korea expanded its privacy legislation (PIPA, 2023) to include learning analytics, within the broader framework of its Digital-Based Distance Education Act (2021). In South Africa, the Protection of Personal Information Act (2013) and the Open-Learning Policy (2017/18) provide the foundation for data governance and academic quality in online higher education.

Table 2. Overview of key regulatory instruments governing e-learning in higher education

Country	Latest Pivotal Update (Year)	Statutory Focus (Abbreviated)
USA	DoE "virtual location" rule (2026)	QA, DP, AC
Canada	AODA enforcement (2005)	QA, DP, AC
UK	DPA 2018 + GDPR	QA, DP, AC
Germany	UrhG education exceptions (2018)	QA, DP, IP, AC
Australia	HES Framework (Threshold Standards) 2021	QA, DP, AC
Estonia	Higher Education Act 2019	QA, DP, AC
South Korea	PIPA amendment 2023 + Distance-Ed Framework 2021	QA, DP, IP, AC
South Africa	POPIA 2013 + Open-Learning Policy 2017/18	QA, DP, AC

Source: Developed by author

Key: QA = Quality/Accreditation; DP = Data Protection; IP = Intellectual Property; AC = Accessibility

A qualitative analysis of these examples points to a converging global trend in which governments are increasingly positioning e-learning as a stable and integrated component of higher education. Across different national contexts, quality assurance and data protection emerge as common pillars - essential to upholding academic standards, reinforcing institutional accountability, and maintaining learner trust in virtual environments. Legislative frameworks related to accessibility are now moving beyond advisory norms, imposing enforceable standards such as the Web Content Accessibility Guidelines (WCAG). Similarly, copyright and intellectual property regulations have been updated to support lawful digital content creation and transnational sharing.

These legal structures no longer function as reactive instruments developed in response to events like the COVID-19 pandemic. Instead, they represent deliberate strategies aimed at reinforcing inclusive, reliable, and forward-looking university ecosystems. Regulation has thus evolved from being an ancillary requirement to becoming a fundamental element of institutional design - supporting the sustainable expansion of e-learning through structure, transparency, and equity.

European Union's Digital Education Action Plan (2021–2027): higher education priorities

The European Union's Digital Education Action Plan (DEAP) 2021–2027 represents a key strategic policy aimed at accelerating innovation and strengthening resilience in education systems, with higher education placed at the heart of its vision. Organized around two main objectives - fostering a dynamic digital education ecosystem

and advancing digital skills and literacy - the plan introduces a comprehensive set of measures tailored to universities across EU member states.

As a first priority, DEAP promotes the development of a high-quality digital infrastructure for higher education. This includes the establishment of European Digital Education Hubs and the enhancement of interoperable systems through initiatives such as Erasmus+ and Horizon Europe. These programs support academic cooperation across borders and enable virtual mobility, while contributing to the mutual recognition of online courses and academic credits between countries.

The second core focus is capacity-building among both students and academic staff through the cultivation of digital competences. DEAP endorses the use of frameworks like DigComp and DigCompEdu, and encourages the implementation of tools for institutional self-assessment and benchmarking. Instruments such as SELFIE for higher education allow institutions to evaluate their preparedness and improve faculty development in digital teaching and learning.

A third significant dimension of the plan addresses the promotion of open education, micro-credentials, and flexible learning pathways. The European Framework for Micro-Credentials, adopted in 2022, provides a foundation for recognizing modular, stackable forms of learning - enhancing accessibility for adult learners, marginalized groups, and individuals balancing study with employment. At the same time, DEAP advocates for broader availability of quality open educational resources (OERs), support for multilingual materials, and the interoperability of digital learning platforms.

These priorities are not merely aspirational. By aligning access to EU funding with compliance to DEAP's strategic directions, the European Commission ensures strong institutional uptake. Universities that align their digital policies and practices with DEAP are more likely to benefit from structural support, cross-border partnerships, and international visibility.

Table 3. DEAP provisions relevant to higher education

Strategic Area	Key Provisions
Digital Infrastructure	European digital spaces, cross-border accreditation, Erasmus+, Horizon Europe
Competency Development	DigComp/DigCompEdu, self-assessment tools, CPD, digital literacy funding
Micro-Credentials & Flexibility	European framework (2022), stackable credentials, lifelong learning inclusion
Open Education & OER	MOOC support, multilingual content, interoperability of platforms
Institutional Alignment	Incentives for digital strategy integration in EU-funded universities

Source: Developed by author

Together, these actions position DEAP as a transformative force in the European higher education landscape, enabling universities to modernize curricula, empower educators and learners, and support equitable access to education through digitally enabled means.

5. Conclusions

Digital education has evolved into more than just a stopgap for emergencies. When carefully developed, it becomes a practical and reliable way for universities to stay open and responsive, no matter the situation.

Its strength lies in how well it fits into students' real lives. Whether someone is learning from a rural area, managing work and family, or navigating personal difficulties,

digital tools help them keep moving forward. They provide structure when things are uncertain and help students feel in control of their own learning.

But for e-learning to genuinely support long-term resilience, it needs to offer more than content online. Flexibility, timely support, and accessible systems are essential. That means building not just good platforms, but also training, policies, and infrastructure that truly support students and educators alike.

Looking ahead, digital learning is set to be a key part of how universities prepare for the future. It also offers the chance to shape a more inclusive and student-centered approach - one built on fairness, independence, and real access to education.

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MANAGERIAL APPROACHES TO SUSTAINABLE ECONOMY DEVELOPMENT

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Abstract: This article examines managerial approaches to fostering sustainable economic development through the integration of Environmental, Social, and Governance (ESG) principles within corporate strategies. The study aims to identify practical managerial models that promote long-term economic viability while addressing environmental and societal impacts. Drawing on expert analyses, institutional reports, and academic literature, the research employs a qualitative synthesis method to extract and compare various frameworks of sustainable, sustainability, and sustainable development management. The article categorizes three key managerial approaches: (1) Sustainable management, focusing on harmonizing corporate responsibility with environmental preservation; (2) Sustainability management, emphasizing long-term viability through strategic resource use and social engagement; and (3) Sustainable development management, aimed at aligning economic growth with resource efficiency and ethical governance. Findings highlight that successful ESG integration requires multi-stakeholder collaboration, internal restructuring, and the adoption of performance measurement systems. Visual frameworks such as the ESG pillars and multi-step sustainability implementation models are discussed. The paper concludes that managerial commitment to sustainability not only supports ecological preservation and social equity but also enhances corporate resilience, innovation, and stakeholder trust. The study offers valuable insights for policy-makers and business leaders seeking to embed sustainability into core business operations.

Keywords: Management, economy, sustainability, ESG, principles, pillars.

UDC: 005:[338.1:502.3]

JEL Classification: O44; Q01; Q54; Q56

1. Introduction

The sustainable economy is a model of organizing long-term economic activity that maximizes general well-being combined with minimizing the use of exhaustible resources, avoiding negative impacts on social sphere, community and environment. In essence, it is an attempt to achieve a balance between economic development (growth) and the promotion of positive ecological changes and living conditions of the global population.

The sustainable economy is built on the following conceptual pillars [1]:

1. *Economic sustainability:* Ensuring conditions when the global demand for natural resources (also known as the ecological footprint) will be less than the supply of renewable natural resources (also known as biocapacity). [2] Maintaining a long-term perspective oriented towards ensuring the well-being of future generations through the slow consumption of natural resources to ensure their availability in the future.
2. *Environmental sustainability:* Maintaining the healthy state of ecosystems, protecting biodiversity and reducing environmental impact.
- *Social sustainability:* Solving problems such as social equity, health care, and quality of life.

The priority objects of promoting a sustainable economy are sustainable economic development and sustainable economic growth.

Sustainable economic development represents a specific process of harmonizing the use of natural resources, the direction of investments, the orientation of technological development and institutional adjustments aimed at increasing current and future economic potential to meet human needs. [3]

Sustainable economic growth represents achieving long-term economic progress without causing future economic difficulties related to the depletion of natural resources and ensuring the well-being of society. [4]

For an economic activity to be sustainable, it is necessary to increase energy production from renewable sources, develop and approve policies and regulations related to increasing energy efficiency, and promote a circular economy capable of minimizing waste and rationalizing the exploitation of natural resources. It is also necessary to stimulate social and economic inclusion, technological innovation through respective investments, ensure efficient and transparent governance, as well as raise awareness and educate society.

The imperative of developing a sustainable economy requires companies to make management efforts, to adjust basic objectives, such as efficiency, sustainable growth and shareholder value. At the same time, sharing the ideals of a sustainable economy can bring significant benefits to companies. [5] The purpose of this article is to highlight the managerial aspects of sustainable economics.

2. Literature Review

Views on the managerial aspects of sustainable economic development can be found in a multitude of works with different approaches to the related issues. Most of the available literature is related to sustainable economics and economic sustainability. For example, the basic aspects of sustainable economic development are examined in Yu-Yun Wang's work "Sustainable Economic Development" [3], as well as the analysis carried out by the McKinsey team led by Bob Sternfels [6].

Author Elina Guzueva [7] examined modern global trends in the economics of sustainable development. The group of authors led by Mohd Akhter Ali [8] researched the issues of balancing the basic elements of sustainable economic development. The importance of focusing a company's activity on ESG is discussed in Jude Lau's paper [9].

Approaches to the pillars of corporate sustainability can be found at Beattie Andrew [5], the origins of the pillars of sustainability - at Ben Purvis, Yong Mao, Darren Robinson [10]. The essence of sustainable management is presented in the respective publication of the University of Central Lancashire [11].

We find green management approaches in the works of Mustafa Altıntaş [12], and the group of authors led by Stephanie Pane Haden [13]. Atin Chhabra [14] examined sustainability management under the aspect of objectives, principles, advantages. The important aspects of sustainable development management were examined by researchers from the International University of Monaco [15], and Weiping Gu [16].

Separately, we should mention the publications regarding technological recommendations for sustainable transformation of companies' activities, which were developed by VLS Environmental Solutions [17], Green Business Benchmark [18], IMD [1], IPPO Engineering [19].

3. Methodology

The research was carried out using a qualitative synthesis method based on a wide range of open-access expert publications, institutional reports, and scientific articles available online. The selection of materials was guided by their relevance to corporate sustainability, ESG integration, and sustainable economic development from a managerial perspective.

Sources were included if they met the following criteria: (1) publication date between 2018 and 2024; (2) affiliation with recognized institutions, corporations, or peer-reviewed platforms; (3) content focused on managerial approaches or frameworks applicable to sustainability, sustainable development, or ESG principles. The analysis excluded outdated or purely theoretical models without applied or managerial relevance.

The research process consisted of several phases:

- **Collection** of materials from academic platforms (e.g., ResearchGate), institutional websites (e.g., McKinsey, IMD, IPPO Engineering), and professional publications;
- **Extraction and classification** of managerial models relevant to sustainability: sustainable management, sustainability management, and sustainable development management;
- **Comparative synthesis** of frameworks, based on their defining characteristics, implementation strategies, and focus on environmental, social, or governance components;
- **Integration** of visual tools such as ESG pillars and multi-step implementation guides, where available, to illustrate practical applications.

This methodology made it possible to identify the core elements and key distinctions between managerial approaches, enabling the formation of a structured view on how ESG principles are integrated into sustainable business models.

4. Results and Discussion

The managerial approach to sustainable economics is related to sharing the concept of sustainability in the activities of companies based on three pillars of ecological, social and economic sustainability, which are expressed by the acronym ESG (Environmental, Social, Governance).

Author Andrew Beattie develops corporate visions on three pillars of sustainability [5]:

- *The environmental pillar* examines the impact of the company's activities on the nature of the planet. It is noteworthy that many companies have taken important steps to reduce their carbon footprint, packaging waste, water use, and other environmental damage;
- *The social pillar* studies a company's relationships with its employees, customers, and communities, covering labor practices, diversity, and human rights;
- *The governance pillar* assesses transparency, business ethics and management. In the traditional approach, the company's activity must be profitable, but not at any cost, that is, without violating the provisions of the other two pillars. From a managerial perspective, this is about compliance, adequate governance and risk management.

In a broader approach, ESG considerations are presented as follows (Figure 1):

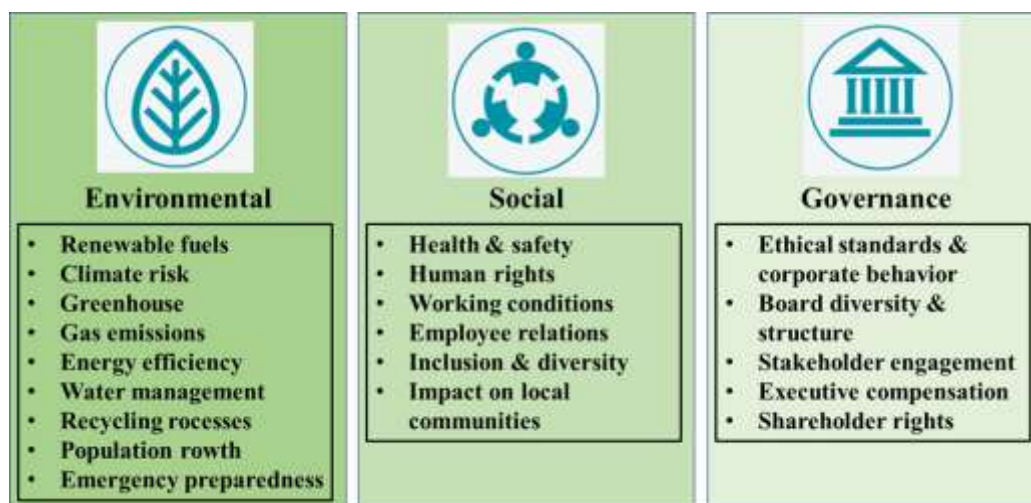


Figure 1. ESG pillars

Source: [9]

The implementation of ESG criteria is important for companies promoting social, environmental and governance responsibility.

According to some experts, it is important to measure the level of acceptance of ESG within the company through a complex of key indicators [20]:

- *Environmental*: greenhouse gas emissions, energy and water consumption, waste management, and natural resource conservation policies;
- *Social*: turnover rates, employee satisfaction and gender equity policies;
- *Governance*: transparency in management, the structure of the board of directors, the existence of anti-corruption policies, and compliance practices.

Specialists from IPPO Engineering have developed a 5-step algorithm for implementing sustainability in the company's activities (Figure 2).



Figure 2. 5 steps guide to sustainability in business

Source: [19]

For each step, respective guidelines have been developed.

Other experts offer an alternative view of the steps for integrating sustainability into the company's activities [1], [17], [18]:

1. Setting goals and establishing values

It is recommended that goals contain economic indicators, such as long-term profitability and innovation rates, along with environmental indicators. Goals may also include:

- Reducing greenhouse gas emissions;
- Improving energy efficiency in the company's operations;
- Increasing the use of renewable resources in the company's supply chain;

- Promoting reuse strategies to minimize waste.

2. Making decisions on the company's sustainability initiatives

It is necessary to determine target initiatives for each sustainability plan, being stability priorities of impact, effort, costs and feasibility. Initiatives should address the following: energy; water; food; waste; buildings; products & packaging; supply chain; transportation; community; employees.

3. Create a green product

If sustainability becomes a component part of the company's mission, it is welcome to create an ecological product, giving priority to sustainable materials. When selecting materials, it is necessary to consider whether they have these characteristics: sourced sustainably; fair trade; recyclable, renewable or biodegradable; locally sourced; reusable.

4. Integrate sustainability into business strategy

Incorporating sustainability into a company's strategy requires seeking opportunities for innovation and growth. These could include:

- Looking for opportunities to redesign products to use fewer natural resources or to be more easily recycled;
- Looking for more sustainable suppliers;
- Looking for opportunities to invest in clean technologies.

5. Create a sustainability plan

It is recommended that the plan initially contain initiatives that are easy to implement in terms of effort and cost. Then you can move on to advanced actions. The plan should contain the following key components: sustainability objectives; key performance indicators; sustainability factors; action plan; implementation plan.

6. Stakeholder engagement

The success of implementing sustainability within the company's activities is determined by the quality of collaboration with many stakeholders:

- It is advisable to involve employees in sustainability initiatives, requesting their contribution to corporate sustainability programs by creating cohesive teams. It is also recommended to involve employees in social responsibility initiatives, such as: remote work options where possible; flexible schedules and shorter work weeks; fitness, meditation and wellness classes at work; healthy, organic food choices; the chance to volunteer for charitable events; embracing diversity, equity and inclusion; support for local communities.
- It is a good idea to communicate with your customers about your sustainability efforts using various channels, including social media. Consumers often prefer eco-friendly brands, and information about the sustainability of your company's activities can help build brand loyalty.
- It is important to collaborate with the company's suppliers to improve sustainability throughout the supply chain.
- It is important to engage with investors by suggesting that sustainability efforts can contribute to long-term value creation and are driven by overall goals.

This collaboration can contribute to the formation of an ecosystem corresponding to the company's sustainability objectives.

7. Monitoring and reporting progress

The company must be transparent about its successes and challenges in the transition to economic sustainability. This is expressed by tracking performance, identifying areas for improvement and building trusting relationships with stakeholders. It is also recommended to use established frameworks for reporting purposes, such as the Global Reporting Initiative or the Sustainability Accounting Standards Board.

Companies can benefit from implementing sustainable practices:

- Reducing costs through reduced energy consumption and waste disposal costs, as well as more efficient use of resources;
- Increasing revenues by exploring new markets and additional customer segments;
- Attracting and retaining talent through sustainability programs, which make employers more attractive;
- Increased resilience, as the activities of sustainable companies better match the needs of society and market;
- Strengthening brand loyalty, as consumers are more loyal to manufacturers who share their values.

The conducted study allows highlighting the following approaches to managerial activity within the sustainable economy:

- sustainable management;
- sustainability management;
- sustainable development management.

Sustainable management is a concept that aims to combine sustainability and management practices in order to create a balanced business model that ensures the benefit of current and future generations. [11]

Sustainable management is a special management approach that considers the long-term impact of decisions and actions on the environment, society and the economy. It focuses on managing resources and processes so that economic, social and environmental aspects are balanced and exhaustible resources are used responsibly and sustainably. [21]

Sustainable management examines the interconnectedness of economic, social and environmental systems, and efforts are made to avoid negative impacts on each other. At a global level, the application of this concept is linked to the research of the long-term impact of decisions and actions on the planet and future generations. [21]

The areas of application of sustainable management are varied, including natural resource management, business management, urban planning, and agriculture, among others. But whatever the area of application, there is a commitment to continuous assessment and adaptation, as well as the intention to prioritize sustainability over short-term gains. [21]

Through this management concept, the company must also consider social equity and its effect on the environment. Its practices must be ethical, conducted in such a way that they can continue in the long term without a major negative impact on society, the environment, and the dynamic global market. [11]

Some examples of the application of sustainable management can be presented [11]:

- Using renewable energy sources such as solar, wind, thermal and hydroelectric;
- Creating green spaces in urban areas where both flora and fauna thrive;
- Promoting sustainable construction with the use of green and recycled materials and energy-efficient practices;
- Investing in public transport, car-sharing applications and the use of electric vehicles.

Closely related to the concept of sustainable management is the notion of *ecological (green) management*, which is a form of environmentally conscious corporate management. That is, it is about the promotion by companies of ecological activities that are focused on the voluntary prevention or continuous reduction of pollution, waste and emissions.

Ecological management is sensitive to ecological issues, provides for environmentally oriented actions and directing the field of activity accordingly. It takes into account the environmental impact in all activities carried out by companies, increases employee awareness, environmental awareness, provides training and uses technologies and raw materials that are not harmful to the environment. [12]

Sustainability management has as its basic objective the preservation of the environment and the ensuring of the optimal functioning of the planet's ecosystem, which is achieved in three dimensions: the environment, the needs of present and future generations and the economy. Applied in this way, it creates the capacity of a system to create well-being while ensuring the needs of present and future generations by limiting the depletion of resources. Sustainability management is focused on preserving the environment and ensuring the optimal functioning of the ecosystem. [14]

It contains organizational practices designed to ensure sustainable development, involving economic production and consumption, which reduces environmental impact and facilitates resource conservation.

Sustainability managers (also called Corporate Social Responsibility managers, corporate responsibility managers) are those leaders within the company who are responsible for organizing social and environmental activities in accordance with the company's strategic and business objectives.

Author Atin Chhabra proposes using the notion of a *sustainability management system*, which represents an integrative concept for environmental, social and economic aspects in decision-making and the conduct of activities to achieve long-term viability and ethical responsibility. [14]

Sustainability helps companies identify and overcome challenges from various sources, such as environmental and social issues. According to the IBM Institute for Business Value Survey, 62% of buyers are willing to change their purchasing habits to reduce their environmental impact. [22] The study conducted by Capgemini demonstrated that 52% of consumers feel an emotional connection with a sustainable product or organization and 79% of consumers change their purchasing preferences depending on the social or environmental impact of their purchases. [23]

Therefore, by adopting sustainable practices, companies can influence consumer behavior and reduce their carbon footprint to slow climate change, while contributing to a more environmentally stable future. [16]

Sustainability can impact a company's profitability. As a result, investors are increasingly considering ESG factors when considering any project.

According to Bloomberg, global ESG assets are estimated to reach \$53 trillion by 2025, representing a third of the world's total assets under management, which will constitute over a third of the total global assets under management of \$140.5 trillion. [24]

The global ESG investing market size constituted about \$25.1 trillion in 2023 and is estimated to increase from \$29.9 trillion in 2024 to \$167.5 trillion by 2034. [25]

Sustainability management is based on the following principles [14]:

- The effectiveness of sustainability management is determined by productive analysis and the implementation of relevant policies and strategies.

- Sustainability management combines management technologies with environmental policies.
- The basis of sustainability management is formed by the awareness of people's dependence on nature and its use to ensure the collective well-being of humanity.
- Sustainability management promotes the use of natural resources by reducing the possibility of depletion and allowing their recovery for future use.

Sustainable development management focuses on promoting a growth strategy that is conditional on the rational use of resources.

Sustainable development management is the complex of activities for managing all activities in such a way as to allow the conservation of the planet and its resources, ensuring the well-being of humanity through several practices. It is based on environmental, social and economic aspects. Each of these sectors must make progress without hindering the progress of other sectors. [15]

In a company there may be at least one department responsible for implementing sustainability elements. This is usually the QHSE (Quality, Health, Safety and Environment) department. One of the policies that must be followed is that of ESR (Environmental and Social Responsibility). The promotion of sustainable development management is based on the following [15]:

- Showing respect for gender equality and equal opportunities related to education, training and access to a position within the company;
- Respecting the environment by promoting technological advances aimed at maximum preservation of available natural resources and rehabilitation of the original natural environment;
- Ensuring sustainable management of the company's economy;
- Carrying out an environmental and social impact study of each company project.

Multiple opportunities must be recognized in the field of promoting sustainable development management, in particular related projects, including carbon credits, green energy development and blue energy.

5. Conclusions

Promoting a sustainable economy globally represents an important opportunity to ecologically save the planet, ensuring the well-being of the population in the future. However, like any model of organizing economic activity, a sustainable economy needs effective management solutions to ensure the success of achieving the established goals.

At the same time, promoting sustainability is an opportunity for companies to undertake efforts under a single umbrella concept and gain public trust for it. Economic development without sustainability is not efficient in the long run. On the other hand, sharing the principles of sustainable economics can bring important benefits to companies.

The managerial aspects of the sustainable economy are about balancing economic growth and generating profit with the impact on the environment and people. High-performance management based on ESG pillars is an important factor in the development of a sustainable economy.

Currently, international experience has developed effective technological recommendations for implementing sustainability within companies. The three-

dimensional approach to management ensures broad-based sustainable development with a long-term horizon.

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THE ROLE OF THREE-DIMENSIONAL PARTNERSHIP IN SUSTAINABLE SOCIAL DEVELOPMENT

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Abstract: *The business environment has a key contribution to make to improving the quality of education and social performance through strategic investments, institutional collaborations and practical training initiatives. In the context of a globalized economy, labour market requirements are changing rapidly, which requires the education system to constantly adapt to these changes. Forming partnerships between companies and higher education institutions is proving to be an effective way of bridging the gap between academic theory and the practical skills that are indispensable in a professional career. In today's context, many education systems face significant challenges, including a lack of modern infrastructure, insufficient adaptability of curricula to the demands of the digital economy and weak links with the business environment. These shortcomings can be addressed by attracting private investment to develop technology labs, digital learning platforms and internship programs. In addition, companies have an important role to play in supporting education through mentoring initiatives, offering scholarships and creating business incubators dedicated to young entrepreneurs. To maximize the impact of these initiatives, it is crucial to develop public policies that encourage collaboration between the private and education sectors. Such an approach would facilitate the transition of graduates into the labor market and contribute to the sustainable development of the economy.*

Keywords: *Quality education, sustainable development, public-private partnership, social responsibility.*

UDC: [378.05:334.72]:331.5

Classification JEL: I23, I25, M19, M53.

*Motto: "Education for All
is not only a powerful lever for economic development,
but it is also a strategic investment - one of the best investments
for individuals, economies and society as a whole."
(Audrey Azoulay, Director-General, UNESCO) [1]*

1. Introduction

Undeniably, nowadays, the activity of any economic unit can only be carried out in collaboration with other entities, which conditions their development strategies not only on the economic dimension, but also from a socio-cultural perspective. Thus, the list of organizations' social responsibilities frequently includes concern for education. Education is a fundamental pillar of economic and social development. An effective education system not only supports economic growth, but also contributes to strengthening social cohesion and reducing inequalities. In a globalized context, marked by rapid developments in emerging

technologies and continuous changes in labor market requirements, collaboration between business and the education system becomes imperative. A three-dimensional public-private-civil partnership leading to sustainable social development is increasingly taking shape.

It should be recalled that the concept of sustainable development was originally aimed at environmental problems and resource scarcity, especially energy. The term itself "came into its own in 1992 after the United Nations Conference on Environment and Development in Rio de Janeiro... Concerns about it continued with discussions at the 2002 Johannesburg Summit on Sustainable Development." [2]

"Another perspective offered by Professor Trevor M. Letcher is the concept of the three Ps (People, Planet, Profit). Sustainable development is often characterized by the three Ps: People, Planet and Profit. These three P's are based on the UN trichotomy of sustainable practices. People stand for socio-cultural issues; Planet stands for environmental issues and Profit stands for economic issues. Scientists can inform society about what needs to change, but society tends to be reluctant to change. Hence the need for a fourth 'P' will create synergies between people, planet and profit and that is politics and policies." [3]

A strategic point for transforming the world in which we live is the adoption by the UN, i.e. world leaders, of the 2030 Agenda, which aims to reduce poverty, protect the environment and human rights. Given that the most important factor of production for economic growth is human capital, education is an element of global, not just national, security. "Quality education and training systems accessible to the population are the foundation of lifelong learning, determining the capacity for innovation and participation in society. EU measures have focused on improving basic skills, early education and childcare, reducing early school leaving, increasing the scale of higher education, adult learning and increasing digital skills. This strategy aimed to improve young people's access to jobs at a time when big changes are expected in employment requirements driven by the green/digital transition and the spread of artificial intelligence that will lead to the elimination of many job categories today occupied by the low and medium educated." [4]

2. Methodology

The present study is based on general and special scientific methods of research of social-economic processes and phenomena, in particular methods such as analysis, synthesis, deduction, induction, and scientific abstraction methods were used.

The informational basis of the research are the national and international scientific publications, annual reports prepared by the Ministry of Education and Research, etc., data published by Eurostat and other informational resources.

3. Results and Discussion

"A public-private partnership is a specific form of collaboration, usually on a long-term basis, between a public authority and the private sector to solve problems of public interest." [5] Education in the Republic of Moldova is a strategic issue of major public relevance. A quality education system contributes to the formation of competent, qualified and resilient citizens to the challenges of contemporary society, i.e. an educated population is more economically productive, more innovative and more capable of contributing to the country's development, reducing dependence on external factors and strengthening economic security.

By the way, according to economics professors at the University of Padua, Giorgio Brunello, Lorenzo Rocco, and UNESCO representative Matthias Eck, Section of Education for Inclusion and Gender Equality, the consequences of not investing in

education for all are drastic "If no measures are taken to change course, by 2030, globally, the annual cost to society of children leaving school early will reach 6 trillion dollars. Similarly, the annual cost to society of children without minimum levels of basic skills [1] is \$10 trillion. These costs are higher than the combined annual gross domestic product (GDP) of France and Japan, two high-income countries (OECD, 2023). [6]

In the Republic of Moldova, the education system faces multiple challenges, including the lack of sufficient funding, inadequate infrastructure, educational programs that do not correspond to economic realities and insufficient preparation of graduates for integration into the labor market. And investing in education is a long-term strategic investment in the country's ability to protect its interests and ensure a secure and prosperous future for its citizens. According to a UNESCO report, "Economic costs are borne by individuals (private costs) as well as the government (fiscal costs), while those borne by society (social costs) include costs for both individuals and the government." [6]

"The Republic of Moldova directs a significant proportion of the National Public Budget (NPB) to education. The share of public spending on education as a percentage of total BPN expenditure has fluctuated between 2016 and 2023. After an increase from 17.7% in 2016 to 18.4% in 2019, this indicator decreased in 2020 to 17.2% due to the impact of the COVID-19 pandemic." [7] Certainly, one of the indicators showing the state of the educational infrastructure is the state investment in education. According to the 2024 Progress Report on the Implementation of the 2030 Agenda for Sustainable Development in the Republic of Moldova, "The share of the budget allocated for education in the national public budget amounted to 15.9% in 2023. The data indicate a relative stability in the percentage between 2014-2019, followed by a significant and steady decrease in the share of this expenditure in the total national public budget expenditure from 2020 to 2023, with a minimum of 15.8% in 2022. It is important to note that investment in education is vital for a country's long-term development, impacting labor productivity and quality of life." [8]

Developing a quality education ecosystem requires a collective effort, hence the three-dimensional nature of the education partnership.

Thus, the public partner in the person of the government has the responsibility to establish coherent educational policies, to ensure adequate financing of the education system and to monitor the quality of education, in the person of the educational institution - it must provide relevant and high quality curricula, create a safe and stimulating learning environment and support the professional development of teachers, including scientific and teaching staff - are meant to train/develop the skills of the learner, and the students have the responsibility to assume their own academic progress of vital socio-professional importance.

The private partner, in our case the business environment, has a vested interest in a quality education that will generate the skilled human capital that entrepreneurs need to thrive. Business has the potential to play an important role in bridging these gaps by investing directly in education, supporting vocational training and developing sustainable partnerships with educational institutions. Through mentoring programs, offering scholarships, facilitating internships and equipping educational infrastructure, companies can make a significant contribution to improving the quality of the educational process. This would make education more practical, relevant and accessible to all young people. Strengthening cooperation between business and education must be achieved through well-defined strategies, long-term investment and active involvement of all stakeholders. This partnership can be essential for preparing a society capable of facing future challenges and building a globally competitive economy.

Among the main social partners of education, we mention the family, which provides the first educators for children, the local community, which through various organizations, cultural institutions, libraries, youth centers, etc., provides non-formal learning opportunities and support for schools.

At the international level, the European Commission considers corporate social responsibility to be the responsibility of enterprises for the impact they have on society by integrating social, environmental, ethical, consumer, environmental, consumer and human rights concerns into the value system and organizational culture, business strategy and operations, to ensure that strategic and operational decisions are taken in a transparent and accountable manner, respecting the rule of law, and thereby establish better practices within the firm to benefit society. Among the main social partners of education we mention the family, which provides the first educators of children, the local community, which through various organizations, cultural institutions, libraries, youth centers, etc., provides non-formal learning opportunities and support for schools. [9]

The collaboration between business and the Government of the Republic of Moldova on modernization of schools and universities is remarkable. Thus, in April 2024, during the Education Week, the Government of the Republic of Moldova, in part the Ministry of Education and Research, launched the "Moldova for Education" Campaign, more precisely, a National Partnership under the patronage of the Presidency of the Republic of Moldova. "The aim of the partnership is to unite the efforts of the Government, business and external partners for the modernization of education in the Republic of Moldova." [10] Within the framework of the Campaign, 12 private companies have made a public commitment to contribute to the improvement of the educational system in our country by investing about 18 million lei in the infrastructure and equipment of the 35 institutions of the Model Schools Network. They are Orange, Moldcell, Starnet, Premier Energy Foundation, Kaufland, Linella, Mixbook, MAIB, OTP, Moldinconbank, DiTA EstFarm and Huawei. [10]

In this context, the Minister of Education and Research, Dan Perciun said that "It takes a healthy and involved community to raise a child. We believe that our role is to strengthen these efforts and join forces to build a project for the country. This partnership is a long-term investment in education, in the future of children, in future employees and researchers. We are making this effort because we have every confidence that despite all the challenges and difficulties, we can have a high-performing education system".[11]

Among the partners of quality education, we find Kaufland Moldova, which has reconfirmed its commitment to support the community in which it operates through involvement and dedication. Since 2016, Kaufland has invested more than 30 million lei in social responsibility projects, with education being one of the basic pillars.... Dona Răpciugă, Executive Director of Kaufland Moldova, emphasized that it is our responsibility to invest in Moldova's most important resource - its people. Thus, through the "Model School" project we want to create a safe, interactive and attractive space for children, where they are motivated, encouraged and enjoy coming to school. Through this project we will provide children with a friendly environment to encourage innovation and creativity - qualities that can be extremely valuable to companies looking for future employees." [11]

Another strategic partner of Quality Education is Moldindconbank, on behalf of the company reconfirmed the commitment to participate in the initiative of the Ministry of Education and Research, the bank's First Vice-Chairman of the Management Committee, Victor Cibotaru, who noted that "Moldindconbank is permanently involved in large-scale social projects. "Moldova for Education" is a very important project and we could not but

accept the invitation to participate in it and we come with a contribution of 2 million lei. Taking into account the fact that Moldindconbank has been more and more involved in various projects for the development of sports for young people and children, we would like to channel this donation for the repair and improvement of sports halls and sports fields in schools in the Republic of Moldova." [12]

"StarNet also recognizes the role of education for the future of the country and supports the "Moldova for Education" project. StarNet is a company that is constantly involved in supporting projects aimed at developing the well-being of the country and has joined the national project "Moldova for Education" which fully resonates with the values that the company holds. Since 2012 and until now, StarNet supports many educational and cultural projects, which it presented during the official launch event of the Moldova Education Week. The event was organized under the patronage of the Presidency of the Republic of Moldova and had as its central theme - Model School. Alexandru Machedon, Founder of StarNet, said that Education is the most important pillar of a nation. Everything starts from education, as both the social and economic development of a community depends on it. By investing in education, we invest in the future of our own country. Alexandru Machedon also briefly presented some of the educational projects supported over the years by StarNet: We value intelligence; StarNet supports chess; StarART Project; ROBOCLUB Project; A computer for every student; Innovative Entrepreneurship for sustainable employment; Gigabit Internet for your school; TIMPUL Magazine Project in Romania, Molodva Republic edition; "eTIMPUL for the Book" Project. Only together we can change the future, that's why StarNet supports Education!"[13] We emphasize that StarNet undertook within the "Moldova for Education" project to develop the IT infrastructure and free Internet connection of 35 schools.

Giorgi Shagidze, President of Maib, subscribed to the "Moldova for Education" campaign by investing 2 000 000 lei for the development of a broad financial education program, while stressing that "Maib shows its support for the educational field through numerous initiatives: technical equipment of educational institutions in the country, through the maib edu program, organization of financial education lessons in the bank, through the maib brand internship programs, dual education and many others. Year after year MAIB's team of trainers develops various educational programs which they deliver to both the bank's employees and the interested public aiming to develop professional and personal skills. Among the most requested courses we mention: Data Analytics, IT, financial education for children and teenagers, etc.

The bank also pilots various partnerships with the country's largest universities and develops educational programs, getting involved through public lectures held by the bank's professionals and curriculum expertise, conducts internship programs and integrates dual education students into the real work environment." [14]

Huawei Moldova representative Guo Min appreciated the launch of the National Partnership "Moldova for Education", expressing the company's openness to contribute to improving the quality of education in Moldova. The Huawei Company has joined with an investment of 1 million lei for the creation of "digital classrooms" in some of the educational institutions of the Model Schools Network"[10] and the Huawei Company.

On the other hand, "The Ambassador of the European Union to the Republic of Moldova, Janis Mazeiks, emphasized that the EU Member States support the efforts of the Chisinau authorities to provide all citizens with equal access to quality education through the repair of kindergartens and schools, educational exchange programs and scholarships from European funds." [15]

OTP Bank has also shown openness to support education in Moldova. The company has come up with two beautiful initiatives, which will lead to the creation of students' well-being, to the creation of opportunities for creative development, such as:

- "a contribution of 2 million lei for the renovation of solar libraries and their transformation into multifunctional educational spaces. By providing modular furniture, individual and group staging areas, resources for interactive education and digital tools;
- delivering, in partnership with the "OK" Foundation, free financial and entrepreneurship education courses." [16]

Last but not least, the Orange Foundation strengthens education in Moldovan schools through various projects:

- "The Orange Foundation and UNHCR have donated 90 digital kits - three for each school - that make learning more interactive and engaging. Each kit includes tablets for students, a server for distributing materials, headphones for focused learning, an audio speaker for group activities, a projector for visual lessons and a laptop to support teachers." [17]
- "The free program "Digital Education and Career Guidance for Women", which runs from March to December 2025, offers 36 hours of free training, conducted over two weeks, in physical format, at the Orange Digital Center, located within the State Pedagogical University "Ion Creangă" in Chisinau." [18]
- "#SuperCoders is an international project, conceived and developed by the Orange Group since 2014." [19]

Orange Moldova Foundation contributes to the creation of digital laboratories for schools, providing equipment and educational materials necessary to improve the quality of education.

And one of the most important business initiatives supporting education in the Republic of Moldova is the program "Tekwill in every school". This project was launched by Tekwill in collaboration with the Ministry of Education and various companies from the IT industry. The main goal of this program is to bring a new dimension in education through digitalization and the introduction of modern courses such as programming, graphic design and artificial intelligence. Also, in 2024, 1299 teachers from all regions of the country have joined this program, taking part in a comprehensive training offer that runs throughout the 2024 - 2025 academic year. Thousands of students across the country now have the opportunity to benefit from digital educational resources and participate in hands-on technology sessions. In this way, Tekwill in Every School not only enhances students' skills, but also prepares them for the challenges of their professional future. [20]

In order to maximize the benefits and minimize the risks in the collaboration between the private sector and education, it is essential to have a well-defined regulatory framework and a well-balanced strategy. We propose several key issues, such as transparent public policies, i.e. the authorities must clearly define the boundaries of collaboration between the private sector and the education system in a way that protects the overall interests of society. These policies should ensure a level playing field for all actors involved.

Another aspect would be diversification of financial support. Private funds need to be fairly distributed across different areas to avoid favoring some industries at the expense of others. A diversified approach helps to maintain a well-balanced education system adapted to society's needs. It is important that government and educational institutions regularly evaluate the effects of working with business. This monitoring can help to adjust

strategies according to the results, ensuring a constant and adaptable evolution of educational initiatives.

Collaboration between universities, companies, NGOs and authorities is vital for creating an inclusive and sustainable educational ecosystem. Each party has an important role to play, and effective cooperation can bring significant benefits to all involved.

4. Conclusions

Based on the above, we conclude that education is not only a fundamental right, but also an essential pillar of national security. A strong and relevant educational system contributes to the formation of valuable human capital, strengthening national identity through critical thinking and preparing citizens to face the complex challenges of the contemporary world, including those related to security.

"The world risks losing enormously if we fail to fulfill the right to education and allocate the financial resources necessary to achieve it." [21] Accordingly, collaboration between educational institutions, government authorities, the business environment and civil society is indispensable to raise awareness of the relevance of education and to ensure the quality of education in relation to national security imperatives.

By joining our efforts, we can contribute to the modernization of the national education system and, as a result, we contribute to the preparation of a competitive workforce capable of responding to current challenges. Undoubtedly, such collaboration also requires a well-founded legal framework. By implementing a well-thought-out strategy, the benefits of public-private partnerships can be maximized, leveraging the resources and expertise of the business environment in favor of education, but, at the same time, measures must be taken to avoid the risks associated with this collaboration. Thus, we can create a sustainable and inclusive educational ecosystem that prepares young people for a future full of opportunities.

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INNOVATION AS A TOOL FOR SUSTAINABLE DEVELOPMENT OF EU COUNTRIES

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Abstract: Innovation creates opportunities for starting new businesses, creating new jobs and contributing to economic development. The article explores the role of innovation and its influence on sustainable economic development. Innovation indicators are examined for different EU countries and disparities in the development of innovation systems are highlighted. The research was conducted based on data provided by the Global Innovation Index and Eurostat across the 27 EU countries. The article focuses on the evolution of the Summary Innovation Index in different EU countries. This index represents the average of 32 indicators in the fields of economy, business environment, governance and public policies, climate change and demographic dynamics. The comparative analysis of the innovation index allowed to highlight innovation leaders and underperforming states, providing useful information to decision-makers to improve the innovation potential of EU countries. In conclusion, it is emphasized that innovation is the engine of sustainable growth and companies must develop innovation strategies in accordance with international and national regulations. Innovation remains a primary factor for the competitiveness of countries and for sustainable economic development.

Keywords: Innovation, investment, digitization, sustainable development.

UDC: 001.895:338.1(4EU)

Classification JEL: O31, O52.

1. Introduction

EU research and innovation policy plays a key role in delivering Europe's recovery plan, paving the way out of the current crisis and towards a fairer future based on economic growth. Insights and breakthroughs from research and innovation play a crucial role in restoring ecosystems, making room for nature, and fundamentally changing the way to operate - paving the way for a more sustainable future in Europe and beyond.

Scientific progress and innovative solutions drive both digital and industrial transitions forward, while also supporting the realization of the Sustainable Development Goals. Innovation enables a rapid shift to a circular economy with a smaller environmental footprint, with cleaner industrial development. To remain a global leader, the EU must uphold high standards for climate action and environmental care.

This article analyses the impact of innovations on the development of EU countries and the evolution of innovation performance over the years. Innovation performance is analyzed through framework conditions, investments, innovation activities and impact.

2. Literature Review

Innovation is the process of transforming an idea into a practical application. Innovation is associated with the implementation of inventions in various spheres of human activity, contributing to the formation of a system of sustainable development of society. As Kahn K.B. (2018) mentions, innovation can be characterized by three different things: innovation is a result, innovation is a process, and innovation is a mentality [1].

Countries that create conditions for the generation and implementation of innovations gain competitive advantages [2,3]. Joseph Schumpeter (Josef Schumpeter, 1883–1950) was among the first to highlight the importance of innovation for creating competitive advantages. Competitive advantages are achieved by constantly improving the quality of products, technology, and organization.

Schumpeter defined innovation as a primary factor of economic development. The essence of innovation consists of:

- novelty of the idea;
- market orientation;
- practical significance;
- increasing economic effects.

Innovation is a complex economic category, including economic, social and environmental aspects [4]. Innovation is one of the objectives of the 2030 Agenda for Sustainable Development.

Innovations are the main factors of economic growth, a source of technological progress and a factor in long-term competition [5]. The development of countries is linked to the knowledge economy and advanced technologies. Many authors Szopik-Depczynska, K. (2020), Mohamed M.M.A. (2022,) note that countries that implement innovative solutions will grow rapidly.

Innovations, as the most important factor of sustainable and effective economic development, cover the national and world economy, and spread to economic, social and ecological aspects of the world community.

The 2030 Agenda for Sustainable Development includes 169 indicators, many of which refer to factors that favor innovation, research and development. The strategies developed and implemented in the EU support the sustainable development of economies that can be achieved through education, innovation and research and development activities (Istudor et al., 2020). Research-development-innovation is the main pillar that connects innovations with market realities, facilitating economic development.

Investment in research and development contributes to sustainable economic growth based on innovative solutions (Sarpong et al., 2022).

Achieving competitive advantages based on knowledge and innovation can guarantee the sustainable socio-economic development of countries.(SzopikDepczyńska et al., 2020). As Szopik-Depczynska, K. (2020) mentions “the assessment of the level of innovation of countries and regions is based on a complex of indicators: human and intellectual resources, public and private financial resources used to develop innovation, the capacity to create innovation, or institutional support for the development of innovation systems”.

The issue of disparities in the EU is a topic of interest in the literature (Brodny J, 2023; Constantin, M., 2021, Ionescu, G.H.,2020). The research carried out in this paper is based on the comparative analysis of EU countries according to the innovation index.

3. Methodology

The author used a complex and systemic research approach such as: analysis, synthesis, induction, deduction, scientific abstraction, documentation, and modeling. The research was conducted based on data provided by the Global Innovation Index and Eurostat across the 27 EU countries.

The Global Innovation Index measures innovation performance through four main pillars: framework conditions, investments, innovation activities and impact.

These pillars include several indices, namely [13]:

- *Human resources* (number of doctoral graduates in science, technology, engineering and mathematics (STEM); percentage of the population aged 25-34 who have completed tertiary education; participation rate of the population aged 25-64 in lifelong learning).
- *Attractive research systems* (international co-publications; publications in the top citations; number of foreign PhD students).
- *Digitalisation* (the proportion of enterprises with access to fixed high-speed internet (minimum 100 Mb/s); the percentage of people with digital skills above the basic level).
- *Finance and support* (investments in venture capital; research and development expenditure carried out by public and academic institutions; direct financial support or tax incentives provided by the government to companies investing in research and development).
- *Firm investments* (private R&D investment; non-R&D innovation spending; innovation spending per employee).
- *Use of information technologies* (development of employees' digital skills; number of employees with ICT expertise).
- *Innovators* (the number of innovations introduced within organizations).
- *Linkages* (partnerships between innovative firms; collaborations between the business and public sectors in the field of research; mobility of the scientific and technological workforce (HRST)).
- *Intellectual assets* (number of international patent applications (PCT); trademark applications; industrial design applications).
- *Impact on the workforce* (share of employees in knowledge-intensive fields; employment rate in innovative firms).
- *Sales impacts* (exports of medium and high-tech products; exports of knowledge-based services; revenues generated by innovative products).
- *Environmental sustainability* (resource productivity; exposure to fine particle air pollution; development of green technologies).

These variables were analyzed and compared between various EU countries for the year 2024 and the dynamics of these indicators were tracked for the period 2017 and 2024.

The comparative analysis of the Global Innovation Index allowed to highlight innovation leaders and underperforming states, providing useful information to decision-makers to improve the innovation potential of EU countries.

4. Results and Discussion

The impact of innovations on sustainable development and economic security is undeniable. An essential direction for achieving sustainable development is to build an innovative and socially focused economic model. Innovations significantly contribute to increasing the economic potential of states, drive long-term progress, support sustainable economic growth and have an impact on the social sphere and the environment.

Investments in innovation represent a strategic investment in the future of all countries, including the countries of the European Union. Through the developed framework programs, the EU aims to achieve such objectives as:

- strengthening Europe's position in science;
- stimulating industrial innovation;
- addressing climate change, renewable energy sources;

- transforming technological innovations into viable products with real market potential.

The current global crisis has a significant impact on economic development and provides an impetus for innovation activities. In this context, the European Innovation Scoreboard (EIS) presents a comparative assessment of the innovation performance of the EU and its Member States.

According to the European Innovation Scoreboard (EIS), published annually, the level of innovation performance is reflected by the Summary Innovation Index (SII). This index represents the average of 32 indicators that assess various aspects that influence innovation capacity, from various fields such as the economy, business environment and entrepreneurship, innovation profiles, governance and public policies, climate change and demographic dynamics [13].

The Innovation Scoreboard measures innovation performance through four main pillars [13]:

- I. Framework conditions;
- II. Investments;
- III. Innovation activities;
- IV. Impact.

The Innovation Scoreboard groups countries into performance categories, depending on how well they perform in relation to the European Union average in 2024 [13]:

- Innovation leaders are countries that perform above 125% of the EU average. In 2024, this group included the following countries: Denmark, Finland, Sweden, and the Netherlands.
- Strong innovators are countries that perform between 100% and 125% of the EU average such as Belgium, Austria, Ireland, Germany, etc.
- Moderate innovators are countries that have a performance between 70% and 100% of the EU average such as: Slovenia, Spain, Italy, Czech Republic, etc.
- Emerging innovators are countries with results below 70% of the EU average such as: Poland, Croatia, Slovakia, Bulgaria, etc.

Figure 1 shows improvement in performance of the EU over time.

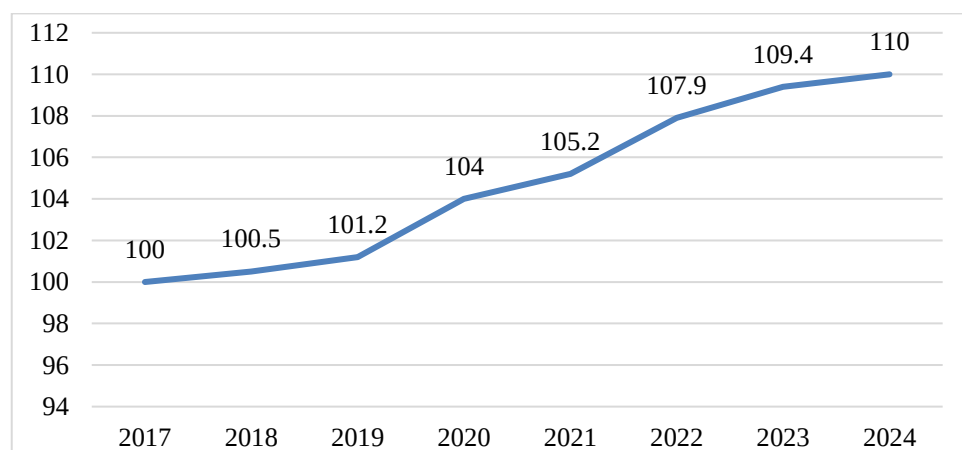


Figure 1. Improvement in performance of the EU over time

Source: research-and-innovation.ec.europa.eu

From 2017 to 2024, the EU's innovation performance increased by 10 percentage points. All EU Member States, except Luxembourg, have made progress in their innovation performance. The pace of this progress differs significantly from one country to

another. Over the period under review, a group of countries such as Romania, Ireland, France, Slovakia, and others have recorded an increase of less than 5 percentage points.

Eleven Member States have made faster progress, exceeding the EU average growth rate. Of these, Cyprus and Estonia stood out for their rapid pace, with improvements of +39 and +27 percentage points respectively. Figure 2 presents the summary innovation index of Member States in 2024 across the four pillars: framework conditions, investment, innovation activities and impact.

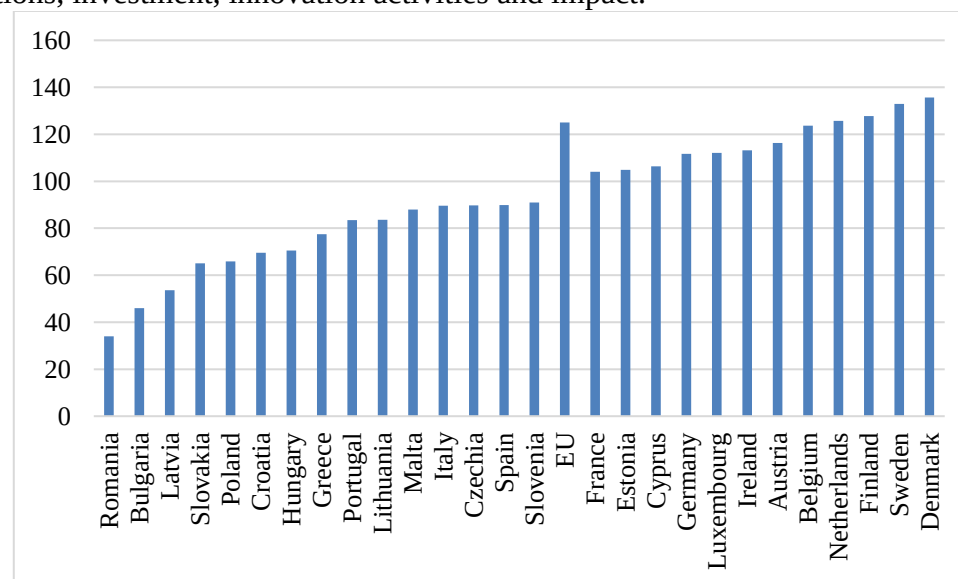


Figure 2. Summary innovation index in 2024 (relative to the EU in 2017)

Source: research-and-innovation.ec.europa.eu

I. Framework conditions

Human resources. This component reflects the availability of a well-trained and educated workforce, assessed by three indicators [13]:

- number of doctoral graduates in science, technology, engineering and mathematics (STEM);
- percentage of the population aged 25-34 who have completed tertiary education;
- participation rate of the population aged 25-64 in lifelong learning.

The best results in this category were recorded by Denmark, Sweden, the Netherlands, Ireland and Luxembourg. Romania, Bulgaria and Hungary were in last place with scores below 50 percentage points, i.e. half of the EU average in 2017.

In the period 2017-2024, the EU average for this dimension increased by 4 percentage points, as a result of progress recorded by 16 Member States. Luxembourg (+27 pp) and Estonia (+23 pp) made the most significant progress. In 11 Member States, performance decreased. The biggest declines were in Slovenia (-29 pp), Finland (-21 pp) and Slovakia (-20 pp).

Attractive research systems. This dimension measures how competitive and attractive a country's scientific base is internationally, taking into account the following indicators [13]:

- international co-publications;
- publications in the top citations;
- number of foreign PhD students.

With results twice above the EU average in 2017, countries such as Luxembourg, the Netherlands and Denmark are at the top of this ranking. The lowest scores were recorded by Bulgaria, Poland and Romania, remaining below the 50 percentage point threshold.

Over the period 2017–2024, the EU average increased, as a result of improvements in 24 Member States. The largest increases were recorded in Cyprus (+74 pp), Estonia (+67 pp) and Hungary (+47 pp). Only three countries registered a decline, the most significant being in Belgium (-24 pp).

Digitalisation. This dimension includes the assessment of the degree of penetration of digital technologies through the following key indicators [13]:

- the proportion of enterprises with access to fixed high-speed internet (minimum 100 Mb/s);
- the percentage of people with digital skills above the basic level.

The highest scores were obtained by innovation leaders Finland, the Netherlands, Denmark and Sweden and a moderate innovator - Spain. These countries exceeded the EU average in 2017 by 70%.

At the bottom of the ranking were Greece, Bulgaria and Latvia, with scores below 70 percentage points. Thanks to the progress recorded in 25 countries, the EU average for digitalization increased by 24% between 2017 and 2024. The most significant improvements were made by Cyprus (+75 pp), Finland (+52 pp) and the Czech Republic (+42 pp). Latvia and Belgium recorded decreases, the most pronounced in Latvia (-19 pp).

II. Investments

Finance and support. This dimension refers to the financing of the innovation process by the state, being assessed by three indicators [13]:

- investments in venture capital;
- research and development expenditure carried out by public and academic institutions;
- direct financial support or tax incentives provided by the government to companies investing in research and development.

The top countries in this dimension were France, Belgium (strong innovators) and Denmark (innovation leader), each exceeding the EU average by 50% in 2017. France continues to be at the top, and Denmark entered the top three in 2024. At the opposite end were Cyprus, Malta, Romania, Bulgaria and Latvia with scores below 50 percentage points.

Thanks to improvements in 20 Member States, the average performance of the EU as a whole increased by 17% between 2017 and 2024. The most significant progress was recorded in Denmark (+52 pp), Belgium (+43 pp) and Croatia (+43 pp). On the other hand, the largest decreases were recorded in Ireland (-42 pp) and Luxembourg (-18 pp).

Firm investments. This component reflects the level of companies' innovation spending and includes [13]:

- private R&D investment;
- non-R&D innovation spending;
- innovation spending per employee.

Germany topped the ranking, followed by Belgium and Sweden, with scores 30% above the EU average in 2017. The top is completed by Denmark and the Czech Republic, reflecting a mix of innovation leaders, strong innovators and moderate innovators. The worst performers were Latvia and Romania, with scores below 30 pp.

In 2024, 20 of the 27 Member States were below the EU average in this respect. Among the innovation leaders, only the Netherlands is below the average. Most strong

innovators are also below this threshold, with the exception of Austria, Germany and Belgium, which stand out positively. All emerging innovators occupied lower positions in the ranking.

During the period under review, the EU average increased modestly, by 6%. The most significant increases were recorded in Belgium (+42 pp), the Czech Republic (+39 pp) and Estonia (+36 pp). The most significant decreases were recorded in Slovenia (-34 pp), Sweden (-19 pp) and Croatia (-16 pp).

Use of information technologies. This component refers to [13]:

- development of employees' digital skills;
- number of employees with ICT expertise.

In 2024, in this dimension, most Member States exceeded the EU average in 2017.

Finland was the country that stood out with performances twice as high as the EU average, followed by Sweden, the Netherlands, Denmark and Luxembourg. At the opposite end were Greece, Romania and Bulgaria.

Overall, the EU average in this dimension increased by 10% between 2017 and 2024. The largest improvements were recorded in Poland (+51 pp), Cyprus (+41 pp) and the Netherlands (+38 pp). On the other hand, Austria (-28 pp) and Ireland (-24 pp) had the most significant decreases.

III. Innovation activities

Innovators. This component reflects the extent to which product or process innovations are introduced within organizations. In some countries, the pandemic pushed companies to adapt their products and processes and in the end, remarkable results were achieved, such as Greece, Cyprus, Belgium, Italy and Sweden.

Other countries such as Hungary, Malta, Spain, Romania, Poland, Bulgaria, Slovakia and Latvia continued to record results 30% below the EU average in 2017. With the exception of the innovation leaders, the differences in performance among country groups were considerable.

Overall, between 2017 and 2024, the EU average improved by 17%, as a result of progress recorded in 20 countries. The largest increases were recorded in Cyprus (+118 pp) and Greece (+67 pp). However, in seven countries, performance decreased, with the largest declines being in Portugal (-63 pp), Luxembourg (-34 pp) and Finland (-26 pp). [13]

Linkages. This dimension reflects collaborations in the field of innovation, through the following indicators [13]:

- partnerships between innovative firms;
- collaborations between the business and public sectors in the field of research;
- mobility of the scientific and technological workforce (HRST).

The best results were obtained by Cyprus, Denmark and Finland, with scores significantly exceeding the rest of the countries, reaching levels above 275.

On the other hand, some countries that refer to emerging innovators such as Romania, Bulgaria, Slovakia and Poland had the lowest performances, below the EU average in 2017. Ten Member States obtained scores above 200, but the EU average remained relatively low.

In 2024, all innovation leaders and strong innovators exceeded the EU average. Two moderate innovators, Slovenia and Lithuania, and one emerging innovator, Croatia, are above this average. The rest of the moderate and emerging innovators have performed poorly, occupying the lowest positions.

Between 2017 and 2024, the EU's performance in this dimension increased by 36%. Cyprus had the highest increase (+174 pp), followed by several countries with

progress above 40%, including Ireland, Italy, Croatia, Hungary and Slovenia. The only countries that regressed are Greece (-8 pp) and Romania (-4 pp).

Intellectual assets. This dimension assesses the performance of states in the field of intellectual property rights, through the following indicators [13]:

- number of international patent applications (PCT);
- trademark applications;
- industrial design applications.

The best performers were Austria, Denmark and Malta. The last places were occupied by Romania, Slovakia, Croatia, Greece, Hungary. Among the strong innovators, five countries are above the EU average (Austria, Germany, Estonia, Luxembourg, Cyprus) and three countries are below this threshold (Belgium, France, Ireland). All moderate innovators are below the EU average, except Malta and Italy. All emerging innovators have underperformed.

Between 2017 and 2024, 18 Member States have regressed and as a result the EU average in this dimension has decreased by 9%. The largest decreases were in Luxembourg (-37 pp), Germany (-19 pp), Denmark (-16 pp), Ireland (-15 pp) and Bulgaria (-16 pp). Nine countries have registered increases, the most obvious being Estonia (+24 pp) and Lithuania (+18 pp).

IV. Impact

Impact on the workforce. This dimension highlights the impact of innovation on the labour market, through the following indicators [13]:

- share of employees in knowledge-intensive fields;
- employment rate in innovative firms.

The best results were achieved by Sweden and Finland, followed by Cyprus, Ireland and Belgium, all with scores over 50% higher than the EU average in 2017. At the opposite end, Romania, Latvia, Slovakia, Bulgaria, Poland, Hungary and Spain had scores below 70, reflecting a modest impact of innovation on employment.

Between 2017 and 2024, the EU average in this dimension increased by 11%, thanks to the progress recorded by 20 Member States. Estonia had the highest increase (+72 pp), followed by Cyprus, Greece, Poland, Finland, Sweden, Croatia, Lithuania and Bulgaria, each with progress of over 20%. In contrast, seven countries saw decreases, the largest being Luxembourg (-32 pp) and Ireland (-15 pp).

Sales impacts. This component analyses the economic contribution of innovation, measured by three main indicators [13]:

- exports of medium and high-tech products;
- exports of knowledge-based services;
- revenues generated by innovative products.

Ireland, a strong innovator, leads the ranking, followed by Germany and Finland. Despite some progress in recent years, Croatia, Latvia, Lithuania, Bulgaria and Poland performed the worst, with scores more than 30% below the EU average in 2017.

Between 2017 and 2024, the European average increased by 5%, supported by improvements recorded by 21 Member States. Finland had the highest increase (+25 pp), and other significant increases (over 10%) were observed in Greece, Denmark, Portugal, Belgium, Croatia, Lithuania, Sweden, Bulgaria, Cyprus and Spain. Six countries recorded declines, with the largest decreases in Luxembourg (-15 pp) and France (-10 pp).

Environmental sustainability. This dimension assesses the negative impact on the environment and includes three important factors:

- resource productivity;

- exposure to fine particle air pollution;
- development of green technologies.

The best performers in this area were Denmark, the Netherlands, Luxembourg, Germany, Italy and France, which scored 20% better than the European Union average in 2017. In contrast, the last places are occupied by Estonia, Portugal, Romania, Bulgaria and Latvia. While Denmark and the Netherlands continue to be leaders in sustainability, Sweden and Finland fell below the EU average in 2024.

Between 2017 and 2024, the EU average increased by 11%, driven by improved performance in 13 Member States, including Ireland, Belgium, Malta, the Czech Republic and Slovenia, which recorded the greatest progress. In contrast, the largest decreases occurred in Croatia, Romania and Spain.

The performance differences between groups of innovators are significant, with the largest being observed in areas such as the use of information technologies, digitalisation and research, while the differences between moderate and emerging innovators are smaller in dimensions such as the use of information technologies and the impact of sales.

Recognizing the role of innovation in sustainable development, the total budget for innovation activities in European ecosystems was set at EUR 527 million.

5. Conclusions

1. Innovation lays the groundwork for the creation of new businesses, job opportunities, and increased productivity, making it a vital force for economic progress.
2. Economies that foster innovation are better positioned to deliver improved living standards. Enhancing innovation is a crucial goal for nations aiming to achieve greater prosperity and improve quality of life for their citizens.
3. Analyses indicate that EU member states are steadily advancing in the field of innovation. Between 2017 and 2024, the EU's overall innovation performance grew by 10%, largely driven by the continued development of advanced technologies and a supportive climate for start-ups.
4. However, progress varies across member states, with faster improvements seen in countries that are already embracing digital technologies.
5. Despite these advances, the EU still lags behind global competitors in terms of investment in research and innovation, particularly from the private sector.
6. Innovation remains a key factor for long-term competitiveness, as it boosts productivity growth in a context of environmental sustainability and macroeconomic stability.

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CONTINUOUS EDUCATION FOR SUSTAINABLE DEVELOPMENT: A TOOL OF SOCIAL EQUITY AND INCLUSION

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Abstract: *From the perspective of the sustainable development of society in general, lifelong learning is essential for social equity and inclusion, providing equal access to learning opportunities, especially for marginalized groups (people with disabilities, from disadvantaged backgrounds and in rural areas). Shared values, respect for diversity and gender equality can be cultivated and promoted including through community education and project-based learning, thus reducing socio-economic inequalities. Effective implementation of such an approach requires identifying and addressing structural barriers, monitoring individual and social factors, and ensuring the relevance of educational programs. However, strategies to improve lifelong learning are vital to turn possibilities into real opportunities and improve access for all people.*

Keywords: *Continuous education, sustainable development, equity and social inclusion, legal access to opportunities, improvement strategies for long-life education, "Upskilling" program.*

UDC: 371.14:304.4

Classification JEL: I20, I24, I25, I38, O15, Q01

1. Introduction

Continuous education, including **community education**, project-based learning (PBL), can significantly contribute to social equity and inclusion through equal access to learning opportunities, by including people with disabilities, from disadvantaged backgrounds, and rural areas in various socio-educational programs, by promoting common values and respect for diversity and gender equality, etc. - all these provide equal opportunities for all individuals, regardless of their socio-economic context [1].

Among the **benefits of continuous education**, we can mention:

- investment in updating and/or learning new IT techniques, which allows the creation of premises for maintaining competitiveness and adapting to new market requirements;
- improving and/or acquiring new skills and abilities by employees through "Upskilling" programs ("continuous professional development and focusing on active learning to keep the workforce relevant and competitive in a constantly changing business environment"), increasing networking opportunities, thus career prospects and better-paid positions [3];
- participation in continuous education programs contributes to personal development (self-confidence, development of critical thinking, development of problem-solving and time management skills, reducing anxiety).

The benefits and challenges of continuous education can be measured, perceived over time, both based on quantitative and qualitative indicators, as well as on structural

barriers faced by an institution/entity, with individual and social factors, with issues related to the relevance of continuous education. However, if continuous education is a real tool for social equity and inclusion, certain strategies to improve continuous education are necessary to enhance social equity and inclusion full of opportunities. Thus, this article addresses the impact of continuous education on social equity and inclusion, emphasizing strategies for integrating sustainable development principles into the educational system, but also increasing their impact on vulnerable groups.

The relevance of this article is justified by the practical-applicative importance of continuous education in reducing inequalities and increasing social mobility, including socially, economically, and culturally marginalized groups, as well as improving social cohesion (participation in identifying social problems and public debates with the active involvement of the government, educational institutions, employers, non-governmental organizations, local communities), cultivating entrepreneurial spirit and skills, etc.), thus contributing to achieving the UN Sustainable Development Goals in the EU context (especially goals 4, 5, 8, 10, 16, 17). [4]

2. Literature Review

Continuous education (also known as "lifelong learning") is approached by Peter Jarvis as "a way to cope with changes in society and improve skills and knowledge" [5]. EUROSTAT (2025) defines **continuous education** as "all forms of learning that take place throughout life, aimed at improving knowledge, skills, and competencies."

From the perspective of continuous education, H. George Frederickson defines **social equity** as "a concept that focuses on ensuring justice and fairness in the educational process, so that all individuals have access to equal learning and development opportunities, each individual being provided with what they need to fully develop, taking into account social, economic, and cultural differences." [7]

Maria Vremiş et.al. defines **social inclusion** as "a process through which those at risk of poverty and social exclusion are provided with the necessary resources and opportunities for full participation in economic, social, and cultural life - a standard of living and well-being that is considered normal within the society where they live; under these conditions, these individuals have a more pronounced participation in the decision-making process on issues that concern them, being ensured access to fundamental rights." [8]

3. Methodology

This article used a mixed methods approach to collect and analyze information on the effects of continuing education on equity and social inclusion. Thus, it used: academic literature review, policy documents and reports from international organizations (such as UNESCO, European Commission), databases such as Scopus, Web of Science and Google Scholar, government publications and NGO reports, key policy documents such as the European Pillar of Social Rights, national education strategies and reports from organizations such as the European Court of Auditors to understand current frameworks and initiatives. Information and updates from various websites and organizations such as the Ministry of Education and Research, the Association for Entrepreneurship Training and Development (AFAD), Equity, etc. have also been gathered to provide relevant examples of actions already undertaken for lifelong learning.

5W1H Framework: The 5W1H framework (Who, What, When, Where, Why, How) was used to organize the analysis and make sure all important parts of the research questions were covered. And the information gathered from various sources was synthesized to create a clear perception and understanding of the topic.

4. Results and Discussion

The relevance of this article is justified by the practical-applicative importance of continuous education in reducing inequalities and increasing social mobility, including socially, economically, and culturally marginalized groups, as well as improving social cohesion (participation in identifying social problems and public debates with the active involvement of the government, educational institutions, employers, non-governmental organizations, local communities), cultivating entrepreneurial spirit and skills, etc.), thus contributing to achieving the UN Sustainable Development Goals in the EU context (especially goals 4, 5, 8, 10, 16, 17). [4]

The key questions that guided us in this work were: 1- *To what extent does continuous education contribute to social equity and inclusion?* 2- *What are the main structural barriers to access to quality continuous education?* 3- *How can the impact of continuous education be optimized through sustainable educational strategies and policies?*

According to the first principle of the European Pillar of Social Rights (Education, training, and lifelong learning), "every person has the right to education, vocational training, and lifelong learning, inclusive and high-quality courses, to acquire and maintain skills that allow them to fully participate in society and successfully manage transitions in the labor market" [9]:

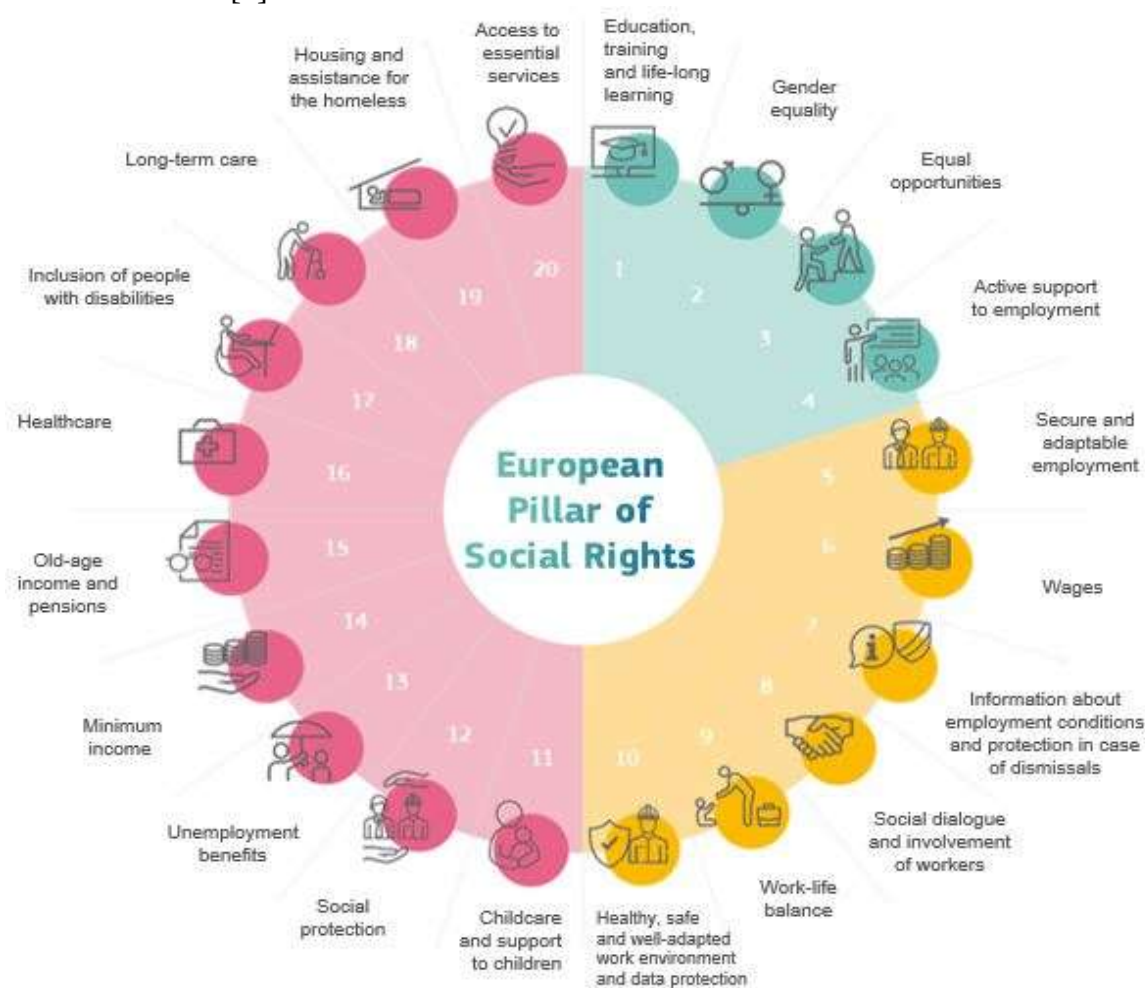


Figure 1. European Pillar of Social Rights

Source: https://employment-social-affairs.ec.europa.eu/european-pillar-social-rights-20-principles_en

The methodological guide "Early Inclusive Education", developed within the Project "Development and Promotion of Inclusive Education" and implemented by Lumos Foundation in coordination with the Ministry of Education, Culture and Research of the Republic of Moldova (MEC of RM), clearly stipulates: "The Global Agenda 2030 for sustainable development clearly states that disability and special needs in development and learning cannot be a reason or criterion for restricting access to the realization of the right to education. The ODD framework includes targets that explicitly refer to disadvantaged groups in relation to which the states of the world commit to combating inequalities and guaranteeing quality, inclusive and equitable education." [10]

Thus, not only early education must be inclusive, but also continuous education, lifelong learning. Long-term unemployed, women returning to the labor market after maternity leave, refugees, migrants, people living in poverty, national minorities, people without qualifications or with a low level of education, people with disabilities, people from disadvantaged backgrounds and rural areas with limited employment opportunities acquire and/or need to acquire skills relevant to a better-paid, more stable job for life and active citizenship thanks to various international projects (EU4Moldova, Erasmus+, UNDP, UNICEF, UN Women Moldova, organizations specialized in financial education - "Financial Education Moldova", "Foundation for Financial Education "OK"" etc.; Junior Achievement Moldova, EBRD etc.) that promote and implement programs for personal development, digital literacy, financial education, and communication and teamwork skills.

From an economic perspective, access to continuous education for vulnerable groups, therefore to quality education programs and jobs, as well as monitoring and evaluating the impact of these continuous education programs, is determined by the concern for smart, sustainable and inclusive economic growth.

From an educational perspective, extended access to quality education can be considered an indispensable condition for the realization of an Action plan on Integration and Inclusion 2021-2027. (European Commission. Action plan on Integration and Inclusion 2021-2027, 2020)

According to the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Action plan on Integration and Inclusion 2021-2027, from early childhood education and care (ECEC) to tertiary education, adult education and non-formal learning, "education and training constitute the foundation of successful participation in society and one of the most powerful tools for building more inclusive societies."

What does the European Commission want to achieve in the field of continuous education and employment? What does the Republic of Moldova want to achieve in the field of continuous education and employment? The answer is transparent and unequivocal:

- strengthening the inclusive nature of our education systems; promoting an inclusive educational system based on democracy, active citizenship and critical thinking skills; providing guidance and mentoring especially for people in transition;
- learning the host country's language as essential for successful integration into a new socio-educational and professional environment (especially for refugee or migrant students, who often face difficulties adapting to a new learning environment, and here it is appropriate to mention the "National program on learning the Romanian language by national minorities, including the adult population, for the years 2023-2025"); [12]
- promoting multilingualism as "one of the eight key competences necessary for anyone to fulfill themselves personally, to have a healthy and sustainable lifestyle, to integrate more easily into the labor market and to be an active and

socially integrated citizen", this being emphasized by the EU Member States in the Council recommendation on key competences for lifelong learning; [13]

- providing specific training for youth workers to acquire the necessary integration skills (for example, mobility projects for youth workers); [14]
- improving the recognition of qualifications through promoting cooperation between national authorities responsible for integration and national centers for the recognition of qualifications (ENIC-NARIC networks); supporting transparent practices for recognizing refugee qualifications through the Erasmus program; [14]
- supporting inclusive entrepreneurship and promoting inclusive mentoring, encouraging entrepreneurial spirit among migrants through individualized training and mentoring programs and opening integrated support structures for migrants' entrepreneurial spirit, as well as including entrepreneurship in integration programs; [14]
- developing an EU action plan on inclusive e-governance, which promotes human-centered digital public services for citizens, including migrants, and migrant participation in the creation and provision of digital public services etc. [14]

The main structural barriers to access to quality continuous education for vulnerable groups are:

1. Educational institutions in rural areas have limited access to educational resources.
2. Financial expenses associated with education often represent an obstacle for low-income individuals, which reduces their chances of accessing quality continuous education programs.
3. The lack of modern educational infrastructure and adequate technologies in such rural educational institutions affects the quality of continuous education.
4. The insufficient number of qualified teaching staff to teach Financial Education, Entrepreneurship and other subjects in disadvantaged areas.
5. The lack of recognition of non-formal learning outcomes, which limits continuous education opportunities for vulnerable individuals.
6. The lack of continuous collaboration between educational institutions, state institutions and employers often becomes an impediment to the effective implementation and monitoring of continuous education program results.

Therefore, certain **sustainable educational strategies and policies are necessary to optimize the impact of continuous education**. This is possible through:

1. Using digital educational platforms and tools to extend access to continuous education in rural areas

In 2024, Ministry of Education and Research of the Republic of Moldova announced the list of institutions that will be part of the "Model Schools Network", a national project that involves the renovation and complete equipping of 35 general education institutions in the country - the aim of the initiative being to increase access to quality education for students from disadvantaged backgrounds, especially those from small rural localities. [15]

In 2025, Ministry of Education and Research of the Republic of Moldova mentioned that many educational institutions still face a deficit of technological resources, which limits students' access to modern learning tools. In this regard, UNICEF equipped 70 schools with modern equipment, this initiative being aligned, according to the Minister

of Education and Research, Dan Perciun, with the "Education Development Strategy 2030, the National Digital Transformation Strategy 2023-2030 and other relevant policies" [16];

2. Implementing projects, funding programs and financial support for individuals from socially and economically vulnerable groups:

In the plan of the Ministry of Education and Research for 2025, the Ministry of Education and Research of the Republic of Moldova stipulates: "The quality of education directly depends on the well-being and preparation of teaching staff. (...) In addition to investments in teachers and researchers, we will continue investments in modernizing infrastructure and equipment. A quality educational system requires modern and well-maintained infrastructure. Classrooms, laboratories, libraries and sports spaces must meet current standards, providing students and teachers with a safe and attractive learning environment. The digitalization of educational institutions is a priority, ensuring equal access to technology for all students, regardless of their background. In 2025, we will continue several initiatives started in 2024 and allocate resources for investments in schools, kindergartens, vocational schools, colleges and universities. (...) Education is for everyone, and our system must be inclusive, responding to the needs of every child. The Ministry is committed to supporting students from disadvantaged backgrounds, ensuring access to psychological counseling services and creating a safe environment, free from bullying or discrimination. The physical and emotional well-being of children is the foundation on which their educational and personal success is built. (...) The curriculum must be dynamic, adapted to current needs and challenges. It is crucial to introduce transversal skills such as critical thinking, creativity, digital and entrepreneurial education, and to promote subjects that meet labor market requirements. We will collaborate with the private sector and international experts to develop and contribute to the creation of a relevant and competitive curriculum." [17] [18]

Another example of increasing the awareness of vulnerable individuals about available social services and how to access them is the project "Justice and Equity for People in Difficulty", a project implemented by the Social Justice Center "Equity", president Maria Zugravu, whose objectives are to increase the awareness of vulnerable individuals about available social services and how to access them, as well as to improve social services for disadvantaged individuals. The mentioned project is carried out by AO Social Justice Center "Equity" in partnership with People in Need Moldova within the project "Moldova ASSIST: improving access to quality public services and social cohesion", funded by the European Union. [19]

A relevant example of support for NEET youth living in the Security Zone for their educational inclusion and employment is the Project "Equal Opportunities for All and Everyone", part of the project "Better Opportunities for NEET Youth (Youth Inclusion Initiative)", implemented with the support of the Eastern European Foundation in partnership with the National Youth Council of Moldova, the Partnership for Development Center and the Regional Development Agency of Transnistria, from resources provided by the European Union and Sweden. Within the project, information and awareness activities were carried out for young people from 36 localities within the "Profession Caravan". [20]

An example of promoting social activism and entrepreneurial spirit among women and youth, democratic values based on the principle of equal opportunities between women and men, as well as active involvement in the economic and social life of the community is A.O. Association for Entrepreneurial Training and Development (AFAD), which aims to contribute to the economic and social development of the country by creating and developing a sustainable entrepreneurial ecosystem and providing economic and social development opportunities. Thus, the implementation of projects "Strengthening socio-economic resilience in RM for vulnerable women and girls, refugees from Ukraine and the local community, affected by the crisis" (July

2023 - January 2024), "Digital education for young people with initiative" (July 2022), "Increasing resilience through employment and social cohesion" (2024), "Export opportunities for beneficiaries of Business Skills Hub" (May 29, 2024 - January 30, 2025), Employment and Integration Support Center "ESC" (2023-2024) etc. - all through its members, beneficiaries and employees, respect and advocate for the respect of the rights of every person without any discrimination, promote active involvement in the economic and social life of the community, as well as the valorization of the unlimited potential of each community member in order to improve the economic and social situation. [21]

3. Attracting and implementing investments in the infrastructure of modern educational institutions in disadvantaged areas

A distinctive feature of the National Development Strategy "European Moldova 2030" (hereinafter - NDS), approved by Law no. 315/2022, consists in the accountability of public authorities in its implementation, by developing a coherent implementation mechanism, which ensures clear synchronization between NDS, sectoral and institutional strategies and the budget planning framework. To ensure the realization of this desideratum, the Strategic Planning Framework, established according to Government Decision no. 386/2020, provides for the development of the **National Development Plan for the years 2024-2026**, with objectives relevant to sustainable educational strategies and policies to optimize the impact of continuous education, such as: **General Objective 1.** Increasing income from sustainable sources and mitigating inequalities, **General Objective 3:** Ensuring appropriate and quality education for all throughout life.

4. Recruiting and retaining qualified teaching staff in rural areas can improve the quality of continuous education

In 2024, Ministry of Education and Research of the Republic of Moldova announced a deficit of 1,033 teaching staff at the beginning of the new school year. [22]

According to the Study "Evaluation of the initial and continuous professional training system for teaching staff in the Republic of Moldova", the study carried out within the project "Strengthening the system of continuous professional training and development of human resources in the field of education" (2023), implemented by the Institute for European Policy and Reform, with financial support from the Open Society Foundations, one of the consolidated recommendations of all study participants aims at: "Ensuring good living, working and equipment conditions for the teaching staff assigned to small urban and rural areas", this recommendation being justified as follows: "To motivate teaching staff to participate in continuous training and to retain teachers in the education system, in addition to a decent salary, the Government and Local Public Authorities must ensure good living, working and equipment conditions for teaching activities. Excellence and quality cannot be demanded in small urban and rural areas without normal conditions for carrying out activities - the physical condition of schools, utilities, equipment and teaching materials." [23]

5. Developing mechanisms for recognizing non-formal learning outcomes to extend educational opportunities for socially and economically vulnerable groups

According to Ministry of Education and Research of the Republic of Moldova, **the recognition of non-formal and informal learning outcomes** is "a priority for policy agendas both for developed and developing countries. Although learning usually takes place in a formal context, a large part of learning is carried out either non-formally or informally. Currently, the knowledge, skills and competencies specific to a profession, obtained in this way, do not allow employment due to the lack of opportunity to certify them. The recognition and validation of non-formal and informal learning outcomes will

contribute to improving employability and mobility, as well as increasing motivation for lifelong learning, especially for socio-economically disadvantaged individuals, individuals with special educational needs or those with low qualifications. The impact of validating non-formal and informal learning can also contribute to improving the functioning of the labor market, strengthening competitiveness and economic growth." [24]

At the same time, Ministry of Education and Research of the Republic of Moldova ensures the development, promotion and implementation of policies in the field of authentication, recognition and equivalence of study documents and qualifications. The National Qualifications Framework Directorate, a structural subdivision of the Ministry of Education and Research of the Republic of Moldova, has the competence to systematically establish and update, in accordance with national and international requirements, the normative framework regarding the process of authentication, equivalence and recognition of study documents and qualifications and monitoring its implementation. Study documents for recognition, equivalence and authentication (except for the recognition and equivalence of study periods for continuing studies in national education) are submitted to the Information and Communication Technologies Center in Education (CTICE) of the Ministry of Education and Research.

According to the UNESCO Institute for Statistics, equity is very important for the Sustainable Development Goals (SDGs) – especially Goal 4.5, which focuses on “eliminating gender disparities and ensuring equal access to all levels of education and training for vulnerable people, including persons with disabilities, indigenous communities and children in vulnerable situations.” [25]

According to EUROSTAT data, public spending on education represents "one of the most important investments that can be made in people". We quote: "Education has the potential to boost socio-economic development: this is especially the case in a globalized world where a highly skilled workforce can be an advantage in terms of productivity, innovation and competitiveness". [26]

According to the European Commission, "Council Resolution on a new European agenda for adult learning 2021-2030" outlines the vision for the development of continuous learning until 2030, one of its priority areas being "quality, equity, inclusion and success in adult learning". [27]

From an international model perspective, there are countries that support social inclusion through various effective continuous education programs. For example, **Finland** stands out for implementing professional retraining programs that provide equal opportunities for all social categories. According to the **Finnish National Agency for Education (EDUFI)**, the **Liberal Adult Education system in Finland** includes adult education centers, folk high schools, learning centers, sports training centers and summer universities that promote active citizenship and the eco-social perspective, offering adapted courses (basic skills, literacy, writing, calculation and digital skills, Finnish language courses, professional life and social orientation) including for individuals with a low level of education such as refugees and immigrants. [28]

Germany stands out for its dual learning system that combines theory with practice, thus facilitating access to jobs. **Continuous education in Germany** responds to labor market requirements, people's needs to obtain additional qualifications and extend knowledge through multiple formal and informal programs offered by municipal institutions, private institutions, religious organizations, chambers of industry and commerce, associations, companies, public institutions, academies, vocational schools, universities (for example, "non-formal education courses for adults who want to acquire new skills in sewing, basic home repairs etc., master's courses and seminars, online courses, foreign language and integration courses, vocational training, training programs for executives such as Executive MBA") etc. [29] **Canada**

(Government of Canada) through digital education initiatives, aimed at supporting the integration of immigrants and low-income individuals. [30]

5. Conclusions

Continuous education is an essential tool for promoting equity and social inclusion, having a direct impact on sustainable economic development. Extended access to lifelong learning reduces inequalities and supports the transition to a sustainable economy. And to maximize the benefits of continuous education, an integrated educational policy is necessary, based on collaboration between educational institutions - local authorities - the private sector.

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THE ROLE OF HEALTH IN PROMOTING ECONOMIC SUSTAINABILITY

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Abstract: Health has been and remains one of the fundamental concerns of human society. Ever since the time of Hippocrates, who, more than 300 years before our era, set out to empirically diagnose temperament types and identify typological and psychological personality traits, health has been a major topic of interest. Today, health continues to be an important field of research, as the constant evolution of the means and forces of production generates new opportunities and perspectives for the scientific investigation of health-related problems. The article examines the role of health status in promoting economic sustainability, emphasizing the close link between healthy life expectancy and sustainable economic development. A healthy population with higher life expectancy has a greater capacity to contribute to economic growth through an active and productive workforce. Investing in health not only improves the living conditions of the population, but also reduces health care expenditure, with a positive effect on the economy in the long run. Particularly in low- and middle-income countries, where access to health services is more limited, improving health status and increasing life expectancy can become fundamental drivers for economic sustainability. The article highlights the importance of health policies that support improvements in healthy life expectancy to ensure a prosperous and sustainable future. Health status, economic sustainability, public health, investing in health, life expectancy, healthy life expectancy, health policies. **Materials and methods:** The research was based on a review of relevant scientific literature and international reports to examine the link between public health status and sustainable economic development. Sources such as the Quality of Life Index by Country Report (Numbeo, 2023), the Institute for Health Metrics and Evaluation (IHME) Report and the WHO Health Emergencies Program Report were used to obtain data on life expectancy and health status of the population. The methodology included comparative analysis to identify correlations between public health and economic performance across countries. The extracted data were synthesized to highlight how investments in health can contribute to economic sustainability. **Results and conclusions:** The importance of the research lies in identifying the link between health and the economy. The authors emphasize that health status, as reflected in life expectancy, directly influences employability and GDP growth. Efficient management of health spending can bring significant benefits, such as improving prevention, promoting healthy lifestyles and increasing quality of life, thus contributing to greater longevity and overall population satisfaction.

Key words: Public health, public health assessment indicators, life expectancy at birth, healthy life expectancy, well-being, work capacity, life satisfaction.

UDC: 314.17:[314.47:614.2](478)

Classification JEL: A10, H56, Q57.

1. Introduction

Today, health status is recognized as an essential component of quality of life and is one of the most important indicators of population well-being. This complex indicator reflects the results of social, economic and medical efforts aimed at ensuring a long life and contributes significantly to the development of human society. At the same time, health is an expression of the social, economic and moral well-being of the population, living conditions, as well as access to and consumption of services, including health care.

The concept of health status and its links with life expectancy is diverse. Currently there are scientific opinions on the essence of the category of Average Life Expectancy

(AELS). The world's most famous scientist who has been concerned with the category of AELS has been Prof. U. Grosman, from the USA since 2012, but it should be recalled that conceptual approaches to Average Life Expectancy (AELS) have been demonstrated as early as 1980. The importance and timeliness of the study of the LMS problem stems from the fact that its value as an economic category is determined by the contribution of the population as a labor force that contributes to the production of various goods and the provision of various services. The authors capitalize on the concept of the value of public health in economic growth by maintaining a long life expectancy. They mention the importance of perceiving the essence of VHS as an economic category. Several value researches have been executed in this direction, some overlapping and some contradictory. The concept proposed by the authors advances an approach for the development of manageable models of the dynamics of health status and health-related standard of living/quality of life, which develop and complement each other.

The authors state that, Health status can be defined as a state of the human spirit, when the individual feels well, has the capacity to work and is satisfied with living conditions. Public health and public health protection are two separate intersecting categories: the economic-medical category with the managerial process of its realization; at the same time, which studies the regularities of the influence of socio-economic factors, environmental conditions on the health of the population and substantiates the system of state, public and medical measures for public health protection. Precupeţu 2008, states: Health is the result of a complex combination of factors with relevance at the individual and macro levels.

Romanian researcher Elena Cozmin (2009) conceptualizes health as a dimension and domain of quality of life. The dimension of health, like other aspects of human life, is described by subjective and objective indicators, emphasizing how individuals perceive their own health status, access to health services and their evaluation. The indicators used to describe health are analyzed at various levels of depth [1, p. 274].

Gorobievschi S. (2022), points out that Public health is an economic category, because it meets a set of personal characteristics that provide the individual a harmonious interaction with the social environment, as a result of which human biopsychosocial needs are realized through his activities in the social environment. Consequently, a person's social characteristics, together with psychological (mental) and physical characteristics, determine his or her public health [2, p. 207].

WHO considers that public health consists of the scientific and practical aspect of disease prevention, life prolongation and health promotion through coordinated action by society [3]. Most authors mention the multitude of socio-economic indicators used in health assessment, have developed various consistent methodologies in analyzing and forecasting its indicators, having a direct correlation with health status.

Alber and Kohler (2004) have determined that at the societal level, high health status is a key element of each country's human capital, contributing to its competitiveness vis-à-vis other countries [1, p. 274]. Life expectancy at birth reflects the average number of years that people born in a given period will live, assuming that the mortality rate at each age will remain constant throughout their lifetime, similar to the level in the year of birth [4, p. 33].

The scholars Murray, Christopher J. L, Salomon, Joshua A. determine the notion - Healthy life expectancy has a common term for a number of health indicators within which the evolution of life expectancy is adjusted according to health status. [5], Its content refers to the average length of time (years, months, days, weeks) that a person is expected to live in a given state of health at a constant level of morbidity and mortality characteristic for a

given country. These levels are determined on the basis of epidemio-statistical data, and the paradigm and the set of terms belong to the same category.

Hans Rosling (2012) therefore assesses healthy life expectancy as a statistical abstraction based on existing age-specific mortality rates and the prevalence of health conditions. While average life expectancy continues to be almost the most important indicator of population health, most of the developed world calculates this health indicator specifically.

These are the indicators that most adequately reflect the vitality and longevity of life of different age groups. For example, in Romania the share of employed people in the labor force is 65%, and in Moldova - 40%, of course, the contribution to GDP is different and, first of all, it should be emphasized that it is a decisive factor in people's health. The health status of the population is an essential element of the human capital of each country and plays a fundamental role in defining the quality of life. Indicators such as life expectancy, morbidity, mortality, subjective perceptions of well-being and the level of health expenditure contribute to detailed assessments of health, which are of particular importance in analyzing quality of life [6, p.219].

Precupeţu I., Cozmin E. adj. "Health is determined by a complex combination of factors that are significant at both the individual and global level." At the personal level, health depends on a number of interrelated factors such as genetic inheritance, social status, lifestyle choices, behaviors, attitudes and assumed values [1, p. 276].

In general, worldwide, the literature is dominated by numerous studies, which empirically demonstrate the viability of subjective measures of health in assessing the actual level of health (including, by demonstrating their predictive ability in relation to mortality, - Benjamin Gompertz (1825) [7]. One of the most popular models describing the influence of environmental factors on demographic processes is the Gompertz-Makem model, which describes the level of overall mortality in terms of the number of people surviving to old age in the population, taking into account empirical parameters [8]. Although the limit to the possible length of life is a subject that is unlikely to be addressed, to ever be determined, "even if it should exist, it nevertheless appears of interest to dwell on the consequence that would follow if the mortality rate were to be determined in old age.

However, both society and the economy suffer losses not only from premature mortality, but also from poor health, which can lead to total or partial disability, even at the most active ages. These losses have generally received less attention in the literature [7, p. 301].

Life expectancy at birth, also known as average life expectancy, is the average number of years that a newborn would live if he or she lived the rest of his or her life under the age-specific mortality conditions of the reference period. This indicator has been developed based on data on the number of the population as well as deaths by years of birth and ages in the reference period, producing the mortality table evaluated by the WHO [9]. The name and methodology for calculating these indicators (Healthy Life Expectancy (HALE)/Disability Free Life Expectancy (DALE) - were proposed by the scientist DANIEL F. Sullivan (1971) [3, p. 347]. He proposes to study the mortality rate under different aspects, the purpose of this index is to assess the change over time in the health status of the whole nation [3, p. 349].

2. Data and methodology

In terms of health status assessment, in international practice, two approaches are commonly distinguished - subjective and objective [1, p. 291]. The purpose of this mortality-morbidity index is to assess the change over time in the health status of the whole nation. The technique for combining mortality and morbidity rates into a single index - was devised

and reported by DANIEL F. Sullivan, USA [3, p. 353]. The objective method involves assessment of health status through the prism of an independent observer, a professional, with the use of special methods and instruments in the context of specialized examinations.

The subjective method - is the assessment of the state of health by the person's own feelings. Subjective assessment of health can be obtained based on a survey of the public. The present study is an example of health measurement using the objective approach.

The subjective approach to health assessment has been repeatedly criticized by researchers abroad as reflecting only individual perceptions and often having little to do with "real", objective health as measured by medical examinations. For example, Nobel Laureate A. Amartua Sen (1986), in one of his papers, writes about the discrepancy between the mortality rate in one of the poorest regions of India and the self-assessed level of health. Thus, he concludes that a high mortality rate in certain population groups can be successfully combined with a positive perception of health in general. In contrast, other work based on empirical data from India, as well as other developing countries, has found that self-rated health reflects actual levels of health and shows a positive relationship with socio-economic status [3, p. 33].

The WHO approach widely uses the HALE indicator to monitor health status in different countries, to develop recommendations for increasing healthy life expectancy and to reduce inequalities between countries. The results are published in the WHO World Health Statistics reports and on the World Health Organization website in the Global Health Watch section.

Eurostat approach. The Statistical Office of the European Union, in addition to WHO data, calculates the Healthy Life Years (HLY) indicator, also called Disability Free Life Expectancy (DFLE), which also combines information on mortality and health status, but the methodology differs from that used by the WHO [10, p. 33].

While the World Health Organization's assessment of the loss of healthy life years is mainly based on morbidity statistics and models for calculating losses by disease groups, Eurostat data are mainly based on people's self-assessment of their health status. Eurostat publishes a series of data characterizing the health status of the population, on the basis of which healthy life expectancy is estimated, under the following headings:

1. self-assessment of health and well-being (symptoms of depression according to severity; self-assessment of general health);
2. self-assessment of functional limitations (physical and sensory limitations; difficulties with self-care and household management for people aged 65 and over; self-assessment of long-term limitations in usual activities due to health problems);
3. self-assessed chronic morbidity;
4. injuries due to accidents (as reported by respondents);
5. health determinants (body mass index; recreational physical activity; fruit and vegetable consumption; tobacco and alcohol consumption) [11].

The Healthy Life Expectancy (HALE) indicator, calculated by Sullivan's method [3], characterizes the functional status of the population and, if it is found, that the increase in life expectancy is accompanied by an increase in good health status or, conversely, poor health status. Rosling Hans derived the method of calculation in 2006, arguing the importance of implementing this indicator in the population well-being approach.

The demographer from the Republic of Moldova, Olga Gagauz (2015), mentions the HALE indicator, which divides life expectancy into different health states throughout life [7, p. 8]. This indicator adds a qualitative dimension to the quantitative concept of the average number of years lived. HALE measures how many years, on average, a person is expected to spend in good health at a given age, considering the specific mortality, morbidity, and disability risk rates in the country for the corresponding year [12, p. 8].

Van Oyen H., Nusselder W., Jagger C. (2016), Kolip P., Cambois E., and Robine J.-M. (2018) emphasize that HALE is a health indicator that reflects the impact of mortality and morbidity. Recent studies conducted by Young-Eun Kim, Yoon-Sun Jung, Minsu Ock, and Seok-Jun Yoon (2022) have demonstrated a trend toward using various HLE indices that comprehensively evaluate or reflect the level of disability or dysfunction, such as QALE or DALE. Murray, Christopher J. L., and Salomon, Joshua A., noted that, in addition, for estimating QALE/DALE, the data scale was larger than in previous studies; thus, it can be predicted that the estimated health weighting validity is higher [5].

The authors consider that the previously expressed opinions are medically valid (from the perspective of evidence-based medicine), but when analyzing the issue from economic, demographic, and sociological positions, they agreed that life expectancy categories can be classified and arranged in the following dependency:

- HLE (Healthy Life Expectancy): Expected life span based on national statistical trends. Life expectancy at birth contributes to maintaining overall life expectancy (SVG) because the more people are born healthy and without disabilities, the larger the labor force. SVN is calculated by a weighted evaluation of all age categories (years), multiplied by their number (unit of measure – people × years); the sum of the products per age group is divided by the total number of inhabitants in the respective country, obtaining the average number of life years from birth;
- HALE (Health-Adjusted Life Expectancy): Life expectancy without morbidity and disabilities, also recognized as active life expectancy, expressed by the duration of working capacity (active labor force, from workforce entry to retirement). The same calculation method is used for this value, but the number of citizens with severe illnesses, chronic diseases, and disabilities is subtracted.

The formula is as follows:

$$HLE \Rightarrow HALE \Rightarrow ALE \Rightarrow GDP - total \% - HLE\# \quad (1)$$

Where:

- HLE – Healthy Life Expectancy;
- HALE – Health-Adjusted Life Expectancy;
- ALE – Average Life Expectancy.

The average life expectancy (SMV) of citizens represents the weighted arithmetic mean of individual life expectancies.

1. HLE (Healthy Life Expectancy at Birth): The average number of years lived in good health from birth;
2. HALE (Health-Adjusted Life Expectancy): The number of years a person is expected to live in good health throughout their life;
3. QALY (Quality-Adjusted Life Years): An indicator combining both life duration and quality, reflecting how many years lived in good health are considered equivalent to a completely healthy life;
4. DALE (Disability-Adjusted Life Expectancy): Represents the number of years lived without disabilities, indicating the duration of life without major health impairments;
5. ALE (Average Life Expectancy): The weighted arithmetic mean of all individual life expectancy values, considering different living conditions, health factors, and economic aspects.

The formula suggests that the weighted average life expectancy (ALE) is calculated as a combination of multiple types of individual life expectancy, each reflecting a different aspect of health status or quality of life, and ultimately relating to GDP and its percentage.

A more complete formula might look like this:

$$ALE = function(HLE, HALE, QALY, DALE, GDP) \quad (2)$$

This model could be used to examine the relationship between population health (through different types of life expectancy) and economic performance (reflected in GDP).

The logical regulatory chain of these socio-economic categories is reflected in various national and global scientific studies. For example, Young-Eun Kim (2021), Yoon-Sun Jung, Minsu Ock, and Seok-Jun Yoon state that SMV is formed by reducing this value by the number of people with disabilities and morbidity, meaning that this value is equivalent to the number of employable individuals within age groups.

In recent decades, the WHO has widely used the Healthy Life Expectancy (HALE – Health-Adjusted Life Expectancy) indicator in this field. It has been established that, globally, healthy life expectancy averaged 63.1 years (2022) for both sexes. This naturally correlates with the total life expectancy in a country but deviates downward by 9 to 14 years in different countries [5].

The Disability-Adjusted Life Expectancy (DALE) refers only to the period during which a person has lived in good health, up until illness. Life expectancy at birth represents the life expectancy for a given age level starting from 0. The data source for calculating this indicator is a preliminary assessment of the population structure by age and gender and the number of deaths by age group over a year, based on death records from public authorities.

The global life expectancy in 2023 was 73.16 years, marking an increase of 0.24% compared to 2022. The global life expectancy in 2022 was 72.98 years, showing a 0.24% increase from 2021.

Table 1. Life expectancy in rich countries, 2022 (years)

Countries	Life expectancy at birth 2022			Life expectancy at birth 2012			Abatement	
	Both sexes, years.	Men, years.	Women, years.	Both sexes, years.	Men, years.	Women, years.	+, -	% 2022/2012
Hong Kong	85,5	83,2	87,9	83,5	81,1	86,7	5,7	102,4
Japan	84,6	81,5	87,6	83,1	80,7	87,9	6,1	101,8
South Korea	84,2	81,8	86,6	82,4	80,4	85,6	5,2	102,2
Iceland	84,2	81,8	86,3	82,9	81,2	84,6	3,8	101,7
Spain	84,0	81,7	86,2	82,4	82,9	81,2	3,4	101,9
Switzerland	83,7	81,5	85,9	82,7	81,6	83,4	3,8	101,2
Singapore	83,6	81,4	85,9	82,2	80,7	85,2	4,5	101,7
Norway	83,4	81,7	86,0	81,5	81,0	84,2	3,2	102,3
United Kingdom	83,1	81,8	84,3	81,1	80,9	84,9	4,0	102,5
Luxembourg	83,0	81,2	84,8	81,4	81,0	83,4	2,4	102,0
Sweden	82,9	81,4	84,4	81,7	81,5	84,8	3,3	101,5
Italy	82,8	81,3	84,3	83,0	80,9	85,9	5,0	99,8
France	81,3	80,7	81,9	82,0	79,4	85,2	5,8	99,2
Austria	81,1	80,3	80,9	80,1	77,8	82,4	4,6	100,2
Germany	80,7	80,5	80,9	80,2	77,5	83,0	5,5	97,7

Source: Authors' calculations based on data from [19; 20; 21; 22]

Table 1 presents the Average Life Expectancy at the Global Level, where the healthiest countries worldwide have been identified. These include Hong Kong (85.5), Japan (84.6), South Korea (84.2), Singapore (83.6), Spain (84.2), Sweden (82.9), Luxembourg (83.0), Italy (82.8), and France (80.3). This group consists of the most economically developed countries, where, at present, life expectancy at birth is the highest, reaching 85.5 years.

Table 1 reflects life expectancy in wealthy countries. Over a decade, life expectancy at birth rose by 1.2% to 2.5%, with the UK showing the highest increase. Conversely, France, Italy, and Germany recorded decreases of 0.2%, 0.8%, and 2.3%, respectively. In high-income countries, longevity is boosted by high living standards, economic growth, public health investments, higher wages, well-being, biodiversity, food culture, and lower health risks.

Such investments positively affect public health and life expectancy. In 2021, life expectancy at age 60 reached 19.2 years - 20.9 for women and 17.3 for men.

Among European countries, France and Spain had the highest life expectancy at age 60 in 2021 (21.3 years), while Bulgaria had the lowest (13.6 years). For women at age 65, Spain led with 23.5 years, Bulgaria was lowest with 15.5. For men, Sweden had the highest (19.6), Bulgaria the lowest (11.6).

Table 2. Life expectancy, Healthy life expectancy, infant mortality rate and overall mortality rate in different countries, year 2022

Countries	Healthy life expectancy at birth, years.			Healthy life expectancy at birth, 60 years.			Infant mot. rate ¹ , %	Overall mort. rate ² , %
	Both sexes	Women	Men	Both sexes	Women	Men	Both sexes	Both sexes
Japan	74,9	72,5	77,2	21,1	18,9	23,1	0,8	235,4
Singapore	73,9	71,8	75,9	20,2	18,2	22,0	0,2	118,4
South Korea	73,2	70,8	70,3	20,0	17,9	21,7	9,1	237,1
Israel	72,8	71,6	73,9	19,5	18,6	20,4	1,8	285,3
Iceland	72,7	68,6	76,5	18,4	15,9	20,4	1,9	
Italy	72,8	71,8	73,7	19,9	18,7	20,9	1,6	289,1
France	72,6	70,6	74,4	20,3	18,7	21,7	2,5	290,1
Sweden	72,1	71,1	73,0	19,1	18,2	20,0	1,4	300,5
Norway	72,0	70,6	73,4	19,0	17,8	20,2	1,3	294,3
United Kingdom	71,4	70,3	72,5	18,8	17,8	19,6	4,8	330,1
Denmark	70,1	69,7	82,9	20,9	20,1	21,9	1,9	342,9
Spain	71,2	70,3	70,8	20,1	20,3	19,4	2,5	284,1
Switzerland	71,7	70,9	71,3	17,7	13,5	19,9	2,6	269,1
Germany	68,9	68,4	69,4	17,9	15,4	20,5	2,1	329,3
Austria	69,8	69,1	70,5	17,6	14,6	20,6	3,0	329,9

Source: Authors' calculations based on data from [19; 20; 21; 22]

¹ Per 1000 children

² Per 1000 Per 100000 inhabitants

Women generally live longer due to their reproductive function, which renews the immune system and strengthens disease resistance - a fact reflected in Table 2.

According to international data, in 2022, the annual number of deaths among children under five decreased to 4.9 million. Since 2000, the global under-five mortality rate (U5MR) has dropped by more than half. This remarkable achievement has been largely driven by the sustained commitment of governments, organizations, local communities, healthcare professionals, and families. In 2022, the difference in Life Expectancy at Birth between genders in the EU was 5.4 years, with variations among EU countries. That same year, Spain had the highest life expectancy at birth in the EU region.

Table 3. Assessment of public health in middle-income European countries, 2022

European neighboring countries	Health indices in rating	Investment in public health, % GDP	Life expectancy at birth, years	Overall mortality rate ³ , %	Mortality rate ⁴ Both sexes f/b, %
Bosnia and Herzegovina	69,7	9,0	78,8	550,3	368,7-798,7
Albania	68,4	6,7	77,1	601,9	385,6-905,4
Hungary	68,7	6,7	77,2	554,5	398,3-757,3
Romania	66,4	6,5	75,8	555,3	398,6-752,6
Kosovo	59,9	8,0	76, 5	-	-
Montenegro	69,7	6,4	74,0	603,1	417,9-847,5
North Macedonia	60,2	6,2	75,1	733,7	500,6-1032,0
Greece	57,3	8,6	76,8	329,0	247,6-431,8
Serbia	61,9	8,5	74,8	600,8	416,5-845,7
Bulgaria	61,4	8,6	74,3	616,5	432,5-849,3
Moldova	48,3	6,9	72,4	638,0	472,1-837,8
Slovenia	60,3	6,8	74,5	441,8	294,0-690,7
Belarus	45,7	5,6	71,2	608,0	429,6-858,9
Russia	56,8	8,4	71,3	619,5	474,7-788,8
Ukraine	49,1	7,0	68,6	649,0	482,7-870,2

Source: Based on data from [19; 23; 24]

Studies show that declining health status is correlated with aging and influences life expectancy, with differences also observed between men and women regarding longevity and health conditions. The authors determined that life expectancy gaps between men and women recorded the highest values in countries with a medium level of development.

The authors mention that the dynamics of health indicators in other countries show that without significant economic progress, the quality of health will continue to decline. In turn, this will have a strong negative impact on both citizens' health and workforce capacity. This will, in turn, strongly affect the development of the national economy.

Income plays a crucial role in determining life expectancy inequalities at both individual and societal levels (CSDH, 2008; Anderson et al., 2009). Bogdan Voicu (2005) also highlights the close connection between educational level, health status, and economic resources, and this relationship can be supported both theoretically and practically.

³ WHO defines it as standardized and it is assessed Per 100000 population.

⁴ Per 100000 population.

Table 4. GDP per capita income and average wages in selected European countries, 2022

Country	Population, persons, thousands	GDP per capita (USD)	Average wage per capita (USD)	Health status	Life expectancy at birth, years
Ukraine	39701738	7 283	480	69,7	78,8
Romania	19237000	4 664	1255	68,4	77,1
Greece	10322307	20571	1627	68,7	77,2
Hungary	9689 010	18728	1140	66,4	75,8
Belarus	9485 000	6289	609	59,9	76, 5
Serbia	8737 000	7243	563	69,7	74,0
Bulgaria	6948 000	23155	800	60,2	75,1
Slovenia	5643455	18344	860	57,3	76,8
Bosnia and Herzegovina	3280000	9831	859	61,9	74,8
Moldova	2900 000	5 995	650	61,4	74,3
Albania	2832439	12 484	461	48,3	72,4
Macedonia	2 083 000	10 366	705	60,3	74,5
Kosovo	1 907 000	3 460	555	45,7	71,2
Montenegro	628 000	15 800	850	56,8	71,3
Russia	141927297	14404	1056	49,1	68,6

Source: Based on OECD Health Statistics 2023 data and authors' calculations from [19, 25, 26]

Moldova differs from Western Europe in mortality structure. In middle-income countries, breast cancer is the leading cause of death among women (e.g., Bulgaria, Moldova, Ukraine, Russia, Hungary, Romania, Belarus). In Bosnia, Romania, Albania, Montenegro, and Russia, strokes are the primary cause, followed by ischemic heart disease and liver cirrhosis. Serbia and North Macedonia also report high mortality from heart disease, stomach cancer, colorectal cancer, and Alzheimer's.

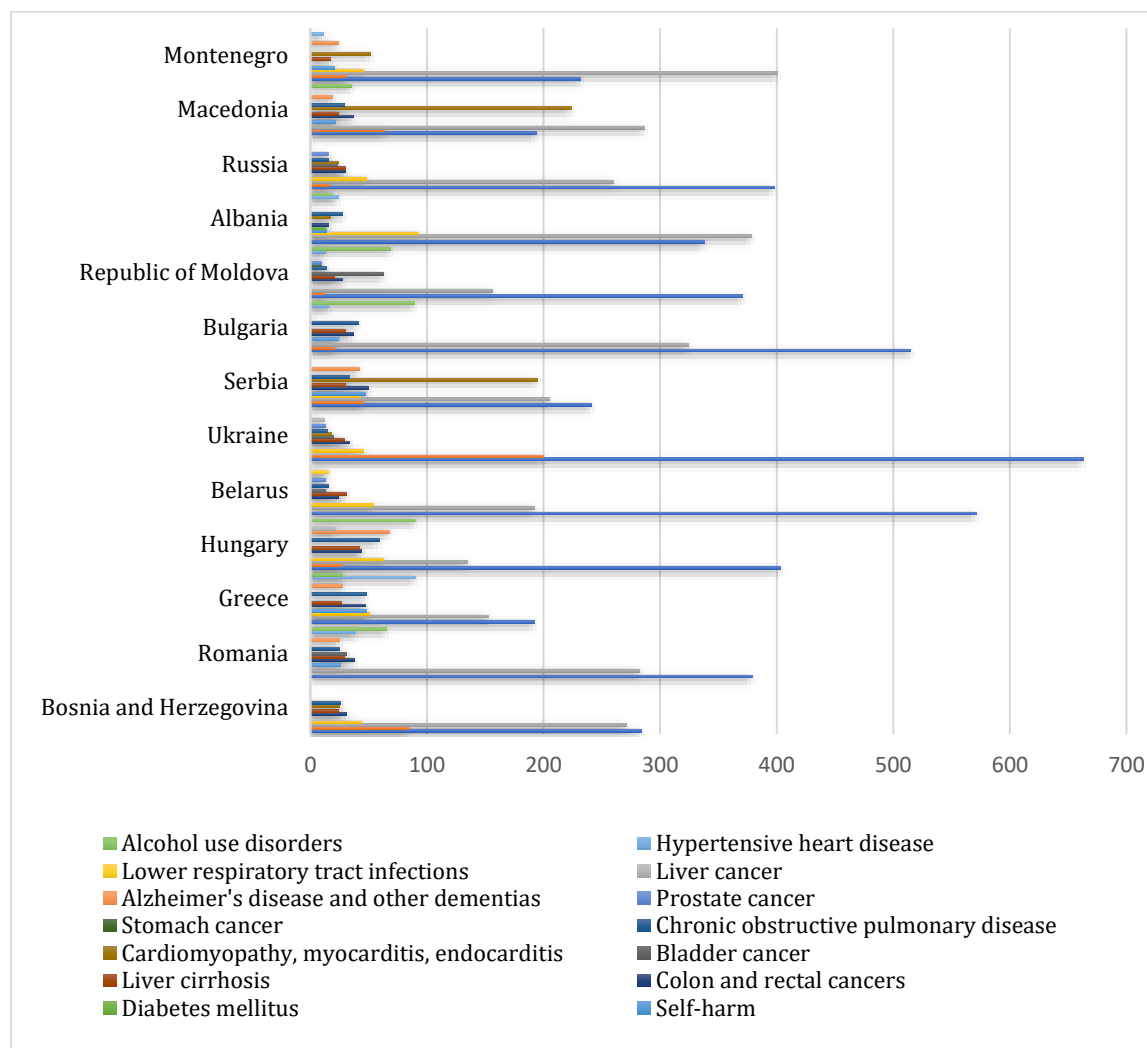


Figure 1. Causes of female deaths per 100,000 inhabitants, 2022

Source: [27]

Developed countries enjoy higher life expectancy due to factors like quality of life, economic growth, public health investments, biodiversity, nutrition, and risk reduction. Figures 1 and 2 illustrate key health factors and causes of death by country per 100,000 people. Negative health factors and mortality rates vary based on socio-economic development, geography, environmental quality, and healthcare investment. In developed countries, ischemic heart disease is the leading cause of death. In Romania, it accounted for 71,810 deaths (30.8% of total deaths), with an age-adjusted mortality rate of 153,780 per 100,000. In Moldova, ischemic diseases caused 14,292 deaths (37% of total deaths), with a rate of 245,760 per 100,000.

Liver cancer deaths in Moldova reached 2,869 cases (7.43% of total deaths). The age-adjusted hypertension mortality rate was 50,570 per 100,000, ranking Moldova 10th globally. In 2021-2022, hypertension deaths totaled 2,287 cases (5.92% of total deaths), with a rate of 39.16 per 100,000.

Lung cancer caused 1,131 annual deaths (2.93% of total), with a mortality rate of 18.69 per 100,000. Colorectal cancer led to 1,030 deaths (2.67% of total), with a rate of 17.43 per 100,000.

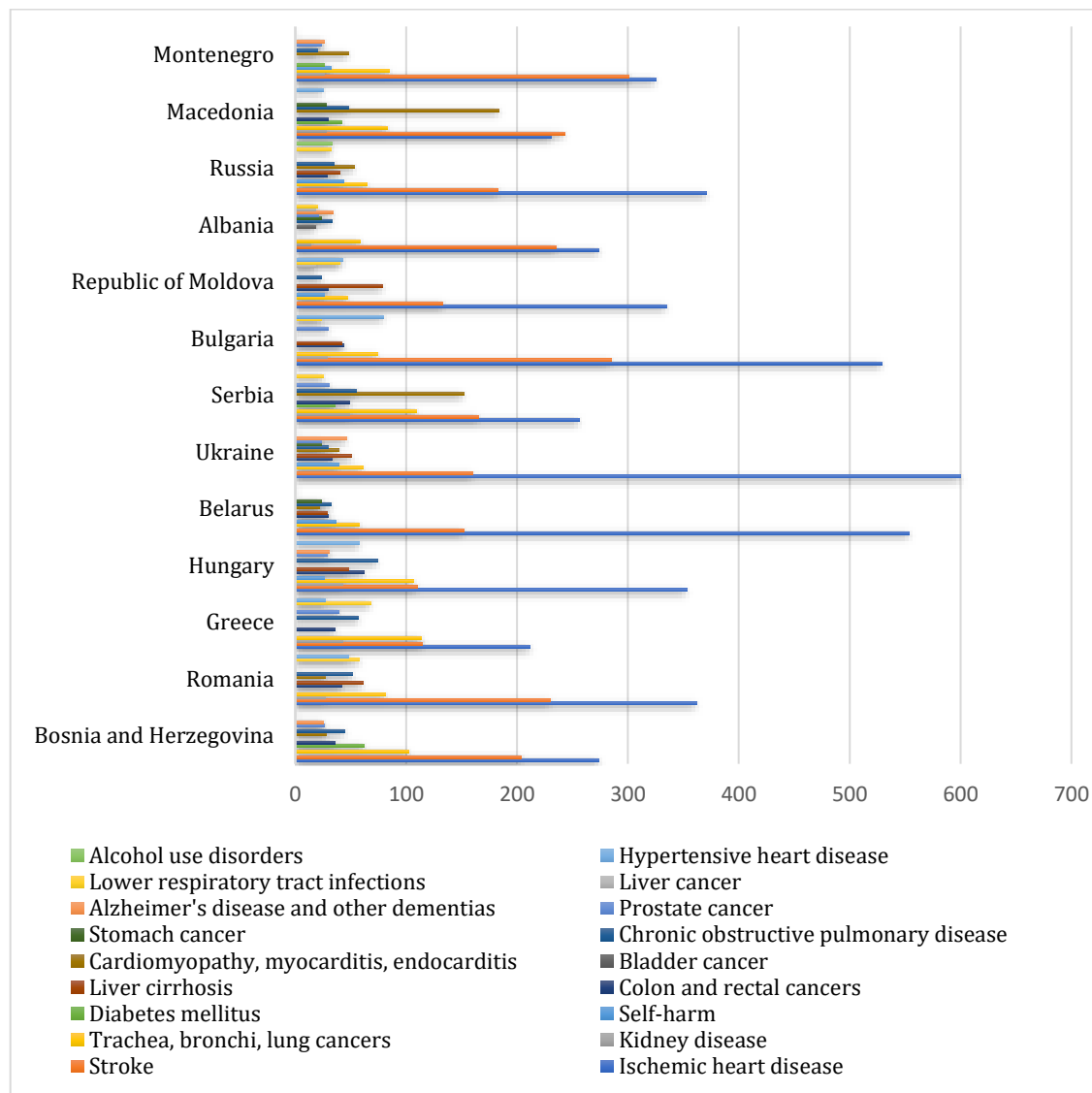


Figure 2. Top causes of death for males. Deaths per 100 000 population.

Source: [28; 29]

In developed countries, major causes of death include physical inactivity, obesity, stress, alcohol, and smoking, while in developing nations, mortality is driven by malnutrition, poor sanitation, low income, and high crime rates. The WHO ranks the leading causes of death by income level: in high-income countries, ischemic heart disease (15.6%), stroke (8.7%), lung cancer (5.9%), and Alzheimer's (4.5%) dominate. Middle-income nations face ischemic heart disease (12.3%), lung cancer (12.3%), and stroke (16.3%), while in low-income countries, diarrheal diseases (8.2%), HIV/AIDS (7.8%), and malaria (5.2%) are most prevalent.

Many low- and middle-income countries face a "double burden" of disease, battling both infectious diseases and rising chronic conditions like obesity, particularly in urban areas. Authors redefine life expectancy as the total lifespan, including healthy and productive years, alongside years lived with chronic conditions. The Global Health Journal [2019, Jun; 9 (1)] highlights the increased use of health indices like DALY and QALY to measure population health and prioritize interventions. However, there is a need for systematic guidelines to ensure their validity [15, p. 40].

Sindyashkina (2022) notes that studying healthy life expectancy involves analyzing social inequalities, public health policies, and demographic trends, particularly aging [16,

p. 40]. Gorobievski et al. (2021) emphasize that health indicators, such as life expectancy, mortality, morbidity rates, and healthcare investment, assess medical system efficiency and economic impact [17, p. 80].

Table 5. Top 15 Healthiest Health status in middle-income countries in the European Union and top 15 healthy high-income countries.

Economic indicators	Middle income countries	High income countries	Mathematical deviation
Life expectancy at birth 0 (years)	70,3	76,2	+4,9
Life expectancy at 15 e 15 (years)	58,2	62,4	+4,2
Death risk at 0-5 years (%)	1,6	0,8	-0,8
Death risk at 15-59 years (in %)	19,8	12,2	-7,5

Source: Authors' calculations based on [29, 30]

Aligning socio-medical activities with European standards requires a thorough evaluation of health status, life expectancy, and quality of life. Healthcare services should be effective at all levels, with statistical analyses updated to European and global standards. Public health assessments should incorporate both objective indicators (as per WHO) and subjective perspectives (as per Eurostat), reflecting individual satisfaction with health-related factors. This dual approach helps highlight public health strengths, weaknesses, and unaddressed gaps, contributing to sustainable development and improved life quality.

The elderly workforce should not be feared; rather, they can fill job vacancies unattractive to younger generations. Historically, Average Life Expectancy (SMV) has been seen as a demographic and medical indicator. However, this research presents it as a socio-economic concept, emphasizing its role in economic growth.

Health plays a crucial role in economic sustainability by:

1. Boosting productivity – Healthy individuals contribute more effectively to the workforce.
2. Reducing healthcare costs – Investments in prevention lower long-term medical expenses.
3. Ensuring economic stability – A healthier, longer-living workforce supports long-term economic participation.
4. Enhancing child health and education – Good health improves educational outcomes, strengthening human capital.
5. Reducing inequalities – Access to healthcare fosters social and economic inclusion.
6. Encouraging innovation – A healthy population is more creative and productive.

Investing in health not only enhances life quality but also strengthens economies, creating a sustainable cycle of prosperity.

3. Results and Discussion

The paradigm of life longevity - The healthier an individual is, the higher their life expectancy, and the more sustainable their working capacity becomes. This, in turn, ensures a longer participation in the labor market, ultimately contributing to economic development.

A longer life in good health is a crucial objective for societies facing demographic aging. Identifying health inequalities and disparities in access to medical care provides essential insights for developing and implementing social policies. This study examines the

socio-economic indicators of life expectancy and the relationships between them, with a focus on achieving healthy longevity.

Aging in relation to health does not merely refer to the absence of diseases but also to maintaining an individual's functional capacity. If the necessary policies are not implemented and adequate investments are not made in public health to promote a healthy life expectancy, the losses to society will be significant and difficult to recover.

Allocating a portion of the GDP to public health has a strong impact on reducing morbidity through health prevention measures, dietary culture, and maintaining a healthy lifestyle. As a result, this contributes to an increase in the longevity of the population while also reflecting an improved state of health.

The significance of this research lies in the fact that the authors have established the interdependent links between health status, life expectancy, workforce capacity, and a country's GDP. This confirms that health should be recognized as a socio-economic category that actively contributes to a nation's economic growth.

Life expectancy at birth [18, p. 12] - often referred to as Average Life Expectancy - is commonly identified as a comprehensive measure of mortality. However, this indicator also has certain limitations, particularly highlighting the influence of circumstantial factors specific to different time periods.

The research was carried out within the framework of the project "Using Socio-Economic Methods for Public Health Management Research", under the number 23.00208.0807.087.08/PDI

4. Conclusions

1. Public health plays a crucial role in human society. A healthy body nurtures a healthy spirit, one that is capable of innovation and productive work. This, in turn, contributes to the economic growth of nations.
2. Average life expectancy refers to the duration of life from birth to death, encompassing several components: healthy and productive life expectancy, as well as the period spent living with chronic diseases and other health conditions. In modern public health theory, various evaluation indicators are used; however, the most significant one for a nation's economy is recognized as the average life expectancy (ALE) of individuals and society as a whole. The gap in life expectancy between men and women has shown the largest disparities in countries with a medium level of development.
3. Average life expectancy is a complex and multifaceted indicator that varies across countries, genders, and age groups. It is influenced by multiple factors such as living conditions, dietary habits, genetic background, geographical location, environmental conditions, and overall well-being of citizens.
4. A global economic analysis of life expectancy has identified the healthiest countries worldwide, including Japan, South Korea, Singapore, Spain, Sweden, and Luxembourg. These nations make the highest investments in healthcare. Notably, the countries with the strongest economies currently have an average life expectancy of 85.5 years. In contrast, in middle-income countries, this figure is approximately 78.8 years. The largest gender disparities in life expectancy remain prevalent in countries with moderate economic development.
5. The Republic of Moldova lags behind other European middle-income countries such as Hungary, Serbia, Albania, Bulgaria, and Romania in terms of life expectancy for both men and women. The gap is even more significant when analyzed in a global context. Women tend to have a longer life expectancy than men, a difference largely attributed to lifestyle choices and genetic factors.

6. Investments in public health yield substantial benefits, as they directly contribute to the expected outcomes. Wealthier countries tend to allocate more resources to their healthcare systems, which in turn leads to an increase in national ALE. At the same time, these investments positively impact economic growth.
7. Access to advanced medical care and pharmaceutical innovations directly correlates with increased life expectancy, thereby contributing to overall well-being. It is now widely acknowledged that a rise in active life expectancy plays a significant role in boosting a country's GDP, particularly in nations that prioritize this aspect.
8. Health status plays a fundamental role in analyzing life expectancy, and the correlation works both ways. This indicator is closely linked to numerous socio-economic factors. Continuous monitoring and breaking it down into various aspects allow for a more comprehensive and coherent analysis, incorporating both objective and subjective perspectives.

The importance of the research lies in identifying the link between health and the economy. The authors emphasize that health status, as reflected in life expectancy, directly influences employability and GDP growth. Effective management of health spending can bring significant benefits, such as improving prevention, promoting healthy lifestyles and increasing quality of life, thus contributing to greater longevity and overall population satisfaction.

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INFLUENCE OF FAMILY AND SOCIAL ENVIRONMENT ON THE ENTREPRENEURIAL INTENTIONS OF PEOPLE FROM GENERATIONS Y AND Z

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Abstract: This study investigates the influence of family and social environments on the entrepreneurial intentions of individuals from Generations Y and Z, emphasizing the significance of intergenerational relationships in shaping entrepreneurial mindsets. The research is grounded in a systematic review of contemporary academic literature, as well as original empirical data collected through a survey conducted among 224 students at the D. A. Tsenov Academy of Economics during the 2023–2024 academic year. The findings reveal a strong predisposition toward entrepreneurship among young individuals, with a pronounced preference for launching ventures in cooperation with family members. Notably, respondents demonstrate high levels of autonomy while still valuing the tangible and emotional support of their immediate social circles. The study identifies diverse patterns of entrepreneurial collaboration, highlighting a strategic orientation toward both innovation and continuity through intergenerational business initiatives. These insights contribute to the broader discourse on entrepreneurial ecosystems by providing an empirically grounded perspective on how generational dynamics and familial capital intersect in shaping entrepreneurial intentions.

Keywords: Entrepreneurship, entrepreneurial intentions, entrepreneurial attitudes, entrepreneurial activity, family and social environment.

UDC: 316.4.063:334.72-053.6

Classification JEL: A20, L 26

1. Introduction

In modern society, entrepreneurial intentions are formed by numerous factors, among which the family and social environment play a leading role. The family is a fundamental social unit that helps shape entrepreneurial attitudes by conveying ideals and providing role models and early resources. Young people's desire to establish their businesses is heavily influenced by their social circle, which includes friends, teachers, and mentors. These elements have a profound impact on generations Y and Z, which are characterized by high digital adaptability, innovative thinking, and a desire for autonomy. The current study examines the effects of familial and social environments on shaping entrepreneurial inclinations among members of different generations.

2. Literature Review

The family plays a vital role in launching and managing businesses. According to statistics, a significant proportion of enterprises globally are family-owned, highlighting the importance of this component in the economy. In 1996, 75% of the over 27 million enterprises in the United States were categorized as family-owned, and the European Commission believes that 70% to 90% of businesses in EU countries fall into the same group. In the Asia-Pacific region, the share of family enterprises ranges from 80% to 90%

in Singapore, and in China, over 85% of private businesses are owned and operated by families. In Latin America, this percentage ranges from 65% to 98% [1].

Research supports the premise that the social environment has a substantial impact on entrepreneurial activities. According to Djankov et al. [2], the social network of family, relatives, and friends has a significant effect on whether an individual becomes an entrepreneur. A 2007 study in several Brazilian towns found that 81% of the entrepreneurs surveyed had relatives or friends who owned and operated their firms. Additionally, 70% reported that their best friends had launched their enterprises. Similar findings are seen in Russia and China, where the network of friends and family strongly encourages entrepreneurial involvement.

Academic research confirms that the family environment has an impact on entrepreneurial intentions. According to Thresiamma and Adil [3], a study conducted in Malaysia in 2011, the family serves as a role model for students, influencing their entrepreneurial attitudes. Similar findings were obtained by Goethner et al., who discovered that students with entrepreneurial support from their families were more likely to establish a firm [4]. A study of three Bulgarian economic universities found that close and familiar businesspeople, parents, friends, and university instructors have the greatest influence on students' entrepreneurial inclinations [5].

In the context of Fishbein and Ajzen's Theory of Planned Behavior [6], family and social environments are key elements that shape the perceptions and expectations of young entrepreneurs [7]. Social norms, such as the expectations of relatives, friends, and mentors, influence the entrepreneurial decisions of generations Y and Z. Although studies suggest that social norms have a lower effect on those with a high internal locus of control, they continue influencing entrepreneurial attitudes [8]. Furthermore, perceived behavioral control – the belief in one's abilities – is often shaped by the support and example of family and social environments.

According to Shapiro, entrepreneurial intentions result from psychological processes influenced by previous experiences, education, social networks, and personality characteristics [9]. Family and friends play a crucial role in this process, providing both moral support and practical resources, as well as advice and examples of successful firms. Shapiro's concept emphasizes the significance of social connections in acquiring knowledge and accessing opportunities. Young people with entrepreneurial parents or relatives are more likely to consider entrepreneurship a realistic career path. Furthermore, a supportive family atmosphere can foster confidence, creativity, and the ability to deal with problems [7].

In more recent literature, Carr and Sequeira [10] stress that family social capital – defined as the quality and availability of relationships and support within the family – significantly influences entrepreneurial intentions. They argue that beyond simple exposure, the quality of family interactions, trust, and shared values play a crucial role in whether an individual develops a positive attitude toward entrepreneurship.

However, contradictory findings also emerge. Laspita et al. [11] point out that while entrepreneurial parents may inspire their children, they can also exert pressure, create high expectations, or even discourage risk-taking due to fear of failure, leading to ambivalent or negative effects. This introduces a paradox: the same familial influence can be both enabling and constraining, depending on its nature and context. Moreover, Aldrich and Cliff [12] argue that research often romanticizes family influence without addressing intra-family tensions, gender roles, and generational conflicts that can inhibit entrepreneurial activity.

Another theoretical gap concerns intersectionality – how the influence of the family varies across gender, socioeconomic status, and culture. For example, Welter [13] calls for greater sensitivity to contextual influences, noting that family support may manifest differently in collectivist versus individualist cultures, or among men and women with different role expectations. Similarly, Jennings and Brush [14] criticize the lack of gender-aware research in studies of family and entrepreneurship.

Furthermore, although many studies highlight positive correlations between family support and entrepreneurial intention, there is a lack of longitudinal research proving causality. Most studies are cross-sectional and rely on self-reported perceptions, which may suffer from biases. Future research should incorporate long-term, mixed-method studies to trace the developmental trajectory of entrepreneurial mindsets in various family structures.

3. Methodology

This paper includes a literature review of publications related to entrepreneurial attitudes, analyzed through a systematic approach. The sources used include Research Gate, Google Scholar, ScienceDirect, Scopus, and WoS. In addition to theoretical analysis, the study also relies on empirical research⁵ conducted in 2023 and 2024 among bachelor's and master's degree students at the D. A. Tsenov Academy of Economics. The study involved 224 respondents, of whom 206 (92%)⁶ were representatives of generations Y and Z. These generational cohorts were selected due to their increasing role in shaping the entrepreneurial landscape and their heightened exposure to dynamic socio-economic environments. A structured survey method was employed, as it enables the collection of comparable and quantifiable data on attitudes, perceptions, and the influence of family and social factors, thus allowing for both descriptive and inferential analysis.

4. Results and Discussion

Most responders (85%⁷) had a strong entrepreneurial mindset (Figure 1). This reflects the ambition and desire for independence shared by generations Y and Z. They are constantly seeking ways to showcase their creativity and capitalize on opportunities for innovation. Only a tiny percentage (9%) are uninterested, which could be attributed to a preference for the stability of traditional employment.

⁵ The INTERGEN project seeks to explore the views of university students in nine countries regarding starting their own or continuing a family business. The project's results can be found in multiple articles indexed in the world's top databases, including SCOPUS and WoS, from 2018 to the present. For further information, see www.intergen-theory.eu.

⁶ The data in the “Results and Discussion” part of this publication are only for the two generations combined. The author considers the prospect of more detailed analysis and comparisons in future scientific breakthroughs.

⁷ The percentage shown represents the sum of those who replied “Yes” and “Rather yes”.

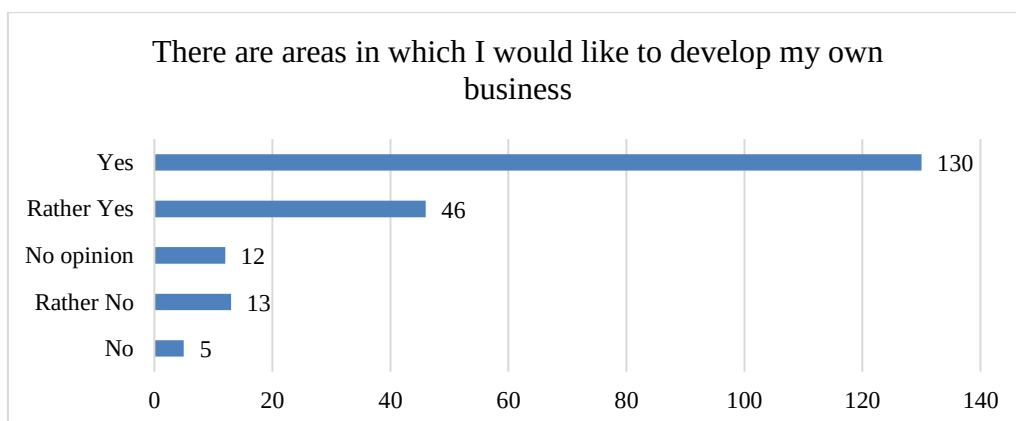


Figure 1. Desire to start own business

Source: INTERGEN Project 2024 Survey

People of generations Y and Z value the support of their loved ones. This could be due to cultural views in which the family plays a vital role in decisions, particularly when beginning a business or managing an existing one. Individuals' business talents and attitudes are heavily influenced by their families. Family history, support, and inspiration from relatives, friends, and loved ones are key influences on entrepreneurial activity. A conducive socio-cultural context is required for the successful implementation of such initiatives. However, approximately 36% are prepared to act without such backing, indicating that for some, trust in one's ability takes precedence over family acceptance (Fig. 2).

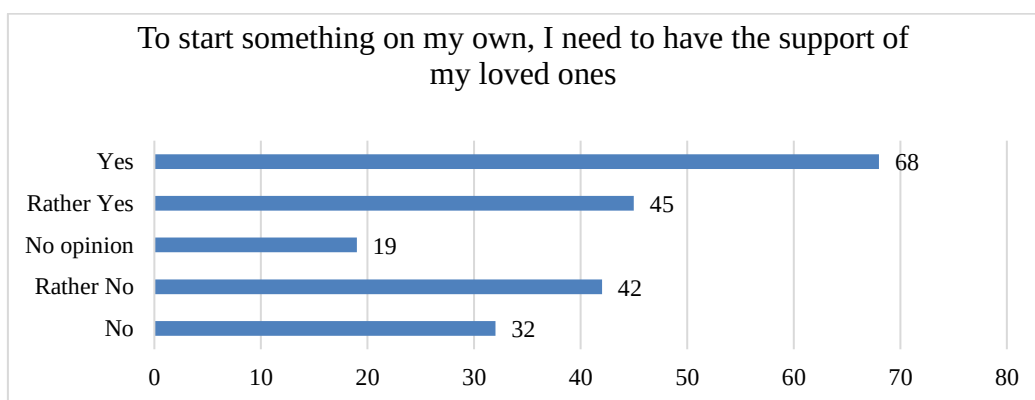


Figure 2. Support from loved ones when starting a business

Source: INTERGEN Project 2024 Survey

The survey data correspond to the answers to the question: “I would start my own business even without the support of relatives and friends”, where 80% of respondents said “Yes” or “Rather yes”. This result indicates a high level of autonomy and self-confidence among representatives of Generation Z, who demonstrate strong internal motivation, and Generation Y, who balance internal beliefs and external factors when making decisions. This indicates a readiness to take risks despite the lack of a supportive social network. In this context, nearly 40% of respondents prefer starting a neoclassical intergenerational family business, as this would provide them with a greater sense of security compared to a completely independent entrepreneurial path. The differences in the answers to this question reflect variations in entrepreneurial strategies. While some respondents seek stability and support within the family business, others are oriented towards independent business ventures. The significant share of those who responded “No opinion” may be an

indication of insufficient practical experience or ambiguity about the potential benefits and challenges of intergenerational business models.

On the other hand, Generation Y and Z students report feeling secure when their parents work as suppliers or subcontractors for their company. People in these generations frequently rely on family support, particularly regarding resources or skills. This indicates an interest in intergenerational cooperation. Certain cultural and family values can account for children's great trust in their parents.

More than half of the respondents are interested in continuing a family business (Figure 3). This may be related to the stability and opportunities offered by the already established foundation, but still, a significant portion, nearly 30%, prefer to create something new.

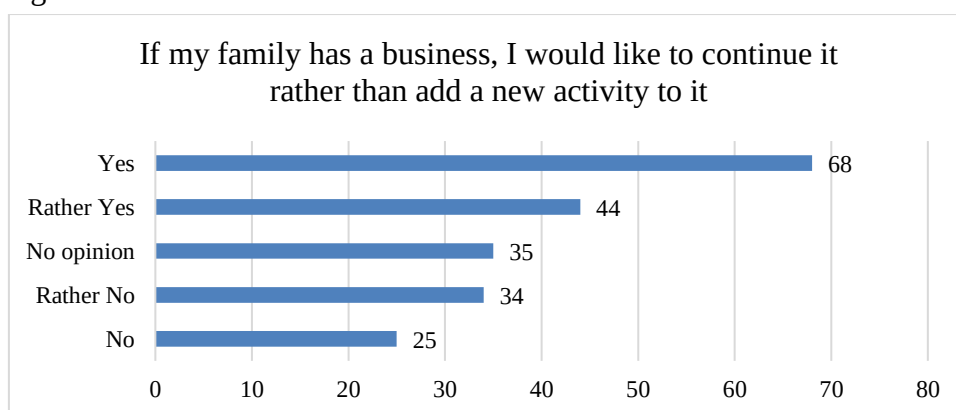


Figure 3. Interest in continuing the family business

Source: INTERGEN Project 2024 Survey

The data from the presented graphs (Figure 4) reveal significant trends in the preferences of generations Y and Z regarding collaboration with family members in an entrepreneurial context.

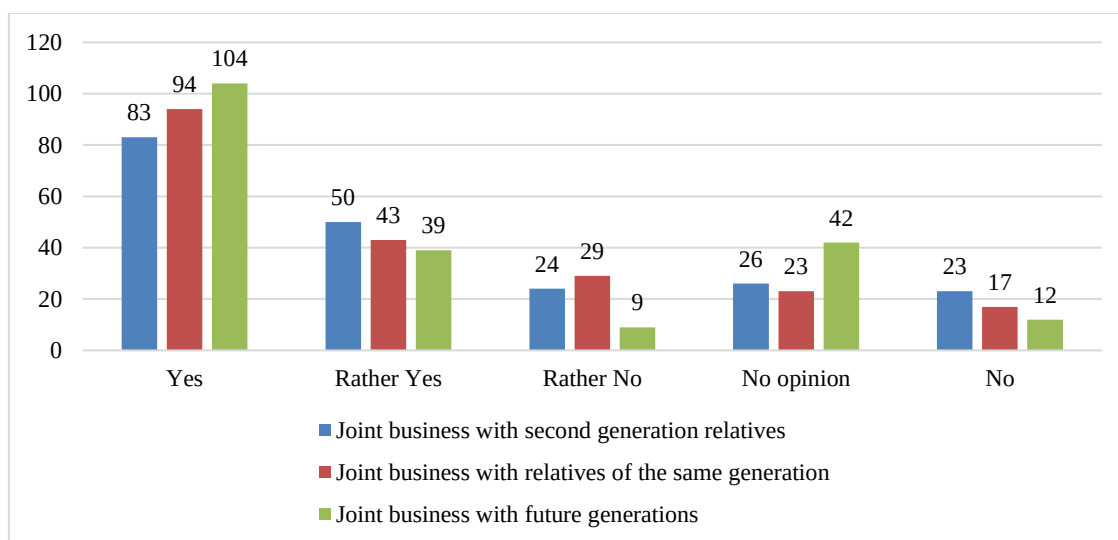


Figure 4. Establishing joint businesses with different generations

Source: INTERGEN Project 2024 Survey

According to the analysis, representatives of the future Alpha⁸ and Beta⁹ generations have the largest tendency for business collaborations (70%). This might be

⁸ Generation Alpha encompasses those born from 2010 to 2024.

seen as a statement of a forward-thinking strategy in which youthful entrepreneurs perceive opportunities to adapt to new technologies and business models.

Business relationships involving members of the same generation, such as siblings, cousins, and in-laws, rank second (67%) in terms of desire. This can be attributed to shared ideals, understandings, and life experiences, which aid communication and cooperation in the entrepreneurial process. At the same time, the high level of trust and shared interests among these relatives likely increases motivation for collaborative effort.

Collaboration with parents (Baby Boomers and Generation X) ranks third with 64%¹⁰, a surprisingly high percentage that reflects some variations in business perspectives between younger and older generations. Young entrepreneurs likely see their parents as a source of experience and stability, but they may have different management styles and perspectives on innovation.

The data reveals that family continues to play an essential role in the entrepreneurial inclinations of generations Y and Z. Despite their great degree of independence, these generations realize the benefits of family support in numerous forms:

1. Close relatives (brothers, sisters, cousins) are seen as the most trustworthy partners, maybe due to a shared life viewpoint and the ease with which a joint company vision can be developed.
2. Parents continue to be a key source of mentorship and financial resources, but younger generations are likely to struggle to align classic company methods with current advances.
3. Y and Z's interest in collaborating with future generations reflects their commitment to sustainability and long-term planning. They seek a balance between technical breakthroughs and accumulated family resources.

5. Conclusions

The findings of this study reaffirm the substantial influence that the family and broader social environment exert on the entrepreneurial intentions of individuals from Generations Y and Z. Despite their pronounced individualism and desire for autonomy, these cohorts continue to rely on emotional, cognitive, and material support from their immediate social circles. This dual orientation, toward independence and interconnectedness, highlights the complex interplay between personal agency and socio-familial structures in entrepreneurial decision-making.

The data reveal a high level of entrepreneurial predisposition among the surveyed students, with 85% expressing an active interest in starting their own business. While a considerable portion (36%) indicates a willingness to proceed without external support, the overall preference for collaboration with family members remains strong. This tendency is particularly notable in the expressed interest in partnerships with both younger and older generations, an indicator of strategic thinking focused on continuity, innovation, and shared responsibility.

However, several limitations must be acknowledged. The study is based on a cross-sectional survey conducted within a single academic institution, which may restrict the generalizability of the findings across different cultural or institutional contexts. Moreover, the reliance on self-reported data introduces the possibility of response bias, especially about socially desirable attitudes toward entrepreneurship and family values. The study

⁹ Generation Beta encompasses those born from 2025 to 2039.

¹⁰ The percentages indicated correspond to the sum of those who answered “Yes” and “Rather yes”.

also does not account for actual entrepreneurial outcomes, focusing instead on intentions and attitudes, which may diverge from future behaviors.

Considering these limitations, future research should consider adopting longitudinal and mixed-method approaches that would allow for deeper insights into how entrepreneurial intentions evolve within varying family dynamics. Further exploration is also warranted into how factors such as gender roles, socio-economic background, and cultural orientation shape the nature and efficacy of intergenerational collaboration in entrepreneurial ventures. Additionally, the impact of emerging technologies and global socio-economic shifts on family business models remains a promising area for inquiry.

By addressing these gaps, future studies can contribute to the development of more nuanced frameworks that capture the dynamic and context-dependent nature of family influence on entrepreneurship. This, in turn, may support the creation of targeted policies and educational programs that enhance entrepreneurial potential among younger generations while fostering sustainable intergenerational business practices.

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THE 2001 RECESSION, THE SARBANES-OXLEY ACT, AND DIRECTOR CHARACTERISTICS

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Abstract: *This study examines how director characteristics like age, tenure, remaining tenure, total years, shares held, gender, and ethnicity changed during the run-up to the 2001 Recession as well as during the period that follows the Sarbanes-Oxley (i.e. SOX) Act. The study also examines how the professional affiliation of the directors to the firm had changed during this period. In addition to director characteristics, the paper also focuses on director independence. Has director independence improved after the SOX? Overall, what dimensions of director characteristics and independence improved? The study contributes to two separate streams of literature: the literature on crisis and CEO pay and the literature on CEO pay and firm performance.*

Keywords: *Director, SOX, Sarbanes-Oxley, corporate governance, recession.*

UDC: [005.322:316.46]:331.2

Classification JEL: G30, G34

1. Introduction

This paper examines the effects of the Sarbanes-Oxley (SOX) Act of 2002 on the composition and characteristics of corporate boards in U.S. companies. Specifically, it investigates changes in director attributes such as age, tenure, and gender representation, as well as professional affiliation. The paper also looks at the impact of the SOX on director independence. Did corporate board members become more independent after the SOX was passed?

2. Literature Review

Prior research offers mixed evidence on how the SOX Act influenced board composition. Linck et al. (2009) report that firms increased the presence of outside directors in response to SOX, favoring lawyers, consultants, financial experts, and retired executives while reducing the number of active corporate executives on boards. Uzun et al. (2004) found that firms hiring more external directors experienced a decline in corporate fraud.

To assess the extent of these changes, this study examines director tenure before and after SOX. A decline in average tenure could indicate a shift toward hiring external directors. Hillman and Dalziel (2003) argue that the board's role in monitoring management aligns with agency theory, which suggests that an increased presence of internal directors may weaken oversight due to their dependence on the CEO. Raheja (2005) models the interaction between internal and external board members, concluding that external directors can improve governance by leveraging CEO succession to enhance project decision-making.

Valenti (2008) found that firms adjusted board structures post-SOX to improve monitoring capabilities, while Petra (2005) examined five governance areas, concluding that independent directors contributed to stronger corporate boards, improved firm performance, and increased shareholder wealth. This study builds on these findings by

analyzing board composition in terms of age, tenure, gender diversity, and the prevalence of dual executive roles.

Research also highlights gender disparities in board assignments. Peterson and Philpot (2007) found that female directors were underrepresented in executive committees and more commonly assigned to public affairs committees. Dalton and Dalton (2010) observed a steady increase in female board participation, including leadership roles, while Bear et al. (2010) noted that female directors typically had diverse educational and professional backgrounds and demonstrated more democratic decision-making styles.

Kesner (1988) examined board committee composition, concluding that membership was significantly influenced by directors' occupation, tenure, and gender. McIntyre et al. (2007) emphasize that age and tenure diversity benefit board effectiveness, with younger directors bringing fresh perspectives (Bere, 1991; Siciliano, 1996) and older, longer-tenured directors providing stability. Similarly, Forbes and Milliken (1999) and John (1995) argue that external board members enhance diversity, introduce cognitive conflicts, and contribute to improved decision-making.

Linck et al. (2008) find that board structures evolved in response to SOX. While large firms had reduced board sizes throughout the 1990s, this trend reversed after SOX's implementation, whereas small and medium-sized firms experienced minimal changes. This study explores whether firms adjusted their board structures by increasing or decreasing the number of internal executives serving on boards in response to SOX reforms.

3. Methodology

The study uses the directorship data from the Investor Responsibility Research Center (IRRC) dataset over the 1999–2003 period. The study examines 25 variables in total. We examine how these variables changed during the run-up to the 2001 recession and also after the SOX was passed.

The variables that we examine include the director's age, tenure, remaining tenure, total years, shares held, gender, ethnicity, professional type, and whether the director was a former employee. We also look at the number of common shares outstanding for the firm and the annual revenue. In terms of director independence, we look at six variables.

We run nonparametric tests as well as regressions to see if any of the director characteristics or independence variables had changed significantly during the run-up period as well as during the post-SOX period.

4. Results and Discussion

When we examine the trend in each variable, we find that corporate governance improved, but not in every area. During the run-up period, age and tenure were both going down, and shares held were going up (worsening). After the SOX was passed, age, tenure, and total years went up, and shares held went down (improved). The percentage of female directors was increasing, it continued to increase. The percentage of former employees among the directors was flat during the run-up and after. Five out of six independence measures improved after the SOX was passed.

Our trend analysis shows that, during the run-up, the percentage of Asian, African American, and Hispanic was going up, and Caucasian was going down. After the SOX was passed, the trends continued except for the percentage of Asian directors. The percentage of Asian directors declined. During the run-up, the percentage in Consulting and Legal was going down, and Financial, Insurance, Other, and Real Estate were going up. After the

SOX was passed, the trends continued except for Legal and Other. The percentage in Legal went up and the percentage in the “Other” category went down.

Our logistic regressions show that % Female, African American, Hispanic went up Post-SOX, while Caucasian went down and Asian was flat. Our logistic regressions also show that % Financial and Real Estate went up Post-SOX, while Consulting and Other went down.

5. Conclusions

Overall, our results show that, post-SOX, most of the measures improved. Interestingly, the percentage of Asian directors went down after the SOX was passed. Also, the percentage of directors that has a charity-related relationship with the firm went up after the SOX was passed. Those are the two areas that deteriorated, instead of improving, post-SOX. The long-run impacts of the SOX on these variables can be examined. Do these mostly positive impacts continue in the long run? If not, then it will mean that authorities need to observe and control firms’ boards more closely.

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OCCUPATIONAL HEALTH AND SAFETY: AN ESSENTIAL COMPONENT FOR GUARANTEEING QUALITY OF LIFE

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Abstract: Quality of life is a complex concept, which includes physical and mental health, safety, financial stability and work-life balance. An organizational culture oriented towards prevention, respect and care for employees contributes directly to their well-being. Occupational safety and health (OSH) is a fundamental element of employee well-being and an essential factor for the sustainable development of any organization. A safe and healthy working environment contributes not only to protecting the life and health of workers, but also to increasing their productivity and quality of life. Despite legislative and technological advances, many sectors of activity still face challenges related to the effective application of OSH rules. Lack of resources, insufficient information or negligence can have serious consequences, both for the individual and the organization. OSH is not only a legal obligation, but also a moral responsibility of employers and employees. Implementing effective workplace protection measures helps prevent accidents and occupational diseases, thus reducing the economic and social costs associated with them.

Keywords: Occupational safety, occupational health, working conditions, quality of life, occupational health, social responsibility.

UDC: [331.45+613.6]:316.728

Classification JEL: I 18, J 81, H 51.

1. Introduction

In a modern and responsible society, occupational safety and health (OSH) no longer represent merely legal obligations or norms imposed by authorities, but rather become fundamental elements for sustainable development, employee well-being, and the increase in quality of life. A safe and healthy work environment is key to maintaining a productive, motivated, and balanced workforce, with a positive impact on both the individual and the community.

Occupational safety and health aim to prevent workplace accidents and occupational diseases through a set of organizational, technical, and educational measures. An employee who works in a safe and risk-free environment is more productive, has higher morale, and is less exposed to stress or long-term health problems.

Furthermore, employers who invest in OSH avoid financial losses caused by accidents, absenteeism, staff turnover, or legal disputes. Thus, protecting the life and integrity of workers becomes a central pillar of social responsibility and economic efficiency.

2. Literature Review

The specialized literature reflects an increasingly complex approach to this issue, combining legal, economic, medical, and sociological perspectives. However, certain gaps are noticeable regarding the holistic integration of OSH into quality of life policies and modern organizational management.

Theoreticians such as Maslow (1943) based their theories on motivation and human needs on the idea of security as a fundamental necessity. In this sense, health and safety in the workplace are a concrete expression of fulfilling this basic level in the hierarchy of

needs. At the same time, the theory of social systems (Luhmann, 1995) [1] suggests that modern organizations must operate within predictable safety parameters to ensure internal stability and employee trust.

Another relevant theoretical framework is that of corporate social responsibility, which considers care for employees as an integral part of organizational sustainability (Carroll, 1991) [2]. From this perspective, OSH is not just a legal obligation but also a strategic investment in human capital.

Numerous studies highlight the correlation between safe working conditions and the level of job satisfaction or employee productivity. For example, the study conducted by Eurofound (2022) [3] shows that workers who benefit from a safe and healthy work environment report a superior general well-being and increased engagement in professional activities.

The dominant methodologies in the specialized literature are quantitative, based on standardized questionnaires [4], statistical and correlational analyses. However, some recent studies propose qualitative or mixed methods approaches to understand workers' perceptions of risks and how OSH influences the work-life balance. A major gap lies in the lack of longitudinal studies that track the impact over time of OSH interventions on the physical and mental well-being of workers. Furthermore, although there is extensive research on the legal framework and good practices in the field of OSH, the literature rarely treats this subject as an integral part of the concept of *quality of life*.

3. Methodology

The present paper aims to highlight the importance of occupational safety and health (OSH) as a fundamental element in ensuring the quality of life of employees. To this end, a mixed methodology was used, combining theoretical analysis with applied research. The research is exploratory-descriptive, with the aim of highlighting the role of occupational safety and health measures in creating a safe, productive, and employee well-being-oriented work environment. A review of the specialized literature, the current legislation, and relevant national and European statistics on occupational safety and health was conducted.

4. Results and Discussion

Quality of life is a complex concept that includes physical and mental health, safety, financial stability, and the balance between professional and personal life.

Work inherently implies the consumption of human labor. Under certain conditions, the pace or quality of this consumption can exceed the normal limits of self-generation and psycho-somatic balance, which manifests as accidents or illness.

The purpose of occupational safety and health (OSH) is to minimize the probability of an employee being injured or becoming ill while simultaneously creating comfortable working conditions for maximum productivity. [5]

To achieve its purpose, occupational safety and health relies on the existence and functioning of a well-founded multidisciplinary system of theoretical concepts, legislation, technical, socio-economic, organizational, hygiene, and occupational medicine measures and means.

Occupational safety and health (OSH) as a concept can be defined as *a system of socio-economic, organizational, technical, curative, and prophylactic measures and means, which operate on the basis of legislative and normative acts with the aim of*

ensuring safety, preserving health, and maintaining the working capacity of the employee during the work process.

The connection between occupational safety and health and quality of life is very close, as a safe and healthy work environment has a direct impact on the physical and mental well-being of employees. This influences not only their performance at work but also their personal life and their general state of well-being. Here are some ways in which these concepts are interconnected:

- A safe workplace, where risks are properly managed, prevents accidents and occupational diseases, contributing to the maintenance of a healthy body. This has a direct effect on the quality of life, as employees do not face health problems that affect their personal and social lives.
- Occupational safety does not only mean preventing physical accidents but also creating a work environment where employees feel protected, respected, and supported. Such an environment reduces levels of stress and anxiety, which are important factors that negatively influence the quality of life.
- When employees feel safe at work, they are more motivated and engaged. A work environment that promotes physical and mental health leads to better performance and job satisfaction, which, in turn, improves their quality of life. Career satisfaction can also positively influence other aspects of life, such as interpersonal relationships and the feeling of personal fulfillment.
- Providing good working conditions, such as adequate breaks, flexible schedules, or access to resources for stress management, can contribute to a better balance between professional and personal life. Employees who have more time and energy for family and personal activities enjoy a higher quality of life.
- A workplace that cares about employee safety, implements health programs (e.g., health education programs for a healthy lifestyle), and minimizes occupational risks contributes to their long-term health. Thus, they will be less exposed to chronic diseases or serious accidents, which will lead to a longer and more active life.
- A workplace that prioritizes the safety and health of employees not only improves performance at work but also contributes to a more balanced and satisfying life.

Maintaining good worker health has a direct and measurable positive impact on the quality of life (Table 1), on productivity, and contributes to improving the sustainability of social security systems. Preventing workplace accidents or serious occupational diseases and promoting health throughout the entire professional life, starting from the very first job, is vital to allow for the longest possible period of activity for employees.

Table 1. Direct Link Between OSH and Quality of Life

Effective OSH leads to...	Which improves the quality of life through...
prevention of workplace accidents and occupational diseases.	maintenance of physical and mental health; avoidance of pain, disability, and suffering.
safe and risk-free work environment.	reduction of work-related stress and anxiety; feeling of safety and protection.
workplace health promotion.	improvement of general well-being; adoption of a healthy lifestyle.
ergonomics and adequate working conditions.	prevention of musculoskeletal problems and physical discomfort; increased comfort at the workplace.
work-life balance.	more time and energy for personal and social life; reduction of burnout.
feeling of value and respect.	high morale and job satisfaction; improvement of self-esteem.
job security	financial stability and reduction of uncertainty
access to occupational health services.	early detection of health problems; appropriate medical intervention and support.

Source: authored by the author

The safety of the worker during the work process is considered that state of the work system in which the possibility of accidents and occupational diseases is excluded.

Risk factors for accidents and occupational diseases are factors (characteristics, processes, phenomena, behaviors) inherent to the elements of the work system, which can cause, under certain conditions, work accidents or occupational diseases [6]. These factors are found at the level of each element of the work system. The most general classification criterion divides them into **inherent risk factors**:

1. the worker;
2. the work task;
3. the means of production;
4. the work environment.

During the period 2016–2020, numerous workplace accidents were recorded in the Republic of Moldova, a significant portion of which had serious consequences, including fatalities (Table 2). The analysis of the causes of these accidents highlights several determining factors, reflecting both working conditions and the level of compliance with occupational safety and health regulations.

OSH aims to protect workers against accidents and occupational diseases by:

- identifying and reducing risks in the workplace,
- promoting a safe and healthy work environment,
- training employees in preventive behavior.

OSH is not limited to legal compliance and represents more than just an administrative task. It is, without a doubt, an essential component of good business management. Experience demonstrates that every euro invested in OSH by an employer will generate a return of over two euros in the future. [8]

Table 2. Victims of Workplace Accidents by Cause, Republic of Moldova for the Years 2016-2023

Years	2016	2017	2018	2019	2020	2021	2022	2023
Total, persons	371	448	503	493	419	553	518	576
Causes:								
• dependent on the worker	317	333	356	346	316	453	455	493
• dependent on the means of production	10	27	18	20	31	36	22	19
• dependent on the work task	37	33	79	88	46	35	24	27
• dependent on the work environment	8	55	50	39	26	29	17	37

Source: National Bureau of Statistics of the Republic of Moldova. Statistical Form: Workplace Accidents.
<https://statbank.statistica.md/> [7]

Avoiding losses and production interruptions, sick leave, equipment damage, and damage to the company's image, as well as avoiding administrative and legal costs, are just some of the potential benefits that businesses can gain from reducing the incidence of workplace accidents and occupational diseases.

To provide a clear picture of **the costs associated with workplace accidents and sick leave**, we can analyze these aspects from several perspectives: economic, social, and at the company level.

The social costs: according to statistics, it is estimated that over 2.3 million deaths occur annually worldwide due to work-related accidents and occupational injuries, a figure comparable to the number of victims in a war. The International Labour Organization estimates that, annually, over 313 million workers suffer accidents resulting in temporary incapacity for work, and approximately 160 million cases of occupational diseases occur. Approximately 6,400 deaths occur daily as a result of workplace accidents and occupational diseases, and around 860,000 workers are injured at work daily. [9]

A more in-depth examination of **the economic cost** of workplace accidents further highlights the importance of this issue:

According to a report by the International Labour Organization (ILO), work-related accidents and illnesses lead to an annual loss equivalent to 4% of the global Gross Domestic Product (GDP). [10]

In the European Union, according to Eurostat and EU-OSHA:

- It is estimated that workplace accidents and occupational diseases cost the European Union economy over EUR 476 billion annually (approximately 3.3% of the EU's GDP).
- A serious accident can cost the employer between EUR 10,000 and EUR 50,000, depending on the severity.
- Over 3.9 million working days are lost annually due to accidents and occupational diseases. [11]
- An accident resulting in absence >3 days costs an average of EUR 8,900 per employee.
- The average medical leave generates costs between EUR 150 and EUR 300 per day (costs borne by the employer and the state). [12]

At the company level, the costs of workplace accidents can include:

Direct Costs:

- Employee medical treatment
- Compensation for temporary or permanent disability
- Fines, legal damages, or penalties (if the accident was the employer's fault)

Indirect Costs:

- Time lost for investigations
- Recruitment and training costs for a replacement
- Decreased team productivity
- Increased insurance premiums
- Loss of image and low morale.

Other Associated Costs:

- Psychological and moral costs for the employee and family
- Negative image for the employer (damaged reputation)
- Legal costs (if litigation occurs).

In Table 3, we can observe the dynamics of expenses related to workplace accidents in the Republic of Moldova over the last 8 years (reflected in national statistics), and their breakdown by categories of direct expenses.

Table 3. Expenses Related to Workplace Accidents in the Republic of Moldova for the Years 2016-2023, Thousands of Lei

Years	2016	2017	2018	2019	2020	2021	2022	2023
Expenses Related to Workplace Accidents, Total, Thousands of Lei	11767.9	6951.8	5908.7	3501.1	4808.0	4324,6	4828,3	9138,8
- payments according to medical leave certificates	1789.9	2591.8	3415.4	2797.3	1786.9	2160,1	2421,9	2997,7
- payments for compensation of damages	95.7	921.3	487.1	55.3	412.5	84,0	71,6	642,6
- payments for one-time allowances in case of reduced work capacity or death of the employee	1440.2	2563.3	599.7	637.9	1574.5	922,6	1186,6	4756,1
- value of damaged machinery and tools, damaged buildings and constructions, and other expenses	8442.1	875.4	1406.5	10.6	1034.1	1157,9	1148,2	787,4

Source: National Bureau of Statistics of the Republic of Moldova. Statistical Form: Workplace Accidents.
<https://statbank.statistica.md/> [13]

Occupational safety and health (OSH) systems offer advantages for businesses, in addition to being their legal and social obligation.

An organizational culture oriented towards prevention, respect, and care for employees contributes directly to their well-being. For example, the proper equipping of the workplace, regular OSH training, reduced exposure to risk factors, and the promotion of a healthy lifestyle lead to a decrease in the risks of illness and an increase in job satisfaction. Thus, the employee feels valued and safe.

Businesses consider that OSH prevents workplace accidents and occupational diseases, but it also constitutes an essential element of their success.



Figure 1. Benefits of the good OSH

Source: <http://europa.eu> [8]

OSH constitutes an essential element of a business's efficiency. An effective Occupational Safety and Health Management system:

- helps demonstrate that the business is socially responsible,
- protects and enhances brand image and brand value,
- helps maximize worker productivity, improves employee loyalty to the business,
- builds a more competent and healthier workforce, reduces costs and periods of work interruption,
- allows businesses to meet customer expectations regarding OSH and encourages the workforce to remain active for longer.

For the organization and operation of an effective OSH Management System within any organization, we could formulate some recommendations that, in our opinion, are very important:

- Commitment and leadership to improve OSH,
- Investments in prevention and safety training,
- Effective OSH policies and procedures,
- Ergonomic assessments of workplaces,
- Proactive risk assessment programs,
- Effective risk control measures,
- Continuous monitoring and review processes of OSH management systems,
- Psychological support for employees and stress management in companies,
- Trained and competent workers.

Any company can enjoy significant advantages by investing in OSH. Simple investments can increase competitiveness, profitability, and employee motivation. Implementing an OSH management system provides an effective framework for preventing or minimizing accidents and illnesses and increasing the quality of life of employees. In other words, OSH is a pillar of quality of life, not just a set of administrative rules.

5. Conclusions

A safe and healthy workplace not only prevents accidents and occupational diseases but also significantly contributes to a better, more balanced, and more satisfying life. Occupational safety and health are fundamental pillars of a modern, responsible society oriented towards individual well-being. Ensuring safe and healthy working conditions contributes not only to the prevention of accidents and occupational diseases but also to increased productivity, employee morale, and, consequently, to the improvement of their quality of life.

It is essential for employers and employees to be aware of the importance of complying with safety regulations, to be properly informed and trained, and for authorities to monitor and support the implementation of these measures. A culture of prevention must become a standard, not an exception.

In a safe and healthy work environment, the employee is protected, valued, and motivated, which leads to a positive organizational climate and sustainable development. Therefore, investing in occupational safety and health is a direct investment in people, in the quality of life, and in the future of the entire society.

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STUDY OF HUMAN RESOURCE MANAGEMENT AND THE ROLE OF ARTIFICIAL INTELLIGENCE IN PATIENTS' SATISFACTION

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Abstract: *We are living in a new era of technology in which artificial intelligence (AI) is becoming increasingly prevalent in as many sectors of activity as possible. Artificial intelligence is predicted to transform human resource management by automating processes of recruitment, evaluation and development of employees as well as managerial decision-making. One of the most demanding sectors of activity that presents a high degree of interest for every person is health. Human resource management has a crucial role in terms of the quality of services provided by medical personnel. Sustainable human resource management is increasingly recognized as a key driver in achieving organizational sustainability goals. The purpose of this study is to analyze the way in which the implementation of artificial intelligence in human resource management in the health sectors can influence patients' satisfaction. The results of this study indicated significant correlations between human resources efficiency and employee performance monitoring, employee skill development, the monitoring of physicians' role and behavior, and the patient satisfaction evaluation system. These findings highlight that the implementation of AI in the various work structures of human resource management can increase the efficiency of employees and implicitly, the patients' satisfaction. This study lays the groundwork for future explorations into the synergistic relationship between human resource management and AI in enhancing patient satisfaction. By identifying key factors and outcomes, it paves the way for future research that can deliver actionable recommendations for healthcare organizations seeking to leverage AI in their human resource management practices, ultimately contributing to improved patient care and satisfaction levels.*

Keywords: *Human resource management, artificial intelligence, service quality, employee performance, patient satisfaction.*

UDC: 005.96+[004.8:614.253.8]

Classification JEL: M12, O15

1. Introduction

The development of sustainable Human Resources Management is increasingly recognized as a key factor in achieving organizational sustainability goals. It extends traditional human resource management practices by integrating economic, environmental and social dimensions. In parallel, Artificial Intelligence (AI) is transforming business operations, including human resource management, by providing tools for automation, prediction and decision-making.

The purpose of this study is to deepen the specialized knowledge regarding the role that AI can have on patient satisfaction when integrated into human resource management. The present study is based on syntheses and analyses of the specialized literature in the field of human resource management and outlines a theoretical model with the role of contributing to the improvement of patient satisfaction in the health sector in a sustainable way. Also through this study, we have come up with recommendations to amplify the crucial role that AI can have in human resource management when we want to improve patient satisfaction in a sustainable way.

This review explores how AI contributes to sustainable human resource management practices, identifies current trends and highlights research gaps. One of the most important sectors in which AI plays a crucial role is that of the healthcare sector. By combining AI technology with human understanding, the healthcare sector can build a future-ready, equitable and sustainable workforce aimed at increasing patient satisfaction.

2. Study of patient satisfaction and factors that determine it

Patient satisfaction has become a central focus in healthcare management, serving as both an indicator of service quality and a determinant of health system performance. In recent decades, healthcare reforms in both developed and developing countries have increasingly emphasized the role of patient-centered care, recognizing the influence of patient satisfaction on outcomes, compliance and institutional reputation (Batbaatar et al., 2017)[1]. The literature reflects a growing consensus that service quality and patient satisfaction are deeply interconnected and influenced by multiple variables within healthcare delivery.

Patient satisfaction has always been an essential element in the process of reforming healthcare systems, both in Europe and in the United States. For this reason, numerous specialized studies focus on the relationship between the quality of medical services and patient satisfaction, either according to the type of services provided or by analyzing patient satisfaction with the healthcare system (Bleich et al., 2007) [2].

Patient satisfaction is commonly defined as the extent to which patients perceive how their needs and expectations are met by healthcare services (Ware et al., 1983) [3]. Healthcare service quality, on the other hand, encompasses both technical and functional dimensions, including clinical effectiveness, accessibility, communication, empathy and environment (Donabedian, 1988) [4].

Numerous empirical studies have confirmed a strong positive correlation between service quality and patient satisfaction. For instance, Otani et al. (2003) [5] found that interpersonal communication, particularly between patients and healthcare professionals, significantly impacts satisfaction. Similarly, Andaleeb (2001) [6] identified responsiveness and assurance as primary predictors of patient satisfaction in developing country hospitals.

Effective communication has been consistently highlighted as a key determinant of patient satisfaction. Studies have shown that patients who feel listened to, respected and involved in decision-making report significantly higher satisfaction levels (Street et al., 2009) [7].

Although Human Resource Management influences patient satisfaction indirectly, it plays a critical role in ensuring quality care through staff training, motivation and performance evaluation (Redman & Mathews, 1998) [8]. The alignment of Human Resource Management strategies with patient-centered care has been shown to improve job satisfaction among staff, which in turn, positively affects patient interactions.

In both Europe and the United States, patient satisfaction has long been recognized as a key component in healthcare reform initiatives. As highlighted by Heath (2016) [9], one illustrative example underlines the importance of prioritizing communication between patients and healthcare professionals: the difference between merely waiting and understanding why one must wait can significantly alter the patient experience. In situations where unexpected emergencies delay care, proactive communication by medical staff can prevent a decline in patient satisfaction.

Developing a conceptual framework for understanding patient satisfaction with healthcare services presents significant challenges due to the complexity of defining and measuring this construct and the variety of perspectives regarding its key components. Patient satisfaction is shaped by numerous factors, including lifestyle, individual expectations and personal values.

To better capture the essence of satisfaction, some studies have instead focused on identifying causes of dissatisfaction. Roy Carr-Hill (1992) [10], for instance, identified poor communication between doctors and patients - particularly regarding treatment options and procedural expectations - as a leading source of dissatisfaction. These findings also show variability based on patient age, education level, and socio-demographic background.

In the academic discourse, patients are often conceptualized as both clients and consumers of healthcare services, with a subtle yet meaningful distinction between the two. The client is viewed as the primary recipient, while the consumer represents the end-user. Recognizing this distinction is vital when assessing satisfaction as it influences the analytical lens through which improvement strategies are developed. Sample selection also plays a crucial role; respondents should be recent users of public healthcare services and both the timing of data collection and duration of response are considered critical to the reliability of findings (Carr-Hill, 1992).

Another angle in the analysis of patient satisfaction involves its behavioral consequences. Satisfaction may affect patients' health-seeking behaviors, treatment adherence and willingness to cooperate with medical personnel. From a methodological perspective, the timing and format of satisfaction measurement are essential, especially in terms of how results are interpreted by healthcare management to inform strategic improvements. Disease type and severity also influence how patients evaluate their care experiences (Crow et al., 2002) [11].

Patient satisfaction may be measured from two distinct perspectives: content and methodology. In terms of content, it may involve general multidimensional assessments, condition-specific evaluations, or direct versus indirect approaches.

The overarching goal of these measurement approaches is to integrate patient perspectives into the strategic planning and delivery of healthcare services (Hudak & Wright, 2000) [12]. As such, patient satisfaction has become a critical indicator of care quality in the eyes of both policymakers and healthcare providers (Steiber & Krowinski, 1990) [13].

Ross et al. (1995) [14] conducted a study evaluating the impact of different measurement tools on reported patient satisfaction. Methods included analog scales, multidimensional surveys, satisfaction-based dual-criteria evaluations, six-component attitude measures, and behavior intention scales. The sample comprised 233 participants, mostly women, aged between 21 and 87 years. The findings confirmed that the method of assessment significantly influences satisfaction results, thus underlining the importance of methodological consistency.

In assessing the quality of nursing care, it is essential to consider both patient perceptions and professional performance evaluations. Additionally, psychosocial factors must be acknowledged. For example, some patients may report higher satisfaction based on the opinions of trusted individuals or out of fear of retaliation. Anonymity in survey responses is therefore crucial to ensuring honest feedback.

The growing consumerist orientation within the healthcare sector further amplifies the relevance of patient satisfaction as a concept. However, one theoretical limitation lies in the lack of a consistent framework to conceptualize and measure satisfaction. A major

challenge stems from its inherently subjective nature - shaped by the gap between expectations and actual experience.

Healthcare service quality has been interpreted from multiple angles. From a patient-centered perspective, it is influenced by emotional needs, personalization of care, involvement in treatment decisions, access to individualized information, respect, privacy and emotional support.

A study involving 448 patients and 350 nurses developed a new conceptual model of healthcare service quality from the patient perspective. Cultural variables were found to significantly influence how patients perceive service quality (Sofaer & Firminger, 2005) [15].

A study conducted with 500 participants from the United States population identified two distinct models for assessing patient satisfaction, both centered around the variable of time. The first model emphasizes immediate evaluation following a medical visit and considers factors such as patient age, expectations and the quality of the doctor-patient relationship. The second model proposes a follow-up analysis conducted three months after the medical visit, incorporating not only patient age and expectations, but also the degree of symptom improvement experienced during the intervening period (Jackson et al., 2001) [16].

In the United Kingdom, a survey involving 340 hospital professionals revealed that 59% observed a notable increase in patient satisfaction when they were able to spend more face-to-face time with patients. Another factor contributing to improved satisfaction levels was enhanced accessibility to various healthcare services (Heath, 2016).

Given the critical role of healthcare quality and patient satisfaction in the performance of health systems, a study conducted in North Lampung, Indonesia, sought to identify the key determinants influencing patient satisfaction. Utilizing a randomized sample of 200 patients across 25 healthcare centers, data were collected through structured questionnaires. The findings indicated that patient satisfaction was significantly influenced by socioeconomic factors such as income and education level, the frequency of medical visits and the perceived quality of healthcare services provided (Widavati et al., 2017) [17].

3. The Role of Artificial Intelligence in Enhancing Human Resource Management in a Sustainable Manner

A sustainable Human Resource Management (HRM) system is defined as the implementation of Human Resource practices that ensure the long-term well-being of employees, efficient resource utilization and organizational resilience (Ehnert, 2009) [18]. This concept encompasses several key areas, including:

- Employee engagement and retention;
- Work-life balance;
- Environmentally responsible HRM practices;
- Diversity, equity and inclusion.

Recent scholarly work suggests that sustainability in HRM extends beyond environmental practices and involves aligning human capital strategies with long-term organizational goals (Jabbour & Sousa Jabbour, 2016) [19].

Sustainable Recruitment

The integration of artificial intelligence (AI) into recruitment processes enhances transparency and facilitates more inclusive hiring practices. AI-driven applicant tracking systems and predictive analytics support long-term talent planning and help reduce employee turnover, a critical factor for sustainable workforce management.

Employee Well-being and Retention

AI tools such as sentiment analysis platforms and mental health chatbots promote emotional well-being and assist in early identification of burnout risks. These technologies contribute to early intervention and reduced absenteeism, thus supporting a more resilient and sustainable Human Resource system (Parent-Rochelleau & Parker, 2021) [20].

Learning and Development

AI enables the personalization of employee learning pathways, enhancing skill development and workforce adaptability. Personalized learning fosters long-term employee engagement, which is a cornerstone of social sustainability within organizations (KPMG, 2021) [21].

Workforce Planning and Flexibility

Artificial intelligence also facilitates the design of flexible work arrangements, contributing to sustainable workforce management. Tools that optimize scheduling and support remote work capabilities help decrease environmental impact, for instance, by reducing carbon emissions associated with commuting.

Based on insights from the literature and developments in human resource management, several priority actions are proposed to strengthen the impact of human resource management on patient satisfaction:

Data-Driven Decision-Making in Human Resource Management

The application of predictive analytics in healthcare's human resource management allows institutions to anticipate staffing needs based on patient flow trends, thereby ensuring the appropriate availability of personnel during peak hours. This data-informed approach enhances operational readiness and service continuity.

Workforce Optimization

Artificial Intelligence (AI)-based solutions play a pivotal role in optimizing staff allocation by ensuring that qualified healthcare professionals are deployed at the right time and place to meet patient care demands. Such optimization contributes to both efficiency and the quality of care delivery.

Employee Retention Strategies

Through sentiment analysis, AI tools can identify employees at risk of disengagement or turnover. This enables proactive interventions aimed at improving job satisfaction, reducing attrition rates and supporting continuity of care — an essential component of a stable and effective healthcare system.

Patient-Centered Outcomes

Improving staff competencies through targeted training enhances the ability of healthcare providers to effectively address patient needs. Better-trained personnel are more responsive and adaptable, which contributes to higher levels of patient satisfaction.

Increased Employee Engagement

Engaged and satisfied employees are more likely to deliver high-quality care. Their active involvement fosters positive patient-provider interactions, which in turn elevates the overall patient experience.

Efficiency in Care Delivery

Streamlined human resource processes lead to faster response times and more efficient service delivery. These improvements directly contribute to enhanced patient satisfaction and operational performance within healthcare institutions.

The proposed theoretical model illustrates the potential for integrating Artificial Intelligence (AI) into Human Resource Management (HRM) within the healthcare sector to enhance patient satisfaction. By focusing on improving employee satisfaction and operational efficiency, healthcare organizations can develop a more effective workforce that is better prepared to deliver high-quality patient care. Overall, the model emphasizes the critical importance of aligning human resource functions with patient-centered outcomes to achieve success in the dynamic and evolving healthcare environment.



Figure 1. Theoretical model

Source: developed by the author

4. Methodology

This section should comprehensively describe the research design, data collection procedures, and analytical techniques. Ensure that methodological choices are justified, allowing for reproducibility. When applicable, include descriptions of datasets, statistical models, software used, and any experimental protocols. The section should be structured clearly and precisely.

This study employs a mixed-methods approach, integrating both quantitative and qualitative techniques to obtain a comprehensive understanding of the potential impact that the implementation of AI-based human resource management may have on employee efficiency within healthcare institutions. For data collection, two methods were employed:

- survey method: a questionnaire was used as the investigative instrument;
- documentary research method: this involved the analysis of specialized literature to support the achievement of the general objective and the specific objectives of the study.

The sample consisted of 107 employees from Romanian healthcare institutions, having the position of doctors and surses, more precisely from Bucharest region, due to the high density of medical professionals in this region, all of whom met the eligibility criteria of being direct staff members. As this condition was fully satisfied, no participants were excluded from the dataset. Data collection was carried out through the opinion poll method, the distribution of the questionnaire to the respondents being carried out using the classic pen-and-paper model so that the confidentiality of the individuals could be ensured. The questionnaires were collected in a specially arranged mobile box.

The questionnaire used for this study is a validated questionnaire, short-form patient satisfaction questionnaire (PSQ III), presenting the following scales: human resources efficiency and employee performance monitoring, employee skill development, the monitoring of physicians' role and behavior. These scales were measured using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

For the quantitative analysis, the Statistical Package for the Social Sciences (SPSS) was employed to assess the validity of the measurement instrument and to determine the relationships between the dependent and independent variables. A significance level of 5% and a 95% confidence interval were adopted for statistical calculations. Multiple regression analysis were used to examine the influence of the independent variables on the dependent variable - employee efficiency - based on the following predictors: monitoring of employee behavior, stress monitoring, evaluation systems and skill development.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + \varepsilon \quad (1)$$

where:

- Y: dependent variable;
- $X_1, X_2 \dots X_n$: independent variable;
- $\beta_0, \beta_1 \dots \beta_n$: regression coefficients
- ε : residual error.

Table 1. Descriptive results of the variables

Variable	Mean	Median	Mode	Standard Deviation
Employee efficiency	2.8	3	3	0.85
Employee Performance	3.2	3	3	0.75
Employee skill development	3.0	3	3	0.70
Employee behavior	3.9	3	3	0.80

Source: SPSS data

Following the administration of the questionnaire, the normality of the distribution for all four independent variables was assessed. The data were subsequently processed using SPSS, and Pearson correlation tests were conducted to evaluate the bivariate relationships between variables.

Table 2. Results of the study

Variable	Correlation coefficient r	p-value
Employee behavior	0.511	<0.01
Employee Performance	0.607	<0.01
Employee skill development	0.644	<0.01

Source: SPSS data

5. Results and Discussion

The results of the study revealed the following:

- A statistically significant positive correlation was identified between employee behavior monitoring and employee efficiency ($p = 0.000$), with a moderate-to-strong correlation coefficient ($r = 0.511$).
- A statistically significant positive correlation was observed between employee performance and employee efficiency ($p = 0.000$), with a strong correlation coefficient ($r = 0.607$).
- A statistically significant positive correlation was recorded between employee skill development and employee efficiency ($p = 0.000$), with a strong correlation coefficient ($r = 0.644$).

The Pearson correlation results confirm the study's hypothesis, demonstrating the existence of significant positive relationships between all three independent variables and perceived employee efficiency within the sample of healthcare employees in Romania.

6. Conclusions

The present study underscores the potential of integrating artificial intelligence (AI) into human resource management processes within healthcare services, particularly in enhancing patients' satisfaction. As healthcare systems increasingly adopt digital technologies, the strategic implementation of AI-driven management solutions emerges as critical factor in improving human resources efficiency and employee performance monitoring, employee skill development, the monitoring of physicians' role and behavior.

From a theoretical perspective, this study contributes to the existing literature by bridging two critical areas: human resource management and patient care improvement. It provides empirical evidence that highlights how AI can streamline human resource management functions, thereby reducing operational inefficiencies and enhancing staff engagement. The research implications extend beyond theoretical frameworks, suggesting practical applications of AI tools in optimizing human resource management practices, which can lead to better employee performance and, consequently, higher patient satisfaction.

Despite these valuable insights, several avenues for further research remain. Future studies could explore the specific AI technologies that most significantly impact human resource management practices and their subsequent effects on patient satisfaction metrics. Additionally, longitudinal studies examining the long-term effects of AI integration on employee engagement and patient outcomes would provide deeper insights into the sustainability of these improvements.

Moreover, research could investigate the challenges and ethical considerations associated with implementing AI in human resource management, including issues related to data privacy, bias in algorithms, and the implications for job roles within healthcare. Exploring the perceptions of both healthcare employees and patients regarding AI interventions could further enrich the understanding of trust and acceptance in AI-driven processes.

Findings indicate that AI applications - such as predictive staffing, real-time performance monitoring and personalized training - can contribute significantly to optimizing human resource processes. These improvements are closely linked to enhanced patient experiences, as better-managed healthcare professionals are more likely to provide timely, empathetic and efficient care. Furthermore, AI facilitates data-driven decision-making, allowing institutions to align workforce capabilities with patient needs more effectively.

However, the successful deployment of AI in human resource management requires careful consideration of ethical, organizational and workforce-related challenges. Ensuring transparency, addressing employee concerns about automation and investing in digital literacy and AI readiness are essential steps to maximize the benefits of such technologies.

In conclusion, the integration of AI into human resource management processes is a promising pathway towards not only improving internal workforce efficiency but also elevating the standards of patient satisfaction. Future research should further explore the longitudinal effects of AI adoption in healthcare human resource management and its implications for institutional performance and patient-centered outcomes.

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POTENTIAL FOR APPLYING CIRCULAR ECONOMY PRINCIPLES IN COMPOST PRODUCTION IN SERBIA

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Abstract: *Changes in today's socio-economic systems highlight the importance of addressing environmental issues, applying the principles of sustainable development, increasing the significance of renewable energy sources, and reducing resource exploitation. The concept of sustainable development represents a new long-term development approach, strategy, and philosophy of social progress, based on the Green Deal (2019) adopted by the European Commission. The circular economy represents the most significant model of sustainable development in Serbia, offering solutions for resource optimization, waste reduction, and increased economic efficiency. As one of the priorities of the Western Balkans Agenda (2020), its development can contribute to strengthening environmental awareness, improving industrial processes, and creating new jobs through innovative and sustainable business models. The implementation of the circular economy involves investments in green technologies and education, as well as the adoption of appropriate measures to fully harness its potential in the context of Serbia's economic and environmental progress. Compost production can be one of the key applications of the circular economy in the Republic of Serbia, aiming to reduce food waste. Research indicates that domestic compost producers have access to approximately 180 tons of food waste. The total waste generated by the HORECA sector is estimated at 40 kt, with around 99% of food waste ending up in landfills, according to 2018 data. The potential of applying the circular economy to compost production lies in raising awareness about food recycling and redirecting larger amounts of food waste toward compost production, contributing to environmental protection and reducing the number of landfills with harmful effects. The aim of this paper is to highlight the potential applications of the circular economy in compost production in the Republic of Serbia. Based on this, the paper consists of three parts, in addition to the introduction and conclusion. The first part emphasizes the importance of sustainable development in Serbia, while the second part discusses the significance and opportunities of the circular economy. The third part focuses on the potential application of the circular economy in compost production. Finally, concluding remarks are provided.*

Keywords: *Potential, application, circular economy, compost, Serbia.*

UDC: 504.06:631.879.4(497.11)

Classification JEL: Q53, Q56, O13.

1. Introduction

Instead of the traditional linear consumption model, the circular economy strives for more efficient use of resources through the reuse, recycling, and regeneration of materials (Tošković et. al. 2023). The implementation of the circular economy involves investments in green technologies and education, as well as the adoption of appropriate

measures to fully exploit its potential in the context of Serbia's economic and environmental progress.

This concept enables waste reduction, more efficient use of resources and a transition to sustainable production models, thereby stimulating innovation and opening up new business opportunities. In addition, cooperation between state institutions, industry and the scientific community plays a key role in creating a favorable environment for the development of the circular economy, which contributes to overall economic growth and environmental protection.

The aim of this paper is to highlight the potential applications of the circular economy in compost production in the Republic of Serbia. Based on this, the paper consists of three parts, in addition to the introduction and conclusion. The first part emphasizes the importance of sustainable development in Serbia. The second part discusses the significance and opportunities of the circular economy. The third part focuses on the potential application of the circular economy in compost production.

2. The first part emphasizes the importance of sustainable development in Serbia

The circular economy represents the most significant model of sustainable development in Serbia, offering solutions for resource optimization, waste reduction, and increased economic efficiency. Sustainable development in Serbia (Đorđević et al., 2024; Ignjatović, Đorđević, 2023a) is of key importance for economic growth, environmental protection and improving the quality of life. Serbia faces challenges such as pollution, climate change and unsustainable use of natural resources, which is why sustainable development strategies are focused on environmental protection, energy efficiency and circular economy (Misija OEBS-a, 2017).

As one of the priorities of the Western Balkans Agenda (2020), its development can contribute to strengthening environmental awareness, improving industrial processes, and creating new jobs through innovative and sustainable business models. Furthermore, investing in green infrastructure, renewable energy sources and the digital transformation of the economy enables long-term economic stability and greater competitiveness of Serbia in the global market. The implementation of these measures contributes to improving the quality of life of citizens, preserving natural resources and achieving climate goals in line with international standards (European Commission, 2020).

The Circular Economy Roadmap for the Republic of Serbia is a document of importance for circularity and sustainable development in the Republic of Serbia. The environment would through CE: reduce waste, reduce gas emissions, preserve natural resources and improve energy independence and the use of renewable energy sources (Ignjatović, Đorđević, 2023b). In addition to the environmental benefits, the development of a circular economy creates new economic opportunities by improving the competitiveness of domestic companies and creating new jobs in sustainable technology sectors. Investing in innovation, recycling and energy efficiency contributes not only to environmental protection but also to stable economic growth (Kalkan, 2022). In order to successfully implement this strategy, it is necessary to strengthen cooperation between the public and private sectors, as well as invest in educating citizens about the importance of responsible consumption and sustainable practices. Also, alignment with the goals of the United Nations Agenda for Sustainable Development contributes to European integration and the country's long-term prosperity.



Figure 1. Circular economy – waste as a resource

Source: Kalkan, 2022

3. The second part discusses the significance and opportunities of the circular economy

The implementation of the circular economy principle contributes to the development of the agricultural and food market (Ignjatović et. al, 2024) in Serbia. In addition, it includes long-term sustainability, through the preservation of soil fertility, the protection of water and biodiversity, and the reduction of negative environmental impacts (Blagojević et al., 2024).

Agrarian policy in the field of agriculture and rural development is a complex system (Ignjatović et. al, 2024), which can use the circular economy and thus be competitive. However, agrarian policy needs to be strengthened and implemented first (Bajagić, Ignjatović, 2025).in order to follow Western trends. Only some of the recommendations for the development of the circular economy in rural areas in Serbia refer to:

- The existence of infrastructure prerequisites is essential for the quality of life and standard of living of residents in rural areas.
- The development and implementation of organic and circular agriculture is essential for the future development of rural areas in the Republic of Serbia.
- The high level of independent food production shows the potential of production in rural areas.
- Low level of independence and self-reliance of residents in the production of energy necessary for heating.
- It is necessary to increase the level of activity of the population in the work of the local community, groups of citizens or associations dealing with rural issues.
- It is necessary to increase the level of knowledge and awareness of the latest developments in agriculture and rural tourism, through the implementation of education.
- It is necessary to increase the quality of the environment through the reduction of waste, changes in transport and waste disposal.
- Increase the number of waste recycling facilities, which is crucial for environmental quality and local regional development.

- Insecurity, lack of information and inadequate training of residents for investment, threaten the transition to organic agricultural production.
- Necessary reorganization of subsidy distribution at the state level.
- Introduction of the E-agrarian platform by the state.
- Increase the availability of preschool and school facilities in rural areas.
- Increase the availability of health stations in rural areas.
- Increase the availability of organized public transportation in rural areas.

3. The third part focuses on the potential application of the circular economy in compost production

Compost production can be one of the key applications of the circular economy in the Republic of Serbia, aiming to reduce food waste. Research indicates that domestic compost producers have access to approximately 180 tons of food waste. The total waste generated by the HORECA sector is estimated at 40 kt, with around 99% of food waste ending up in landfills, according to 2018 data. The potential of applying the circular economy to compost production lies in raising awareness about food recycling and redirecting larger amounts of food waste toward compost production, contributing to environmental protection and reducing the number of landfills with harmful effects.

Food waste is still a current topic that leaves many consequences, starting from food safety to environmental protection (Danon et al., 2019), resulting in the formation of waste and the creation of uncontrolled landfills. Today, waste is considered one of the leading environmental problems of the modern world. Due to the ever-increasing amount of waste generated as a result of human activities, one of the specific objectives of environmental protection is proper waste management. Acquainting citizens with the need for adequate waste management is necessary, because citizens are the largest producers of municipal waste (Ilić Krstić et al., 2018). According to the criteria of origin, waste is divided into: communal (household) waste, waste on public areas, industrial waste, construction waste, agricultural waste, sediments and sludge from waste water, sewage, septic tanks and street drains (Albanell et al., 1988). Also, waste is characterized as hazardous and non-hazardous waste.

Municipal waste consists of a variety of waste that is created as a by-product in households, institutions, shops, and stores. It appears in different forms, such as waste (from animal and plant sources), ash, paper, fabric, cardboard, objects made of rubber, wood, glass, leather, porcelain, furniture, household appliances, etc. (Ilić Krstić et al., 2018). According to the Statistical Office of the Republic of Serbia, in 2022 the amount of waste generated in the Republic of Serbia was 1,746,539.29 tons, while in 2023. year it was 1,801,838.46 tons, originating from agriculture, forestry, fishing, mining, processing industry, construction, the service sector, etc. (Statistical Office of the Republic of Serbia, 2023).

The utilization of food waste can be improved for energy production, composting, as animal feed, for donations to food banks and as a last, and least desirable, reaction disposal in landfills (Danon et al., 2019). The reduction of waste and its utilization is influenced by the circular economy (Rajković et al., 2020). The concept of the circular economy, which is increasingly accepted, overcomes the outdated concepts of the linear economy, which implies the uncontrolled exploitation of natural resources and the flow of materials from the factory, to the user, and finally to the landfill (Drljača, 2015). Circular economy, in terms of waste, implies less waste and more efficient use (NALED, 2021). A

comparison of the concepts of linear and circular economy is given in a graphic representation in Figure 2.



Figure 2. Concept of linear and circular economy

Source: <https://www.aandapackaging.co.uk/how-is-a-circular-economy-different-from-a-linear-economy/>

By replacing non-renewable energy sources with renewable ones, the circle is closed: product - waste - product. Thus, industry is expected to function as a natural ecosystem, and waste from one industry (output) becomes raw material in another (input), i.e. it imitates circulation, which is where the name "circular" comes from (Zavargo, Jokić, 2010). Separation of waste is a necessary condition without which there is no application of the circular economy (NALED, 2021). The food reuse hierarchy model indicates the ways in which waste can be used, after its separation (Figure 2). The model is based on the legislative system, practice and model hierarchy developed by the EPA (United States Environmental Protection Agency).



Figure 2. Food reuse model hierarchy

Source: https://19january2021snapshot.epa.gov/sustainable-management-food/food-recovery-hierarchy_.html

Based on Germany's long-term experience in introducing a circular economy, 5 stages were defined in the process of improving the waste management system (OSCE Mission, 2017):

- Phase 1 – disposal of waste in uncontrolled landfills;
- Phase 2 – reliable waste collection and improvement of landfills;
- Phase 3 – introduction of separate waste collection and sorting;
- Phase 4 – improvement of the recycling industry;
- Phase 5 - circular economy - waste as a material and source of energy.

Considering the growth of the population on Earth, it can be concluded that the food industry will have a significant increase in production capacity, which also indicates an increase in waste. In this regard, the HORECA sector also joins in the generation of waste. In this paper, the emphasis on waste generation will be on the food industry, that is, the HORECA sector.

The food industry produces significant amounts of waste, which includes: fruit and vegetable residues, discarded items, molasses and flakes from sugar refining, bones, blood and skin from meat and fish processing, residues from wineries, distilleries and breweries, dairy waste such as whey, wastewater from washing, blanching and cooling (Arora et al., 2002). Food waste, according to the NALED guide, means any food or inedible part of food, intentionally or unintentionally removed from the supply chain and discarded without reuse. Food waste is classified into vegetable and animal waste. Waste of plant origin is classified according to the Law on Waste Management and the Rulebook on categories, testing and classification of waste in biodegradable kitchen and restaurant waste, as stated by NALED. Also, the waste generated can be unavoidable, potentially avoidable and certainly avoidable (NALED, 2021).

Most of the waste in the food industry is less hazardous waste due to its organic origin, however, it can have a negative impact on the quality of the environment. Waste in the food industry is generated in various sectors along the production chain, from farms, processing, packaging, transport, retail, services and households, with an estimated 18% of waste coming from food processing and packaging as a result of necessary operations such as washing, peeling, deseeding, separation, etc. (Yu, Brooks, 2016). By using the by-products of the food industry, the importance can be multiple (Rajković et al. 2020). With appropriate waste treatment, it can be used in the form of bioabsorbents, additives, new products that include functional food and bioactive ingredients, animal feed, substrate for the growth of microorganisms, materials for fertilizer after composting or as energy sources, for the production of biofuels (bio-hydrogen, biodiesel) (Kosseva, 2011; Dominquez-Perles et al., 2018).

When it comes to waste from the HORECA sector, compared to other categories of waste, there is the generation of unavoidable waste and waste that can be avoided. Unavoidable waste is formed through food preparation in the kitchen, and is mostly inedible parts of food. Avoidable waste mainly depends on the efficiency of the staff themselves. Facility guests also generate a mixture of these two types of waste. In 2018, the Center for Advanced Economic Studies (CEVES) estimated that the HORECA sector in the Republic of Serbia generates about 40 kt of food. About 25 kt is kitchen waste, which includes inedible parts of raw food, such as egg shells or banana peels. The waste left by guests in the HORECA sector is about 15 kt. Most of the waste, almost 99%, is deposited in landfills, and has a negative effect on the environment, which creates an

unfavorable economic impact. The remaining part is used for composting and biogas production (Danon et al., 2019).

The Republic of Serbia has adopted a strategy of sustainable development and a series of important regulations, including regulations on waste that is present on the entire territory of Serbia and has a negative impact on the environment. A significant percentage of that waste is organic waste that can be seen as material for composting. Since the origin of organic waste, in addition to feeding the population, is mainly related to agriculture and forestry, where Serbia has significant resources and where large amounts of organic waste are produced, there is a need, both in the ecological, economic and social sense, to find opportunities to increase the volume of composting (Vemić et al., 2014). Composting helps reduce waste. Serbia, like other countries in Europe and the world, is trying to systematically solve the problem of waste (Komazec et al., 2011).

Composting is one of the possibilities for realizing the concept of sustainable development and a good way to deal with organic biodegradable waste. Composting increases cyclicity, i.e. circular flow of production, which is one of the goals of sustainable production. Sustainable production tends to move from linear systems (raw materials are used for products, by-products and waste) to circular systems (waste is reused as energy or raw material for another product or process) (Vemić et al., 2014).

Types of waste that can be composted (Albanell et al., 1988):

- bio-waste rich in nitrogen (50 %): fruit and vegetable residues, fruit and vegetable peels, coffee and tea grounds, grass clippings, weeds and plant residues in the garden, withered flowers,
- bio-waste rich in carbon dioxide (50 %): leaves, chopped branches, straw and hay, fruit and grape pruning residues, sawdust, coniferous tree needles.

In addition to the mentioned types, for composting, they are also used (Williams, 2005):

- residues from food processing: material for composting that results from the processing of fruits, vegetables, grains and meat;
- manure and agricultural by-products: generated in piglet barns, livestock farms, incubators, farms, greenhouses, plastic greenhouse covers, etc;
- residues from forestry and the wood industry: including bark, sawdust and fibrous residues from paper production;
- waste sludge or organic waste: created by biological treatment of waste sludge in wastewater treatment plants;
- leaves, bushes, twigs and other plant remains, as well as waste from yards, gardens and vegetable gardens;
- organic waste containing sorted compostable fractions of municipal waste.

Which sources of material will be used and in what proportions depends on the geographical region, economic structure, standards, lifestyle and eating habits of the population. The most important natural resources of the Republic of Serbia belong to agricultural land, followed by forests and forest land, where organic matter is mainly produced, while a large amount of biodegradable waste remains behind it (Vemić et al., 2014).

Composting, as a modern method of municipal waste treatment, is an exothermic process of biological oxidation, in which the organic substance undergoes aerobic biodegradation under the influence of microorganisms under conditions of elevated temperature and humidity (Ilić Krstić et al., 2018). It is usually defined as the rapid dissolution of wet, solid biodegradable organic matter: food waste, garden waste, paper,

cardboard, using aerobic microorganisms under controlled conditions (Vemić et al., 2014). During the biodegradation process, the organic substance undergoes physical, chemical and biological transformations, creating a stable humic end product, which is called compost (Atiyeh, et al., 2001; Ilić Krstić et al., 2018).

The main goals of composting are (Vemić et al., 2014):

- transformation of biodegradable organic material into biologically stable material, while reducing the volume and weight of waste during the process;
- decomposition of pathogenic microorganisms, insect eggs and other unwanted organisms that may be present in solid municipal waste;
- retention of basic nutrients such as sodium (N), phosphorus (P) and potassium (K) in the greatest possible quantities;
- obtaining a product that can be used for growing plants.

Compost is a material similar to humus, which does not have an unpleasant smell and can be used to improve the soil or as an organic fertilizer important for agriculture, a means to control the temperature and humidity of the soil, or to prevent the growth of weeds, which results in the circulation of matter in nature (Vemić et al., 2014; Ilić Krstić et al., 2018; Danon et al., 2019). Compost can be used in agriculture, but only under the condition that all sanitary regulations are followed and that compost is controlled in terms of the presence of pathogenic microorganisms and harmful chemicals in it (Lješević, 2009). Domestic compost producers have about 180 tons of food waste at their disposal, while about 25% is lost in the composting process (Danon et al., 2019).

Compost can be used for:

- bioremediation and pollution prevention, restoration of contaminated soil, odor control or decomposition of volatile organic compounds;
- control of erosion and outflow of nutrients, as well as soil compaction;
- encouraging growth, controlling plant diseases and suppressing plant pests, which increases the yield in agriculture;
- afforestation, wetland restoration, habitat rehabilitation, etc.

4. Conclusions

The circular economy is a key step towards a sustainable future for Serbia, enabling the harmony of economic growth and environmental protection through innovation and responsible resource management. For starters, Serbia should adhere to EU advice on sustainable development but also adopt best practices for the circular economy. Food waste is still a current topic that leaves many consequences, starting from food safety to environmental protection, resulting in the formation of waste and the creation of uncontrolled landfills. The utilization of food waste can be improved for energy production, composting, as animal feed, for donations to food banks, and as a last and least desirable reaction, disposal in landfills. Composting is one of the possibilities for realizing the concept of sustainable development and a good way to deal with organic biodegradable waste. Composting increases cyclicity, i.e. circular flow of production, which is one of the goals of sustainable production. Compost can be used for: bioremediation and pollution prevention, erosion control, growth promotion, plant disease control and pest control, reforestation, wetland restoration, habitat rehabilitation, etc.

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MODELING THE PROCESS OF EDUCATIONAL MANAGEMENT IN SCHOOLS IN SOCIALLY AND ECONOMICALLY VULNERABLE REGIONS OF ISRAEL

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Abstract: Ensuring effective educational management in socially and economically vulnerable regions of Israel is crucial for reducing inequality and promoting equal access to quality schooling. This study examines the challenge of developing an adaptive educational management model for schools in disadvantaged areas of Israel, where multiple factors undermine educational resilience. Existing literature lacks a comprehensive model tailored to such conditions, highlighting the need for a data-driven, flexible management approach. This research employs a mixed-method approach, combining theoretical analysis of educational governance structures with empirical statistical data reflecting the state of school education in Israel. The findings indicate that a multi-component model enhances school resilience, optimizes resource allocation, and improves decision-making processes. The key contribution of this study is the introduction of a management framework based on modeling, enabling real-time data-driven adjustments. Schools implementing this model improve managerial efficiency. The proposed model serves as a practical tool for policymakers and school administrators, offering a scalable solution to address systemic challenges in Israel's vulnerable educational environments.

Keywords: Educational management, school education, regions of Israel, school management, process model.

UDC: 005:371.014(569.4)

Classification JEL: I28

1. Introduction

Effective educational management plays a significant role in ensuring equitable access to quality education, especially in countries where disparities exist between developed and socio-economically disadvantaged regions. In such contexts, the ability to adapt governance structures to local conditions is essential to sustain educational institutions and improve student outcomes. Israel, like many other countries, experiences significant regional disparities in its education system. Schools in economically disadvantaged areas face persistent challenges including underfunding, high staff turnover, and low parental involvement, all of which negatively impact educational quality and student achievement [14]. Despite the growing recognition of these challenges, there is a lack of a clear and generally accepted definition of educational management in the academic literature. Instead, scholars have approached the concept from a variety of perspectives, including pedagogical, managerial, performance-based, systemic, environmental, and societal approaches [25]. While these perspectives provide valuable insights into specific aspects of educational

management, no comprehensive model has been formulated to address the unique challenges faced by schools in vulnerable regions. The absence of a clearly defined and structured model of adaptive educational management necessitates the development of a management framework that can optimize decision-making, resource allocation, and policy implementation in challenging educational environments.

The central challenge addressed in this study is to find an optimal structure for an educational management model that can adapt to the diverse circumstances of disadvantaged regions while ensuring equitable access to education and long-term institutional sustainability. Given the socioeconomic disparities within Israel's education system, it is essential to develop a data-driven, flexible, and resilient management approach that accounts for regional differences, resource constraints, and policy limitations.

The purpose of this study is to lay the foundation for developing an adaptive educational management model that will promote the sustainability and resilience of school education in socially and economically vulnerable regions of Israel. The study aims to develop a framework that enables schools to dynamically adjust management strategies based on real-time data, thereby improving learning outcomes and reducing inequalities between developed and underdeveloped regions.

Thus, the research in this paper is based on the following hypotheses: an adaptive model of educational management in schools increases institutional resilience through improved decision-making and smart resource allocation; a decentralized management approach increases the autonomy of Israeli schools, resulting in more effective management structures in economically weak regions; an adaptive model of educational management should be a multi-component structure integrating financial management, human resource management, academic strategy, digitalization, and community engagement, providing a comprehensive and flexible approach to school management in socially and economically vulnerable regions.

A mixed-method approach, combining theoretical and empirical analysis, was employed to test the research hypotheses. The theoretical study consisted of a review and analysis of existing approaches to educational management, including their conceptual foundations and practical application in Israel. The empirical study consisted of a statistical analysis of educational performance indicators in vulnerable regions of Israel, combined with case studies and qualitative assessments of school governance structures.

2. Literature Review

The development of educational management is influenced by the complexity of educational systems, globalization, technological progress, and the need for accountability. The significance of human capital necessitates effective resource management to ensure quality education. Social changes and the increasing diversity of needs call for an innovative approach. Educational management integrates pedagogy and management, raising the question of their compatibility within a single conceptual framework [29]. These foundations define the content, goals, objectives, subjects, objects, principles and functions of management in education. The interdisciplinary nature of educational management stems from its dual foundation.

The term is interpreted differently due to the absence of a unified definition of "education" and "management", as well as the relative novelty of this concept in the field. Terminological disagreements persist, particularly regarding the distinction between "educational management" and "management in education". These discussions emphasize

the complexity of managing educational systems [20], [10], [3]. Educational management covers the management of the education system as an integrated social and institutional structure, including strategic planning, coordination, resource management, program development, and quality control [29]. Conversely, management in education is commonly understood as the application of general management principles within the educational sector, emphasizing administration, regulation, and efficiency enhancement in individual institutions or systems.

School educational management has distinct characteristics due to the unique nature of the educational process. Primarily, school management aims to achieve social objectives, such as enhancing educational quality and fostering student development, necessitating a balance between pedagogical and administrative management. In addition, schools interact with various external structures - government agencies, parents, the local community, and the labor market, which complicates management processes. The main task of educational management in schools is to create conditions for the stable functioning and development of the educational institution. This includes ensuring high quality education in the context of strict standards and limited resources, creating a favorable educational environment, supporting the professional growth of teachers, strategic resource management, introducing modern technologies, strengthening teamwork and cooperation with parents and the community [1]. A review of the scientific literature enabled the author to identify various approaches to defining 'educational management' (EM), as illustrated in Figure 1.

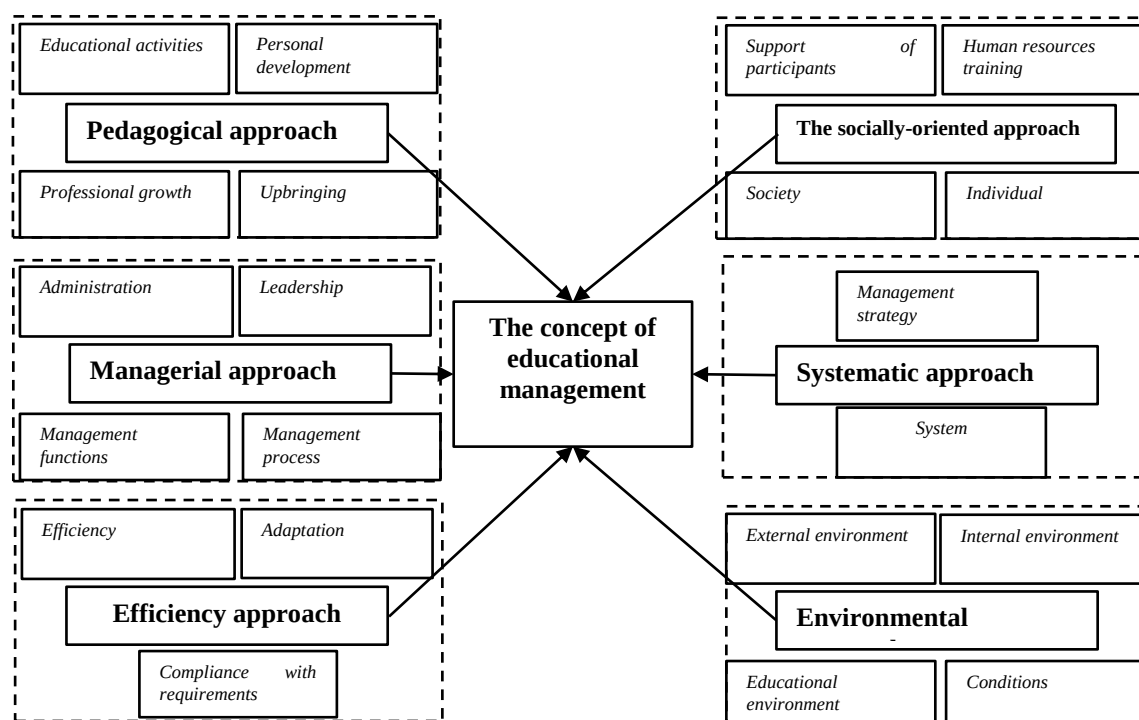


Figure 1. Approaches to the concept of educational management

Source: developed by the author based on [1], [22]

The authors examine a number of approaches to educational management: pedagogical approach, managerial approach, efficiency approach, socially-oriented approach, systems approach, environmental approach.

The pedagogical approach is aimed at creating conditions for the personal development of students and the professional growth of teachers [15]. It is focused on the

design of curricula, the implementation of innovative educational practices and support for teachers. *The managerial approach* focuses on the structured management of resources and processes. The main elements are planning, coordination, motivation, control and optimization of resource use [9]. *The efficiency approach* focuses on achieving measurable educational results, such as knowledge, competencies and success of graduates [9]. Includes strategic planning, process optimization and economic sustainability. *The socially-oriented approach* emphasizes the social role of education, ensuring equal opportunities, inclusiveness and support for vulnerable groups. It is focused on the accessibility and social responsibility of educational institutions [5], [18]. *The systematic approach* considers educational management as a set of interconnected elements [21]. It strives to form long-term strategies that ensure sustainability and adaptation to change. *The environmental approach* takes into account the influence of the external and internal environment on education management [16], [26], [13]. Emphasizes the need to adapt to social, economic and technological changes in order to effectively engage with stakeholders.

Each approach to educational management reflects different aspects of educational process management, allowing for pedagogical, managerial, social and economic factors to be taken into account. The comprehensive application of these approaches contributes to the effective development of educational institutions and improvement of the quality of education.

3. Methodology

This study employs a mixed-method approach that integrates theoretical analysis, empirical research, and system modeling to develop an adaptive educational management model for schools in socially and economically vulnerable regions of Israel. The research design is structured to ensure a comprehensive understanding of the challenges faced by schools, identify key management variables, and validate the proposed model through data-driven simulations. The study consists of three stages: theoretical analysis, which involves reviewing existing educational management structures and governance approaches; empirical research, which includes data collection and statistical analysis to assess the current state of educational management in vulnerable regions of Israel; and modeling, which focuses on the development and evaluation of an adaptive educational management model. A combination of descriptive statistics and system modeling is used for data processing and interpretation. System modeling is applied to simulate the educational management process within schools, enabling the design of a resilient school education system in vulnerable regions of Israel.

Although the study involves the development of a comprehensive model, several limitations must be acknowledged: reliance on secondary data may lead to bias based on existing reporting structures, the adaptive educational management model assumes rational decision-making in school management, which may not fully capture the complexities of the real world, and the long-term effects of the proposed management interventions require further theoretical and practical research beyond the scope of this study. This methodological approach provides rigorous, data-driven insights into optimizing educational management in socio-economically disadvantaged regions of Israel.

4. Results and Discussion

The authors conducted an analysis of the current state of educational management in vulnerable regions of Israel over the past five years. Economic and social issues of the regions were identified, along with the shortcomings of existing management models in

regional schools. The authors also presented their conclusions and established trends that lay the foundation for future research in this field. As a result of the analysis, the authors identified an imbalance in the distribution of educational resources. There is a significant gap in school funding between developed regions and socio-economically vulnerable areas of Israel, as shown in Table 1.

Table 1. Imbalance in the distribution of educational resources in the regions of Israel, 2020

Municipality	Annual expenses per student (shekels)
Tamar Regional Council (богатый регион)	≈100,000
Tel Aviv (город)	≈34,600 (city hall invests ₪8,650 per student)
Kiryat Bialik (city)	≈34,000 (city invests ₪11,000 per student)
Shfar'am (Arab city)	≈26,000 (city invests only ₪1,300 per student)
Al-Batuf (Arab reg. council)	24,400
Jerusalem (city)	≈23,000 (city hall invests ~₪3,000 per student)

Source:

<https://www.shomrim.news/eng/336#:~:text=however%2C%20since%20the%20two%20localities,provided%20by%20the%20Education%20Ministry>

An analysis of per-student funding in different municipalities of Israel reveals significant disparities in the allocation of resources, directly related to the economic development level of the regions. While wealthier municipalities, such as the Tamar Regional Council, invest up to 100,000 shekels per student per year, poorer Arab regions, such as Al-Batuf, receive four times less - only 24,400 shekels per student. There is also a notable gap between cities with high and low local incomes. For instance, Tel Aviv and Kiryat Bialik can afford to add 8,650 shekels and 11,000 shekels per student, respectively, from the municipal budget, increasing total education spending in these cities to 34,600 – 34,000 shekels per year. In contrast, Shfaram (an Arab city) allocates only 1,300 shekels from the local budget, resulting in a significantly lower overall funding level - only 26,000 shekels. However, it is important to note a positive trend - despite ongoing municipal disparities, government funding has become more evenly distributed. Over the past 8 years (2014–2022), the gap in government funding for secondary schools between the Arab and Jewish sectors has halved, from 32% to 16%. In 2022, Arab high school students received an average of 31,000 shekels from the state budget, still lower than the 37,000 shekels in secular Jewish schools and 44,000 shekels in religious Jewish schools, but the difference is no longer as critical. Thus, the government's differentiated funding policy has indeed started to equalize educational resources in Israel, though local economic factors still lead to significant imbalances in the quality of education. Sectoral differences in education funding in Israel, 2014-2022, are presented in Figure 2.

The graph clearly shows the positive trend of narrowing the gap in public funding for high schools between the Arab and Jewish sectors in Israel over the period 2014–2022. In 2014, funding for Arab high school students was 32% lower than in secular Jewish schools and 39% lower than in religious Jewish schools. By 2022, this gap had narrowed to 16% and 29%, respectively, indicating a significant improvement in the availability of educational resources for Arab students.

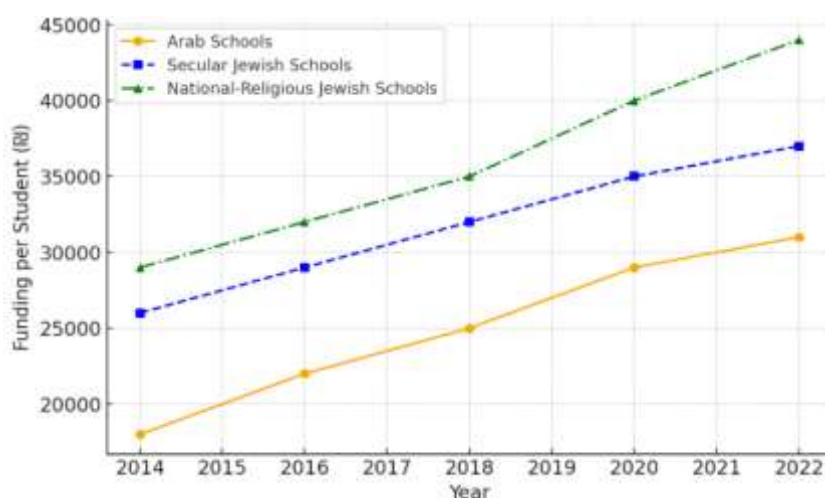


Figure 2. Sectoral differences in education funding in Israel, 2014-2022

Source: <https://www.taubcenter.org.il/en/research/highschool-expenditure/>

From 2014 to 2022, government funding per student in Arab schools increased by 73%, while in secular Jewish schools it rose by 41%, and in national-religious schools by 51%. This demonstrates that government policy has prioritized increasing the budget for the Arab sector, which helps address educational inequality. Despite the narrowing of the gap, inequality persists. In 2022, the average government budget per student was: 31,000 shekels in Arab schools, 37,000 shekels in secular Jewish schools, and 44,000 shekels in national-religious schools. Although the gap has decreased, Jewish schools still receive more funding, especially in the religious sector.

In recent years, due to increased government funding, educational inequality between Arab and Jewish schools has become less pronounced. However, full equality has not yet been achieved - funding for Arab schools remains lower, continuing to create disparities in the quality of educational services and learning opportunities.

In addition to economic factors affecting the implementation of educational management, social and demographic challenges in various regions of Israel can be identified. These challenges also contribute to the differences between regions and impact the sustainability and effectiveness of school education, as shown in Table 2.

The analysis of socio-demographic challenges in vulnerable regions of Israel shows that economic instability, high poverty rates, and unemployment directly affect the accessibility and quality of education. Poverty is a key factor in educational inequality. In the Arab sector, 58% of children live below the poverty line, leading to a shortage of educational materials, lack of private tutoring, and poor academic performance. These conditions contribute to a high dropout rate—although it has decreased from 15.8% in 2003 to 8.1% in recent years, the issue remains significant. The gap in the Bagrut exam results is narrowing, but there are still notable differences. The pass rate for the Bagrut exam among Arab students in the 2021/22 academic year was 75.6%, nearly equal to the rate among Jewish students (77.2%). This is significant progress, indicating successful reforms in the education system. However, the Bedouins in the Negev remain at high risk, as only 64% of them obtain a high school diploma. This underscores the need for additional investments in infrastructure and teacher training in the Bedouin sector. Additionally, unemployment and migration exacerbate the educational challenges in the regions. Unemployment among young Arab men (before COVID-19) increased by 7% over two years due to a mismatch between education and labor market demands.

Table 2. Socio-demographic challenges to education in vulnerable regions of Israel

Factor	Statistical data
Poverty levels in Arab communities	58% of Arab children live below the poverty line
Dropout Rate Among Arab-Israeli Youth	Decline from 15.8% in 2003 to 8.1% in recent years
Bagrut exam pass rate – Arab students	75.6% in the 2021/22 school year
Bagrut exam pass rate – Jewish students	77.2% in the 2021/22 school year
Bagrut exam pass rate – Druze students	Higher than Jewish students, slight advantage
Bagrut exam pass rate – Negev bedouins	About 64% in the Negev
Unemployment rate among young Arab men (pre-COVID-19)	Up 7% in two years due to skills mismatch
The impact of migration on education	"Brain drain" in Arab cities, overcrowded schools

Source: <https://taubcenter.org.il/wp-content/uploads/educationinequalityinisraeleng.pdf>

In peripheral Arab cities, there is a “brain drain” - many educated families move to the center of the country, which worsens the socio-economic balance and reduces the tax base for local schools. At the same time, the high birth rate in Arab cities leads to overcrowding in schools, creating a shortage of educational spaces. Educational problems in vulnerable regions of Israel are closely tied to the socio-economic situation. Improving funding is important but not enough. A comprehensive solution, including poverty reduction, labor market development, crime prevention, and expanded educational infrastructure, is needed to break the cycle of socio-economic instability affecting education. Israel's education system faces serious issues, including bureaucratic barriers, insufficient crisis adaptability, and lack of digital tools. The high centralization and administrative complexity slow decision-making, creating obstacles, especially in vulnerable communities [19]. The Ministry of Education controls most budgets, curricula, and staffing decisions, leaving local authorities and school principals with limited autonomy. Processes such as opening new schools or adding classes require passing through multiple levels of bureaucracy, which delays their implementation. Political instability between 2019 and 2021 worsened this issue, as the lack of an approved state budget delayed investments and hiring of staff [6]. Frequent changes in education ministers shifted priorities and delayed reforms, hindering long-term projects. The system also suffers from outdated, fragmented management processes, causing inefficiency in budget execution and data management.

The last five years have revealed the system's insufficient adaptability to crisis situations, particularly in disadvantaged areas [11]. The COVID-19 pandemic was a major test: the shift to remote learning exacerbated digital inequality [12]. Many students from poor or rural areas had no access to computers or the internet, effectively excluding them from the educational process. The lack of prior planning and inadequate teacher preparation for digital learning exacerbated the situation, increasing the performance gap between students from different socio-economic backgrounds. Other crises, such as political instability and conflicts, also highlighted the system's insufficient readiness to ensure continuity of education and support students in challenging conditions [8]. Despite Israel's reputation as a "startup nation," its education system lags in the digital transformation of management, especially in disadvantaged sectors. Management, monitoring, and forecasting in education were conducted with minimal use of modern

digital tools until recently. The lack of integrated data systems led to inefficiency, delays, and limited opportunities for monitoring and analyzing key indicators such as attendance and performance [7]. The implementation of digital tools at the school level was uneven, and many schools in poorer areas continued to use outdated management methods, hindering the timely identification of issues and informed decision-making.

In addition to economic, technological, and socio-demographic factors, the effective implementation of educational management in school institutions faces several conditions that not only limit and constrain development but also present significant challenges that hinder achieving high-quality educational outcomes. These include insufficient regulatory and legal frameworks, limited digital infrastructure, weak adaptation to changes, low staff qualifications, lack of motivation, resistance to change, limited funding, inefficient resource use, difficulty in attracting additional funds, low levels of innovation implementation, weak adaptation to changes, and a lack of modern educational technologies [23], [28], [2].

Addressing these issues requires a comprehensive approach, including strategic management, systems analysis, and flexible mechanisms. An innovative educational management model, tailored to school specifics, resources, and external constraints, is essential for effective implementation and ensuring sustainability. The authors have developed an adaptive educational management model for schools in vulnerable regions of Israel. The developed model is aimed at ensuring sustainable and flexible application of educational management by schools in socio-economically vulnerable regions, considering resource shortages, high poverty rates, migration processes, staffing issues, and limited local funding. The model is presented in Figure 3.

The model developed by the authors consists of four modules, each performing key functions in the implementation of the educational management process. **The pedagogical module** is responsible for the development, implementation, and adaptation of educational programs, considering the individual characteristics of students and modern pedagogical methods. It includes curriculum development, teaching methods, knowledge assessment systems, and mechanisms for teachers' professional development. **The management module** ensures strategic planning, resource allocation, and control over the effectiveness of the educational process. It encompasses financial management mechanisms, personnel policy, regulatory frameworks, and interaction with governmental and public structures. **The organizational-technological module** supports the educational process infrastructure, school technical equipment, and the implementation of innovative solutions. It includes material-technical resources, digital educational technologies, automated management systems, and safety mechanisms for the educational environment. **The educational management subject** module defines the interaction among all participants in the educational process - administration, teachers, students, parents, and external stakeholders. It focuses on building effective communication links, involving the community in education management, and creating partnership programs to expand educational opportunities.

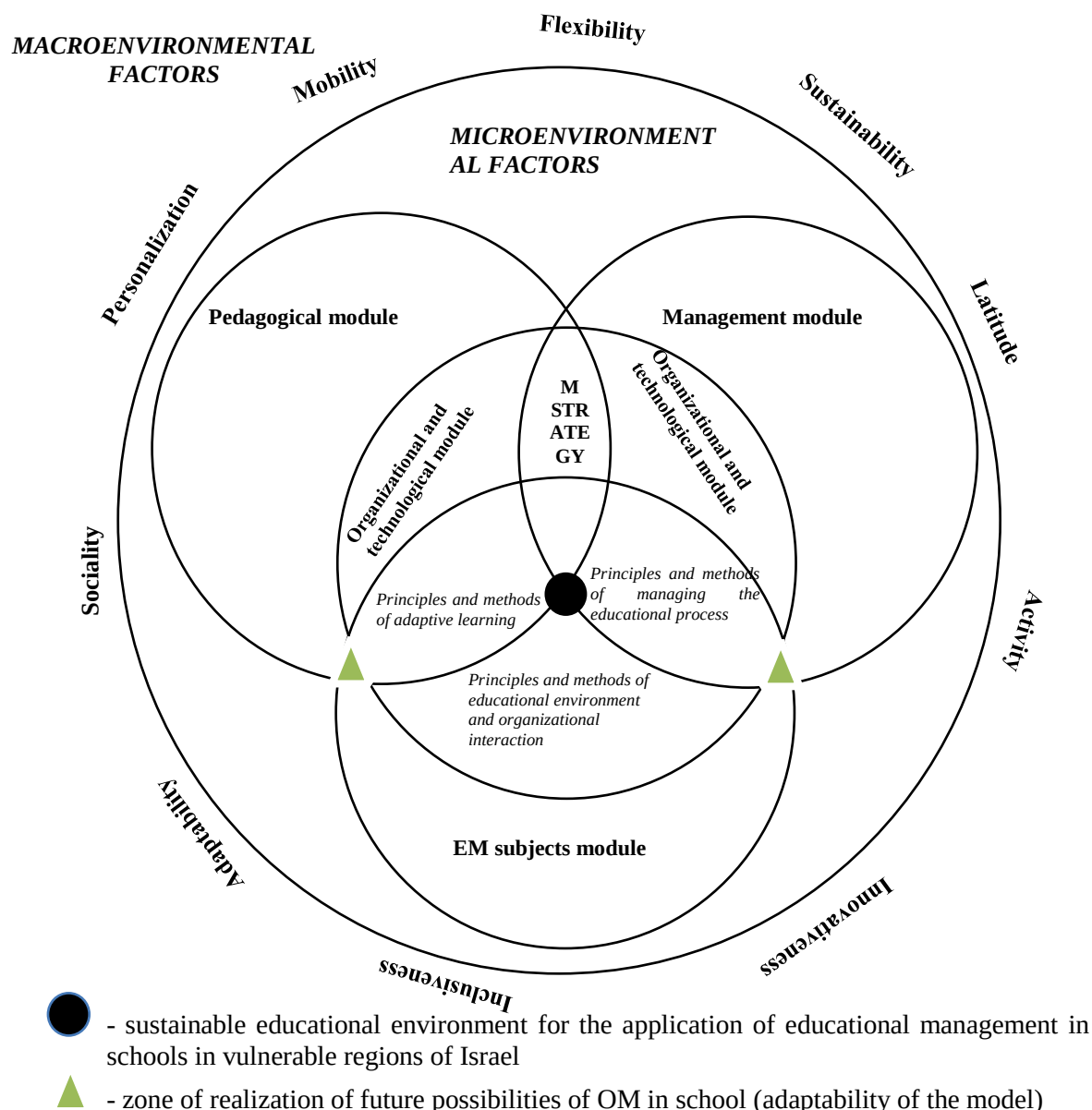


Figure 3. Adaptive model of educational management in schools in vulnerable regions of Israel

Source: developed by the author

The interconnection of these modules ensures a comprehensive and adaptive application of educational management in schools, aimed at sustainable development and improving the quality of education in vulnerable regions of Israel. At the intersection of the pedagogical, organizational and technological modules and the module of the subject of educational management, the principles and methods of adaptive learning are formed, aimed at the digital transformation of pedagogical processes, flexible adaptation of training and the involvement of all subjects of education in the management of educational activities. At the intersection of the organizational and technological, managerial and module of the subject of educational management, the principles and methods of managing the educational process in schools are formed, ensuring effective decision-making, data monitoring and adaptation of the educational process to current challenges. At the

intersection of all four modules, the principles and methods of the educational environment and organizational interaction are formed. Also, the core of this model is a sustainable educational environment for the application of educational management in schools in vulnerable regions of Israel, which involves the development of an educational management strategy. The adaptive strategy of OM allows for dynamic changes in approaches depending on regional characteristics. Thus, at the intersection of all modules, a dynamic and highly effective school management system is formed, based on digital technologies, strategic planning and adaptability to environmental challenges.

The formation of each module is influenced by factors of the external micro- and macroenvironment, as well as internal factors of the school educational institution. These factors form the content component of each module depending on regional conditions.

The model proposed by the authors is based on the fundamental principles that are presented in the diagram on the border between the conditions of the macro- and microenvironment: mobility, flexibility, sustainability, innovation, and others. These principles allow us to adhere to the conceptual foundations of educational management and take into account the initial conditions of economically and socially underdeveloped regions of Israel.

5. Conclusions

In this study, the authors present an adaptive educational management model developed to improve the management of schools in socioeconomically vulnerable regions of Israel. The model integrates pedagogical, managerial, organizational-technological, and stakeholder interaction modules, providing a flexible, data-driven, and technology-enhanced approach. By prioritizing strategic management, digital infrastructure, and collaborative decision-making, this framework enables schools to better allocate resources, personalize learning, and effectively respond to crises. The implementation of this model can significantly reduce educational disparities, improve administrative efficiency, and contribute to long-term sustainability in vulnerable school environments. Future research should focus on pilot implementations, long-term assessments of the impact of digital transformation, and comparative analysis with similar educational systems.

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SUSTAINABLE WINEMAKING IN THE REPUBLIC OF MOLDOVA: STRATEGIES FOR REDUCING ENVIRONMENTAL IMPACT AND ORGANIZING RESPONSIBLE EVENTS

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Abstract: *This study analyzes strategies for sustainable development of the wine industry in the Republic of Moldova, focusing on the role of cultural events such as VinOpera in promoting environmentally responsible behavior. The work identifies key environmental challenges in the industry, including excessive consumption of water and energy resources, pollution associated with the use of agrochemicals, and difficulties in waste and packaging management. A review of international sustainable practices such as biodynamic viticulture, the use of renewable energy sources and the introduction of carbon labeling are reviewed. Special attention is paid to the specifics of Moldovan winemaking, its potential in the context of sustainable development, as well as successful examples of environmentally oriented approaches implemented by leading wineries in the country. In a separate section, the case of the cultural event VinOpera is discussed: its sustainable components are analyzed and its impact on the formation of environmental culture and behavioral patterns of the audience is assessed. In conclusion, practical recommendations aimed at strengthening the sustainability of both the wine industry and related cultural initiatives are presented. Suggested measures include the development of certification mechanisms, educational programs, ecotourism and effective environmental communication strategies. The paper emphasizes the importance of integrating environmental and cultural factors in shaping the sustainable development of the wine industry in the Republic of Moldova.*

Kywords: *Sustainable Winemaking, Environmental Impact, Moldova, Eco-Events, Biodynamic Agriculture.*

UDC: 061.7:663.2(478)

Classification JEL: Q01, Q13, Q56.

1. Introduction

The relevance of the research topic. In the context of global climate change, growing environmental threats and increasing public demand for responsible consumption, the issues of sustainable development are of particular relevance. The wine industry, despite its significant cultural and gastronomic value, is one of the most resource-intensive areas of the agricultural and tourism sectors. Wine production involves significant consumption of water, energy and agrochemicals, and is accompanied by high levels of carbon dioxide emissions, packaging waste and soil pollution. In this context, the transition to sustainable winemaking models is now seen as an indispensable element of agricultural sustainability and responsible tourism development. The Republic of Moldova, despite its small size, plays an important role on the wine map of Eastern Europe. Moreover,

winemaking is not just an economic activity, but also a significant part of the national identity, cultural heritage and international image of the country. In the context of increasing competition on global markets, as well as growing demand for environmentally friendly and organic products, sustainable winemaking is becoming a strategic direction for the development of Moldovan agribusiness and tourism industry.

In addition to the production sector, the principles of sustainability are also being actively implemented in the tourism sector of the wine industry. The organization of environmentally responsible events such as festivals, wine tours and cultural events helps to promote sustainable practices, create environmental awareness among consumers and promote the country's image as a “green” destination. One prominent example of this approach in the field of wine festival organization is VinOpera, a unique cultural event held on the grounds of Castel Mimi winery that combines music, winemaking and sustainability principles.

The present study aims to comprehensively analyze the current state and prospects of sustainable winemaking in the Republic of Moldova. Special attention is paid to case studies, including the experience of leading wineries and analysis of the organization of responsible activities. The paper examines the environmental challenges facing the industry, analyzes the sustainable strategies applied, assesses the influence of cultural events on the formation of perceptions of sustainability, and offers concrete recommendations to further promote the ecological transformation of the Moldovan wine sector.

Therefore, this study combines ecological, social and cultural approaches based on the concepts of sustainable development, wine and rural tourism, and event management. This determines the relevance of the study from both scientific and practical points of view.

2. Literature Review: Environmental Challenges and Global Trends in Sustainable Winemaking

Having conducted various studies on the conceptual literature in the field of winemaking [1]; [3]; [4] as well as statistical studies, the main problems in the research area were substantiated.

Contrary to the romanticized notion of winemaking as a craft inextricably linked to nature, modern winemaking puts significant pressure on the environment. The environmental load is formed at all stages of the value chain: from vineyard cultivation to bottling, logistics and organization of related activities.

The main *environmental problems* of the industry can be classified as follows:

- *Water consumption:* according to studies, the production of one glass of wine can use up to 117 liters of water, including irrigation, equipment washing and tank cleaning. In regions where water resources are scarce, this becomes a critical sustainability factor. Figure 1 shows water consumption by type of beverage.

As can be seen from the chart, the highest consumption is inherent in wine, with juices following closely behind, and then beer.

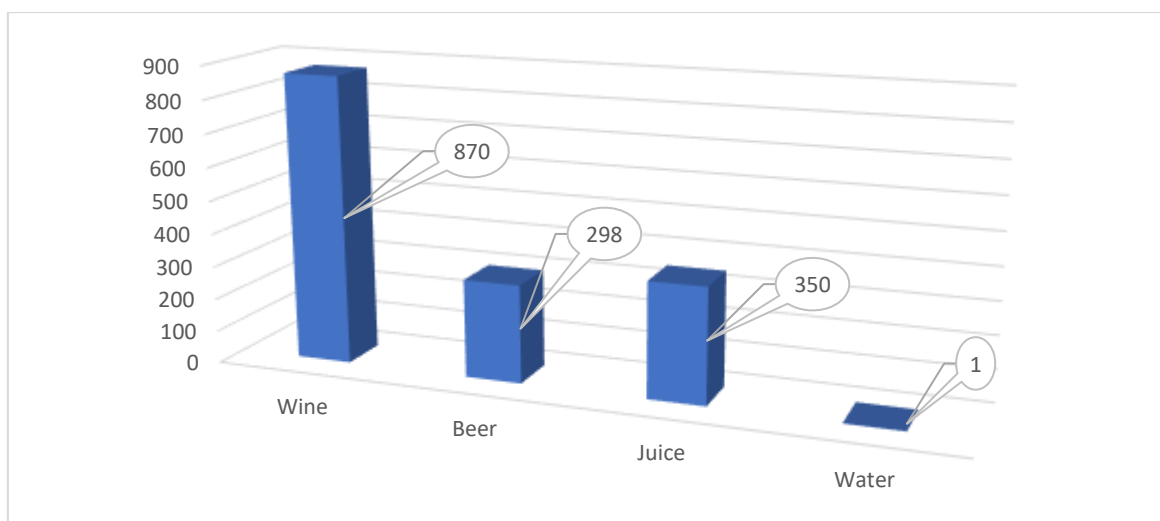


Figure 1. Water Consumption per Liter of Beverage

Source: developed by the authors on the basis of
<https://www.washingtonpost.com/food/2023/11/09/lighter-wine-bottles-carbon-footprint/>

The following diagram shows the distribution of the carbon footprint during wine production by stage of production in terms of CO₂ emission. As can be seen, the greatest amount of CO₂ is emitted into the environment during packaging. Although the other stages account for slightly less emissions, the amount is still significant. [5]

- **Greenhouse gas emissions:** the main sources of CO₂ emissions in the wine sector are the production and transportation of glass bottles (up to 30% of the total carbon footprint), energy inputs for fermentation and cooling processes, water treatment and logistics.

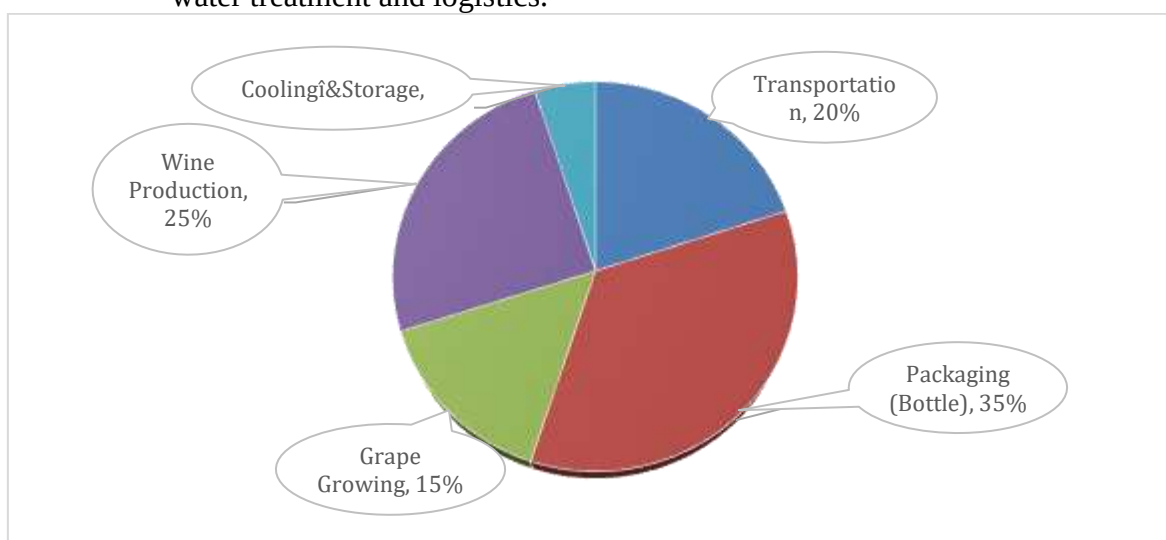


Figure 2. Carbon Footprint Distribution Across Wine Production Stages

Source: developed by the authors on the basis of <https://www.wineaustralia.com/news/articles/wine-australias-climate-change-investments-for-the-sector>

As can be seen, the greatest amount of CO₂ is emitted into the environment during packaging. Although the other stages account for slightly less emissions, the amount is still significant.

The following diagram (number 3) provides information regarding the difference in CO₂ emissions depending on the type of packaging.[6]

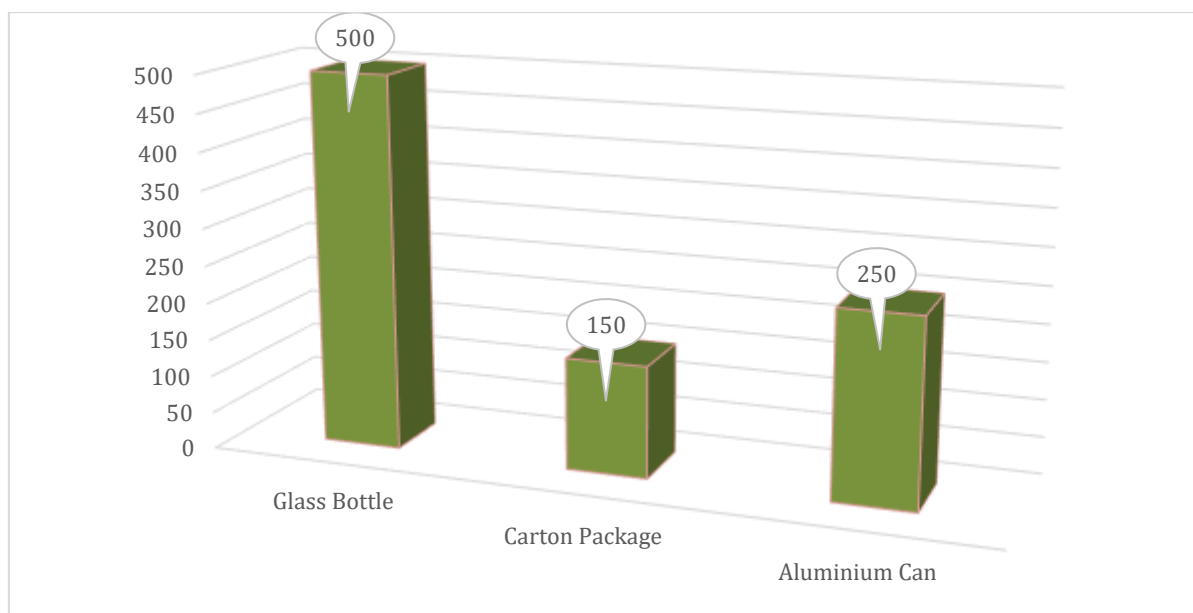


Figure3. CO₂ Emissions by Packaging Type (per unit)

Source: developed by the authors on the basis of <https://www.wineaustralia.com/news/articles/wine-australias-climate-change-investments-for-the-sector>

- Agrochemical pollution: the use of synthetic pesticides, herbicides and fertilizers
- negatively affects biodiversity, contaminates soil and aquifers, and reduces the resilience of agroecosystems to climatic stresses. [7]
- Packaging and waste: glass and plastic containers, corks, cardboard boxes and pallets generate significant amounts of waste, much of which is not recycled. The disposal of organic waste generated during the fermentation process also requires environmentally friendly solutions.
- Energy consumption: the use of fossil fuels to power wineries (fermentation chambers, cooling systems, pumps) contributes significantly to climate change.

The most vulnerable stages of the wine life cycle are:

- Grape growing (significant water and chemical consumption);
- Wine production (high energy and water consumption);
- Packing and packaging (material-intensive and transportation costs);
- Distribution, especially export (transportation emissions). [8]

3. Methodology

The article uses various methods: analysis of theoretical sources and statistical publications, synthesis of the presented data; induction, i.e. the transition from private examples from wineries' experience to general ones and deduction, translation of general conclusions to private practices.

The method of grouping and typologisation was also used. Content analysis and observation methods were used as empirical research. Graphical analysis was used to present the researched data. The Case Study method was also used to provide a case study in the wine sector.

4. Results and Discussion: Specific Patterns of Sustainable Winemaking in the Republic of Moldova

The Republic of Moldova is one of the oldest wine-producing regions in Eastern Europe. Viticulture here has a history of more than 5000 years, and winemaking is an integral part of the national cultural code. Currently, vineyards cover an area of over 140,000 hectares, and wine exports account for a significant share of the country's GDP, especially in rural regions. There are about 200 registered wine producers in the country, of which about 50 are actively developing enotourism and adopting sustainable technologies.

Factors contributing to the development of sustainable winemaking in Moldova:

- **Rich agro-climatic resources:** the regional terroir is favorable for growing both local and international grape varieties characterized by low water consumption.
- **Cultural heritage:** Wine is an important component of Moldovan traditions, festivities and everyday life, which creates a sustainable platform for the development of enotourism.
- **Governmental and international support:** European Union programs (e.g. CEFTA, EU4Environment), national initiatives for transition to sustainable development, as well as investments from USAID, FAO and GEF are being implemented.
- **Increased consumer awareness:** young Moldovan winemakers are advocating biodynamic and organic farming practices. [8]

However, there are also barriers to sustainability, such as insufficient infrastructure for recycling, a poorly developed certification system and limited access to green finance.

Below are examples of wineries that have integrated the principles of environmental responsibility into their production processes and development models:

- **Castel Mimi:** The winery combines tradition and innovation by using solar and geothermal energy, rainwater collection and filtration system, separate waste collection and recycling, and organizing environmentally responsible events (see VinOpera).
- **Purcari Wineries Group:** The largest exporter of Moldovan wine with a strong focus on environmental sustainability. The company has implemented certified organic and biodynamic farming methods, installed photovoltaic panels, and implemented an underground irrigation system that has reduced water consumption by 25%. In 2023, the company achieved a record waste recycling rate of 65.79%, in collaboration with Ecosmart Union SA.
- **Et Cetera Winery:** A family-owned organic farm located in the southern part of the country. The company has eliminated the use of pesticides, uses natural fermentation methods and develops agritourism, integrating guests into the “wine culture”.
- **Fautor Winery:** The winery focuses on terroir conservation, uses drip irrigation, grows autochthonous grape varieties such as Feteasca Neagra and Rara Neagra, and develops landscape sustainability through the use of cover crops.
- **Casa Vinicola Luca:** The company implements innovative sustainable energy solutions, including the use of solar panels for lighting and heating, rainwater harvesting and reuse, and the conversion of organic waste into biogas used for cooking and lighting.

The general principles of sustainable winemaking implemented in Moldovan wineries include switching to biofertilizers and avoiding herbicides, implementing energy-saving technologies, using packaging with reduced CO₂ emissions and developing tourism with a low carbon footprint.

Case Study: Vinopera: The Role of Cultural Events in Promoting Sustainability

In today's world, cultural events are becoming increasingly important not only as a form of leisure, but also as a platform for transmitting values and shaping social consciousness. Wine festivals, tasting evenings and music and gastronomic events have the potential to become a powerful mechanism for creating environmental awareness and promoting sustainable lifestyles. They combine elements of education, emotional impact and engagement, making them particularly effective in communicating and popularizing the principles of sustainable development.

According to scientific research [1] events contribute to:

- dissemination of knowledge on biodiversity, terroir characteristics and climate risks;
- promotion of environmentally friendly goods and services;
- stimulating local economies by supporting small producers;
- development of eco-tourism and the concept of “slow travel”.

In this way, the events serve not only as an entertainment venue, but also as an educational platform, acting as a “green bridge” between producers and society.

VinOpera is a unique annual event held at the Castel Mimi winery that brings together art, environmental responsibility and wine culture. The event serves as a model example of the successful integration of sustainability principles into a mass festival format.

Key sustainable practices implemented at VinOpera:

Eco-design and cyclicity of materials:

- Guests receive reusable fabric bracelets that are later used to garter the vines, symbolizing the cyclical nature of the processes.
- Using natural decorations and maximizing the use of recycled materials.

Green logistics:

- Organizing the transfer of guests by electric buses and coaches allowed a significant reduction in CO₂ emissions, equivalent to removing 400 cars from the streets of Chisinau for one day.

Localization of production and support for local producers:

- All food and wine presented at the festival is made exclusively from local ingredients, helping to reduce the carbon footprint associated with transportation of products.
- Organization of an artisan market with local farmers, artisans and winemakers to support the local economy.

Social and cultural inclusion:

- Performances by artists from Moldova and Romania, emphasizing cultural commonalities and contributing to the strengthening of interregional dialogue.
- Active use of elements of traditional Moldovan heritage, including national costumes, folklore and music.

Responsible consumption:

- Offering guests tasting portions and providing information on “wine etiquette” to foster a culture of conscious and moderate wine consumption.

Partnerships and Sustainable Management:

- Actively engage environmental non-profit organizations, local governments and international donors in the project, forming a multi-stakeholder ecosystem of sustainable engagement. [9]

The aesthetic design of an event, combined with ethical principles, is a key factor in ensuring the long-term impact of such events. VinOpera is not just a festival, but a model case of event sustainability, demonstrating that it is possible to integrate sustainability principles into large-scale cultural events. Its impact goes far beyond a one-day event:

- Improving the environmental literacy of participants by involving them in the practice of conscious consumption and familiarizing them with concrete examples of sustainable practices.
- Formation of a new image of the Republic of Moldova as a country that successfully combines a rich cultural heritage with a commitment to ecology.
- Formation of sustainable behavioral patterns among visitors. According to the surveys conducted by Castel Mimi, about 40% of visitors started to use reusable accessories in their daily life and to show more interest in environmentally friendly products.

In this way, VinOpera acts as a "sustainability ambassador", effectively integrating sustainability principles into an emotionally rich cultural experience.

5. Conclusions

Based on the analysis of production practices, event formats and cultural dynamics, it is possible to identify key areas that will contribute to increasing the sustainability of Moldova's wine sector and promote the country as a "green" wine destination in Eastern Europe.

Expansion of the organic certification system. Although individual wineries have already obtained or are seeking organic certification, there is a need to develop and implement a national certification incentive program:

- Implementing and supporting EU Organic, ISO 14001 and Demeter standards;
- Creation of an accessible audit and certification mechanism for small and medium producers;
- Development of grant programs and tax incentives to facilitate the transition to sustainable technologies.

Expected results: certification will not only increase consumer confidence in products, but will also open access to premium markets in the European Union and Scandinavia, which will increase export opportunities for Moldovan winemakers.

Development of National Recommendations for Green Events. Currently, Moldova lacks uniform standards for organizing sustainable events. Therefore, it is proposed to develop a National Code of Green and Cultural Events, including the following elements:

- Clear criteria on logistics, catering, waste management, energy consumption and community involvement in event organization;
- Establishing minimum requirements for event partners, including mandatory use of eco-friendly tableware and avoiding the use of plastic products;
- Introduce a system of certification of events by level of environmental responsibility ("Eco-friendly", "Green", "Carbon-aware"). [10]

The role of the Ministry of Culture and National Agency of Tourism is crucial to successfully promote this initiative and ensure its wide acceptance. Staffing is a key factor

in the successful transformation of the industry. In this regard, there is a need to implement comprehensive staff development and training programs:

- Developing and conducting courses on sustainable agro-management, water efficiency and waste management for wine industry employees;
- Creation of specialized programs for wine tourism guides with a focus on developing skills in environmental storytelling and local interpretation;
- Integration of sustainable development topics into the curricula of agrarian higher education institutions and technical schools;
- The creation of an online platform with open access to educational materials will ensure scalability of training and broad stakeholder outreach.

It is proposed to combine wineries, natural sites and cultural centers into integrated eco-routes that comply with the following principles:

- Minimizing carbon footprint (e.g. bicycle tours and use of electric transport);
- Promoting local cuisine and organic products;
- Providing a high level of interactivity for tourists, including organizing workshops, participating in harvesting and specialized tastings.

An example is the development of the “Green Wine Route: from Fautor to Castel Mimi”, passing through scenic woodlands, local farms and wineries, and equipped with QR codes with detailed information for tourists.

Promoting Sustainable Storytelling. The environmental efforts of wineries must not only be realized, but also effectively communicated to consumers. In this regard, it is recommended that:

- Developing an eco-branding strategy and promoting a visual identity that reflects sustainability values (e.g., using specific eco-labels on labels and packaging, creating a specialized section on the company's website).
- Active use of stories and symbols that emphasize the connection between the product and the environment (e.g. the example of VinOpera fabric bracelets, which are subsequently used to girdle vines).
- Engaging influencers and travel bloggers with specialized training in sustainable narratives as brand ambassadors for the country's brand on the international stage.

The transition to sustainable winemaking in the Republic of Moldova is not just a technological modernization of the industry, but a deep cultural transformation that combines environmental, social and economic aspects. Analysis of the practices of leading wineries demonstrates the existence of successful models of ecologically and socially responsible wine production in the country. The VinOpera event format deserves special attention, as it serves as an example of effective integration of sustainable development principles into cultural events and promotes environmental education and involvement of the general public. To ensure a sustainable future for the Moldovan wine industry, it is necessary not only to scale up already implemented initiatives, but also to implement systemic approaches covering a wide range of areas, from certification and specialized training of personnel to the development of sustainable tourism and effective communication of values. In this way, sustainable winemaking becomes an integral part of the national image and contributes to the global sustainable development goals.

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TOURISM CLUSTERS AND THEIR ROLE IN SUSTAINABLE COMMUNITY DEVELOPMENT

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Abstract: *The article examines the role of tourism clusters in the sustainable development of local communities in Ukraine. The features of the functioning of tourist clusters are studied, on the basis of which a general vision of their development is formulated on the basis of a general model of functioning, which includes successive stages of creation of tourist clusters. It is proved that the functioning of tourism clusters as a component of the tourism industry is increasingly dependent on the concept of sustainability, which is the ascendant of society's consciousness and directly affects the environment and cultural values, making sustainability a prerequisite for the long-term development of the tourism sector. The main criteria for assessing the sustainable development of tourism, which should be taken into account when developing a strategy for managing the development of any region of Ukraine with the definition of environmental safety policy, current norms and requirements adapted in accordance with European standards, are determined. It is taken into account that for the effective development of tourism clusters, cooperation between the public and private sectors, as well as the active participation of local communities, is necessary. It is noted that the main types of sustainable tourism that will be developed on the territory of communities will depend on the preserved natural complexes and the state of cultivated natural spaces.*

Keywords: *Tourism clusters, sustainable development, tourism industry, sustainable tourism, local communities, entrepreneurship, development strategies.*

UDC: 338.48:334.72

Classification JEL: L83, Z32, O10.

1. Introduction

The growing importance of tourism and the problems that arise in the course of its functioning require a rethinking of approaches and the search for new ways to develop it. This prompts numerous attempts to adapt the principles of the sustainable development concept to the specifics of the Ukrainian tourism industry, which has enormous potential and can make a constructive contribution to the sustainable development of all regions. With its considerable resource potential, Ukraine has the opportunity to develop the tourism sector of the economy on a sustainable basis with a focus on supporting and developing tourism clusters in communities. The popularization of these types of associations is caused by the war and the deepening crisis in the country's economy, without which it is impossible to promote the concept of sustainable development in the context of post-war community recovery. In the context of post-war recovery, the concept of sustainable development of Ukraine's tourism industry will require fundamental changes, including the restoration of tourism potential and infrastructure in communities, through the formation of a new labor market segment and a new system of state regulation of tourism activities, in accordance with the concept of sustainable growth in the period of post-war reconstruction.

2. Literature Review

A wide range of both domestic and foreign scholars are currently studying the peculiarities and implementation of sustainable tourism priorities in Ukraine. O. Roik explores the directions of sustainable tourism development in Ukraine in the context of post-war recovery, focusing on how the country can develop its tourism industry after difficult periods [1]. V. Poplavska scientific achievements are aimed at determining the role of sustainable tourism development, focusing on its impact on mass tourism and development, as well as ways to preserve natural and cultural resources [2]. The formation of tourism clusters contributes to the creation of regional tourism brands and strengthens well-known geographical concepts, differentiated positioning of clusters in the market to increase attractiveness, marketing, productivity and management of destinations [3]. Juan B. Duarte-Duarte et al. offers a methodology for identifying tourist routes in a particular region using clustering methods. This approach helps to speed up the decision-making process related to the design and creation of routes and maximizes the potential benefits of tourism [4]. However, despite significant achievements in the study of sustainable tourism, the problem of instability and post-war recovery of the tourism sector in the territorial communities of Ukraine on a sustainable basis remains relevant and requires further study and resolution.

3. Methodology

To solve the tasks set out in the article, a comprehensive method was used to determine the conditions for the functioning of tourism clusters and their role in the sustainable development of communities, which, on the one hand, allowed to determine the successive stages of the formation of tourism clusters, and on the other hand, to assess the criteria for sustainable development in the implementation of the concept of sustainable tourism, a systematic approach to take into account the most important indicators for assessing sustainable tourism development, taking into account national priorities and peculiarities of the country's development in the context of interaction with the environment, economy and society; a survey method to determine the percentage of interest of travelers in sustainable and responsible tourism using a conscious approach to travel; a formalization method to determine the main priorities for the development of tourism clusters in the regions of Ukraine in the post-war period in the form of generalized.

4. Results and Discussion

The development of the tourism industry in Ukraine should be viewed from the perspective of introducing innovative development approaches, and therefore it requires the formation of new conditions for economic relations. The cluster approach is considered to be one of the most effective areas of economic development of the tourism sector, which takes into account the study of regional economic policy strategies, including strategic community development, economic structuring and increasing the competitiveness of products and services. The development of clusters as a trend to increase the national and regional competitiveness of communities is one of the components of the modern innovation economy.

All over the world, clusters are a promising type of activity aimed at building national competitive advantages and increasing production efficiency through vertical and horizontal integration of both individual industries and enterprises. By interacting with each other, the members of a tourism cluster receive a comprehensive, internationally competitive tourism product that cannot be obtained from the functioning of each individual element of this system. In the process of cluster development, the effect of synergy is especially evident, allowing to obtain a total effect that is not equal to the sum of the effects of the isolated functioning of each element of this system. For the

development and functioning of the tourism sector on a regional scale, the cluster synergistic effect will be achieved faster due to the close interaction and cooperation of all cluster members [5].

The effectiveness of the tourism business may be associated with the implementation of the idea of the need to coordinate the activities of all enterprises involved in the creation of tourism products and services, establishing partnerships between these enterprises, combining technologically related enterprises, searching for related and supporting enterprises to improve infrastructure, and concluding cooperation agreements [6].

The activities of tourism clusters and their role in the sustainable development of communities should take into account new methods of increasing the attractiveness of tourism products for potential travelers, innovative approaches to improving the performance of tourism and other related businesses, and new ways of managing them.

The special conditions for the functioning of tourism clusters are characterized by the following features, which are designed to ensure them:

- improvement of tourism enterprises' activities through modernization of market infrastructure;
- use of new knowledge and intensification of innovative activities of tourism enterprises in the process of providing tourism services;
- improvement of opportunities for tourism enterprises to enter global markets;
- development of business structures by attracting additional investments;
- increasing the competitiveness of tourism enterprises by increasing their income;
- achieving the expected results of tourism enterprises by improving the quality of their management;
- efficient use of intellectual, technological, financial, labor, material and other types of resources of tourism enterprises;
- improving the quality and accessibility of tourism services for consumers;
- creation of new jobs in the tourism industry;
- concentration of business activities of business entities in the tourism industry as a means of increasing the efficiency of their business activities [7].

Based on the peculiarities of the functioning of tourism clusters, some researchers propose to form a general vision of their development based on a general model of functioning, which should include certain successive stages of tourism cluster formation.

- formation of an initiative group and its goals;
- implementation of marketing research on the needs of the tourism market;
- definition of tasks, goals and objectives of the tourism cluster functioning;
- structural identification of the tourism cluster;
- approval of the cluster's regulatory documents;
- registration of the tourism cluster with the state authorities.

The basis for the functioning of tourism clusters is the state policy aimed at coordinating and professionally managing the work of such types of associations in accordance with the need for its timely, appropriate and effective functioning. In particular, the state policy should ensure social development of the population of the respective territories and science, regulation of the political situation to create conditions for the functioning of clusters, the availability of a favorable economic situation (currency, monetary, customs, tax policy, etc.), as well as proper regulatory and legal support for the activities of clusters in the state [8].

The functioning of tourism clusters as part of the tourism industry is now increasingly dependent on the concept of sustainability, which is the growing awareness of the impact of tourism on the environment and cultural values that make sustainability a prerequisite for the long-term development of the tourism sector. Sustainable tourism, which takes into account environmental and

socio-cultural aspects, is key to the development of tourism in the future. It helps to preserve natural resources and support local communities, which is key to the long-term success of the industry [9].

To monitor the effectiveness of the implementation of the sustainable tourism concept, UNWTO [10] recommends assessing the following factors that have the greatest impact on it, namely seasonality, employment, economic contribution of tourism activities to local budgets, governance, level of satisfaction with the life of the local population, effective management of energy consumption, water resources, wastewater and solid waste. However, each country is a complex ecosystem with its own individual characteristics, which necessitates the development of indicators to assess sustainable tourism development based on national priorities.

The following criteria are used to assess sustainable development [11]:

- the level of actual employment of the population. The higher the level of social and economic well-being, the higher the employment rate;
- the Human Development Index (HDI) includes GDP per capita, educational level, and health status of the population. The HDI serves as an indicator of the social well-being of a society;
- environmental Performance Index (EPI), which includes 32 indicators in 11 categories. First of all, it is about the quality of air and drinking water, climate change and biodiversity.

The development of a strategy for managing the development of any region of Ukraine should be based on an environmental safety policy, the current norms and requirements of which should be adapted in accordance with European standards. In this regard, it is necessary to analyze the positive experience gained by the international community in the field of theoretical, methodological, and practical principles of rationalizing the use of natural and resource potential of tourism in the regions; to explore ways to optimize the functioning of the ecological and economic system to preserve the quality of the environment in communities [12].

In 2023, Booking.com surveyed 33,228 respondents from 35 countries and territories. This study was the largest to date and showed that interest in sustainable tourism remains high among travelers around the world. Three quarters (74%) of travelers believe that we need to start taking a more conscious approach to traveling immediately to preserve the planet for future generations. Moreover, 74% of respondents would also like to see travel companies offer more responsible travel options (up from 66% in 2022) [13].

Nowadays, there are many different models of sustainable tourism development, but they do not fully reflect the factors and indicators that ensure the sustainability of tourism. Increasing the effectiveness of community development in Ukraine is possible through the creation and operation of regional tourism clusters, which will contribute to their regional development and improve their competitive advantages. The development and attractiveness of the community's tourism sector depend on its resource potential, in particular the specifics of the tourism service, which is manifested in the significant role of a person in the process of its provision (Figure 1).

When considering the regions of Ukraine in the post-war period, the model of sustainable tourism should emphasize the following points already at the stage of weak sustainability [14]:

- calculation of the optimal recreational load on different types of natural complexes;
- determination of the stage of degradation of natural complexes and development of measures to restore natural complexes;
- reclamation of waste dumps and renovation of industrial spaces to create cultivated recreational and tourist areas on them, taking into account innovative trends;
- use of environmental technologies in industry, agriculture, and construction;

- creation of an ecological and recreational framework, as well as a change in the ratio of industrial, rural and recreational (1:2:3) territories towards an increase in the share of the latter (1:2:5);
- restoring the population's health and increasing its life expectancy.

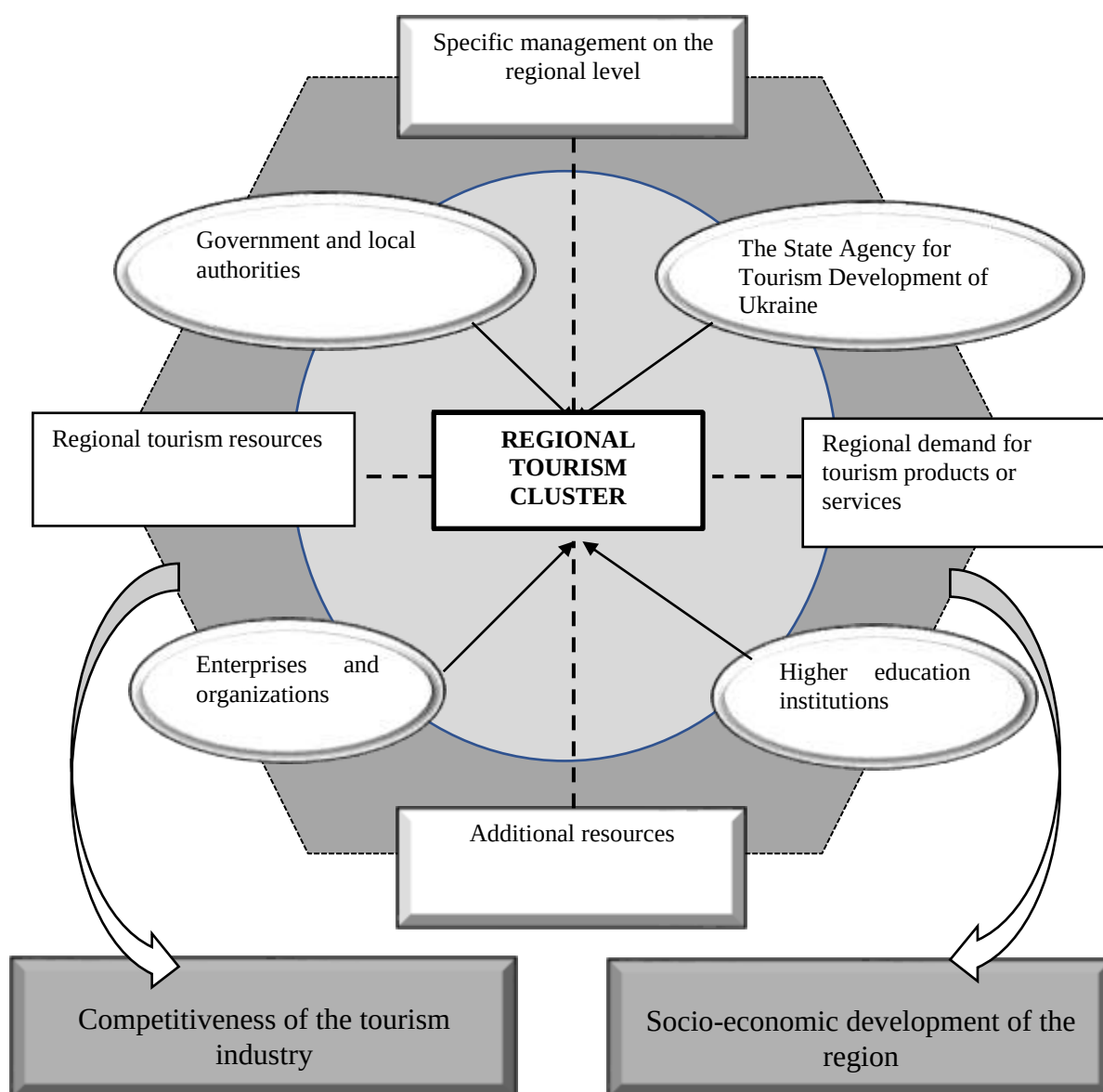


Figure 1. Scheme of regional tourism cluster development in Ukraine

Source: developed by authors

It is also necessary to determine what types of sustainable tourism should be developed in the territory of communities, depending on the preservation of natural complexes and the state of cultivated natural spaces.

5. Conclusions

The key role of tourism clusters in the sustainable development of communities is to stimulate entrepreneurial activity in the tourism sector, promote the creation of new jobs, increase

local incomes and revenues, and improve the quality of tourism products. The functioning of tourism clusters also contributes to the wider introduction of innovative and information and communication technologies, as well as to improving the skills and intellectual potential of tourism industry employees. Thus, the development of tourism clusters is an important factor for the economic and social development of communities.

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TRANSFORMING THE FASHION INDUSTRY: INTERSECTIONS OF MARKET DYNAMICS, SUSTAINABILITY, AND EMERGING TECHNOLOGIES

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Abstract: *The fashion industry has undergone a profound transformation over the past two centuries, evolving from aristocratic guild-dominated craftsmanship to a globalized market driven by innovation, marketing, and sustainability. From the establishment of Haute Couture in the mid-19th century to the dominance of global fashion conglomerates, the industry has reflected shifts in consumer demand, market dynamics, and branding strategies. This study examines the evolution of the fashion sector, with a focus on the financial performance of major global brands from the luxury, premium, and fast fashion segments. The data reveal significant shifts in market dynamics, highlighting the increasing dominance of luxury fashion houses. While fast fashion brands previously thrived on affordability and accessibility, their reliance on overproduction and lower-quality materials has raised concerns about sustainability. Beyond financial trends, this study explores the role of emerging technologies in sustainability-driven business strategies. The adoption of artificial intelligence (AI), blockchain, and 3D printing is reshaping the fashion industry by enhancing transparency, improving the traceability of the supply chain, and reducing material waste. As sustainability becomes imperative for both environmental and economic reasons, these innovations offer pathways for fashion brands to align with global initiatives such as the UN 2030 Agenda and the EU Green Deal. By integrating historical analysis with insights into financial shifts and technological advancements, this research highlights how the fashion industry must adapt to remain competitive while embracing sustainability.*

Keywords: Fashion evolution, sustainable fashion, technology in fashion, sustainable technologies.

UDC: 391:001.895

Classification JEL: M31

1. Introduction

The years 1850-1890 represent the period in which modern fashion emerged, defined by the development of the “fashion designer” as a profession and the haute couture system (1). Haute couture is “at the heart of the fashion ecosystem” (2), and Charles Frederick Worth is called the “father of haute couture,” often regarded as the first to put his name on a label, establishing himself as an “arbiter of taste and style” (3). Since 19th-century technology allowed the creation of ready-to-wear pieces at affordable prices so that the French middle class could afford them, members of high society began seeking new ways to differentiate themselves, changing their clothing style more frequently. Thus, Haute Couture was born, with high craftsmanship and original design stimulating the progress of the luxury fashion industry (4). The Englishman Charles Frederick Worth arrived in Paris in the mid-19th century and, demonstrating mastery, began creating exceptional garments for the elite of Parisian society, including Eugénie, Empress of France, and Elisabeth, Empress of Austria (1). Thus, Haute Couture transformed France into the center of modern Western fashion until the mid-20th century. From the 1900s to the 1940s, designers in this sector experimented with structure, silhouette, materials, and

techniques used (4). Before the emergence of couture fashion, the fashion segment was dominated by numerous strict laws and craft guilds with basic skills, and fashion was primarily the domain of aristocrats, who determined styles and purchased couture “made-to-measure” clothing from salons (5). Charles Frederick Worth succeeded in transferring this industry from guilds to couturier status, highlighting the idea that a couturier is an artist and that the only difference between his creations and art is defined solely by technique (5). Indeed, through imagination and talent, the couturier sets the tone in fashion, offering those who wear his creations, images characterized by refinement and splendor.

Designers of the early 20th century, such as Paul Poiret, Coco Chanel, Cristóbal Balenciaga, Madame Grès, Madeleine Vionnet, and Mariano Fortuny, were pioneers of innovative directions in fashion development, driven by creativity, research, and development (4). A new chapter in fashion began at the end of the 1910s, dominated by simplicity, which was much more suited to post-war society (1). Thus, Jean Patou focused on creations that included shorter skirts and developed sporty styles, while the graphic-accented illustrations of George Lepape, the bold designs of Wimmer-Wisgrill, and the relaxed designs of Coco Chanel outline the existence of a new sensibility (1).

2. Marketing Instruments Used to Improve Fashion Presence Between 1850-1950

Since the 1850s, fashion trends and styles of the time were presented through publications, with French ones influencing the entire fashion world. French fashion journals such as *La Mode Illustrée*, *L'Art et la Mode*, *Le Moniteur de la Mode*, and *La Mode Pratique* showcased images of new clothing styles, accessories, and hairstyles, thereby setting beauty standards (1). These publications appeared periodically, with some still existing today, such as *Harper's Bazaar* in America, an important fashion magazine. Additionally, in 1900, the Exposition Universelle in Paris displayed pieces reflecting the Belle Époque period, with French designer Jeanne Paquin designing the “clothes” for the *La Parisienne* sculpture placed at the main entrance-another marketing technique used. Paquin was among the first fashion houses to renew this segment by introducing more modest designs, reducing excessive amounts of fabric and ornamentation, and liberating women from the constraints of the corset (6). Paquin also drew inspiration from the Empire style, which was responsible for modernizing women's clothing after the French Revolution. Thus, in 1907, when she launched the “*Empire*” dress, Jeanne Paquin published a two-page advertisement in *Les Modes* magazine, featuring a painting by Henri Gervex depicting an afternoon in the House of Paquin's salon (6). Another communication and marketing tool used since the early 20th century has been fashion shows. Authors Cole and Deihl (1) highlight that designers such as Paquin, Paul Poiret, and Lady Duff Gordon (Lucile) staged dramatic fashion presentations. From the early 20th century to the present, a series of fashion designers have revolutionized this industry, shaping it as we see it today. Among the pioneers of that era, names such as Lanvin, Chanel, Schiaparelli, Dior, Balmain, Hermès, Yves Saint Laurent, Balenciaga, and Givenchy remain key pillars of the fashion world, as they are the most renowned and significant fashion houses globally, a fact reflected in the frequency of purchases by customers worldwide.

In the mid-20th century, another fashion promotion tool emerged - television. By 1950, over a million households in the United States owned televisions (1). This represented an important tool for promoting consumer goods, and together with the print

media, it transmitted marketing messages to women, who played a crucial role in purchasing decisions.

In the book *Fashion Theory* edited by Malcolm Barnard, Adam Geczy and Vicki Karaminas (5) state that fashion emerged with modernity, manifesting as an expression of capitalism's desire for change, as the key link between modernity and time, and as an intertwining with representation - an aspect that is increasingly present today with the rise of digital fashion. While early marketing tools like fashion journals and couture salons set the groundwork for fashion's cultural power, today's industry is increasingly shaped by data, technology, and evolving consumer expectations. These shifts are especially visible in the financial performance and market positioning of fashion brands across different segments.

Having provided the historical evolution and early strategic approaches shaping modern fashion, the following section briefly outlines the methodological framework adopted for analyzing current market dynamics and technological developments.

3. Research Method

This study employs a narrative literature review methodology, synthesizing secondary data from scholarly literature and authoritative industry reports to analyze contemporary market dynamics and technological innovations influencing sustainability in fashion. Following the foundational historical context provided earlier, the article analyzes current market trends within luxury and premium fashion segments using industry reports (McKinsey & Company, Bain & Company, Brand Finance). Subsequently, it evaluates emerging technologies - blockchain, artificial intelligence, and 3D printing, highlighting their role in advancing industry sustainability and operational efficiency.

This narrative literature review thus synthesizes insights across historical, economic, and technological domains, providing a coherent analytical perspective on the contemporary challenges and opportunities facing the global fashion industry regarding sustainability and innovation.

4. Financial Performance and Market Shifts in Fashion

As established by the methodological framework, this section begins the detailed analysis by exploring contemporary market dynamics within the fashion industry. Even though there are several brands with historical significance, defined by know-how and cultural identity, financial indicators remain an extremely important dimension that determines the survival capacity of these companies. Therefore, it is necessary to analyze the most profitable brands in the fashion industry. Financial data provided by Brand Finance outlines the ranking of apparel companies with the highest brand value. Thus, as of 2023 (7), the first position is held by Nike, with a brand value of \$31,307 million, followed by Louis Vuitton with \$26,290 million, and Chanel in third place with \$19,386 million. Compared to 2017 (8), the first place was held by the same company with \$31,762 million, followed by two fast-fashion companies: H&M with \$19,177 million and Zara with \$14,399 million. In 2017, Louis Vuitton ranked sixth, after being in third place in 2016, emphasizing the fact that consumers were placing greater importance on fast-fashion brands (H&M, Zara, Uniqlo) as they were widely available at affordable prices. Although Nike remains in first place, its brand value decreased by -6% in 2023 compared to 2022, while Zara recorded a -15% decline, reaching \$11,049 million. H&M and Uniqlo, which were in the top rankings in 2017, dropped to positions 11 and 12, respectively, in 2023, while Zara fell from third place in 2017 to ninth in 2023. Positive fluctuations in brand

value were recorded by luxury brands: Dior +46%, Chanel +27%, Rolex +28%, Louis Vuitton +12%, Hermès +5%, and Cartier +1%. This trend is due to the increasing purchasing power of consumers in Asia. A report by BDA Partners (9) indicates that since 2020, the luxury goods segment in Asian countries has grown steadily, with China accounting for the largest share of sales. The main factors driving the increased appetite for luxury products include China's economic growth, the millennial generation segment, and shifting consumer preferences. The previously mentioned report (9) also highlights that the target segment consists of millennials, whose interest in luxury products has grown considerably. They consume high-end streetwear items and are willing to spend increasing amounts on products from brands that align with their values, paying attention to aspects such as sustainability and social responsibility. Another key factor contributing to the growth of the luxury fashion segment is the rising popularity of the K-Pop industry. As a result of this trend, luxury brands have started collaborating with Asian celebrities, particularly K-Pop idols, who are predominantly followed by Generation Z. This strategy has brought luxury goods closer to this demographic, boosting sales.

According to Statista (10), the luxury fashion market in Asia is expected to grow at a CAGR of 4.18% between 2024 and 2028. Bain & Company (11) estimates that by 2030, in the global personal luxury goods market, customers from different regions will account for the following shares: China will represent 30-40%, while America and Europe together will hold 40%. The large share of Chinese consumers in luxury goods is primarily due to economic indicators that exhibit a positive growth trend and an increasing appetite for luxury. A ranking reflecting luxury goods consumption projections until 2028 by Statista (10) estimates that the United States will rank first, with a total consumption of \$83,312.79 million, followed by China with \$65,415.67 million, and Japan with \$38,806.58 million. France follows with \$21,759.45 million, and Germany with \$18,509.65 million. Asian markets, especially China and Japan, show the highest projected growth rates through 2028, reinforcing the global pivot toward luxury. Compared to Western consumers, Chinese consumers are relatively new entrants to the luxury fashion segment, which is one of the factors contributing to the rapid growth of this segment in the Asian retail market. Additionally, online commerce, the high availability of fashion items, social media, and influencer marketing are other factors driving luxury goods consumption in these relatively new markets. Fashion, as both art and a symbol of the West, remains a significant determinant of consumer desire.

Bain & Company (11) states that in the coming years, online and monobrand channels will account for two-thirds of the entire luxury goods market by 2030. Consequently, companies will need to provide customers with unique and differentiated experiences throughout the purchasing process, with sustainability and technology also being essential focal points.

According to Brand Finance's "Global 500 2024" ranking (12), which assesses the most valuable and powerful brands worldwide across all industries, Louis Vuitton ranked 52nd globally in 2024 with a brand value of \$32.235 million, up from 70th in 2023. In contrast, Nike, which previously held the top spot in the apparel category, ranked 62nd in 2024 with a brand value of \$29.873 million, down from 54th in the previous year. Chanel also saw significant growth, moving from 98th in 2023 to 73rd in 2024, with a brand value of \$26.028 million, recording a growth of +34.47%. Another brand from the LVMH portfolio, Dior, has also seen an increase in value, rising from 147th place in 2023 to 136th place in 2024. A spectacular increase also recorded the fast-fashion brand Zara, which

jumped from 181st place in 2023 to 120th place in 2024. Looking ahead, Brand Finance's 2025 projections (13) highlight the continued rise of luxury fashion brands. Chanel is projected to climb further to 46th place, with its brand value growing to \$37.913 million, while Louis Vuitton and Nike are estimated to fall slightly to 55th place in case of the first brand (brand value \$32.917 million) and the 66th place for the second one (brand value of \$29.428 million).

These shifts underscore the growing dominance of luxury fashion brands in the global market and reflect changing consumer preferences toward quality, exclusivity, and brand values such as sustainability and ethical practices. The position occupied by each fashion company in the coming years will be determined by several factors, one of the most significant being sustainability. The increasing demand for conscious production and consumption aligned with sustainable development principles, as well as shifting consumption trends, will dictate the direction each manufacturer must take. Companies that fail to adapt may risk being pushed out of the market. Although in recent years, many companies have initiated sustainability efforts - from responsible sourcing of raw materials and design to improvements in sales and distribution processes - challenges persist, particularly for fast-fashion companies. These brands often lack full transparency and continue to rely on overproduction models, which are fundamentally misaligned with sustainable development goals. Despite its own environmental footprint, the luxury fashion sector is often perceived as more sustainable by comparison. While luxury brands are not without issues - such as labor practices or resource intensity - their use of higher-quality materials and production of fewer collections annually can contribute to a lower overall environmental impact. For instance, according to Britannica (14), certain fast fashion brands release up to 36 collections per year, while luxury houses typically launch only four: spring/summer, autumn/winter, resort/cruise, and pre-fall (15).

Economic data further illustrates the resilience of the luxury segment. According to The State of Fashion 2024 report (16), the luxury fashion segment had the highest economic growth in 2022, increasing by +36% in a single year from 2021. In an unstable economic context, with rising inflation rates and various emerging challenges, the luxury segment managed to grow its economic profit due to its ability to set higher prices without reducing demand. The same report (16) shows that among the five analyzed fashion segments - luxury, affordable luxury, premium, mid-market, and discount - only luxury and affordable luxury recorded positive performance, with affordable luxury growing by +10%, while the others experienced declines: -20% for premium and discount, and -34% for mid-market (including Inditex), or -64% if Inditex is excluded. While affordable luxury saw growth, the economic profit (EP) index recorded the same average value as in 2010-2018. However, the luxury segment had an average EP four times higher than the same indicator recorded in 2010-2018, reaching 90 in 2022.

In this volatile economic and social landscape, sustainability has become not only a moral imperative but a strategic necessity. The European Parliament (17) reports that the textile sector was the third-largest contributor to water pollution and land degradation in Europe, in 2020. It is responsible for approximately 20% of global clean water pollution, primarily due to dyeing and finishing processes. Moreover, textile consumption in the EU generated an average of 270 kg of CO₂ emissions per person in 2020, totaling 121 million tonnes. To address these challenges, global frameworks such as the UN 2030 Agenda for Sustainable Development (18) and the European Green Deal (19) advocate for a systemic transformation of the economy. These initiatives aim to balance the social, economic, and

environmental dimensions of development. The European Green Deal, in particular, envisions a resource-efficient, zero-emission economy by 2050, with economic growth decoupled from resource use and inclusive of all communities and regions. For fashion companies, this means shifting from a linear model of production and consumption to a circular, sustainability-driven business model - redefining growth as a continuous, responsible journey rather than a resource-intensive race.

5. Emerging Technologies and Their Role for a Greener Future

To support the shift from linear to circular business models, fashion companies are increasingly turning to emerging technologies such as blockchain, artificial intelligence (AI), and 3D printing. Among these, blockchain holds particular promise in addressing long-standing challenges related to transparency and traceability across global fashion supply chains.

5.1. Blockchain: Enhancing Transparency and Traceability

Blockchain is a large distributed digital database (ledger) that stores records of transactions and consists of a growing list of data structures and records, named 'blocks', which are linked and secured cryptographically (20). In the fashion industry, its core function is to provide an immutable, transparent record of every stage in a product's lifecycle - from the sourcing of raw materials to retail distribution. Transparency and traceability are key factors when it comes to sustainable fashion, and they can be both guaranteed by the blockchain technology. According to an online article named Europe's Future in Blockchain Technology (21), the benefits of blockchain include enhanced data security, real time traceability, greater transparency, operational efficiency and process automation.

These capabilities are particularly relevant in a sector where lack of supply chain transparency remains a persistent issue. As Fashion Revolution (22) reported, in 2022, 50% of major global fashion brands disclosed little or no information about their supply chains. Although this figure improved slightly in 2023 - with 52% of companies publishing first-tier supplier lists - deeper layers of the supply chain remain largely opaque (23). Blockchain offers a promising solution to these ongoing issues, enabling the traceability of raw materials, verification of product authenticity, and monitoring of labor conditions. The fashion industry is also vulnerable to unauthorized manufacturing practices (24). Blockchain technology can help reduce the risk of counterfeits, protect brand integrity, and prevent the circulation of potentially unsafe products. In this context, blockchain acts as a security layer that protects product authenticity and facilitates quality assurance. Blockchain offers a structural solution to these gaps by recording and verifying every transaction and stakeholder involved, thereby reducing the risk of counterfeiting, unethical labor practices, and material fraud (24). Furthermore, blockchain enhances product provenance and custody chain allowing stakeholders to access accurate information about a garment's origin, production flow and the related social and environmental conditions (25). This capability supports global sustainability efforts such as the United Nations Sustainable Development Goals (SDGs), particularly those related to responsible production, climate action, and labor rights. It also helps address critical vulnerabilities, such as unauthorized subcontracting - a widespread practice that increases the risk of labor exploitation (26). By digitizing and verifying each point in the supply chain, the blockchain helps mitigate this risk. It creates digital records that track every step of the supply chain, including the suppliers and contractors, enabling all are able to monitor

supplier credentials and enforce compliance, supporting fair working conditions and transparency at every level.

In doing so, blockchain aligns with the triple bottom line framework, having a positive impact on all of the three components: environmental - minimizes material waste through traceable, responsible sourcing; social - ensures ethical labor practices, fair wages, and safe working environments; economic - improves product quality and trust, reducing loss from counterfeits and increasing long-term profitability.

Despite its advantages, blockchain implementation is not without challenges (25):

Technological barriers:

- Scalability and Speed - blockchain systems are limited in transaction throughput, which can slow down large-scale operations in the fashion supply chain;
- Security Risks and Platform Selection – even though blockchain platforms such as Ethereum are widely used, they can still carry security vulnerabilities such as previous hack incidents or platform forks, which can undermine trust;
- Interoperability and Platform Suitability - the existence of numerous blockchain types (public vs private, proof-of-work vs proof-of-stake) complicates integrations, because not all are suitable for all business models;
- Data Immutability - although seen as a benefit, it can be problematic in dynamic industries like fashion, where production characteristics may evolve;
- User Acceptance – the effectiveness of this technology in fashion depends on the consumer understanding and acceptance and currently, the awareness is limited and will take time to develop, which can delay the adoption of blockchain.

Organizational barriers:

- Lack of Internal Knowledge and Skills - many fashion companies lack the technical expertise to understand and manage blockchain systems;
- Limited Middle-Management Engagement – in some cases, blockchain initiatives are driven more by the upper management and the lack of involvement of the operational teams can negatively influence the implementations and scalability of this technology;
- Absence of Universal Standards - the industry lacks standardized blockchain protocols for traceability, making implementations inconsistent.

Environmental Challenges:

- Internal Environmental factors - companies need to have powerful sustainable practices set up before adopting blockchain. Without this pre-existing commitment to transparency and sustainability, blockchain cannot fulfill its purpose of traceability and trust-building.
- External Environmental Factors: government regulations - legal and regulatory environment for blockchain is still emerging and uncertain in many regions, making it hard for companies to implement it easily; lack of government incentives - the absence or reduced financial incentives which support blockchain adoption lead to a lower motivation to experiment with this technology; market uncertainty - consumers still prioritize price and design over sustainability and traceability and as a result, market demand for blockchain verified products is reduced.

While blockchain is not a stand-alone solution for sustainability, it can serve as a powerful tool that can improve transparency and verification when included within a

broader system of responsible business practices. Its success, however, depends on overcoming these technological, organizational, and environmental hurdles through strategic investment, cross-sector collaboration, and consumer education.

While blockchain provides the infrastructure for transparent and accountable supply chains, it is only one part of the technological toolkit required to transform fashion into a sustainable industry. The integration of additional technologies such as artificial intelligence (AI) allows for further optimization, enabling companies to enhance efficiency, predict demand more accurately, and make environmentally informed decisions throughout the product lifecycle. As the fashion industry struggles with overproduction, resource waste, and shifting consumer preferences, AI offers the potential to address these challenges through data-driven solutions that support both environmental and economic sustainability.

5.2. Artificial Intelligence: Driving Efficiency and Innovation

On the other hand, artificial intelligence (AI) represents a critical technological tool that, when strategically applied, can support fashion companies in adopting more sustainable business models. AI is an important factor which enables sustainability within the fashion sector, offering a transformative capability across production, supply chain, retail and consumption. AI supports the Sustainable Development Goals (SDGs) by optimizing resource use, reducing waste and improving decision-making throughout the product lifecycle – from the raw materials sourcing to final consumer interaction (27). One of AI's most significant contributions is in supply chain optimization. It can be used in garment classification, as well in identifying fabric defects and selecting appropriate materials, all of which help reduce waste and long-term production costs. Techniques such as machine learning (ML), conventional neural networks (CNNs) and Artificial Neural Networks (ANNs) are used to predict demand, detect fabric flaws and automate sorting tasks and monitor waste flow, reducing waste and energy usage. For example, H&M uses AI-based forecasting tools to predict trends and avoid overproduction, thereby preventing garments from ending up in landfills (28).

Additionally, AI facilitates eco-conscious design by enabling data-informed decisions related to fabrics, fit, and functionality. Tools such as 3D scanning and AI-powered morphotype mannequins help optimize sizing, reduce product returns, and improve resource efficiency during manufacturing (27). AI also enhances sustainability by promoting consumer engagement and transparency. Platforms like Farfetch utilize AI to provide users with detailed information on the environmental footprint of garments, empowering shoppers to make more ethical and informed purchasing decisions (28). Through predictive analytics and demand forecasting, AI helps reduce overproduction - one of fashion's most pressing environmental issues. By forecasting customer preferences, purchase patterns and market trends, brands can align supply chain with actual demand, thus lowering overstock and minimizing textile waste (27)(28).

Overall, AI technology contributes positively across all three dimensions of sustainability: environmental - through waste reduction, optimized resource use, and minimized carbon emissions; economic - by lowering operational costs through automation and process efficiencies; social - by improving working conditions, reducing errors, and increasing transparency in labor practices. Despite its potential, the integration of AI into fashion operations presents several challenges. The AI systems require vast amounts of high-quality, annotated data to function effectively. However, in the fashion domain, such data is not only limited in availability but also expensive to produce, often requiring skilled

human annotators. This lack of well-structured datasets restricts the efficacy of AI applications in areas such as design automation, personalized marketing, and product recommendation (29). Also, AI may involve high costs and the need for organizational change and consumer education.

In conclusion, AI plays a crucial role in advancing sustainability across the fashion value chain by enabling data-driven decision-making, minimizing resource use, optimizing production, and empowering conscious consumption. While promising, its full potential will be realized through targeted investment, industry collaboration, and a commitment to integrating AI with ethical, environmental, and social sustainability goals.

While AI enhances decision-making, demand forecasting, and supply chain efficiency, another transformative technology is 3D printing, which is redefining the physical creation of fashion products. Unlike AI, which optimizes processes, 3D printing transforms the production methods themselves. It enables material efficiency, design customization, and local manufacturing - core principles of sustainable fashion. As the industry moves toward circularity and reduced environmental impact, 3D printing presents promising opportunities to reshape not only what we wear, but how and where it is made.

5.3. 3D Printing: Sustainable Innovation in Fashion Manufacturing

3D printing is a transformative technology with significant potential to advance sustainability in fashion manufacturing. It is a process by which objects are created layer by layer from a digital model, often developed in computer-aided design (CAD) software (30). Within the fashion sector, this technology facilitates the creation of complex, highly customizable designs while enabling more material-efficient production methods (31). 3D printing offers several sustainability benefits for fashion manufacturing:

- a. Reduced material waste - Unlike traditional cutting and sewing methods, 3D printing uses only the required amount of material, thereby significantly minimizing waste (31);
- b. Support for localized and on-demand production - this technology supports localized, on-demand production, helping brands avoid overproduction and lowers the environmental cost of global supply chains;
- c. Lower carbon footprint and energy usage - due to its localized nature, 3D printing reduces emissions associated with transport and warehousing. Additionally, because 3D printing requires fewer production processes, it uses less energy (31);
- d. Use of biodegradable and recyclable materials - Bio-based filaments such as PLA and lignin, derived from renewable resources, can be used in the fashion industry. These materials often biodegradable, promote eco-conscious innovation (32)(30). Biopolymers such as PLA, PHA, and PBS offer sustainable alternatives to conventional petroleum-based plastics, with good biodegradability and lower carbon footprints (33);
- e. Extended lifecycle product - the ability to produce, replace and fix broken or missing parts of the products enhances repairability. Moreover, the capacity to customize garments according to individual preferences supports longevity of the garments due to a perfect fit and emotional satisfaction (32).

Despite these advantages, the integration of 3D printing into mainstream fashion manufacturing faces several challenges. Material rigidity and limited flexibility can affect garment comfort and wearability (32). There are also usability barriers linked to complex software tools and steep learning curves, which may slow down adoption among non-

specialist users. Furthermore, current 3D printing technologies struggle to match the speed and scalability of the traditional mass production methods (31). Initial implementation costs are relatively high and companies must invest in training workforce with the technical skills required for effective use of this technology.

In conclusion, while 3D printing offers meaningful opportunities for enhancing sustainability in the fashion industry - particularly through waste reduction, localized production, and material innovation - its long-term success will depend on overcoming technical, operational, and infrastructural challenges.

6. Conclusions

The fashion industry has undergone a significant evolution, shifting from guild-based craftsmanship and elite couture to a globalized system driven by branding, marketing, and mass production. This transformation, while generating economic growth and creative expression, has also created complex challenges related to overproduction, environmental degradation, and ethical labor concerns. Fast fashion's rise, marked by affordability and rapid turnover, has intensified these issues, while luxury brands are increasingly positioned as potential leaders in sustainable innovation due to their ability to invest in quality, longevity and consumer trust.

The fashion industry is widely recognized among the most polluting and resource-intensive sectors globally. It contributes to environmental degradation through excessive water consumption, greenhouse gas emissions, and textile waste, and continues to face persistent issues related to labor exploitation and production ethics. These challenges are particularly evident in fast fashion, which is built on high-volume production, short product life cycles, and low-cost materials. In this context, sustainability emerges not as an option, but as an urgent necessity - one that requires structural change across the entire value chain. Financial data show an evolving landscape in which luxury brands have gained market strength, indicating a shift in consumer expectations toward higher quality and more durable products. However, solving the industry's issues takes more than a change in how brands position themselves. The adoption of emerging technologies offers specific tools to support this transformation. Blockchain enables traceability and ethical oversight across complex supply chains. Artificial intelligence helps reduce waste and improve efficiency through data-driven planning. Meanwhile, 3D printing presents new opportunities for zero-waste production and material innovation. To ensure long-term resilience, fashion companies must integrate these technologies within a broader commitment to circularity, transparency, and responsible growth. Only through this kind of systemic adaptation can the industry move toward a future that is economically viable, socially just, and environmentally sustainable.

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THE CORRELATION BETWEEN INVESTMENTS IN HUMAN CAPITAL AND ECONOMIC PROGRESS

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Abstract. This study examines the relationship between investments in human capital and economic development, focusing on the evolution of countries such as Singapore, Japan, and Finland from 1990 to 2023. Using statistical data and academic sources, the research highlights the impact of investments in education and healthcare on economic growth and global competitiveness. The study demonstrates that effective resource allocation in these areas has led to increased labor productivity, innovation, and economic stability. Singapore has distinguished itself with a high-quality education system and a well-trained workforce, transforming into a technological and financial hub. Japan has invested in research and development, supporting technological advancements and maintaining a high level of human capital. Finland, through an innovation-driven and equitable education system, has achieved remarkable economic performance. The study emphasizes the importance of a consistent investment policy in human capital to sustain long-term economic growth. The recommendations highlight the necessity of an integrated strategy that includes education, healthcare, and research reforms to maximize their impact on economic performance.

Keywords: Human capital, investments, economic growth, education, healthcare, sustainable development, innovation, productivity, global competitiveness, public policies.

UDC: 330.354:[330.322:37]

Classification JEL: O15.

1. Introduction

Human capital, representing the accumulation of knowledge, skills, and population health, is a key factor for sustainable economic development. Investments in education and healthcare not only improve citizens' quality of life but also contribute to increased productivity and economic competitiveness. Countries such as Singapore, Japan, and Finland have demonstrated that the strategic allocation of resources in these areas can lead to significant economic transformations [1, 9].

Singapore has undergone a remarkable economic transformation in recent decades, becoming a leading technological and financial hub. One of the pillars of this transformation has been the strong emphasis on education. The government implemented policies aimed at developing an education system focused on excellence and adaptability to global market demands. According to a World Bank report, investments in education were essential to Singapore's rapid development. In addition, the country's efficient healthcare system ensured a healthy population capable of actively contributing to the national economy.

Japan has also demonstrated the importance of human capital in its post-war economic development. Massive investments in education and healthcare were fundamental to the country's reconstruction and rapid economic growth. The Japanese educational system places a strong emphasis on discipline, innovation, and academic excellence, resulting in a highly skilled workforce. According to an OECD study, Japan ranks among the countries with the highest adult competency levels. Moreover, a universal and accessible healthcare system has contributed to a high life expectancy and consistent productivity [3, 10].

Finland is frequently cited as a success story in education. Reforms implemented in the 1990s transformed Finnish education by emphasizing equality, innovation, and the development of individual skills. This model led to outstanding results in international assessments and has been linked to a knowledge- and innovation-based economy. A report by the Finnish National Board of Education highlights that investments in education were essential for the country's economic development. Additionally, a strong healthcare system has ensured a healthy population, able to actively participate in the labor market.

Analyzing the period from 1990 to 2023, it is evident that these countries have maintained a consistent commitment to investing in human capital. These investments have been correlated with GDP growth, improved public health indicators, and higher living standards. For instance, Singapore recorded an average annual GDP growth of approximately 5.5% during this period, while Japan and Finland experienced more moderate but steady growth rates of 1–2% annually [4].

The specialized literature supports the idea that investments in education and healthcare are fundamental to economic development. Becker (1993) argues that education increases individual productivity, leading to higher incomes and, consequently, economic growth. Furthermore, Bloom and Canning (2000) highlight that improving population health has a direct impact on productivity and economic growth [2, 3].

Furthermore, recent research by Hanushek and Woessmann (2015) underscores that not only the quantity of education matters, but also its quality, particularly in terms of cognitive skills, which significantly correlate with long-term economic growth across nations [8].

The experience of countries such as Singapore, Japan, and Finland demonstrates that strategic investments in human capital, through education and healthcare, are essential for sustainable economic development. These investments not only improve citizens' quality of life but also create the foundation for a robust and competitive long-term economy.

2. Literature Review

The relationship between human capital development and sustainable economic growth has been extensively analyzed in economic literature. Foundational works such as those by Becker (1993) emphasize that education enhances individual productivity, which in turn leads to higher income levels and economic advancement. Bloom and Canning (2000) further reinforce this perspective by demonstrating a direct correlation between improvements in population health and increased national productivity.

Empirical studies have consistently highlighted the role of strategic investments in education and healthcare in achieving long-term economic success. The World Bank (2018) reports that Singapore's rapid economic transformation was significantly influenced by a policy-driven commitment to educational excellence and an efficient healthcare system. Similarly, the OECD (2019) notes that Japan's post-war economic recovery and sustained growth were underpinned by a disciplined and innovative education system, coupled with universal healthcare access [7].

The Finnish model offers another important perspective, as reforms in the 1990s emphasized equality and personalized skill development, contributing to high performance in international educational assessments and fostering a robust knowledge-based economy (Finnish National Board of Education, 2016). These country-specific studies underscore a common trend: strategic investments in human capital yield measurable improvements in GDP, public health, and living standards over extended periods.

Despite these insights, gaps remain in the literature regarding the longitudinal comparison of policy implementation and its differentiated impact across various socioeconomic contexts. Furthermore, few comparative analyses integrate both educational

and health metrics over a span exceeding three decades, such as the 1990–2023 period referenced in this study [8].

This paper positions itself within this academic discourse by examining how sustained investments in education and healthcare in Singapore, Japan, and Finland have contributed to economic resilience and competitiveness. By synthesizing data from international organizations such as the World Bank, OECD, IMF, and national education boards, the current study contributes to a deeper understanding of human capital as a catalyst for economic sustainability [9].

3. Methodology

This study adopts a mixed-methods research design, combining quantitative data analysis with comparative and literature-based approaches to investigate the relationship between human capital investments and economic development in Singapore, Japan, and Finland during the period 1990–2023.

1. Data Collection Procedures. Data were gathered from reputable international databases, including the World Bank, OECD, IMF, and national statistical offices. The collected data encompassed government expenditures on education and healthcare, gross domestic product (GDP), labor productivity, and other relevant socio-economic indicators. In parallel, academic publications and policy reports were reviewed to provide context and theoretical grounding.

A. Analytical Techniques. The research employs the following analytical methods: A. Quantitative Analysis. A descriptive statistical analysis was performed to evaluate the level of investments in education and healthcare. Correlation and regression techniques were applied to identify relationships between these investments and economic indicators, such as GDP growth and labor productivity.

B. Comparative Analysis. A cross-country comparison of the three selected cases was conducted to assess how strategic investment policies influenced economic outcomes. The analysis focused on identifying patterns, differences, and common factors that contributed to successful human capital development.

C. Literature Review. A systematic review of existing scholarly literature and institutional reports was conducted to frame the research questions and interpret the empirical findings within a broader theoretical and policy-oriented context.

3. Software and Tools Used. Statistical analysis was conducted using IBM SPSS Statistics and Microsoft Excel for data processing, visualization, and modeling. Graphical representations and trend analyses were used to support the comparative evaluation and provide clarity to the findings.

4. Research Design Justification. The choice of a mixed-methods design ensures both depth and breadth of analysis, enabling the study to quantitatively assess macroeconomic impacts while contextualizing the findings within the policy frameworks and national strategies of the selected countries. This approach enhances the reliability, validity, and reproducibility of the results.

5. Research Organization. The research process was structured in three main stages:

- Stage 1. Data Collection. Collection of quantitative economic indicators and qualitative policy documents from 1990 to 2023.
- Stage 2. Data Analysis. Statistical and comparative analysis to identify causal relationships and successful strategies in human capital investment.

- Stage 3. Conclusions and Recommendations. Integration of empirical findings with theoretical insights to formulate evidence-based conclusions and policy recommendations applicable to emerging economies.

4. Results and Discussion

In order to conduct a thorough analysis, we examined the data and identified the following significant aspects regarding the correlation between investments in human capital and economic progress:

Aspect 1. Data Collection – Gathering Statistical Information and Specialized Literature.

- **Singapore.** Consistent investments in education and healthcare have transformed Singapore into a global technological and financial hub. The education system is heavily oriented towards STEM disciplines (Science, Technology, Engineering, and Mathematics), while effective health strategies have contributed to a highly productive and innovative workforce. Government policies supporting lifelong learning and the development of digital skills have further contributed to maintaining economic competitiveness (openknowledge.worldbank.org).
- **Japan.** Japan has allocated substantial resources to education and healthcare, supporting technological and industrial development. The education system emphasizes academic excellence and research, while the universal healthcare system ensures accessibility and quality. These investments have directly impacted the population's longevity and economic stability, with Japan having one of the highest life expectancies in the world.
- **Finland.** Renowned for its equitable and high-performing educational system, Finland demonstrates that strategic investments in education and healthcare can foster a knowledge-based economy and an egalitarian society. Educational reforms focused on flexibility, autonomy, and equal access to quality education have led to a highly competent population. Additionally, a well-structured healthcare system has contributed to a high level of well-being and productivity.

Aspect 2. Evolution of Education and Health Expenditures (1990–2020).

The table below presents investments in education and healthcare as a percentage of GDP in the three countries studied, for the years 1990, 2000, 2010, and 2020.

Table 1. Government Spending on Education and Health as a Percentage of GDP in Singapore, Japan, and Finland (1990–2020)

Country	Year	Education (% of GDP)	Health (% of GDP)
Singapore	1990	3.0	2.8
	2000	3.5	3.2
	2010	3.9	3.8
	2020	4.2	4.2
Japan	1990	3.5	5.9
	2000	3.7	6.5
	2010	3.9	7.1
	2020	4.1	7.7
Finland	1990	5.4	6.1
	2000	5.8	6.7
	2010	6.2	7.3
	2020	6.5	7.8

Sursa: [10]

Analyzing the data presented in Table 1, we observed a strong correlation between investments in education and healthcare and GDP growth in Singapore, Japan, and Finland from 1990 to 2020.

- **Singapore** recorded remarkable GDP growth, from USD 78 billion in 1990 to USD 340 billion in 2020. Concurrently, government spending on education increased from 3.0% to 4.2% of GDP, while healthcare spending rose from 2.8% to 4.2% of GDP. These investments were pivotal in the country's transformation into a global hub for innovation and technology.
- **Japan** exhibited steady GDP growth, increasing from USD 3.9 trillion in 1990 to USD 5.06 trillion in 2020. Education spending grew from 3.5% to 4.1% of GDP, while healthcare spending increased from 5.9% to 7.7%. These investments played a crucial role in supporting the country's technological and industrial development.
- **Finland** saw GDP growth from USD 98 billion in 1990 to USD 276 billion in 2020. Education spending rose from 5.4% to 6.5% of GDP, while healthcare spending increased from 6.1% to 7.8%. These investments contributed significantly to the development of a high-performing educational system and a knowledge-based society.

Aspect 3. Comparative Analysis of Investments and Economic Impact.

To better understand the relationship between human capital investments and economic development, the table below presents and compares the evolution of spending on education and healthcare in the three countries studied and its impact on GDP.

Table 2. Correlation Between Government Spending on Education and Health and GDP Growth in Singapore, Japan, and Finland (1990–2020)

Country	Year	Education (% of GDP)	Health (% of GDP)
Singapore	1990	3.0	2.8
	2000	3.5	+120%
	2010	3.9	+280%
	2020	4.2	+436%
Japan	1990	3.5	5.9
	2000	3.7	+60%
	2010	3.9	+95%
	2020	4.1	+136%
Finland	1990	5.4	6.1
	2000	5.8	+45%
	2010	6.2	+90%
	2020	6.5	+181%

Sursa: [10]

Analyzing the data in Table 2, we observe a strong correlation between government investments in education and healthcare and GDP growth in Singapore, Japan, and Finland from 1990 to 2020.

Singapore recorded significant GDP growth, accompanied by a consistent increase in spending on education and healthcare. In 2020, education and healthcare expenditures reached 4.2% of GDP, contributing to a GDP increase of 436% compared to 1990.

Japan maintained a balanced approach to education and healthcare spending, with moderate GDP growth. In 2020, education and healthcare expenditures amounted to 4.1% and 7.7% of GDP, respectively, while GDP increased by 136% compared to 1990.

Finland consistently invested in education and healthcare, leading to robust economic growth. In 2020, spending on education and healthcare reached 6.5% and 7.8% of GDP, respectively, and GDP grew by 181% compared to 1990.

Based on the research findings, the following strategies are recommended for emerging economies that seek to leverage investments in human capital for economic growth:

1. Allocating financial resources. Increasing the percentage of GDP allocated to education and healthcare, given the direct impact on workforce productivity and innovation.
2. Educational system reforms. Implementing a flexible curriculum focused on digital skills and adaptable to labor market demands, in order to support the transition to knowledge-based economies.
3. Improving the healthcare system. Ensuring universal access to quality healthcare services to maintain a healthy and productive population, which is essential for sustained economic growth.
4. Promoting lifelong learning. Developing professional training and retraining programs to respond to technological changes and labor market demands, thereby fostering workforce adaptability and competitiveness.
5. Supporting research and innovation. Investing in research and development, along with providing incentives for innovation, to support technological progress and productivity growth in key sectors of the economy.
6. Monitoring and evaluating impact. Implementing a monitoring system for public spending in education and healthcare to assess the effectiveness of investments and adjust policies based on the results.

These measures, when adapted to the local context, can contribute to creating an environment conducive to economic development through the enhancement of human capital.

5. Conclusions

The research confirmed the hypothesis that investments in human capital have a significant impact on economic progress. The countries analyzed – Singapore, Japan, and Finland – demonstrated that the efficient allocation of resources to education and healthcare contributes to the development of a sustainable and competitive economy.

Emerging economies can learn from these examples and adapt their policies to stimulate economic growth through strategic investments in human development. Implementing modern educational policies and an effective healthcare system are key elements in ensuring a prosperous future.

As emphasized in the Human Development Report (UNDP, 2024), sustained investment in human capital remains one of the most reliable strategies for achieving inclusive growth and resilience, particularly in the face of global uncertainty, demographic change, and technological disruption [9].

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CHALLENGES IN THE ADAPTATION OF FAMILY POLICIES IN THE CURRENT SOCIAL AND ECONOMIC CONTEXT OF THE REPUBLIC OF MOLDOVA

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Abstract: *The article reflects the main instruments regulating the state's family policy, some of which are compared with those developed at the European level. The analysis of the system of allowances/benefits granted to families and those with children reveals that family policies in Moldova are predominantly financial, with insufficient attention paid to family services. The changes made to the system of child care leave aimed to facilitate the reconciliation of family and professional life; however, their impact remains limited due to the insufficient availability of child care services. Although flexible work programs are regulated within the legal framework, their implementation is limited. The article concludes that current family policies in Moldova must adopt a multidimensional and cross-sectoral approach in order to effectively address the challenges of demographic sustainability and social inclusion, promoting real support in the face of economic and social vulnerabilities and ensuring a better balance between work and family life.*

Keywords: *Family policy, family, maternity allowance, paternity allowance, flexible working arrangement.*

UDC: 316.356.2:338.1(478)

Classification JEL: J11, J13.

1. Introduction

The intensification of contradictions within social development and the urgent need to support a proportion of the population exposed to various forms of exclusion and marginalization highlight the pressing necessity of developing protection programs aimed at helping individuals adapt to current realities characterized by social polarization and increased inequalities. The implementation of family protection policies is generally driven by changes in family structure, transformations in its functions, and decreasing cohesion. The rapid pace of these changes over a short period undoubtedly acts as a stressful factor for families.

The family is a fundamental social institution, and consequently, the state, through its family policies, is obliged to support it to a greater or lesser extent in exercising its functions. These policies are based on the premise that the family is autonomous and independent in decision-making regarding its development. Family policy targets the family and can be defined as a set of governmental activities specifically designed to support families, enhance the well-being of family members, and strengthen family relationships. These activities include the objectives of decision-makers, policies for ensuring family well-being, and specific measures undertaken by governments to achieve these objectives.

The current economic and social context of the Republic of Moldova continues to present a series of challenges. Although Moldova has recorded modest growth over recent years, not the entire population perceives an increased level of welfare. The high poverty

rate, despite moderate recovery of income and consumption, remains the most pressing social problem [1].

One of the most significant changes is the transformation of family structure through increased celibacy, single-parent families, reconstituted families, cohabitations, etc. These transformations imply the need to adapt public policies to provide equitable support for all forms of family, avoiding social exclusion and stigmatization.

In today's society, full of responsibilities and commitments, achieving a balance between professional and family life proves to be a real challenge. Substantial changes in the labor market and in the organization of family life create a context in which parents find it increasingly difficult to develop successful strategies to combine professional responsibilities with family duties. There are two types of problems simultaneously, each belonging to the public and private spheres [2].

2. Literature Review

In the Republic of Moldova, the subject of family policy is not approached in a comprehensive and intersectoral manner. Predominantly, it is emphasized that family policies in Moldova are mainly based on monetary transfers (various allowances), and less on services aimed at families [3]. Furthermore, it is argued that Moldova's family policies, primarily focused on financial, monetary, and material support, will not be accompanied by significant changes in demographic indicators, such as birth rates. These benefits, being small compared to current requirements for child growth and socialization, and diminished by inflation trends, are unlikely to significantly influence couples' decisions to have children [4].

At the international level, the idea is promoted that numerous schemes and practical models differ largely from country to country, depending on the prevailing ideology and specific geo-political-cultural context [5]. Variations between and within countries regarding family policies are influenced by existing political institutions, the leadership of political parties over time, religious roots, public opinion, social organization, and the attitudes of decision-makers towards the changing family dynamics. Family policies are further influenced by the value attributed to the institution of the family, acceptance of alternatives to the socially constructed ideal family form, the determination to meet family well-being objectives, current assessments of family well-being, and knowledge of family policies in other countries [6].

3. Methodology

The family policy promoted in the Republic of Moldova was analyzed through the lens of a systemic paradigm, considering that the family constitutes a system of interdependent individuals. Additionally, the family is in close interconnection with all aspects of economic, social, and cultural life.

Starting from the premise that family policy aims to protect families and children through redistributive measures, as well as regulate family life by ensuring a balance between professional and family responsibilities and promoting equitable involvement of both partners in child-rearing, the conducted scientific analysis focused on the main areas encompassed within family policy - namely, the system of allowances, benefits, services, the system of leaves directed at families, and work flexibility.

4. Results and Discussions

In recent decades, the family policies of the Republic of Moldova have been subjected to multiple pressures generated by the transition process, mass migration, and demographic changes. Analyzing the family policy in our country reveals that it does not represent an integrative approach regarding support for families; it remains fragmented and mainly focused on minimal financial assistance (allowances, benefits). For this reason, the conducted scientific analysis will focus on the main directions within family policy.

The first area analyzed concerns the system of allowances granted to families with children. Currently, Moldova provides the following types of allowances: the single allowance at the birth of the child, the monthly allowance for child care until the age of 2, the monthly allowance for raising the child, the monthly support allowance for raising twins or multiple children born from a single pregnancy until they reach 3 years of age, the single allowance during the custody period for an adoptable child, the single allowance for an adopted or fostered child in a tutorship/guardianship service, and the monthly allowance for raising an adopted or fostered child over 3 years old.

The single allowance at the birth of a child is established for each live-born child, including in the case of twins. Starting from January 1, 2024, the single maternity allowance is automatically granted to the mother based on birth data available in the State Population Register, without the need for her to submit an application. For children born from January 1, 2025, mothers will benefit from a single childbirth allowance of 21,350 lei for each live-born child.

The monthly allowance for child care until the age of 2 is granted for each child from the date of birth, regardless of the parent's status (insured/uninsured). The amount of this allowance has been set at 1,000 lei since October 1, 2022.

The monthly allowance for raising the child, according to options—in the case of insured persons—is determined for one of the insured parents, grandparents, or another relative directly involved in caring for the child, based on the following options: a) from the day after the expiry of maternity leave until the child reaches 3 years of age; b) from the day after the expiry of maternity leave for a period of 24 months; c) from the day after the expiry of maternity leave for a period of 12 months.

According to Decision No. 1478 regarding allowances granted to families with children under the option "until the child reaches 3 years of age," the amount of the monthly allowance for child-rearing constitutes 30% of the calculation base for each child, but not less than the minimum monthly allowance for child-rearing of the insured person (740 lei). Under the option "for a period of 24 months," the amount of the monthly allowance for child-rearing is 60% of the calculation base for each child, but not less than twice the minimum monthly allowance for the insured person's child-rearing during the first 12 months from the initial granting of parental leave, and 30% of the calculation base for each child for the following 12 months, but not less than the minimum monthly allowance for the insured person's child-rearing. Under the option "for a period of 12 months," the monthly allowance for child-rearing is 90% of the calculation base for each child, but not less than three times the minimum monthly allowance for the insured person's child-rearing during the first 12 months from the initial granting of parental leave.

Once the child-rearing allowance is established, it is paid regardless of whether the parents are engaged in employment activities and continue to work, maintaining their salary and work schedule.

Until 2019, there was only one option - allowances up to 3 years at a rate of 30% of the calculation base. These changes in the policy of child-rearing allowances reflect a significant transformation of the Moldovan state's approach to family policies. By introducing three options, the state offers parents the possibility to choose the most suitable variant based on family and professional needs, representing a step toward a more adaptable and individual-centered family policy. The option for up to 3 years remains the traditional version, with extended protection but a reduced monthly income (30%). The 24-month option is a mixed variant, with 60% for the first year, then returning to 30%. The 12-month option is an intensive variant, with 90% of the insured income, but over a shorter period. These options give parents autonomy to decide based on financial stability, career considerations, or the needs of the child, and reflect alignment with European trends in family policy.

Although the number of births has shown a decreasing trend in recent years, the number of beneficiaries of allowances for child-rearing and care has increased, indicating a correlation with the increase in amounts allocated to uninsured parents. Thus, in 2023, a total of 102,300 beneficiaries of allowances were recorded (including mothers, fathers, and other persons), representing a 20.3% increase compared to January 1, 2020. Among them, 38,900 were insured persons, and 63,400 were uninsured, with the number of children for whom these allowances were granted reaching 105,300. At the beginning of 2024, the average monthly allowance granted to insured persons for raising a child until 3 years of age was 4,020.2 lei, compared to 1,000.0 lei for uninsured persons, regarding the care of the child until reaching 2 years of age (which was 640 lei in 2020-2021 and 740 lei in 2022). The monthly allowance for child care covers the basic living needs for insured persons but not for uninsured persons (up to 1 year, it covers 90.1%, and up to 2 years, only 41.6%) [7]. In this context, further adjustment of the allowance value in accordance with the cost of living is necessary so that it covers the minimum subsistence level for both insured and uninsured persons.

The monthly support allowance for raising twins or multiple children born from a single pregnancy has been established since January 1, 2017, regardless of whether the parents are engaged in employment. The amount of the monthly support allowance for raising twins or multiple children born from a single pregnancy is 50% of the monthly allowance for child care until age 2, at the date of the child's birth, and since October 1, 2022, it is 500 lei per month.

The single allowance for the custody period of an adoptable child is granted to insured persons for the custody period indicated in the territorial guardianship order, but not less than 60 days and not more than 90 days. The amount of the single allowance for the custody period of the adoptable child constitutes 60% of the average insured monthly income earned over the last 12 calendar months.

The single allowance for an adopted or fostered child is granted to insured persons who have adopted a child or taken one into foster placement. The amount of the single allowance for the adopted or fostered child is 100% of the average insured monthly income earned over the last 12 calendar months.

The monthly allowance for raising a child over 3 years old, adopted or placed in a guardianship/curatorship service, is granted to insured persons who have adopted a child over 3 years old or taken one into foster placement. The amount of this monthly allowance is 60% of the social insurance benefit calculation base.

The last three types of allowances reflect an approach centered on social inclusion. These measures can be appreciated as: incentives for adoption and family reintegration;

tools for preventing institutionalization; mechanisms for balancing parental effort in cases of children from vulnerable situations. Through these measures, the state sends a clear message of support for alternative forms of child protection, while simultaneously strengthening social responsibility and the inclusion of adoptive families.

Maternity allowances are a crucial form of support. According to Law No. 289 regarding allowances for temporary incapacity for work and other social insurance benefits, maternity allowances can be benefits for insured women, wives caring for their employed spouses, and unemployed persons. The monthly amount of this allowance is 100% of the average insured monthly income earned over the last 6 calendar months.

The allowance for caring for a sick child is granted in cases where the child is ill until the age of 7, or for a child with a disability with ongoing health conditions until the age of 16, for a period of no more than 14 days in the case of outpatient medical assistance or up to 30 calendar days in the case of inpatient medical assistance.

Family policies must provide adequate support to vulnerable families, including through poverty reduction measures. For this purpose, *state social allowances* are offered, which may be a sum of money paid monthly or a one-time benefit from the state budget to individuals who do not meet the conditions for pension rights. Beneficiaries of social allowances can include: persons with severe, pronounced, and moderate disabilities; persons with severe, pronounced, and moderate disabilities from childhood; children with severe, pronounced, and moderate disabilities up to age 18; children in cases of loss of a caregiver from age 18 or up to age 23 if they are continuing full-time studies; elderly persons. Regarding allowances for care, accompaniment, and supervision, benefits are available for children with severe disabilities up to 18 years old; persons with severe disabilities from childhood; and severely blind persons. Families in difficult situations can also benefit from social assistance, material aid, or aid for the cold season.

Although the amounts of these social allowances and benefits are limited, they provide a guaranteed minimum support to individuals who, for various reasons (disability, childhood marked by exclusion, lack of a caregiver), have not contributed sufficiently to the social insurance system. This reflects the state's commitment to the principles of equity and social justice, guaranteeing a right to a minimum level of dignity for all citizens, including those without prior contributions. These allowances are also a tool for combating poverty, reflecting a form of solidarity between the state and its citizens. Allowances for care, accompaniment, and supervision provided in cases of severe disability are essential for: supporting caregiving families, which assume part of the responsibilities of social services; promoting family-based care rather than institutionalization, in line with modern directions in child protection and social inclusion.

Given that most allowances are granted until the age of 3 years for children, some researchers propose identifying budget resources to enable gradual increase in direct financial support for families until the children reach 18 years of age. Providing financial incentives, such as monthly support for each child, would reduce the financial burden on parents and encourage families to have more children, supporting their development in a healthy and educated environment [8].

Maternity leave, paternity leave, vacation leave, and leave for caring for sick children can be considered important tools of family policy. These types of leave, regulated by law, reflect the commitment of public authorities to promote and protect the family as a fundamental institution of society. They serve a dual purpose: on one side, ensuring favorable conditions for the reproductive and educational functions of the family;

on the other side, reducing the pressure on parents during periods when they care for young children or are in situations of family vulnerability.

Maternity leave contributes to the protection of the health of the mother and child during the perinatal period and is granted to women starting from the 30th week of pregnancy, lasting 126 calendar days, or 140 days in cases of complicated births or the birth of two or more children. Compared to other countries, this leave period is quite extended. At the European Union level, a pregnant employee, or one who has recently given birth or adopted a child, has the right to a uninterrupted maternity leave of at least 14 weeks, allocated before and/or after birth or adoption, in accordance with national legislation. The employee must take at least 2 of these 14 weeks ("mandatory maternity leave").

In this context, maternity leave should be interpreted not only as an individual right of the employee but also as a strategic investment by the state in public health, human capital, and sustainable demographic development. Providing an adequate duration and financial support is part of an active family policy model aimed at supporting birth rates, equal opportunities, and combating demographic decline.

Paternity leave plays an important role in promoting active involvement of fathers in child care and in reducing gender inequalities within the family. In the Republic of Moldova, this leave lasts for 14 days and is granted within the first 12 months after the child's birth. During the paternity leave period, the employee (father) benefits from a paternity allowance that cannot be less than the insured person's average monthly income for that period, and it is paid from the state social insurance budget. The amount of the paternity allowance amounts to 100% of the insured person's average monthly income. In using paternity leave, fathers face a series of difficulties fueled by various barriers: **social** – lack of awareness of the right to benefit from paternity leave; absence of role models or examples in the community of fathers who have benefited from paternity leave; **professional/workplace-related** – undeclared employment, specific periods of activity at the enterprise or company, inability to replace specialists, labor shortages, employer attitudes; **financial** – double salary (official and unofficial) in some enterprises, dependence on supplementary income outside the workplace, poverty, lack of stable jobs in small towns and rural areas; and **cultural** – the belief that current paternity leave is too short to contribute significantly to any change; traditional gender concepts that assign women responsibility for child care; fear of stigmatization for acting contrary to gender norms; and conflict with the ideal norm that employees should prioritize work [9].

Child care leave can only be taken at the end of maternity leave and is offered in three options, which have been analyzed above.

Leave for caring for sick children, accompanied by a benefit, is granted until the child reaches 10 years of age, and in the case of a child suffering from oncological diseases or a child with disabilities with ongoing health conditions, until the child reaches 18 years of age. In cases of the child's illness, the benefit is granted for the period during which the child needs care, but no more than 14 calendar days in the case of outpatient treatment, and up to 30 calendar days in the case of inpatient treatment.

Leave for caring for a sick family member is granted in accordance with a medical certificate, for a duration of up to 2 years. These two types of leave help reduce family stress, prevent parental burnout, and ensure a stable environment for the child's development.

In this context, these forms of leave should not be viewed solely as facilitations for employees, but primarily as mechanisms of a coherent family policy aimed at improving quality of life, supporting birth rates, and consolidating the social role of the family.

A central element of family policies is the set of **child care services**, which are not only a logistical support for parents but also a strategic instrument for social inclusion, equal opportunities, and early childhood development. Accessibility, quality, and diversity of these services directly influence women's participation in the labor market, fertility rates, and the well-being of children in their early years.

Child care services - such as nurseries, kindergartens, and alternative or community-based services - contribute to the development of active family policies, aimed not only at compensating for family responsibilities but also at supporting family autonomy and strengthening social cohesion. In this regard, investments in the infrastructure and professionalization of these services can be viewed as an essential component of a modern and sustainable social protection model capable of addressing the complex needs of contemporary families.

Despite measures taken to improve the situation in this field, in the Republic of Moldova, issues persist related to the integration of children up to age 3 into preschool institutions, unmet needs of students in extended-day schools, and the lack of alternative or community-oriented services focused on early childhood education.

In the context of changes in the labor market and the transition toward more inclusive, individual-centered economic models, **work flexibility** has become a key element of contemporary social and family policies. It refers to the possibility of adapting work schedules, workplaces, and workloads to meet employees' needs, especially those of parents with dependent children. Work flexibility is particularly essential for the employment of parents (full-time) and for reducing work-family conflict, thereby improving time management. According to the Labor Code of the Republic, flexible work arrangements are established by the employer in mutual agreement with the employee, at the employee's request, provided that this possibility is stipulated in the collective labor agreement, internal regulations of the unit, or other normative acts at the organizational level. Additionally, the Labor Code of Moldova regulates telework, under which employees working from home are considered those who have concluded an individual employment contract regarding telework, using materials, tools, and mechanisms provided by the employer or purchased at their own expense. Work flexibility should be viewed not only as an individual option but also as a mechanism for structural balance between work and personal life, with positive effects on family cohesion, child development, and the functioning of the labor market within a continuously evolving socio-economic context.

The accentuation of the demographic crisis in the Republic of Moldova has prompted authorities to initiate certain **demographic measures**. Thus, in 2011, the *National Strategic Program in the field of demographic security of the Republic of Moldova (2011–2025)* was approved, which emphasizes issues related to the institution of the family. The essence of this program lies in promoting measures aimed at favorable trends in fertility, mortality, migration, and other demographic phenomena. The National Program for Demographic Security reflects an important strategic intention (social protection, labor market, health care, education, housing) to respond to demographic challenges; however, its effective implementation is inseparable from the country's economic developments. In the absence of a favorable economic framework, demographic policies risk losing their operational character and failing to produce the expected impact on demographic trends in the medium and long term.

5. Conclusions

Family policy measures in the Republic of Moldova chiefly aim to maintain the material well-being of families with children through child care allowances. Additionally, Moldova's family policy does not reflect support measures for young people at the beginning of family life, nor does it include favorable fiscal policies. The measures for work flexibility provided by the normative framework are insufficient. Considering that a major challenge is reconciling professional and family life, modern family policies should promote equitable parental leaves, access to nurseries and kindergartens, and flexible work arrangements. Overall, a strategic, integrated vision is necessary—one that genuinely supports diverse types of families and ensures the demographic and social sustainability of the country.

Even if fertility growth is not often an explicit objective of family policies, such policies can influence fertility-related behaviors. They can affect the timing of births, increase intentions to have children, and facilitate the realization of these intentions. A consistent mix of financial benefits, parental leaves, and childcare support can stimulate long-term fertility potential, insofar as these measures address “direct costs” of children and reduce indirect costs. An essential aspect of these policies is also their contribution to reducing environmental uncertainty in which households make decisions about fertility [10].

Adapting family policies to the current social and economic context requires a multidimensional and intersectoral approach. Effective policies are those that recognize family restructuring, promote gender equality, support balance between work and personal life, and offer real support in facing economic and social vulnerabilities. Without such adaptation, policies risk being ineffective relative to the real needs of contemporary society.

Acknowledgments: This article was developed within the Research Subprogram Demographic Transition in the Republic of Moldova: Particularities, Socio-economic Implications, and Strengthening Demographic Resilience (2024-2027).

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DECARBONIZATION PROSPECTS IN THE ROMANIAN ENERGY SECTOR

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Abstract: Decarbonization is the reduction of carbon dioxide emissions by reducing the amount of greenhouse gas emissions produced by burning fossil fuels. In general, this implies a decrease in CO₂ production per unit of electricity generated. Reducing the amount of carbon dioxide that occurs as a result of transport and energy generation is essential to meet the global temperature standards set by the Paris Agreement. The study analyzes the need for a change in the energy sector in Romania, through the gradual elimination of coal/lignite power plants, and provides an analysis of the impact of climate change on energy systems, as well as on the national economy.

Keywords: Power plants, pollution, decarbonization, energy sector, climate change.

UDC: 620.9:504.06(498)

JEL classification: Q40, Q43, Q48

1. Introduction

The UNEP Emissions Gap Report 2024 signals a major global concern about the gap between current commitments and the objectives needed to limit global warming to 1.5°C. This gap shows that, although progress has been made, the measures adopted are not sufficient to prevent the catastrophic effects of climate change. In this context, it is essential that each country strengthens its commitments and adopts urgent and coordinated measures.

Romania plays an important role in this global transition, and the National Energy Strategy 2025-2035 is an example of a concrete commitment to the climate challenge. The plan to achieve climate neutrality by 2050 is ambitious and requires a rapid and effective implementation of the proposed measures. Diversifying energy sources, increasing energy efficiency, protecting the environment and ensuring security of supply are key elements that will contribute not only to reducing greenhouse gas emissions, but also to ensuring a balance between economic development and environmental protection.

By increasing the use of renewable energy sources (solar, wind, hydropower), Romania is gradually reducing its dependence on traditional sources, such as coal, which are high carbon emitters. At the same time, energy efficiency measures will help reduce consumption, which directly contributes to reducing emissions. At the same time, strengthening the energy infrastructure and ensuring a just transition will protect energy security and economic competitiveness, essential aspects in a constantly changing international context.

This approach reflects a vision that is not limited to meeting climate goals, but also to strengthening a sustainable and resilient economy. Today's geopolitical and economic challenges, such as energy crises and international instabilities, make this transition all the more important, and Romania has the chance to be a regional leader in the field of energy security and sustainable development.

Implementing these measures will require both strong national commitment and close international collaboration to ensure the success of the energy transition and meet global commitments to climate change.

2. Description of the Problem

Romania aims to make significant progress in reducing greenhouse gas (GHG) emissions in the energy sector, through a series of strategic measures that include the transition to renewable energy sources, improving energy efficiency and developing energy storage technologies.

The target of reducing GHG emissions by 89% by 2035 and by 99% by 2050 compared to 1990 levels reflects a strong commitment to decarbonizing the energy sector. These targets are ambitious, given the need to replace traditional coal-based energy sources with less polluting technologies and renewable energy sources.

Romania will phase out coal-based energy by 2032, which will involve the closure or modernization of coal-fired generation units. This step will be replaced by a significant increase in the share of renewable sources, which will reach 41.1% of final energy consumption by 2035 and 86.1% by 2050. This objective will require the rapid development of infrastructure for wind, solar and hydropower sources.

Romania's Long-Term Strategy for Reducing Greenhouse Gas Emissions – Romania Neutral in 2050 recognizes the transitional role of natural gas, which will contribute to ensuring stable energy production as renewable sources become increasingly important. It also supports the expansion of nuclear energy, which can significantly contribute to reducing carbon emissions and ensuring a stable energy mix.

To cope with the variability of renewable sources, Romania will focus on developing energy storage capacities. Pumped hydropower plants and batteries will become essential for balancing electricity networks, allowing the storage of excess energy from variable sources (such as wind and sun) and its supply when demand exceeds production.

Improving energy efficiency will be another central objective. Among the proposed measures are reducing losses in distribution networks, implementing operational optimization solutions, and promoting efficiency measures in households and industry. These measures will help reduce energy consumption and increase Romania's economic competitiveness.

The strategy promotes the digitalization of the energy sector, including the implementation of smart meters that will allow for real-time monitoring of energy consumption. Smart grids will contribute to more efficient management of energy demand and supply, facilitating more responsible consumption and optimizing costs for consumers.

Through these measures, Romania aims to significantly reduce its carbon footprint, support the transition to a cleaner and more sustainable energy system, and improve the efficiency and competitiveness of the national energy sector.

3. Methodology

The methodology used in the article consists of a descriptive, comparative analysis (Romania compared to other EU countries), interpretation of realities and illustration and argumentation of announcements, enriched with examples, which are based on bibliographical exploration and identification of the main trends in the field.

4. Results

In the context of climate change and international greenhouse gas (GHG) emission reduction targets, Romania, as a member state of the European Union, has the following

climate policies based on relevant European legislation: Regulation on the Governance of the Energy Union, European Climate Law, EU Emissions Trading Scheme, Social Climate Plan, Effort Sharing Regulation (ESR), Land Use Regulation, Land Use Change and Forestry (LULUCF).

The *Regulation on the Governance of the Energy Union* (Regulation (EU) 525/2013) aims to ensure the coordination and integration of the energy and climate policies of the Member States of the European Union. It contributes to the creation of an Energy Union that responds to common challenges, in particular with regard to energy security, the energy transition, and the reduction of greenhouse gas emissions.

Romania is required to develop and submit to the European Commission integrated national energy and climate plans (INECPs) for the period 2021-2030, with reviews every 10 years. These plans must detail the measures to achieve the EU decarbonisation, energy efficiency and other priorities related to the energy transition. In addition to the INECPs, long-term (30-year) emission reduction strategies must also be reported to the Commission.

The implementation of national plans is monitored through biennial reports, which allow for the assessment of progress and the identification of corrective measures where necessary.

The impact of the Energy Union Governance Regulation on Romania consists of the integrated national energy and climate plans that have become national strategic instruments, fundamental for the development and implementation of Romania's climate policy, and in the European legislation that influences national policy. Romania, as an EU Member State, is obliged to comply with these regulations and to integrate European objectives into its national strategies and measures.

Thus, the Energy Union Governance Regulation plays a crucial role in achieving the environmental objectives of the European Union and in ensuring a just and efficient transition towards a low-carbon economy.

The European Climate Law is not only a regulatory instrument at European level, but also requires the revision of national legislation of the Member States. Although the targets set by the law are at European level, they guide the revision of relevant European legislation and, implicitly, affect Romania's decarbonization trajectory which must contribute to achieving common European objectives. In Romania's case, this means that it will have to adapt its domestic policies in the fields of energy, transport and agriculture to actively contribute to achieving the established objectives. Thus, Romania will have to implement decarbonization measures and contribute to the transition strategy towards a greener and more sustainable economy.

The EU Emissions Trading System (ETS) is the main policy for reducing greenhouse gas (GHG) emissions in the European Union and the largest carbon market in the world. The European Commission controls the number of allowances issued annually and the pace at which they are reduced, thus setting a decarbonisation timetable.

To meet the decarbonisation timetable, Eastern European countries, including Romania, benefit from the Solidarity Clause and the Modernisation Fund, which consist of additional allowance allocations through special mechanisms. These measures are designed to support the transition to a greener and more sustainable economy, given that these countries have a greater dependence on the coal-based energy sector. Romania will receive approximately €21 billion by 2030 from these mechanisms. It also benefits from the revenues from the auctioning of emission allowances, which are used through the Environment Fund Administration to support investments in cleaner technologies and environmental projects.

The revised ETS has already been approved at European level, but it has not yet been transposed into national legislation. Given the increasing emphasis on the rapid transition to a carbon-free economy, and the policies implemented will significantly influence the development of the industrial and energy sectors in the coming decades, the European Commission has started infringement proceedings against Member States that do not meet the implementation deadline.

Romania does not have a national climate law, it is not mandatory under European legislation, although these could bring significant benefits for climate governance.

In the absence of such a law, Romania has adopted important measures to combat climate change by developing the National Energy - Climate Change Plan (PNIESC), which is important for achieving the objectives of reducing greenhouse gas (GHG) emissions. In the draft version of the 2024 PNIESC, Romania has set more ambitious targets than those presented in the 2023 Long-Term Strategy (LTS) for the Reduction of Greenhouse Gas (GHG) Emissions.

Thus, the PNIESC foresees a reduction of GHG emissions by 85% by 2030 compared to 1990 levels (Figure 1), a 96% reduction by 2040 and, considering net emissions, a 105% reduction by 2050. These objectives are more ambitious than those in the LTS, which aim for a 78% reduction in 2030 (in the most ambitious scenario) and 67% without taking into account emissions absorbed by LULUCF (Land Use, Land Use Change and Forestry) measures. In this context, the PNIESC reflects Romania's clear commitment to comply with the Paris Agreement and the European objectives for climate neutrality by 2050.

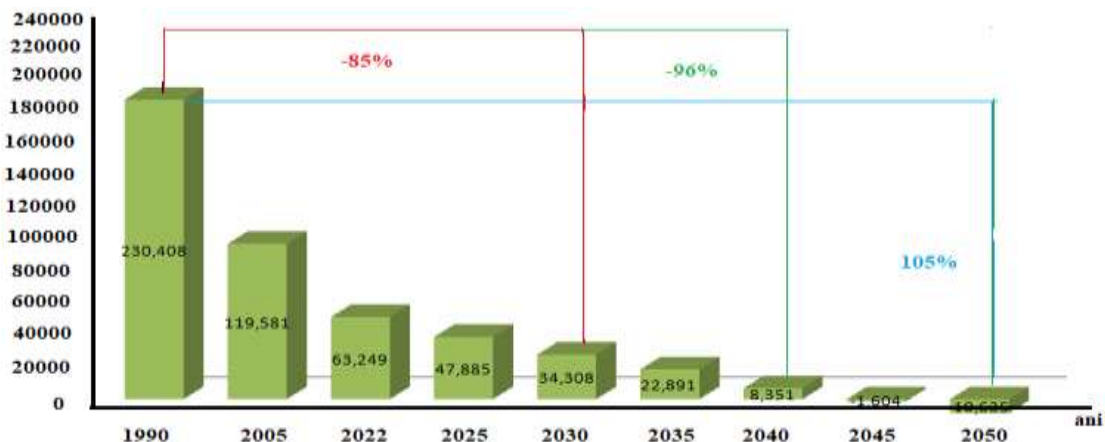


Figure 1. Targets and estimated trajectory regarding the reduction of net GHG emissions in Romania

Source: PNIESC (2024)

The national climate legislative package includes:

- Long-Term Strategy (LTS),
- National Energy-Climate Change Plan (PNIESC),
- National Circular Economy Strategy,
- National Sustainable Development Strategy,
- National Long-Term Renovation Strategy,
- Law on Decarbonization of the Energy Sector,
- Law on Energy Efficiency,
- Law on the Promotion of Energy Production from Renewable Sources and
- Law on Energy Performance of Buildings.

These policies are coordinated for their implementation by the Interministerial Committee on Climate Change (CISC), created in 2022. The Climate Change Adaptation Strategy for the period 2022-2030 provides for important steps in coordinating and setting priorities for managing the impact of climate change, in adapting various economic sectors (such as agriculture, transport and construction) to new climate conditions, which represents significant progress in implementing an integrated climate change policy. For example, in agriculture, emphasis is placed on diversifying and adapting plant varieties, and in transport infrastructure, on the use of materials more resistant to extreme temperatures. In the residential building sector, emphasis is placed on improving thermal comfort through insulation and ventilation measures. However, there are also multiple shortcomings in the implementation process, especially in decarbonization policies that are still reactive and there is neither a clear strategic vision nor sufficient resources to monitor their progress. Also, in many important economic sectors, such as transport, industry, agriculture or waste management, there are no specific plans and clear measures to reduce greenhouse gas emissions, despite the requirements imposed by European legislation. Public authorities also lack the necessary resources to develop and implement these policies effectively.

Thus, although progress has been made in some areas, a significant gap remains between strategic intentions and their effective implementation.

In 2022, the energy sector continued to be one of the main sources of greenhouse gas (GHG) emissions globally, from the energy sector in Romania were estimated at approximately 40-45 million tons of CO₂ equivalent.

The share of fossil fuels (especially coal and natural gas) in Romania's energy mix remains significant (Figure 2), and the transition to renewable sources has not yet been fast enough to drastically reduce emissions.

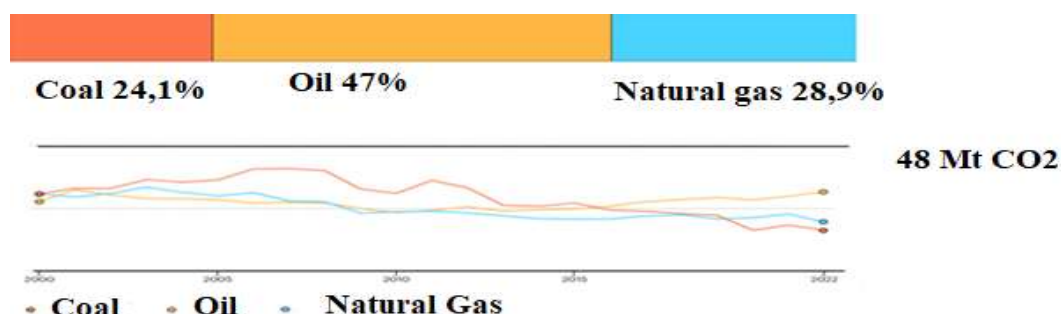


Figure 2. Share of fossil fuels in Romania's energy mix

Source: Eurostat data (2024)

The electricity generation sector has made significant progress, also thanks to the implementation of strict carbon pricing policies, but also through increasing investments in renewable sources. Increasing renewable energy capacities, in parallel with gradual reductions in the use of lignite, is essential to reduce CO₂ emissions and achieve decarbonisation objectives.

Under the influence of a European carbon price, the electricity generation sector has seen an increase in renewable energy capacities simultaneously with the adoption of a lignite phase-down schedule. This will lead to a progressive decarbonisation of the sector, with the exception of energy-intensive industry, which has not started the profound transformation necessary to put it on a trajectory towards climate neutrality.

Romania aims to significantly increase its production capacity, reaching 32.3 GW by 2030, which represents an increase of 68.2% compared to the 2022 level. Almost 75% of this capacity will come from renewable energy sources (RES), a clear objective to reduce greenhouse gas (GHG) emissions.

In addition to renewable sources, there is also a strong focus on nuclear energy, through the development of new plants based on Small Modular Reactor (SMR) technology and the expansion of the Cernavoda nuclear power plant with 2 additional units (Unit 3 and Unit 4), planned to be completed between 2031 and 2032. The construction of natural gas-fired power plants, including cogeneration units and combined cycle power plants (CCGT), is also planned to support the energy transition.

Romania also aims to eliminate fossil fuel imports for electricity and heat production by 2030, by closing coal-fired power plants and developing new production capacities based on natural gas and renewable sources.

A medium-term objective is for Romania to become a net energy exporter, with almost zero natural gas imports by 2030, and starting in the second half of the next decade, to even become a net energy exporter.

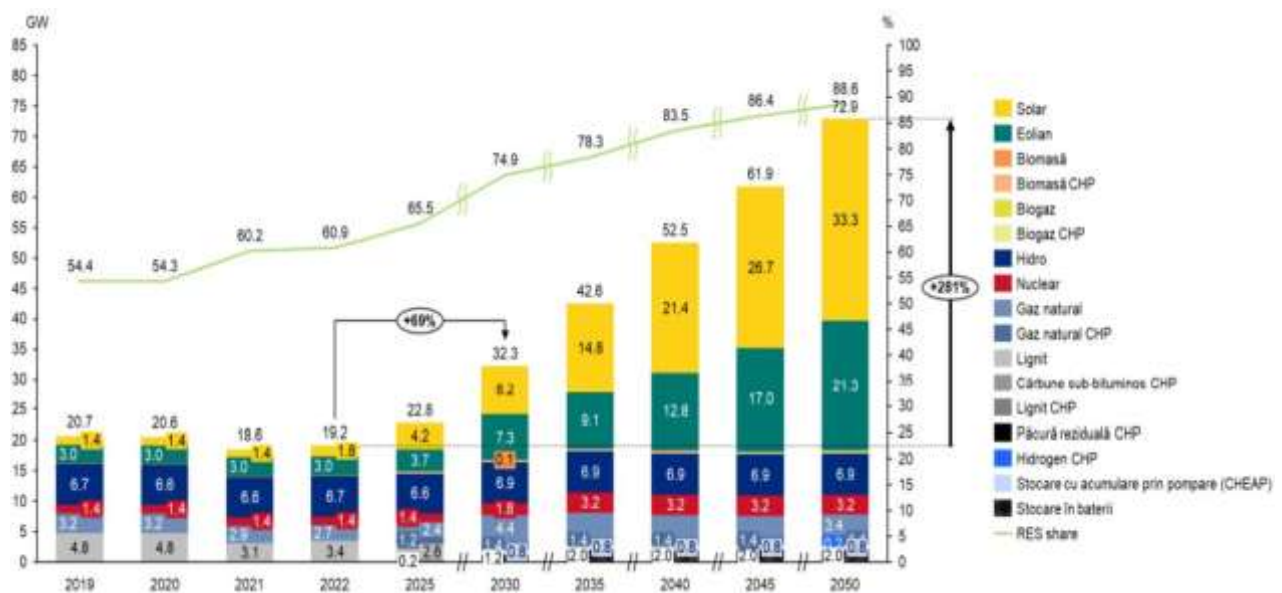


Figure 3. A possible electricity generation mix in Romania

Source: PNIESC (2024)

The exploitation of natural gas resources in the Black Sea (Neptun Deep project) will play a key role in reducing Romania's dependence on natural gas imports. Romania is expected to become a net exporter of natural gas by 2030 and maintain this status until at least 2040.

Overall, Romania wants to transform its energy sector to reduce carbon emissions and ensure its long-term energy security, becoming a net energy exporter in the coming decades. The plans reflect a significant transition, with a cleaner and more diversified energy mix (Figure 3).

3. Conclusions

Romania lacks an integrated and coherent national vision on reducing GHG emissions across the economy. The report launched by the Presidential Administration "Limiting

Climate Change and Its Impact: An Integrated Approach for Romania” provides an overview of the national needs for managing climate change, and in order to improve climate policies in Romania, there are several strategic and operational measures that can contribute to a more coherent and integrated national vision in addressing climate change, in line with European requirements and international recommendations, such as those formulated within the framework of the accession process to the Organization for Economic Cooperation and Development (OECD). These can be grouped into several main directions:

A national climate law would ensure a clear legislative framework, with precise objectives for reducing greenhouse gas (GHG) emissions in the short and long term. It could also set up a scientific advisory board to support decisions based on research and up-to-date data. An effective monitoring and reporting mechanism would be needed to assess progress in implementing climate policies and specific measures.

Transposing and implementing the Emissions Trading System (ETS 2) by extending its applicability to the buildings and transport sectors is crucial to support their decarbonization. Carbon pricing can create economic incentives to reduce emissions and to replace fossil fuels with electric and sustainable solutions. In implementing ETS 2, it is important to ensure constant monitoring of carbon prices so as to minimize the impact on sensitive sectors without expose to danger their competitiveness. Also, creating support mechanisms for sectors vulnerable to rising carbon prices and implementing a “Social Climate Plan” can mitigate the socio-economic impact on vulnerable populations.

To offset the socio-economic impact of the transition to a green economy, support mechanisms for vulnerable groups (e.g. low-income households or people working in sectors dependent on fossil fuels) can be introduced when carbon prices rise, and social protection measures, such as a Social Climate Plan, should be adopted. The gradual reduction of fossil fuel subsidies can be followed by incentives for decarbonising technologies, such as transport electrification and energy efficiency in buildings.

Romania should gradually reduce fossil fuel subsidies, targeting them towards vulnerable consumers. It is important to rethink support schemes for the transition to a greener economy, including through incentives for building renovation, creating renewable energy infrastructure and supporting the adoption of new technologies such as hydrogen and carbon capture, and by abandoning barriers that hinder the energy-efficient renovation of buildings and implementing policies to make centralized energy systems more efficient are essential.

Preserving and expanding forests and other ecosystems that can contribute to carbon dioxide absorption are essential for achieving climate goals. Romania should adopt measures to prevent illegal deforestation and to rehabilitate degraded lands. Also, integrating forest and degraded land management into a coherent national biodiversity conservation policy could support both GHG emission reductions and environmental protection. Rehabilitating degraded lands can also contribute to reducing net carbon emissions.

Improving strategic planning capacity, including through the development of economic and climate models that include essential economic sectors, is necessary to ensure a just transition, involving all stakeholders: public authorities, the private sector, non-governmental organizations and citizens, in a transparent planning and implementation process can increase the acceptance and effectiveness of measures to combat climate change.

Green Energy Infrastructure Development can be achieved in parallel with the increase in carbon prices, but money must be invested in the development of electricity, renewable and hydrogen infrastructure to support the electrification of the transport sector and buildings. Electricity networks must be expanded and modernized to support the

integration of renewable energy sources and to cope with increased consumption demands. These investments will support the increase in electrification of key sectors and will contribute to their decarbonization.

Romania must implement measures to increase resilience to climate change, including by investing in infrastructure to protect against extreme weather events and by developing policies to adapt to high temperatures and prolonged drought.

The implementation of a national mechanism to monitor and report on progress in achieving decarbonization objectives is essential. This should be supported by technology and an

In parallel with technical and economic measures, it is essential to place greater emphasis on environmental education and public awareness about the importance of reducing emissions and how citizens can contribute to the ecological transition.

Improving climate policies in Romania by strengthening these directions and by creating a strong legislative and institutional framework, investing in infrastructure, developing an efficient and participatory government framework and social protection, will be able to ensure a fair and sustainable transition, strengthening Romania's position in the transition towards a green economy, integrated into the European single market.

In conclusion, the Romanian energy sector has made significant progress in reducing GHG emissions, but challenges remain, especially in the context of geopolitical changes and the energy crisis, which may further hinder the transition to a low-carbon economy. These developments highlight the need for an integrated approach, including both energy efficiency measures and investments in renewable energy sources and innovative technologies.

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ENERGY POVERTY ACROSS THE EU-27: A CRITICAL ASSESSMENT

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Abstract: *At the global and European level, the current geopolitical conjunctures bring to light various extremely dramatic realities, and the fight for resources often overrides people and their needs. In this framework, poverty and inequality, quality of life and well-being seem less important than the petty interests of the great powers. However, they are the real driving force of these interests or they should be. In this context, discussions about poverty, and especially about energy poverty, should not be missing. Energy poverty is an extremely complex concept and little understood in the fullness of its meanings. Many policymakers, members of the media and researchers associate it in one form or another with material poverty or income poverty, but its meanings are much more granular, delicate, difficult to capture and may or may not overlap with income poverty. Thus, **the objective** of the article is to critically analyze the concept of energy poverty, identify several valuable indicators for describing energy poverty and analyze them at the EU27 level for the period 2015-2024. **The methodology** reflects the comparative analysis of several energy poverty indicators, based on Eurostat statistical data. **The results** emphasize that energy poverty must be treated in a broad way, overlapping different filters or nuances, each new indicator outlining yet another problem to be solved and requiring particular solutions depending on the desired direction of analysis.*

Keywords: Energy poverty, energy poverty indicators, multidimensionality, living conditions, social inequality.

UDC: 620.9(4EU)

Classification JEL: I32, Q43, R2

1. Introduction

Since the 1990s, the concept of energy poverty has begun to take shape, but its definition continues to have various understandings, with approaches varying substantially between developed countries (aiming more at the financial perspective – energy income and expenditure) and developing countries (aiming at access to energy infrastructure or services). In pulse, conceptually, the degree of overlap between energy poverty and income poverty remains debatable. Thus, if income poverty is based on the concept of a poverty line – that is, a minimum of food and non-food items necessary to sustain life and standard of living, on the other hand, energy poverty does not have a defined energy poverty line – that is, a minimum amount of energy to sustain standard of living. In addition, the two forms of poverty, although both are expected to decrease as household incomes increase, nevertheless differ both in terms of regional impact and in which income deciles they begin to manifest themselves (Khandker, 2013). Thus, they can overlap (especially in urban areas), but they can also exist in the absence of the other (e.g. energy poverty can surpass it or exist without income poverty, especially in rural areas, especially in countries in Asia or Africa, where access to energy infrastructure is precarious).

In all this tangle of theoretical controversies regarding the definition, energy poverty is a reality that politicians find difficult to remove from public attention. Thus, in

2023, at the European Union (EU) level, 17.9% of the EU population lived in dwellings that were not comfortably warm during winter and 31.2% of people at risk of poverty lived in dwellings that were not comfortably warm, compared with 14.4% of those not at risk. Regarding the rural-urban discussion, cities had the highest rates of people living in dwellings that were not comfortably warm in winter, with 19.1% of people affected, and compared with 17.6% in towns and 16.3% in rural areas (Eurostat article, Living conditions in Europe - energy efficiency in households, Sept. 2024).

2. Literature Review

Although since the last decades of the last century, energy poverty has captivated the concerns of the media, researchers and public policy makers, the terminology itself is difficult to fit into a unitary structure, with numerous dichotomies. One of these captures the framing of energy poverty either in the lack of access to energy services (so it rather captures the available capabilities, e.g. Sovacool 2012; Day, Walker and Simcock, 2016; Thomson, Bouzarovski and Snell 2017; Sokołowski 2019) or in the financial impossibility of bearing energy expenses (Buzar, 2007; Tirado Herrero and Ürge Vorsatz 2012; Thomson and Snell 2013).

In the study of Palma and al. (2024) there is a critical analysis of definitions and measurement of energy poverty reflected in the national policy strategies in Portugal and Spain. The results highlight that definitions can benefit from an expansion of the scope and increased representativeness of energy services and types of vulnerability. At the same time, greater efficiency in identifying energy poor households requires increased intersectionality of indicators and alternative indicators.

At the EU level, against the background of the need for the most inclusive identification of people suffering from energy poverty, numerous definitions have been developed (EC, 2020), with states also being encouraged to formulate specific definitions in order not to overlook the diversity of situations that capture the phenomenon (Strakova, 2014; Romanian Government, 2016; Republic of Austria, 2019; Government of the UK, 2024).

According to "energy poverty is a situation in which households are unable to access essential energy services" (EC, 2020), and according to the European Parliament Council of The European Union (EPCEU, 2023) energy poverty means "means a household's lack of access to essential energy services, where such services provide basic levels and decent standards of living and health, including adequate heating, hot water, cooling, lighting, and energy to power appliances, in the relevant national context, existing national social policy and other relevant national policies, caused by a combination of factors, including at least non-affordability, insufficient disposable income, high energy expenditure and poor EE of homes".

In general, energy poverty has many facets, being rather analyzed as a multidimensional concept, capable of capturing both quantitative and qualitative aspects (Nussbaumer et al. 2011, Alkire and Foster 2011, Price, Brazier and Wang 2012; Gouveia, Palma and Simoes, 2019; Sokołowski et al., 2020).

3. Methodology

The paper analyzes a series of energy poverty indicators, starting from the definition. The analysis is carried out over the period 2015-2023 (with the year 2024 being included where there are scattered data), the data source being Eurostat. Regarding the data, where there is data for 2024, it should be viewed with caution, especially at the level

of country groups, because there is no data for all the countries analyzed. The analysis is comparative between the Member States of the European Union.

In order to highlight distinct continental areas of the European Union, a systematized grouping was developed into three groups of countries: Nordic and Eastern Countries (NEC) - Denmark, Finland, Sweden, Latvia, Lithuania, Estonia, Ireland, Netherlands, Belgium; Southern and Western Countries (SVC): France, Portugal, Spain, Italy, Greece, Cyprus, Malta, Croatia and Slovenia; Central Countries (CC): Luxembourg, Germany, Poland, Czech Republic, Austria, Slovakia, Hungary, Romania and Bulgaria.

Depending on these groupings, although the number of energy poverty indicators can be considerable (over 30), a series of 4 energy poverty indicators, from several grouping spheres, are tracked in this analysis, such as: Cooling and heating degree days by country - annual data (Heating degree days); Inability to keep home adequately warm (Percentage); Severe material and social deprivation rate by age and sex (Percentage); Arrears on utility bills (Percentage).

4. Results and Discussion

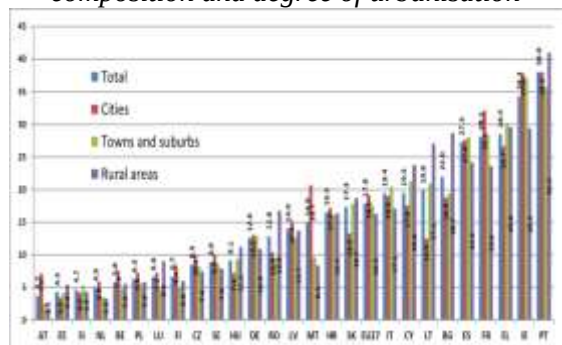
The European Union defines energy poverty as the situation in which a home is forced to reduce its energy consumption to the level where it can have a negative impact on the health and well-being of its inhabitants (European Commission). Among the main causes are low incomes, a high proportion of household expenses for energy, but also poor energy performance of buildings and appliances.

The COVID-19 epidemiological crisis paradoxically seems to worsen energy poverty. Thus, from 2021 to 2023, the indicator describing the inability to keep the house adequately warm worsened, increasing by 3.7 pp.

Thus, we can observe in 2023 that beyond the EU27 average, although there are also a few countries from the east and north of the continent (such as Bulgaria, Lithuania and Ireland), the countries of the western and southern flank of the European Union are the most affected, especially countries such as Italy, Cyprus, Spain, France, Greece and Portugal. If we look at the degree of urbanization, perhaps paradoxically, large cities seem to be the most affected by the inability of citizens to heat their homes sufficiently, in 15 out of 27 countries (Austria, Netherlands, Belgium, Poland, Finland, Czech Republic, Sweden, Germany, Latvia, Malta, Croatia, Italy, Spain, France and Ireland), while the opposite situation (i.e. the share of people affected by this type of energy poverty is higher in rural areas than in urban areas) is recorded in Estonia, Slovenia, Luxembourg, Hungary, Romania, Slovakia, Cyprus, Lithuania, Greece and Portugal.

If we look at the degree of satisfaction by level of satisfaction and education, we can see that if we group the indicator by the general level of education, countries such as Denmark, Belgium, Ireland, Slovenia, Austria, the Netherlands and Sweden are in the top of satisfaction with the energy situation of their households, and the seven countries least satisfied with the energy situation by level of education are Bulgaria, Lithuania, Poland, Italy, Slovakia, Romania and Greece. A relatively similar situation we can obtain if we group by the highest level of education, with the Nordic countries of the EU monopolizing this ranking. Thus, we can conclude that the level of education in general can lead to greater satisfaction with life, to better social conditions on the background of higher incomes as a result of the studies held and therefore greater satisfaction with living and housing conditions.

*Persons living in a dwelling not comfortably
warm during winter by sex, household
composition and degree of urbanisation*



*Satisfaction with the dwelling by level of
satisfaction, sex, age and educational
attainment*

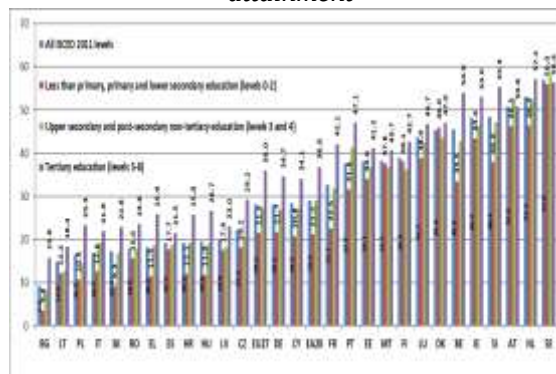


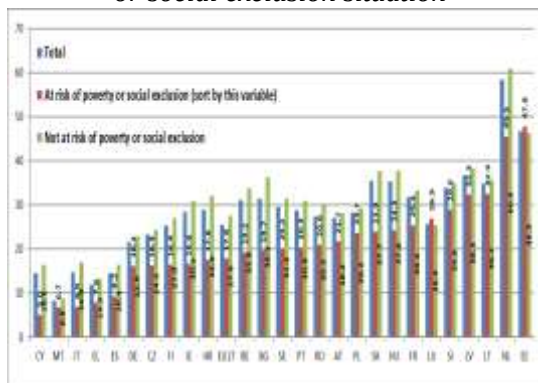
Figure 1. Winter housing comfort and satisfaction by education level (2023)

Source: Eurostat, author processing and systematization

However, in 2023, there are also improvements in the risk of energy poverty. Thus, when we analyze the improvement in the risk of energy poverty, taking into account the entire population and those not at risk of poverty, the countries that have recorded the most improvements are Slovenia, Lithuania, Hungary, Slovakia, Latvia, Estonia and the Netherlands. If, analyzing the improvement in energy efficiency in the last five years, grouped in ascending order by risk of poverty, the countries that have recorded the smallest improvements are Cyprus, Malta, Italy, Greece, Spain, Germany and the Czech Republic, and the countries that have recorded the most substantial improvements are France, Luxembourg, Slovenia, Latvia, Lithuania, the Netherlands and Estonia, although they are still in the top 7 regarding the risk of poverty or social exclusion.

If we also take into account the degree of urbanization, the improvement was recorded more in cities than in villages in the countries like Malta, Spain, Italy, Ireland, Poland, Bulgaria and Slovakia and vice versa in the countries like Greece, Cyprus, Germany, Czech Republic, Finland, Luxembourg, Austria, Romania, Poland, Croatia, Sweden, Belgium, France, Slovenia, Lithuania, Hungary, Latvia, Estonia and the Netherlands.

*Persons living in dwellings whose energy
efficiency had been improved in the last 5
years by sex, current age and risk of poverty
or social exclusion situation*



*Persons living in dwellings whose energy
efficiency had been improved in the last 5 years
by current household composition and degree of
urbanisation*

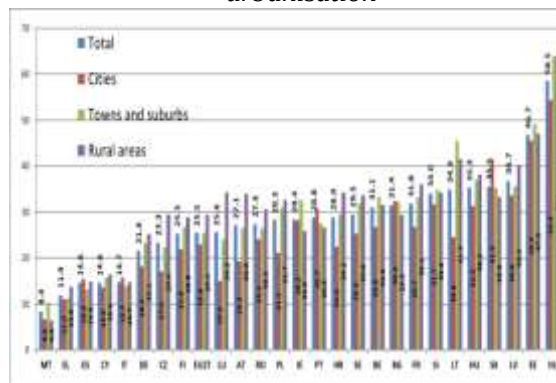
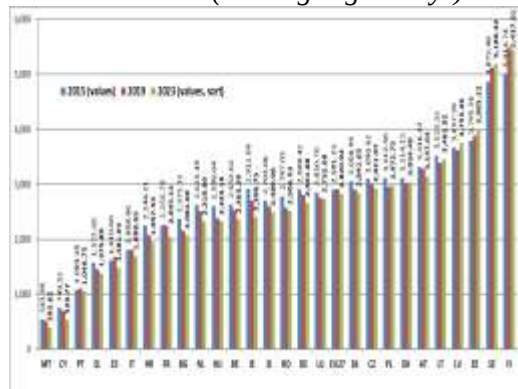


Figure 2. Energy-efficient dwellings by poverty risk, household type, and urbanization

Source: Eurostat, author processing and systematization

Although "The need to cool a given building in the EU in 2022 was almost four times higher compared with 1979." and "In the EU, the needs for heating a given building in 2022 were approximately two-tenths lower than in 1979." (Eurostat, 2023). Nevertheless, the Heating degree days (HDD) indicator can be significant to the correct interpretation of energy consumption for buildings and therefore for describing the general framework for framing the problem of energy poverty.

*Cooling and heating degree days by country
- annual data (Heating degree days)*



*Cooling and heating degree days by country groups
- annual data (Heating degree days) on 2015-2023*



Figure 3. Heating degree days by year and country group (2015–2023)

Source: Eurostat, author processing and systematization

Analyzing the indicator Heating degree days (HDD), we note that during the analysis period (2015-2023) most states recorded a reduction in the number of days requiring heating, with the exception of the countries Lithuania, Latvia, Estonia, Sweden and Finland. At the same time, if we follow the trend during the period 2015-2023 of the various EU regions studied, we note that the years 2016, 2017 and 2021 recorded increases in the indicator for all geographical areas, mainly for the group of countries in the north and east of the continent (NEC), but also for the continental countries (CC). At the same time, a substantial reduction was recorded in 2020 for all groups of countries analyzed. Thus, although we can see that the COVID 19 pandemic brought some disruptions to the indicator (2020-2022), nevertheless the trend regarding the need for heating at the European level decreases from year to year.

If we analyze the indicator regarding the inability to keep the house warm, we can see that although many countries are recording improvements, comparing the year 2023 with 2015 we notice that almost half of the EU27 countries (13 countries) have not recorded positive developments. These countries are: Czech Republic, Denmark, Germany, Estonia, Spain, France, Luxembourg, Netherlands, Austria, Slovakia, Finland and Sweden.

If we follow the increasing indicator, grouped by the value in 2023, we notice that in the negative top, with increasing values, are the countries: Romania, Cyprus, Greece, Lithuania, Bulgaria, Spain and Portugal. Paradoxically, the Nordic countries, although some have recorded increases in the indicator in 2023 compared to 2015, their values are still reduced, in the top of the countries with the fewest households affected by energy poverty according to this indicator are Luxembourg, Finland, Slovenia, Austria, Estonia, Poland and Sweden.

If we analyze the period 2015-2024 as a trend, we notice that all groups of countries registered a decreasing trend in the period 2015-2021, and after 2021 an increasing trend was registered until 2023. This once again highlights the negative impact of the COVID-19 pandemic with all the additional effects, including job losses and

decreased quality of life that led to the worsening of this indicator of housing comfort. The southern flank countries, although paradoxically should be less affected than the northern countries, are nevertheless in the top group of disadvantaged countries, which indicates an increased need for the authorities to remedy the problems related to energy poverty.

*Inability to keep home adequately warm
(Percentage) on countries*

*Inability to keep home adequately warm
(Percentage) on country groups - annual data on
2015-2024*

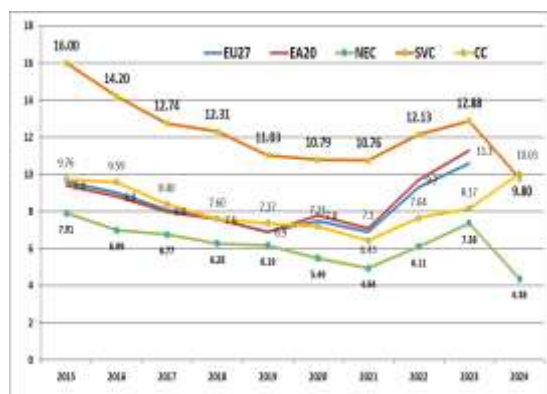
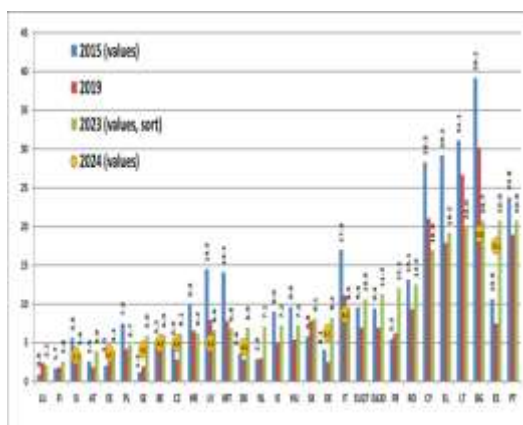


Figure 4. Inability to keep home warm by country and year (2015–2024)

Source: Eurostat, author processing and systematization

Although it does not describe energy poverty per se but rather socioeconomic and housing conditions, severe material deprivation indicates the general framework in which energy poverty can occur.

*Severe material and social deprivation rate
by age and sex (Percentage)*

*Severe material and social deprivation rate by
age and sex on country groups*

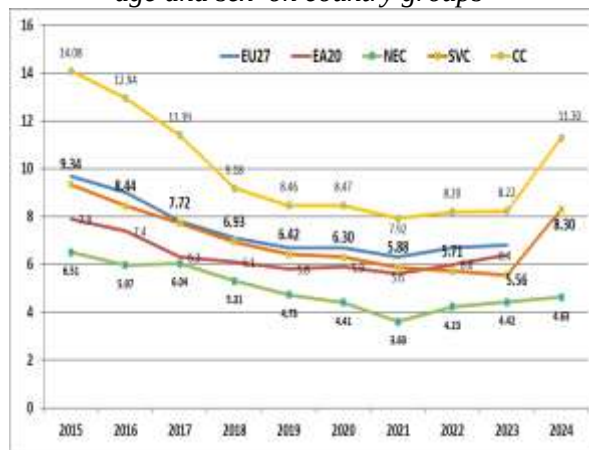
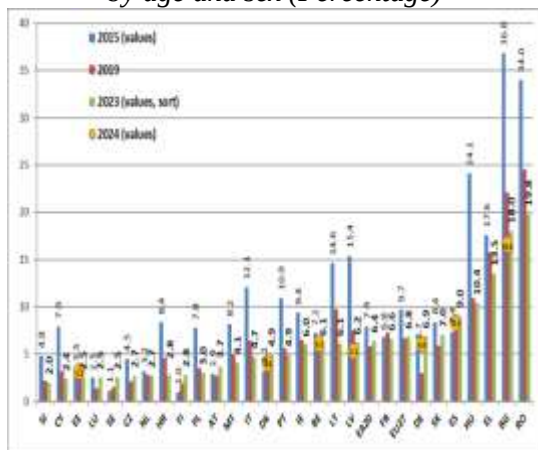


Figure 5. Severe material and social deprivation by age, sex, and country (2015–2024)

Source: Eurostat, author processing and systematization

Thus, at the level of EU27 countries, grouped after 2023, the top seven most materially deprived countries are Germany, Slovakia, Spain, Hungary, Greece, Bulgaria and Romania, although Hungary, Greece, Bulgaria and Romania recorded dramatic reductions in the indicator between 2015 and 2024. If we look at the indicator by country groups at EU27 level, we see that for all country groups the trend is of improvement between 2015 and 2021 and of progressive deterioration between 2022 and 2024. From the

perspective of this indicator, in the top of country groups, the continental, central countries seem to be in the worst shape, followed by the south-western countries.

The previous indicator correlates very well with a classic indicator of energy poverty such as arrears on utility bills. Thus, for this indicator, the top countries with the highest arrears are Ireland, Cyprus, Spain, Croatia, Romania, Bulgaria and Greece, while the countries least affected by energy poverty reflected in the delay in paying utility bills are, in ascending order, the Netherlands, the Czech Republic, Sweden, Belgium, Portugal, Poland and Italy.

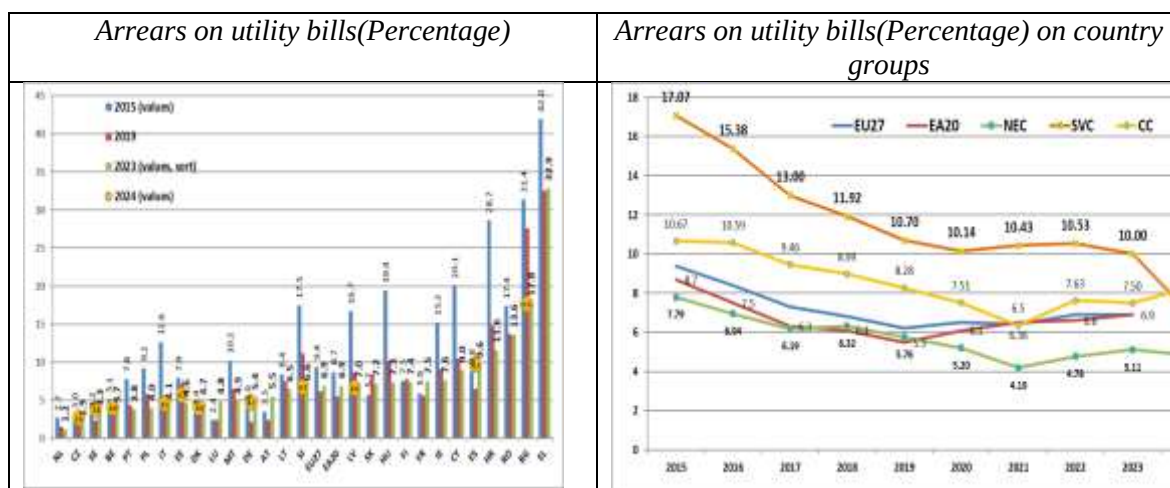


Figure 6. Arrears on utility bills by country and group (2015–2024)

Source: Eurostat, author processing and systematization

If we look at the trend over the analysis period, we generally observe a downward trend across all country groups until 2021, with a slight increase for continental and Nordic countries, not only due to the difficult recovery from the COVID-19 pandemic, but especially, starting in 2022, due to the outbreak of the Russian occupation war in Ukraine. This armed conflict has caused all product groups to have higher prices, but especially those for food and energy products and fuels, which has led to more disadvantaged social categories in regions close to the conflict experiencing problems paying utility bills.

5. Conclusions

Energy poverty, although a construct derived from the classical concept of poverty, has overlapping valences, but also many that diverge from classical poverty, especially material poverty. Energy poverty can very well exist even in situations where material poverty does not exist, in areas where the infrastructure (e.g. isolated, hard-to-reach areas, rural areas, etc.) represents the critical point of access to energy.

In this sense, although the subject seems relatively less important compared to other forms of poverty, through its impact on life, health, work, education, equity and well-being, energy poverty must be addressed more often and more deeply in specialized studies. Thus, the article aims to discern for the period 2015-2024 which are the most important problems are regarding the subject, by taking into account several specific indicators of energy poverty. The results highlight that at the EU27 level, the countries that appear to be substantially affected by energy poverty are not the northern and eastern countries, but rather the southwestern (Mediterranean) flank of the EU27 and, subsidiary, the central flank of EU27 member countries.

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(Data extracted in September 2024).

STRUCTURAL AND TECHNOLOGICAL POLICY AS A TOOL TO ENSURE ECONOMIC RESILIENCE

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Abstract: *The article is devoted to the problems of ensuring economic resilience through the implementation of structural and technological policy measures in the conditions of growing economic uncertainty and sudden shocks. The article considers the essence of economic resilience, identifies the main components that ensure this process: absorptive capacity, adaptive capacity and transformative capacity of the system. It is emphasized that in the conditions of growing economic uncertainty and intensification of catastrophe shocks it is possible to achieve resilience on the basis of structural and technological policy measures. Two main channels of structural policy that contribute to the achievement of dynamic balance and resilience of the economic system are identified: these are measures aimed at (I) increasing the flexibility of the economic system, and (II) strengthening the capacity of the economy and ensuring the stability (robustness) of its structure. It is noted that in the context of geopolitical risks and increasing regionalization of the world economy, the approaches and principles of structural policy are being transformed (the course on securitization, ensuring technological and financial sovereignty, strengthening the role of the state in the economy). At the same time, the change in the content of structural policy and strengthening of its protectionist nature allows successfully absorbing sudden shocks, but creates obstacles for accelerated economic growth in the long term.*

Keywords: *Economic resilience, uncertainty, risks, shocks, transformational resilience, structural and technological policies.*

UDC: 330.342+338.2:330.35

Classification JEL: F52, L16.

1. Introduction

Currently, there is a steady slowdown in economic growth worldwide. This process is largely due to the consequences of the global financial and economic crisis, the coronavirus pandemic, as well as the difficulties in adapting economies to rapidly changing development conditions. Increasing economic uncertainty and complexity of ongoing economic processes, growing waves of systemic shocks and catastrophes, which are intensified by the action of geopolitical factors and the restructuring of the world economy, cause a decline in the potential of economic development in the long term.

The speed of adaptation of the economic system to new conditions of functioning, stress factors and large-scale shocks with a cascading effect depends on the resilience of the economy, its ability to withstand risks and quickly recover from crises. Structural and technological policy is one of the key instruments ensuring the resilience, i.e. flexibility and sustainability of the economic system. It promotes technological renewal of the economy and increases the reallocation of resources between sectors, as well as stimulates the structural complexity of the economy, which in turn contributes to the increase in total factor productivity and long-term economic growth. The purpose of the article is to reveal the essence of economic resilience and to consider the mechanisms through which structural-technological policy ensures the economy's resilience to sudden shocks, to

formulate conceptual directions for improving structural-technological policy to increase the long-term growth potential.

2. Literature Review

Economic resilience is a relatively new subject of scientific research, which came to economics from physics, mathematics and engineering sciences, where it denotes the ability of a system to return to a state of equilibrium after a displacement [1]. In economics, the concept of resilience is closely related to the system approach and the economic theory of complexity, and began to be actively developed only in the mid-2000s. A review of the literature allows us to identify three main waves of increasing interest in the problem under study. The first wave is observed in the period after the global financial and economic crisis; the second one - in the period after the coronavirus pandemic; and then a new surge in 2022 - 2024, associated with the intensification of systemic shocks caused by geopolitical risks and economic turmoil (Figure 1).

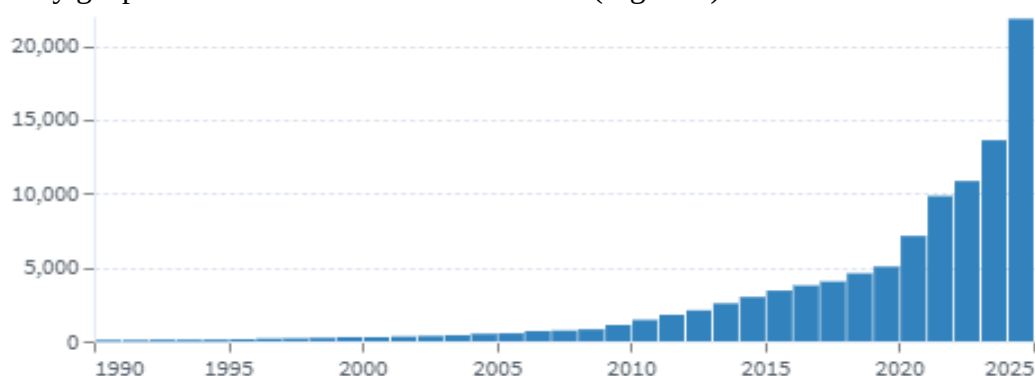


Figure 1. Number of scientific publications on the topic of economic resilience

Source: www.lens.org

Analyses of the subject area on business and economics show an exponential surge of interest in the problem of economic resilience in 2022 - 2024, which correlates closely with the exacerbation of systemic risks, sudden shocks and the challenges of global economic uncertainty during this period (Figure 2).

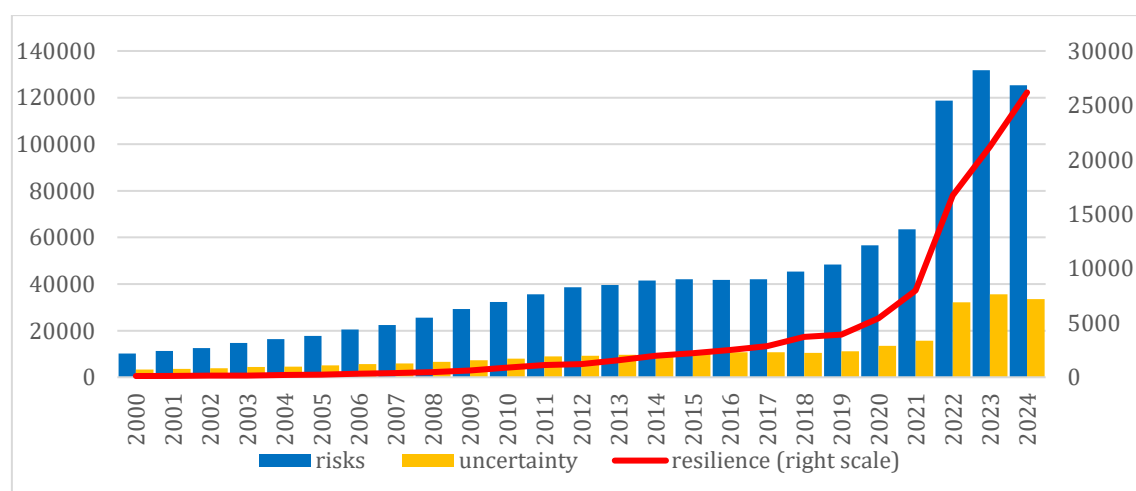


Figure 2. Number of scientific publications on economic resilience, risks and uncertainty

Source: www.lens.org

The concept of resilience is close to the concept of sustainability. However, sustainability implies the ability of the economy to pre-empt risks, reduce the probability and depth of the fall in economic dynamics, quickly recover from shocks and return to the pre-crisis development trajectory. At the same time, resilience reflects the permanent ability of the economy to absorb risks, its ability to function normally in the conditions of a continuous increase in shocks and threats.

Thus, according to the definition [2] economic resilience is the ability of a system exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

The ability of the economy to develop normally in an environment of growing uncertainty and risks, to preserve its key properties and characteristics, to resist numerous external and internal challenges is ensured through change management [3]. In contrast to sustainability, the concept of resilience is considered here as a management process rather than a result, which implies the implementation of policy measures on a continuous basis to anticipate shocks, to counteract challenges and threats to the economy and to adapt to changing development conditions.

According to [4] the resilience of the economic system is ensured by three main components, which are related to each other:

- absorptive capacity, which is the ability of the economy to absorb shocks on a permanent basis, to pre-empt, mitigate and prevent the onset of potential risks and shocks, ensuring the stability of the system;
- adaptive capacity, which implies the ability of the economy to adjust and change its basic characteristics to mitigate likely damage without compromising the structural identity and functional properties of the system. This property implies the possibility of incremental changes in the economic system to increase its flexibility;
- transformative ability, which implies the possibility of creating a fundamentally new economic system under conditions of increasing disturbances, which is least exposed to risks and threats, and creates opportunities for changing the vector of transformation of the system to a qualitatively new level [5].

The role of the components of resilience at different stages of perturbations of the economic system differs significantly: as the intensity and duration of perturbations increase, there is a transition from the absorptive capacity of the economy to adaptive, and then to transformative, which is considered as a key element of the economy's adaptation to disruptions and perturbations that have a sustainable long-term nature (Figure 3).

It seems that it is transformative resilience, which is the main driver of structural adjustment of the economy to long-term challenges and is considered as «bouncing forward to capture the mechanisms and processes that underpin positive adaptation and structural change in response to an acute crisis» [5].

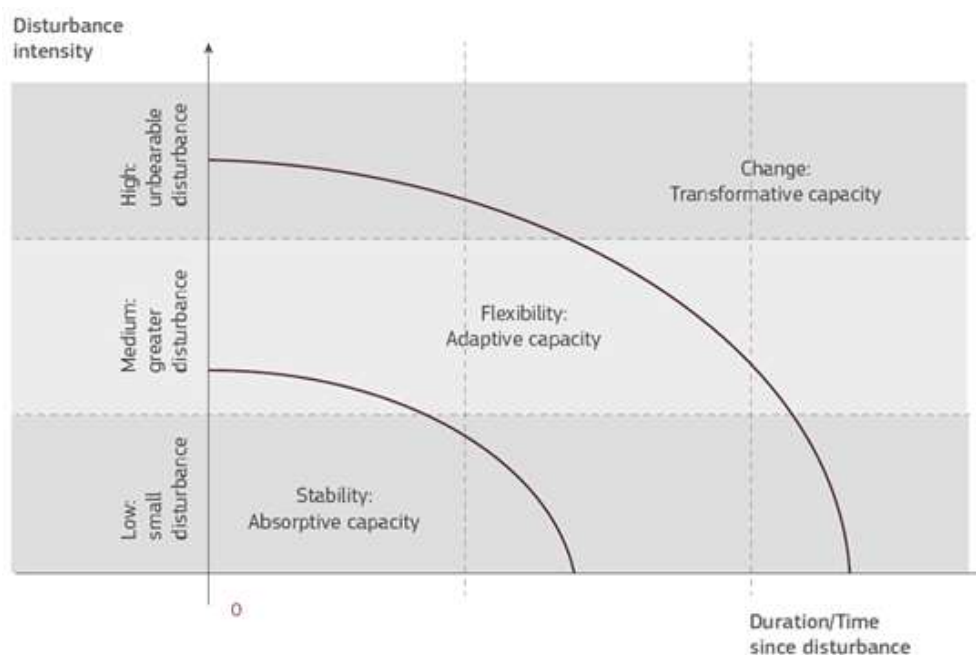


Figure 3. Change in the role of economic resilience components at different degrees of intensity and duration of disturbances

Source: [6]

In this regard, the study of factors and mechanisms of structural and technological policy that contribute to the transformational resilience of the economy is of particular relevance.

3. Methodology

The methodology of this study is based on a qualitative analysis of economic literature that investigates the problems of ensuring the resilience of the economic system through structural and technological policy measures. The methods of system analysis, synthesis, deduction and induction, comparative economic analysis were used in this study.

The first stage of the study involves collecting and analyzing data from official sources describing the dynamics of economic uncertainty and disruption shocks in the world. Then, the literature describing the mechanism of ensuring economic resilience and the economy's resistance to shocks of ripple effects through the formation of redundancy of reserves and the ability of the economy to change its structural and functional characteristics through rapid reconfiguration of resources is reviewed. Based on these conceptual approaches, the key channels of structural and technological policy that influence the rigidity and flexibility of the economic system and support the dynamic resilience of the economy are identified.

The discussion section analyses the changes that structural-technological policy undergoes in the context of increasing economic uncertainty and regionalization processes of the world economy, and considers its possible risks associated with the loss of flexibility in the context of increasing protectionist nature of structural policy. In the final part of the article, based on the results of the study, recommendations in the field of structural policy measures aimed at maintaining the resilience and flexibility of the economic system are developed.

4. Main Results

Currently, there is a radical increase in economic uncertainty around the world. The analysis shows that the Monthly Global Economic Policy Uncertainty Index reached its multi-year high by the beginning of 2025, exceeding the level of pandemic 2020 (Figure 4).

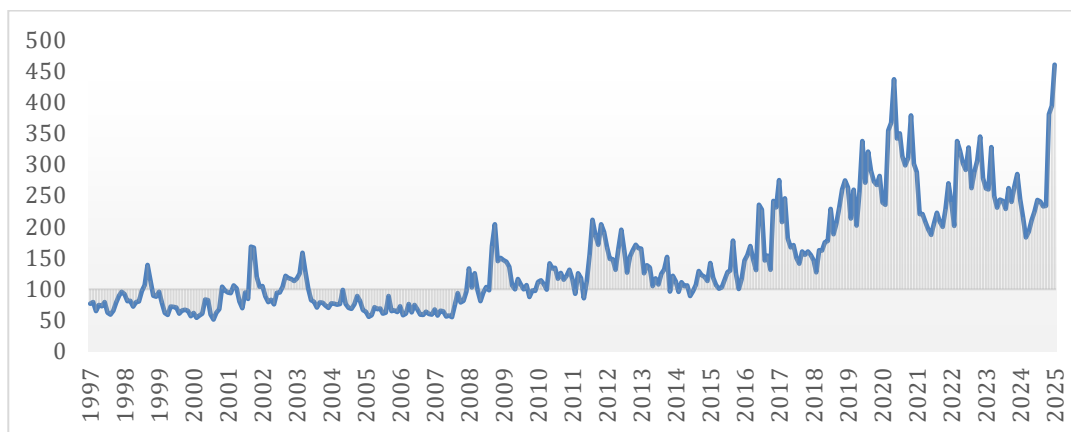


Figure 4. Monthly Global Economic Policy Uncertainty Index (100 = mean value)

Source: <https://www.policyuncertainty.com/index.html>

Increasing global uncertainty is associated with the rapid growth of systemic risks and «disaster shocks» in the world, which are mainly caused by two groups of reasons. On the one hand, it is the human impact on the environment, provoking environmental problems, negative natural, climatic and technological changes. On the other hand, it is the increasing complexity of socio-economic processes taking place in the world, the intensification of the struggle for technological superiority, which cause the reformatting of the system of international economic relations and the restructuring of the global economy, triggering hard-to-predict long-term consequences [7].

The consequence of the ongoing changes is a multiple increase in the number of man-made disasters, natural disasters, pandemics (Table 1), which lead to increased economic divergence between countries, aggravation of the struggle for resources, interstate confrontation.

Table 1. Dynamics of significant disasters and catastrophes in the world, units

Years	Geophysical	Climatological	Hydrological	Meteorological	Epidemic	Technological	Total
1961-1965	31	26	77	93	11	42	280
1966-1970	72	47	130	130	28	63	470
1971-1975	36	29	116	134	6	114	435
1976-1980	110	79	205	191	49	186	820
1981-1985	110	97	292	284	43	267	1093
1986-1990	133	83	358	415	91	845	1925
1991-1995	166	87	469	452	109	924	2207
1996-2000	152	185	664	519	372	1303	3195
2001-2005	198	161	900	685	311	1748	4003
2006-2010	151	122	1046	575	204	1303	3401
2011-2015	159	128	813	609	108	1032	2849
2016-2020	140	126	905	606	122	788	2687
2021-2025 (March)	136	149	815	639	54	661	2454

Source: The International Disaster Database <https://www.emdat.be>

The danger of «disaster shocks» lies in their cascading (ripple) spread, which, having started in one sphere, spreads to other sectors and regions through the domino effect, causing systemic shocks in the economy, up to destructive ones. In the conditions of rapid growth of radical uncertainty and destructive impacts, the ability of transformational resilience of the economy, which is possible on the basis of continuous improvement and restructuring of the basic structures of the economy, regrouping of its elements, properties and resources, becomes especially important [8]. In general, the mechanism of ensuring the resilience of the economy is described by the model developed by Norris [1] (Figure 5).

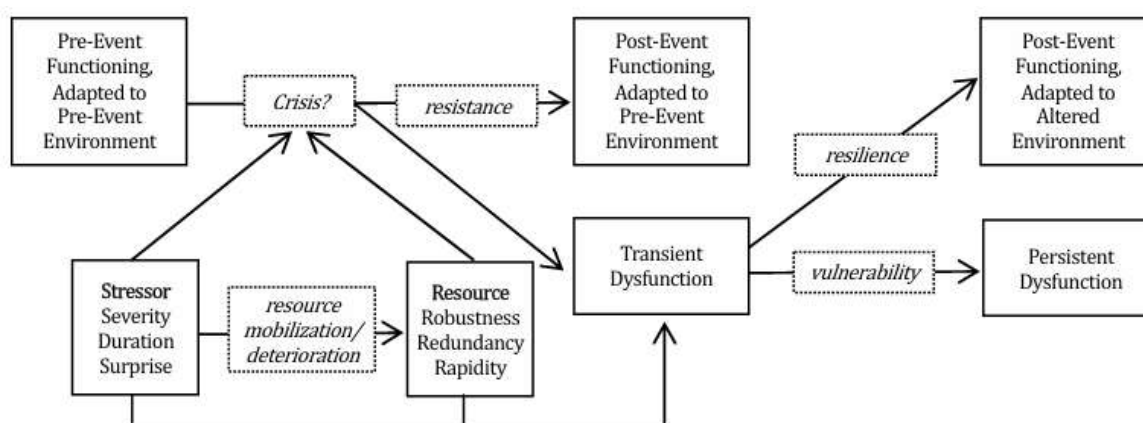


Figure 5. Model of stress resilience and resilience over time

Source: [1]

As follows from the model, the main condition that is necessary to ensure the resilience of the economy is sufficiency (redundancy), reliability and speed of movement of resources, which allows to regroup them to maintain stability and prevent dysfunction of the system. From these positions it is the structural policy that creates opportunities to create new reconfigurations of the structures and functions of the economy in response to shocks [9], and also allows to form a safety margin of the economy, to form reserves to compensate for the probable damage in case of shocks and disasters [10].

Structural and technological policy is an interconnected set of measures aimed at overcoming the limitations of economic growth, smoothing imbalances, developing the production and export potential of the economy, increasing the innovation and technological leadership of the country based on the mechanisms of investment support and financial incentives for strategic goals and priorities of economic development of the state.

In the most general form, structural policy can influence the resilience of the economy by achieving a dynamic balance between two properties of complex systems – robustness and flexibility of the economic structure. Robustness is related to the redundancy of resources and rigidity (resistant) of the system and implies the preservation of its structural stability in the face of shocks, while flexibility is the adaptive ability of the economy to change, which is maintained by changing processes and structure in response to internal and external disturbances [8, 11].

In this context, the impact of structural policy on ensuring the resilience of the economy is realised through two main channels. The first channel is related to ensuring the flexibility of the economy by supporting market instruments, self-development and self-regulation mechanisms, which contribute to the effective reallocation of resources in the economy. As a rule, this implies the development of the private sector and the institution of

entrepreneurship (organizational complexity of the system), liberalization of the labour and capital markets, disposal of inefficiently operating enterprises and their replacement by new, fast-growing and highly productive companies. Basically, these are reactive economic policy measures aimed at maintaining the system's transformative resilience in a changing economic environment (Figure 6).

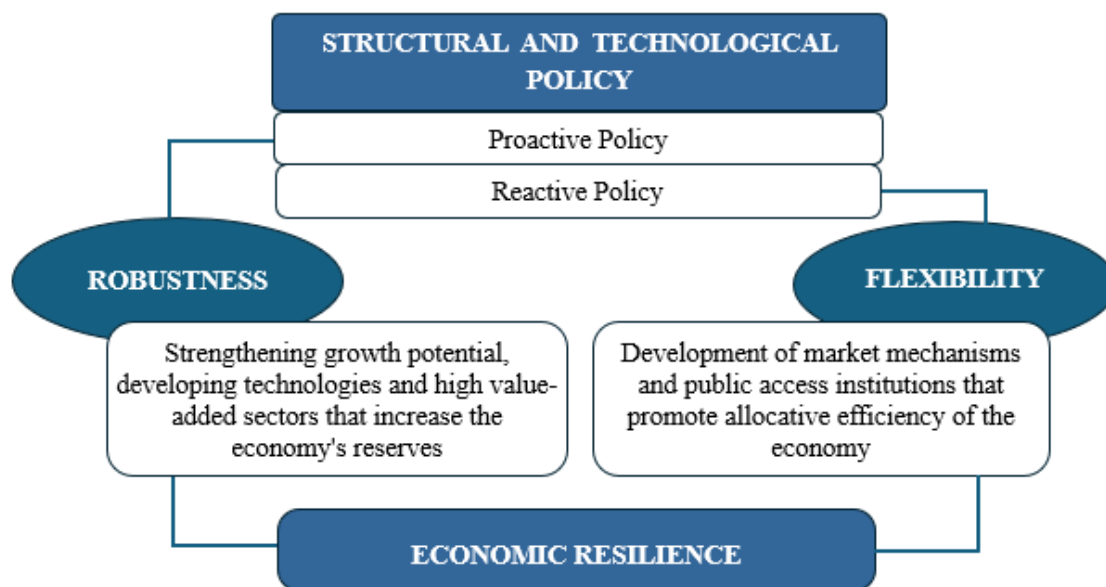


Figure 6. Impact of structural and technological policy on economic resilience

Source: developed by the author based on [11]

The second channel implies the implementation of proactive industrial and technological policy aimed at strengthening the potential of the economy and maintaining the stability (robustness) of its structure. The action of this channel implies advanced development of sectors of the economy with high potential and having developed competitive advantages. Usually, these goals are achieved through increased financing and investment in promising sectors of the economy approaching the global technological frontier. In addition, this direction includes measures to diversify the economy, expand the product space and potential opportunities for the development of new technologically complex industries, taking into account the accumulated competences and available resources. This makes it possible, in case of systemic shocks and deterioration of the economic situation, to switch output between industries, ensuring the maintenance of sustainable production dynamics.

5. Discussion

Meanwhile, at present there is a significant transformation of approaches and principles of structural and technological policy implementation, which is caused by the growing radical uncertainty and strengthening of disruptive shocks. This transformation is associated with the need to protect national interests and maintain the economic security of the state in the conditions of reformatting the system of international economic relations and increasing fragmentation of the world economy. In these circumstances, most countries are implementing a structural and technological policy, which has the following specifics.

Firstly, it is the strengthening of securitization of structural policy, i.e. strengthening of its trend to protect strategic national interests and ensure security,

primarily in the production and technological sphere, which is implemented through the policy of reshoring and nearshoring.

Secondly, as a result, there is a significant strengthening of the role of the state as the main regulator and key investor in the economy, and the expansion of the state sector in the economy.

Thirdly, it is a change in the model of structural policy implementation - a shift from horizontal, non-selective support of the economy to an increase in targeted state financing of strategically important sectors. Thus, the volume of support for the economies of developed countries in the conditions of the 2020 pandemic was about 15%, for developing countries 5% of GDP. At the same time, the size of the budgetary impulse in the Russian economy for 2022 – 2023 is estimated at 8% of GDP, in 2024 just over 3% of GDP. At the same time, the states are providing unprecedented financial support to national producers and directing colossal volumes of investment into sectors of strategic importance. For example, China's dual-circulation strategy, adopted in 2020, provided about US\$250bn in budgetary support; at the end of 2024, it will be just over 3% of GDP. For example, in China, under the dual circulation strategy adopted in 2020, the volume of budget support amounted to about \$250 billion; at the end of 2024, the adoption of a package of economic stimulus measures in the amount of \$1.4 trillion was announced. In the United States, in accordance with the Chip and Inflation Reduction Act adopted in 2022, economic support measures in the amount of over \$420 billion are envisaged until 2030.

Fourth, the core of the structural policy implementation in the context of global security challenges is the course to achieve technological and financial sovereignty, which implies the reduction of dependence on other countries in the field of critical technologies and the ability to conduct an independent and self-sufficient financial and credit policy, resistant to external shocks, risks and threats. Meanwhile, this feature creates risks of slowing down global technological development and fragmentation of the global monetary and financial system, increasing transaction costs of the economy and hindering long-term economic growth.

Such an architecture of structural and technological policy has its own advantages associated with strengthening the ability of the economy to absorb shocks through the formation of reserves and stocks in strategically important sectors of the economy. At the same time, this approach generates the risk of weakening and disrupting the functioning of the flexibility channel (structure variability), which ensures the resilience of the economy. Studies show that the most resilient economies are technologically complex and liberalized economies with developed market institutions that have both high rigidity and flexibility of the structure (the USA, the EU, Japan, etc.). At the same time, robust systems, economies with high rigidity and insufficient flexibility of the structure, usually successfully absorb shocks, but poorly restore productivity growth and, as a rule, experience a decline in resilience with a simultaneous increase in the risk of destabilisation in case of shocks [12].

5. Conclusions

The above raises concerns that the implementation of structural and technological policies with a strong protectionist character will hamper long-term economic growth rates, stimulating inequality and economic divergence between countries. The solution to this problem implies the need to develop policies that maintain the necessary flexibility in the economic system. In this regard, measures to support the private sector and small and medium-sized enterprises, which are highly flexible and adaptive in overcoming the

obstacles associated with the fragmentation of the global economy, seem necessary. It is necessary to create conditions to facilitate the reallocation of resources in the economy, which are associated with the liberalization of the labour market and increased flexibility in the movement of labor resources in the economy. It is necessary to create conditions favorable for the development of the financial sector, which, by attracting funds from private investors, will make it possible to finance large-scale structural and technological transformations in the economy.

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SUSTAINABLE ENTREPRENEURSHIP AND THE FUTURE LABOR MARKET: INNOVATION, TECHNOLOGY AND STRATEGIC ADAPTATION

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Abstract: As the global economy rapidly shifts toward sustainability and digitalization, the role of entrepreneurship education teachers has never been more critical in shaping the future workforce. This article explores how innovation, technology, and strategic adaptation influence the development of essential skills needed to thrive in a sustainable economy. It examines emerging trends that are reshaping both teaching methods and labor market expectations, including the circular economy, automation, and sustainable business models. More than ever, education must be dynamic, equipping students with entrepreneurial thinking, creativity, and adaptability. The study highlights the importance of a flexible approach that prepares students not only to navigate change but to drive it. Ultimately, the findings emphasize the need for strong collaboration between educators, entrepreneurs, and policymakers to create a seamless transition from education to a labor market that is both competitive and sustainable.

Keywords: Entrepreneurship education, future of work, entrepreneurial skills, innovation, adaptability, sustainable economy.

UDC: [001.895:334.72]:331.5

JEL Classification: J21, M12, M21, O32.

1. Introduction

The exploration of the evolution of sustainable entrepreneurship, from an economic initiative to a form of social responsibility and environmental concern, outlined in the specialized literature, highlights the urgent need to adapt entrepreneurial education to the new economic reality shaped by digitalization. As a result, a continuous adaptation of entrepreneurial competencies to the requirements of the 21st century is necessary, with a focus on critical thinking, empathy, and creativity. This analysis creates an overview of sustainable entrepreneurship as a key component in the emerging economic architecture. Recent fiscal, technological, and environmental changes have required a profound reassessment of how the future labor market is structured. The immediate effects of climate change have triggered a re-evaluation of international strategic imperatives, steering efforts toward sustainable practices.

In this context, digitalization, automation, and the rapid development of experimental technologies are transforming job requirements, calling for a rescaling of workers' competencies in an increasingly dynamic market economy. According to the 2023 World Economic Forum labor outlook, the main drivers of occupational evolution over the next half-decade are innovative technology and planetary care. Using transdisciplinary methods, the impact of innovation, technological strategies, and adaptive frameworks on green entrepreneurship is examined, along with approaches to enhance workers' skills for the evolving job market. For the labor market, new technologies, automation, and the shifting landscape of necessary skills pose a considerable challenge, which demands continuous alignment with current trends. Therefore, the development of key competencies such as

critical thinking, flexibility, inventiveness, adaptability, and collaboration is essential forming a foundational link for both entrepreneurs and job seekers.

2. Literature Review

In recent years, the concepts of sustainable development, circular economy, and green transition have significantly diversified and deepened in the specialized literature, as scholars approach these topics from various perspectives [1]. As such, sustainable entrepreneurship represents more than an innovative strategy for entrepreneurs aiming to revitalize the economy and society. Technically, sustainable entrepreneurship is based on the integration of the three aforementioned strategies, thereby combining what should be preserved and protected (natural capital and social cohesion) with the pursuit of innovation, which generates economic value and contributes to profit [2]. Consequently, sustainable entrepreneurs aim to meet needs comprehensively, striving to achieve a balance between people, planet, and profit. The entrepreneurial competencies required today are increasingly influenced by accelerated digitalization and the advancement of artificial intelligence [3], which calls for both strategic support and a robust educational strategy to foster sustainable entrepreneurship.

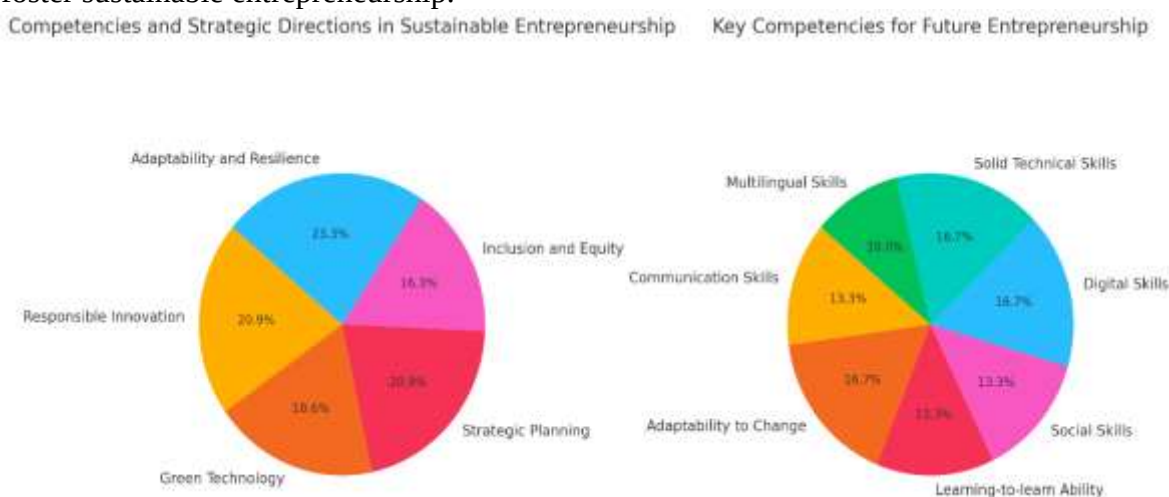


Figure 1. Key competencies in sustainable entrepreneurship

Source: compiled by the author

The convergence of the need for innovation and responsibility has been strongly reflected in the specialized literature in recent years. According to World Economic Forum studies (2023), approximately 23% of occupations will be reconfigured by 2027. Thus, in addition to general challenges, we are witnessing a growing demand for professionals capable of working in a dynamic environment - within a world driven by positive opportunities - where professional training plays a crucial role. In the current context, sustainable entrepreneurs can turn new technologies into powerful allies for achieving their goals. Digitalization and the orientation towards social and environmental purposes enable transformation into sustainable solutions [4]. The integration of AI, blockchain, or big data is becoming a prerequisite for entrepreneurial relevance. The ILO (2018) projection "Greening with Jobs" estimates that by 2030, up to 24 million green jobs could be created, provided a coordinated transition to sustainable industries is achieved [5]. By intertwining emerging technologies with social and environmental values, sustainable entrepreneurs are becoming pillars of a fairer and more resilient economy [6]. Strategic planning and responsible innovation are now essential tools for coping with an evolving regulatory

framework and increasingly conscious consumers. Promoting inclusion and equity in access to economic opportunities is not only a moral duty but also a prerequisite for sustainable competitiveness.

The literature emphasizes that through this deep alignment between innovation and sustainability, the resilience of the socio-economic ecosystem can be ensured in the long term (see Figure 2). Therefore, current literature reviews clearly highlight that sustainable entrepreneurship is one of the most promising responses to the major challenges of our time. In this context, education grounded in science - yet open to reality - can foster leaders who understand the necessity of consistently navigating the future.



Figure 2. Main currents in the specialized literature on sustainable entrepreneurship

Source: compiled by the author

3. Methodology

The transition to a sustainable economic model requires a qualitative-descriptive approach that combines conceptual analysis with contextual interpretation of existing data. The aim of this endeavor was to gain a deep understanding of the dynamics of sustainable entrepreneurship in relation to labor market transformations and educational reforms, based on a systematic review of the specialized literature and current strategic documents.

The research followed several distinct methodological stages. The review of scientific literature enabled the identification of key theoretical paradigms and emerging currents in the field. At the core of the analysis lies the integrative synthesis method, used as both a theoretical and applied instrument to merge findings from diverse sources and methodological backgrounds into a coherent conceptual framework [7]. This approach not only enables the consolidation of existing knowledge, but also facilitates the identification of convergence points between research studies and policy frameworks, interpreted through a shared analytical lens: the redefinition of entrepreneurship in the context of the sustainable transition and the reform of competency models aligned with the future economy [8].

The implementation procedure of the integrative synthesis involved several key steps:

- Thematic coding of sources, highlighting core topics such as digitalization as a transformative driver of the labor market and interdisciplinary skills needed for social equity and corporate responsibility;

- Triangulation of academic and strategic sources, comparing insights across literature types and analytical levels;
- Contextual interpretation of data, aligning results with research objectives and emphasizing the influence of sustainability on skill formation and entrepreneurial models.

Based on this process, a three-dimensional conceptual framework was developed to illustrate the dynamic interrelation between education, the labor market, and entrepreneurial mindsets:

1. *Labor Market Transformations* - These reflect the ongoing adaptation to technological and socio-economic shifts. Entrepreneurial skills- such as innovation capacity, initiative, originality, and flexibility- are becoming critical in shaping a resilient and future-ready workforce[9]. In light of advancements in artificial intelligence and digital transformation, there is an urgent need to redefine professional competencies and adopt a strategic approach to reforming educational systems. The integration of these three dimensions was achieved by identifying feedback mechanisms linking education, the economy, and entrepreneurial practices. In this way, sustainable entrepreneurial education emerges as a bidirectional channel: investments in education generate essential competencies, while emerging labor market needs drive strategic adaptations in both curricula and public policy.
2. *Reorganization of the Educational System*- This dimension underscores the importance of aligning educational programs with the evolving demands of the labor market and entrepreneurial ecosystems. The digital transformation of educational institutions into entrepreneurial models calls for the integration of innovative technologies and curricular revision to prepare a flexible and proactive workforce [10].
3. *Evolution of Entrepreneurial Paradigms*- A shift from a purely economic rationale toward a socially and environmentally oriented entrepreneurial vision is becoming evident. Entrepreneurship is increasingly seen as a strategic tool for systemic transformation, with innovation, technology, and equity forming its foundational pillars. This perspective highlights the complex relationship between strategic decisions, public policies, and professional education[11].

Furthermore, the integrative approach allowed for the correlation of micro-level (individual skills), meso-level (educational practices), and macro-level (policy frameworks) analyses, providing a holistic perspective on the challenges and opportunities of sustainable entrepreneurship. This theoretical construct forms a solid basis for developing evidence-based public policies and innovative educational interventions that are well aligned with current socio-economic transformations[12].

The study is exploratory and interdisciplinary in nature, combining economic analysis with pedagogical and managerial perspectives. The methodology is based on secondary research, grounded in a wide range of recent academic studies, policy reports, and international statistics. This approach not only enabled the identification of global trends but also allowed for the formulation of strategic, evidence-based recommendations in the field of entrepreneurial education and labor market policy[13].

4. Analysis and Interpretation

According to recent studies and strategic frameworks, the circular economy represents a fundamental pillar of economic sustainability, relying on reuse, repair, and regeneration. This model requires new skill sets, such as life cycle assessment of products and innovation in eco-

design. Emerging professions in the field of sustainability include sustainability consultancy, ecological engineering, and green logistics. At the same time, emerging technologies and automation are accelerating the process of transformation at an unprecedented pace, demanding specialists capable of operating within a circular and responsible system.

In this context, there is a growing need for a shift toward experiential learning, interdisciplinary projects, and adaptive digital training. Today, sustainability is increasingly being framed as a core value in entrepreneurship, and the new generation - Generation Z and Alpha - are increasingly drawn to entrepreneurial initiatives that integrate economic purpose with social and environmental impact [14]. As a result, a new business model is needed - one that is built on ethics, diversity, and social innovation as foundational values [15]. Within this framework, entrepreneurs are emerging as agents of change, capable of building flexible teams with an organizational culture that is responsible and committed to the common good.

Four major dimensions are beginning to shape entrepreneurship, employment, and the development of competencies for the economy of the future:

Emerging Trends in the Future Labor Market

The intersection of accelerated technological progress and the imperatives of sustainable development marks a transformative shift in the economy. According to *The Future of Jobs Report 2023*, approximately 23% of jobs are expected to undergo a profound structural transformation by 2027, driven by technological advancements and the sustainable transition[13]. This dynamic reflects both the emergence of entirely new roles and the gradual disappearance of others - particularly in industries dominated by repetitive and manual tasks. Automation, robotics, and artificial intelligence are already realities across many sectors and are prompting a broad reconfiguration of skills demand. While a modest net decline of about 2% in the total number of jobs is projected - equivalent to approximately 14 million jobs globally - this figure fails to capture the depth of qualitative changes in workforce competencies. It is estimated that around 44% of workers' current skills will be redefined by 2027. A new model of skills is emerging, where analytical and creative thinking, continuous learning, resilience, and adaptability become essential [16]. These competencies underscore the need for workers - and especially entrepreneurs - to effectively navigate the complexity, uncertainty, and multiple transitions of the future economy.



Figure 3. Strategies for adapting sustainable entrepreneurship

Source: compiled by the author

Sustainable innovation as a driver of employment and economic transformation

Sustainability was initially perceived as a potential impediment to economic growth, potentially leading to job losses. However, the green transition and the emergence of new ESG (Environmental, Social, and Governance) standards have proven to be powerful drivers of employment - surpassing even automation and globalization in impact. In the field of sustainable entrepreneurship, the number of jobs surpassed 12 million in 2021, and it continues to rise. If the transition is managed efficiently, by 2030, up to 24 million sustainable jobs could be created. After accounting for potential job losses in polluting industries, a net gain of 18 million jobs is projected[17], [18]. A significant shift is also observed within the community of Certified B Corporations (B Corps) - companies verified for their commitment to employees, communities, and environmental stewardship. In 2020, there were 3,700 B Corps, and by now, the number has grown to nearly 8,000 in over 90 countries. Notably, in 2023 alone, more than 1,800 companies obtained certification - the largest growth recorded to date[19], [20]. Young people, who will form the future workforce, are increasingly drawn to such companies. Statistics show that 37% believe companies should prioritize people and the planet over profit, and 75% prefer to work for organizations that clearly uphold social and environmental values[21]. This aligns with the rising demand for sustainability-related roles such as ESG managers and green energy experts. To ensure a sustainable future, it is essential to prepare a new generation of professionals capable of transforming challenges into profitable solutions. The education sector must adapt to the new demands of the labor market by fostering and developing skills tailored to future jobs - those that are sustainable, digitalized, and impact-oriented. Thus, sustainability is emerging as a true economic opportunity, and adaptability to change becomes a key strategy for a resilient economic ecosystem. Interest in concepts like sustainable development, circular economy, and green transition has grown rapidly in recent years, spurring an evolution in both academic and business discourse.

Technology and digital transformation in support of sustainability

Technological progress, far from being a neutral force, is now becoming an essential ally of sustainability. Digital transformation does not act in isolation but operates in synergy with ecological and social imperatives, offering concrete solutions to the major challenges of the 21st century. In today's economic landscape, organizations that implement integrated strategies of digitalization and sustainability not only maintain market relevance but also become key agents of industrial transformation. According to World Economic Forum data, a clear trend has emerged: 75% of global entities anticipate massive adoption of digital technologies by 2027. This shift will lead to a reconfiguration of the labor market through the emergence of hybrid roles, new value models where financial performance and positive impact become interdependent, and structural changes driven by the rise of business ecosystems based on digital collaboration and circular principles. From an applied perspective, digital technologies - such as big data, artificial intelligence (AI), cloud computing, and the Internet of Things (IoT) - enable optimization of logistics flows, reduction of waste, increased efficiency across value chains, and real-time monitoring of environmental impact. By adapting to technology, sustainable entrepreneurship becomes both innovative and empowering. As a result, sustainable start-ups can access international markets via digital platforms, mobilize financial resources through crowdfunding, and engage openly in innovation ecosystems[22]. Small businesses, in turn, can leverage digitalization to improve performance and meet consumer demand more effectively. Studies show that entrepreneurs who have embraced digitalization were

better equipped to overcome recent crises - such as the COVID-19 pandemic - demonstrating superior digital resilience[23]. Looking to the future, emerging technologies such as 5G, edge computing, augmented reality, and biotechnology will open new frontiers for sustainability. AI-assisted bioeconomy, for example, can generate alternative materials with minimal carbon footprints, while the collaborative economy - enabled by digital platforms - can reduce resource underutilization and enhance systemic efficiency.

Sustainable entrepreneurial education and skills adaptation

In a world marked by profound economic, social, and climate transformations, entrepreneurial education must become a catalyst for sustainable change[24], [25]. Recent data show a growing interest among young people in entrepreneurship. According to a 2023 Flash Eurobarometer survey, 46% of young Europeans express a desire to start their own businesses, but more importantly, this generation is driven by a vision of business that is measured not only by profit but also by social impact and environmental responsibility (see Figure 4)[26]. Three out of four young people say they want to work for companies that uphold strong values, protect the environment, and contribute to community well-being. This is not just a preference, but a call for change. As a result, education plays a critical role, particularly in the development of competencies aligned with emerging labor market trends and sustainable entrepreneurship. This form of entrepreneurship merges innovation with sustainability and demands a new set of skills that empower youth to navigate complexity and generate impact. The Sustainable Entrepreneurship Education (SEE) model is essential due to its practical approach, where students learn through real projects, collaborate with their communities, and directly experience how they can make a difference. Investing in such education is vital—students must be provided with both the tools and the confidence they need. In doing so, their creativity and sense of responsibility will become essential contributors to a sustainable economic future.

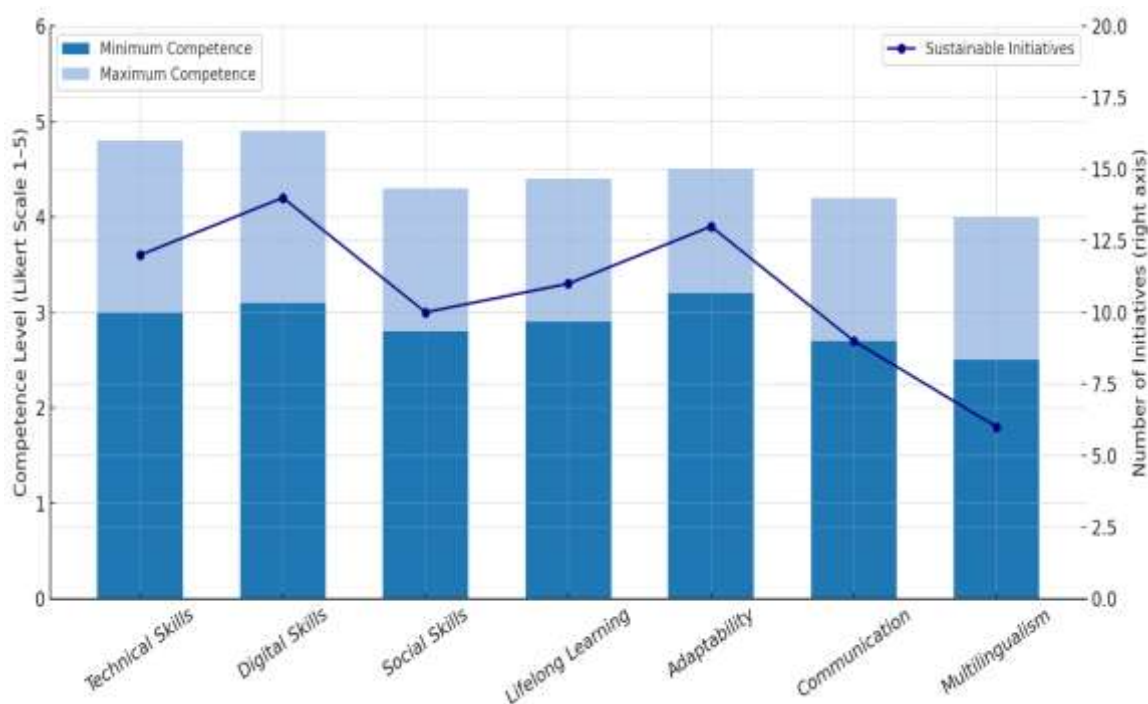


Figure 4. Entrepreneurial competencies and sustainable initiatives

Source: <https://europa.eu/eurobarometer/surveys/detail/>

The Sustainable Entrepreneurship Education (SEE) model is essential due to its practical, hands-on approach, through which young people learn by engaging in real-world projects, collaborating with their communities, and directly experiencing how they can make a difference. It is timely and necessary to invest in education, equipping youth with the tools and confidence they need, so that their creativity and sense of responsibility can actively contribute to a sustainable economic future [28]. According to the study by Rosário and Raimundo (2024), universities and high schools around the world are already adopting SEE models, yet the main challenge remains integrating these initiatives into a coherent educational strategy. The impact is already visible: recent studies show that students who take part in sustainable entrepreneurship modules develop a stronger intention to create businesses with positive impact. In Romania, successful programs such as Junior Achievement offer youth practical and relevant learning opportunities, while initiatives like EFdeTeach support teachers in integrating sustainability concepts into their teaching practices. At the same time, in the Republic of Moldova, entrepreneurial education has been introduced into the curriculum from primary to university level, along with support for pilot projects implemented within the vocational education system. These efforts are carried out in collaboration with international organizations such as the EU, UNDP, and UNICEF [27], [29], [30].

5. Conclusions

The economy of the future is being built at the intersection of innovation, sustainability, and adaptability. From the perspective of academic research, sustainable entrepreneurship emerges as a strategic solution for transforming the labor market. It simultaneously addresses the need to create jobs, protect the environment, and promote social equity.

This research outlines three key dimensions that simultaneously influence entrepreneurship, employment, and skills development for a future-oriented economy:

1. Environmental and social responsibility redefines the purpose of tomorrow's economy and provides a clear path forward.
2. Adaptability and openness to change are increasingly vital in an economic landscape shaped by digitalization and automation. The ability to engage in lifelong learning, manage uncertainty, and integrate new technologies is becoming essential. Both entrepreneurs and employees must develop competencies that allow them to adapt quickly and responsibly.
3. Development of transversal skills is crucial for the economy of the future. These include not only technical knowledge but also critical thinking, creativity, and collaboration. Such competencies are foundational for an entrepreneurial mindset capable of responding to complex and interconnected needs.

The findings of this study emphasize the need for an adaptive and integrated response to the current challenges of the sustainable economy, placing a strong emphasis on the crucial role of education and public policy in shaping the competencies required for the future labor market. Consequently, the study presents a set of strategic recommendations, developed through a synthesis of relevant academic literature and policy documents, with the aim of supporting the effective implementation of sustainable approaches in both education and entrepreneurship. To reinforce the applied dimension of the research, these recommendations have been categorized according to two key stakeholder groups:

educational institutions, as vectors for competence development, and decision-makers, as agents of structural reform in economic and educational policy frameworks.

STRATEGIC RECOMMENDATIONS	
EDUCATIONAL INSTITUTIONS	POLICYMAKERS
Invest in digital tools that help reduce the ecological footprint and support digital learning	Develop a measurement framework integrating simultaneous ROIs and sustainability impact
Develop sustainable entrepreneurship programs within educational institutions	Consider digitalization and green technologies as pillars of economic policies
Adapt existing curricula to strengthen digital and green skills for the current job market	Support public-private initiatives for sustainable entrepreneurship

Figure 5. Strategic Recommendations for Educational Institutions and Decision-Makers

Source: compiled by the author

As shown in Figure 5, educational institutions are encouraged to invest in digitalization, foster green skills, and promote cross-sectoral collaboration to support sustainable innovation. Policymakers are urged to adopt a holistic vision of sustainability, recognizing digital transformation and environmental responsibility as complementary pillars of the emerging economy. Ultimately, the desired transformation can only be achieved through shared commitment and courageous vision. Sustainable entrepreneurship has the potential to serve as a key engine of a balanced economy - one that actively safeguards both human dignity and ecological integrity.

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THE SOCIAL AND ECONOMIC IMPACT OF SOCIAL ENTREPRENEURSHIP IN THE REPUBLIC OF MOLDOVA

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Abstract: *Social entrepreneurship represents an innovative and dynamic strategy for economic and social development, increasingly recognized as an effective tool to address current societal challenges. This concept integrates economic and social objectives into a sustainable business model, where success is not solely defined by financial performance but also by its positive impact on communities and the environment. The paper analyzes the social and economic effects of social entrepreneurship in the Republic of Moldova, emphasizing its capacity to provide solutions to major issues such as migration, poverty, exclusion, environmental degradation, and unemployment among vulnerable groups. Despite the positive outcomes, the development of this sector faces significant challenges, including limited financial access, lack of awareness, and inadequate legislative frameworks. The authors highlight the necessity of a systemic approach involving public institutions, private actors, and NGOs to ensure the sustainability of social businesses and promote inclusive development.*

Keywords: *Social entrepreneurship, economic impact, social inclusion, vulnerable groups, sustainable development, entrepreneurial education, public policy.*

UDC: 316.42:334.72(478)

JEL Classification: L31, O35, M14, J24, I38

1. Introduction

Social entrepreneurship represents an innovative and dynamic strategy for economic and social development, increasingly recognized as an effective means of addressing current societal challenges. This concept integrates economic and social objectives into a sustainable business model, in which success is not defined solely by financial performance but also by the positive impact on the community and the environment. This form of entrepreneurship is distinguished by the fact that its main priority is not maximizing profit, but enhancing societal well-being.

A key aspect of this economic model lies in the reinvestment of generated revenues to support social initiatives, identify and meet emerging needs, promote economic and social inclusion of vulnerable groups, as well as develop markets capable of addressing needs insufficiently covered by the traditional economy.

In addition, social entrepreneurship plays an essential role in developing innovative solutions for the integration of people with disabilities into economic activities, reducing social inequalities, and creating employment opportunities for disadvantaged groups.

In contrast to conventional economic models, social enterprises operate under a different mechanism, characterized by moderate and sustainable economic growth, oriented toward social and environmental impact [1]. These entities effectively combine economic development goals

with social responsibility, acting to address the structural problems of society, such as combating poverty, promoting social equity, or protecting and sustainably managing natural resources.

Therefore, social entrepreneurship is not just an alternative economic model, but also a key factor in the transition toward a more inclusive and sustainable economy, capable of responding to the complex challenges of sustainable development.

2. Literature Review

Recent literature outlines the emergence of social entrepreneurship as a hybrid model that bridges gaps left by traditional public and private sectors. Authors such as Bornstein and Davis emphasize the transformative power of social enterprises in tackling systemic inequalities. In Moldova, studies by local institutions (e.g., Expert-Grup, Government reports) identify social entrepreneurship as a promising, yet underdeveloped, sector. However, a lack of consistent policy and funding frameworks remains a barrier.

3. Methodology

The paper is based on a qualitative analysis of secondary data from national statistical reports, government strategies, and international development programs. Data from 2020 to 2024 on indicators such as disability, youth unemployment (NEETs), and rural demographics were examined to assess the socio-economic context in which social entrepreneurship operates. Comparative analysis and synthesis methods were employed to evaluate policy impact and entrepreneurial trends.

4. Results and Discussion

An essential element of social entrepreneurship is the assessment of its generated impact. Social entrepreneurs use various methods and tools to analyze the positive effects their activities have on the community. These evaluations go beyond financial performance and include social and environmental impact. By continuously monitoring progress, they are able to adapt their implemented strategies, thereby ensuring the ongoing optimization of results and maximizing the benefits delivered to society.

Unlike traditional businesses, social entrepreneurship focuses on:

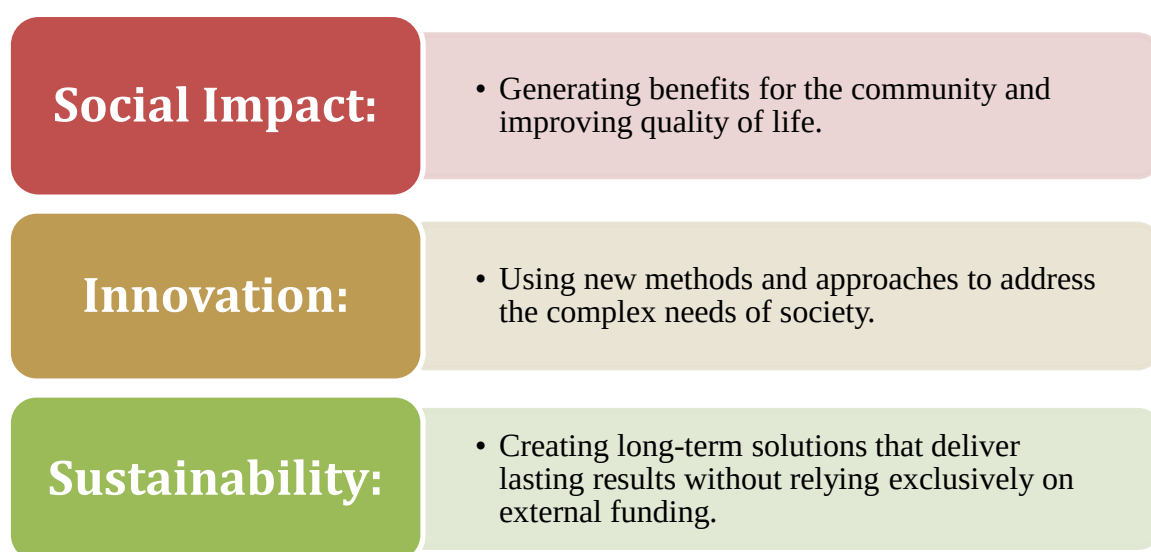


Figure 1. Pillars of social entrepreneurship

Source: developed by the authors

The Republic of Moldova faces numerous social and economic challenges that underline the necessity of adopting innovative models such as social entrepreneurship:

1. **Migration and depopulation:** Moldova is among the countries with the highest migration rates in Europe, leading to a loss of skilled labor and an aging population. In this context, social entrepreneurship can contribute to job creation within communities, offering opportunities for young people and reducing the need to emigrate.
2. **Poverty and economic inequalities:** A significant portion of the population lives below the poverty line, especially in rural areas. Social enterprises can develop vocational training programs, support organic agriculture, or create local businesses to improve living standards.
3. **Limited access to education and healthcare:** Issues in the education and healthcare systems affect the country's social and economic development. Social entrepreneurs can contribute through initiatives that provide access to alternative education, vocational courses, or medical services for disadvantaged communities.
4. **Environmental problems:** Moldova faces massive deforestation, pollution, and poor waste management. Social entrepreneurship can address these issues through ecological projects such as recycling, sustainable agriculture, or renewable energy production.
5. **Dependency on external funding:** The country's economy is heavily influenced by remittances and external financial aid. In this case, social entrepreneurship can stimulate community self-sufficiency by generating local income sources.

Social entrepreneurship in the Republic of Moldova is still in its early stages of development and cannot grow without a series of consistent and sustained efforts from all involved actors. In addition to the regulatory framework, concrete measures must be initiated to create a supportive development ecosystem: access to various financing instruments and markets, business support structures, human resource development and research, differentiated fiscal and non-fiscal incentives based on the type of social enterprise etc. [2].

A significant impact of social entrepreneurship lies in its capacity to generate employment opportunities, especially for vulnerable groups such as people with disabilities, NEET youth (not in employment, education, or training), and the rural population. Through innovative and sustainable initiatives, social entrepreneurship contributes to the integration of these groups into the labor market, offering them greater opportunities for economic and social inclusion.

Table 1. Social and economic vulnerability indicators in Moldova (2020–2024)

Indicator	2020	2021	2022	2023	2024
People with disabilities (thousands)	174.5	168.0	162.3	161.9	-
Share of disabled population (%)	6.8	6.8	6.7	-	-
NEET youth (15–29), %	31.2	26.4	-	-	20.3
Rural population (thousands)	1506.0	1479.7	1442.8	1408.3	1287.5
Unemployment in rural areas (%)	-	-	-	-	4.7

Source: Authors, based on NBS

Between 2020 and 2024, the Republic of Moldova experienced significant changes in the social and economic vulnerabilities of its population. The number of persons with disabilities

steadily declined, and their share in the overall population slightly decreased, suggesting demographic changes or migration. The proportion of NEET youth decreased from 31.2% in 2020 to 20.3% in 2024, indicating a possible improvement in access to education and employment opportunities.

The most notable transformation is the reduction of the rural population, which declined from 1,506 thousand in 2020 to 1,287.5 thousand in 2024, reflecting a phenomenon of both internal and external migration. Although the rural unemployment rate in 2024 stood at 4.7%, this indicator does not provide a clear picture of employment due to the informal nature of many economic activities.

Overall, the analysis of these indicators highlights several major challenges for the Republic of Moldova, particularly regarding rural depopulation, youth labor market integration, and support for vulnerable populations. These developments emphasize the need for effective public policies to reduce social and economic disparities.

In the context of the marginalization of people with disabilities—a persistent issue—accessibility to public buildings remains limited. Data from 2022 shows that public institutions were the most accessible; however, only one in ten buildings (172 buildings) was fully adapted to the needs of people with disabilities. In contrast, police sectors were among the least accessible, with only 1.7% of buildings adapted [3]. This situation significantly restricts the integration of people with disabilities into society. To ensure proper conditions, several measures are necessary [4]:

1. Amending the regulatory framework to hold central and local public authorities accountable for evaluating accessibility conditions.
2. Adjusting the legal framework to designate an authority responsible for identifying violations of construction legislation and regulations.
3. Developing a National Plan for the accessibility of public institutions.

A key challenge for the Republic of Moldova is to strengthen social cohesion by reducing inequalities, which manifest as economic, social, and public service access disparities. According to data from the National Bureau of Statistics, the Gini coefficient - a measure of income distribution - stands at around 35, indicating a moderate level of inequality. Economic disparities between urban and rural areas are significant, exemplified by the fact that the average monthly salary in Chişinău municipality is 50% higher than in rural regions in the south of the country [5].

Through the development of sustainable businesses, social entrepreneurship plays an essential role in revitalizing the local economy, contributing to increased production and consumption within communities. Social enterprises can also have a significant influence in promoting responsible economic practices, based on sustainability principles and positive social impact.

Furthermore, social entrepreneurship serves as an effective mechanism for facilitating the socio-economic inclusion of youth from disadvantaged areas, providing them access to educational and vocational training programs. These initiatives support the development of skills necessary for labor market integration, thus helping reduce social and economic inequalities.

A key element in supporting this process is the collaboration between public institutions and non-governmental organizations (NGOs) in developing regional centers specialized in vocational training for people with disabilities. These centers can be integrated into existing infrastructure, such as the units affiliated with the National Employment Agency (ANOFM), thereby ensuring more efficient resource use and broader access to training programs.

To ensure the financial sustainability of these initiatives, it is important to identify and access appropriate funding sources. European funds, through programs such as “Erasmus+” and

the “Cohesion Fund,” represent relevant opportunities for the development of educational infrastructure and support for social inclusion projects.

In addition, the active involvement of the private sector can play a decisive role in strengthening vocational training. Granting fiscal incentives to companies that collaborate with vocational education institutions and provide paid internships for students could facilitate their labor market integration. Moreover, expanding the network of vocational schools in rural areas - adapted to the local economic context (such as agriculture, carpentry, or beekeeping) - would improve access to education and support the sustainable economic development of disadvantaged communities.

Although social entrepreneurship offers numerous advantages, its development is often hindered by multiple obstacles. One of the biggest challenges is limited access to funding, as most investors seek high profits, and funds allocated to this sector remain insufficient. In addition to financial difficulties, the lack of entrepreneurial education and the absence of managerial support hinder the implementation and management of social initiatives. At the same time, public awareness of this type of entrepreneurship remains low, which limits both community and business sector involvement in supporting it.

Nevertheless, the Republic of Moldova has numerous opportunities for the development of social entrepreneurship. The creation of public-private partnerships can facilitate access to resources and logistical support, while the adaptation of successful models from other countries could help strengthen this sector. Additionally, promoting entrepreneurship education programs could stimulate the emergence of new initiatives and improve the ability of social entrepreneurs to manage their businesses effectively.

5. Conclusions

Social entrepreneurship is a key driver of change, playing an essential role in the economic and social development of the Republic of Moldova. It contributes to reducing inequalities, supports the promotion of social inclusion, and offers solutions to various community issues. Although the social entrepreneurship sector is still in its early stages, its potential to transform communities is significant. By creating jobs and supporting vulnerable groups, social entrepreneurship can have a major impact on improving living conditions and promoting sustainable development.

Among the main challenges and obstacles are the lack of a clear legislative framework, limited access to funding, and a low level of entrepreneurial education. These issues hinder the scaling of social businesses and reduce their capacity to generate significant impact.

Social entrepreneurship contributes to economic development by fostering community self-sufficiency, reducing unemployment—particularly in rural areas—and integrating NEET youth and persons with disabilities into the labor market. At the same time, it plays an important role in promoting sustainable practices and social responsibility.

To support the development of this sector, concrete measures are needed, such as: the creation of a favorable regulatory framework, the establishment of financial support mechanisms, the development of entrepreneurial education, and the encouragement of public-private partnerships. Additionally, the implementation of accessibility programs in public institutions would facilitate the integration of vulnerable groups.

Given its potential to generate positive change, social entrepreneurship must be supported through a systemic approach. Expanding access to financial resources, creating support networks, and developing vocational training centers for individuals from disadvantaged groups are essential steps in strengthening this field.

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BRAND STRATEGY IN THE CONTEXT OF GLOBAL ECONOMIC AND SOCIAL CHANGES

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Abstract: *The article explores the development of branding strategies in the context of global economic and social changes, with a focus on brands' adaptation to new consumer preferences and external challenges. The author analyzes the influence of the social context, particularly the preferences of generations Z and A, on brand formation, their value orientation, and consumer experience. In an era of increased digitalization, mobility, and social responsibility, brands face the need to integrate new technologies into their strategic approaches. One of the central aspects of the article is the attention to global economic changes, such as economic crises, market instability, and the growing demand for ecological and social responsibility. The article examines how brands must adjust their value propositions, adapt to the needs of new generations, consider local characteristics in the context of globalization, and strive for sustainable development. The article presents a branding strategy model focused on flexibility and innovation, which helps brands remain competitive and resilient in the face of changing external conditions. It also discusses examples of successful brands that have effectively implemented innovative approaches in their strategies. The article aims to provide practical recommendations for brands to successfully adapt to the evolving environment. The article also highlights the importance of aligning brand strategies with societal values and global trends to ensure long-term relevance and success in an increasingly interconnected world.*

Keywords: *Strategy, brand, brand strategy, brand adaptation, marketing.*

UDC: 658.626:330.34:316.42(100)

Classification JEL: M31

1. Introduction

In a rapidly changing global environment, brands are faced with the need to adapt their strategies to new economic and social realities. The modern market is characterized by a number of transformative macrotrends, including economic instability, digitalization, the growth of social responsibility, the increasing importance of sustainable development, as well as changing consumer preferences, especially among Generations Z and Alpha. These global trends have a significant impact on the formation of brand strategies, forcing companies to rethink their values, communication approaches and ways of interacting with their audience.

One of the key challenges is the need to align brands with social values and global trends, such as environmental friendliness, inclusiveness, transparency and ethics. Ignoring these factors leads to a loss of trust, a decrease in consumer loyalty and a loss of competitive advantages. However, in practice, many companies do not have a clear understanding of how to adapt their brand strategy in accordance with the global requirements of the market, society and individual consumers. This is the main problem of the study: the lack of a systematic approach to building a strategy in the context of complex global changes among brands. Despite the existence of a significant number of studies in the field of brand strategy development (Aaker, Keller, Kapferer, Kotler), most

of them are either oriented towards a stable market environment or focus on individual aspects (e.g. positioning, loyalty or visual identity), without offering a holistic algorithm for adapting brand strategies to changing global conditions. For example, D. Aaker emphasized the need to build a brand identity [1], and K. Keller focused on the perception of the brand by consumers [2]. However, their works do not consider the challenges associated with the impact of macroeconomic crises or social transformations on branding. Thus, the question of how exactly brands can transform in conditions of social and economic instability remains open.

In this regard, the author identifies the following research hypotheses:

1. Global economic and social changes require strategic flexibility and value adaptability from brands.
2. Successful brands of the future are those that integrate the principles of sustainability, digital innovation and social significance into strategic development.
3. It is possible to form a universal model of brand strategy that takes into account both macroeconomic and socio-cultural factors.

This article uses a methodological approach that includes an analysis of scientific sources and international studies on the topic of strategic branding; systematization of global trends and their impact on consumer behavior; development of a model of adaptive brand strategy based on the identified relationships between economic and social factors at the global level.

The key results were, firstly, the development of a new model of branding strategy capable of adapting to external challenges; secondly, practical recommendations for its implementation in a global context to ensure sustainable brand development.

2. Literature Review

Strategic branding is one of the key areas of company marketing, aimed at creating long-term competitiveness through brand perception management. The scientific literature presents many approaches to defining strategic branding, but to date there is no single interpretation that covers the impact of global social and economic changes.

David Aaker defines strategic branding as the process of creating and maintaining a brand identity that provides a sustainable competitive advantage and a strong emotional connection with the consumer. This author focuses on the role of brand identity and emotional capital as a long-term resource. However, this model does not take into account the dynamics of the external environment and the influence of macrosocial and economic factors. Another researcher of the problem considers strategic branding as managing the perception of the brand in the mind of the consumer in order to create a strong, favorable and unique image. Attention is paid to the cognitive perception of the brand, which is important in the digital age. However, this definition focuses exclusively on perception, ignoring the influence of changes in social values and global trends.

Also, some sources consider strategic branding exclusively as a system of long-term management of all brand elements, including values, visual identity, communication and consumer experience [3]. In general, this is a comprehensive approach that covers all brand elements. But the concept does not pay enough attention to the need to transform strategies under the influence of the global context.

A more modern approach states that strategic branding is the creation of a brand as a value intermediary between a company and society, focused on sustainable development

and social significance [4]. The need for sustainability and social aspects is taken into account. The definition implies that practical models for implementing such principles are required in conditions of economic instability.

Based on the analyzed evolution of the definition of strategic branding, the author made a comparative analysis of the identified gaps in the scientific literature regarding the essence of this concept, which is presented in Table 1.

Table 1. Comparative analysis and identified gaps

Author	Focus	Strengths	Limitations
Aaker	Brand Identity	Emotional Capital	Ignoring external changes
Keller	Brand Perception	Cognitive Accuracy	Insufficient flexibility in a changing environment
Kapferer	Integrated Brand Management	Strategic Integrity	Weak adaptability to global challenges
Kotler et al.	Brand as a Social Agent	Social and Environmental Focus	Insufficient operationalization of the approach

Source: developed by the author

The above analysis of brand strategy definitions shows that modern scientific approaches to strategic branding have high theoretical value, but suffer from fragmentation. Most definitions focus on the internal aspects of the brand (identity, perception, communication) and do not take into account the influence of the external environment, such as economic crises, digital transformations, increased demands for sustainability and the growth of value consciousness of consumers.

Despite a significant amount of research in the field of strategic branding, a number of significant gaps remain in the modern scientific literature. First of all, there is a lack of models that can take into account the influence of the macroeconomic context - such as economic crises, global inflation or market instability - on the formation and adaptation of brands. Most existing theories focus primarily on the internal aspects of the brand, without integrating external factors into strategic planning. In addition, there is no universal algorithm or model that could serve as a practical guide for adapting brand strategy to modern global trends, including digitalization, sustainable development and the growth of social responsibility.

Another important gap is the limited attention to changes in the value structure of consumers, especially among Generations Z and Alpha, for whom authenticity, inclusivity and environmental awareness are becoming key benchmarks. These gaps highlight the need to develop new, flexible and context-sensitive approaches to strategic branding. The relevance of further research lies in the development of an integrative model of strategic branding based on the synthesis of internal and external factors, with an emphasis on flexibility, innovation and compliance with social expectations.

3. Methodology

This study employs a qualitative methodological approach aimed at examining the impact of global economic and social changes on the development of branding strategies. The research is structured as a multi-stage theoretical and analytical process, including a critical review of academic literature, an analysis of practical cases from international brands, and the development of a new conceptual brand strategy model. This research design enabled the author to deeply explore the subject and formulate well-founded conclusions that can be applied in real business contexts.

Data collection was based on the analysis of academic sources (monographs and articles published in peer-reviewed journals), as well as case studies of companies that adapted their brand strategies in response to global challenges. The main criteria for selecting empirical material were the presence of documented strategic changes reflecting brands' responses to economic or social instability and the availability of information regarding the outcomes of these transformations.

The collected data was analyzed using thematic analysis to identify recurring patterns in the actions of international brands, content analysis to systematize the components of strategies, and comparative analysis, which allowed the juxtaposition of existing theoretical models (Aaker, Keller, Kapferer) with real-world business practices. Based on the findings, the author developed the original FLEXI-BRAND model using the conceptual prototyping method. This model represents an adaptive strategic approach grounded in brand flexibility, innovation, and socio-economic orientation.

To ensure transparency and reproducibility of the research process, all stages of data collection and analysis were clearly documented and structured. All analytical work was conducted manually using Miro tools, without the use of statistical software, as the study is conceptual in nature. The chosen methodology made it possible to systematize existing knowledge and contribute to the development of practical tools for strategic branding in the context of the global market.

4. Results and Discussion

Developing branding strategies in the context of global economic and social changes with an emphasis on adapting to new consumer trends and preferences is a fundamental necessity for modern companies. According to the author, in the context of constant dynamic transformation of public demands, traditional branding models are losing their effectiveness. Without taking into account new consumer values, digitalization, environmental and social responsibility, as well as global economic pressure, brands lose their differentiation, become invisible in the media environment and lose trust. A modern brand is not just a logo or a product, but an active participant in public and cultural dialogue, which is obliged to respond to external signals and anticipate changes.

As part of the study, the author compiled data on key global changes that influence brand strategy, which is presented in Table 2.

An analysis of the presented global changes demonstrates that the strategic development of brands in the modern context is impossible without active and systematic adaptation to both economic and social transformations. Economic challenges - such as digitalization, market instability, and the aftermath of the pandemic - require brands not only to make swift changes in their communication and operational strategies, but also to deeply reassess their value structures. For example, digitalization amplifies the trend toward personalization and automation in consumer interaction, prompting a rethinking of the customer experience as a key brand asset. Meanwhile, economic instability heightens consumer attention to business ethics and the genuine value of a brand, pushing companies to move away from superficial marketing toward authentic and meaningful positioning.

Table 2. Global changes influencing brand strategy

Change	Type	Impact on brand strategy
Rise of Digitalization and AI	Economic	Increased personalization, automation of communications, focus on digital experience
Economic Instability	Economic	Decreased consumer confidence, increased sensitivity to brand value and ethics
Post-Pandemic Reality	Economic	Reassessment of the brand as a guarantor of stability and customer care
Generation Z and Alpha	Social	Demand for authenticity, inclusivity, sustainability and value leadership
Globalization with Localization	Social	Need to adapt communications to local culture while maintaining the global core of the brand
Environmental and Social Responsibility	Socio-economic	Transparency of supply chains, ESG focus, social missions

Source: developed by the author

Social changes are having an equally profound impact. The emergence of Generations Z and Alpha - who are driven by brand value identity - has raised expectations for transparency, social responsibility, and cultural relevance. This is shaping a new type of consumer interaction, in which a brand is expected to act not only as a product provider but also as an active participant in social dialogue. The concept of "globalization through localization" suggests that brands must speak to diverse audiences in their own language - not only literally, but also culturally - while maintaining strategic coherence and brand recognition.

Environmental and social responsibility is becoming not an additional, but a mandatory element of branding. Companies integrating ESG principles into their strategy receive not only consumer loyalty, but also support from regulators and investors. The post-pandemic reality increases consumer expectations of stability and care - brands become symbols of trust, capable of performing emotional and social functions previously inherent in institutions.

Thus, each of the listed changes has a multi-level and interconnected impact on brand strategy. A modern brand must be flexible, adaptive and value-oriented in order not only to meet market expectations, but also to shape sustainable development in the context of constant global changes.

One of the key factors in the transformation of brand strategies in the 21st century is the change of consumer generations. Generations Z (born after 1997) and Alpha (born after 2010) are forming a new standard of consumption, which is based not only on the functional or visual appeal of a brand, but, above all, on its value position and ability to reflect the worldview of a young consumer. Generation Z, as the first "digital generation" that grew up in the conditions of the global Internet, socially active and information-saturated, places completely different demands on brands. They demand from companies not just goods, but meanings. The following characteristics are important to them [5]:

- authenticity and honesty (brands must be transparent and not do "greenwashing");
- environmental awareness (consumption without harming nature);
- social inclusiveness (acceptance of differences, equal opportunities);
- value leadership (brand as a voice in social discussion).

Generation Alpha, although still in the process of forming as an active consumer group, already demonstrates increased attention to issues of justice, technology and a sustainable future [6]. They are growing up in a world where climate, equality and mental health are not

the exception, but the norm. For example, Patagonia is one of the most illustrative examples of a brand focused on environmental sustainability. The company not only sells activewear, but also actively invests in environmental projects, fights hyperconsumption and encourages conscious use of clothing. The principle “Don’t buy this jacket” has become a symbol of anti-crisis communication that matches the mood of Generation Z consumers [7].

Another example is Nike, which demonstrates how a brand can be not just a commercial tool, but also an active political and social platform. The campaign with Colin Kaepernick in support of the Black Lives Matter movement was a turning point: the company was not afraid to take a position, risking losing part of the audience [8]. Instead, Nike strengthened the loyalty of a younger, value-active audience.

Ben & Jerry’s is an example of a brand that has integrated social justice into the core of its product and communications strategy. The company consistently speaks out on issues of racial inequality, climate change, and more [9]. They do this not superficially, but through sustainable initiatives backed by action and transparent reporting.

Thus, a phenomenon arises that in Western scientific literature is called “value-based consumption” or “conscious consumption”. It means that the consumer makes a choice not only based on the price or quality of the product, but also based on what the brand symbolizes and how much it “corresponds” to his personal beliefs [10]. The consumer becomes an accomplice to the brand’s ideology, and the brand becomes a participant in the cultural and ethical discussion.

More than 70% of Generation Z expect brands to take an active position on social and environmental issues, and 62% are willing to refuse a purchase if the brand does not match their personal values [11]. This fundamentally changes the principles of building a brand strategy: it can no longer be separated from the social context, but rather becomes part of this context.

The economic context in today’s world is marked by instability, market fragmentation, growing inequality, and a technological revolution. These processes are fundamentally transforming how companies approach brand strategy, pushing brands to act with greater flexibility, adaptability, and strategic transparency. According to the author, ignoring economic factors in brand strategy development is no longer acceptable—especially in an era of digitalization, inflationary fluctuations, and increasing consumer reliance on brands as symbols of stability.

One of the most significant economic factors has been technological acceleration, in particular the introduction of artificial intelligence (AI), Big Data analytics and automated solutions in marketing. These technologies are now not just an auxiliary tool, but an active element of strategic planning. Brands use algorithms to build an accurate profile of the target audience, predict consumer behavior, personalize products and content, and optimize interactions within omnichannel communications. An example is Amazon, which is a leader in the use of AI not only for recommendations, but also for dynamic pricing, logistics management and predictive analysis of needs [12]. This makes the brand not just technologically advanced, but strategically predictable in terms of consumer behavior.

However, economic technologies are not only opportunities, but also a response to challenges. Inflationary expectations, rising product costs, and disruptions in global supply chains are forcing brands to restructure their value propositions. Today, it is important not only to sell a product, but to prove its rationality, sustainability, and compliance with new economic realities. Consumers have become more critical, comparing not only price, but also value - moral, social, and environmental. For example, Unilever, faced with crises and changes in consumer behavior, reworked its brand portfolio, focusing on local brands with

sustainable positioning and clear ESG communications [13]. This helped strengthen consumer trust in key emerging markets.

At the same time, pressure from society and investors in the area of environmental and social responsibility of brands is increasing. Today's market requires companies to be transparent in supply chains, to be resource-intensive, to reduce their carbon footprint, and to have an open dialogue on social justice issues. In the era of “cancel culture,” brands that do not take an active stance risk losing their reputation and, as a result, their market share [14]. An example is IKEA, which consistently implements the principles of the circular economy, including the possibility of returning old furniture, recycling programs, sustainable design, and local production [15]. This not only corresponds to the economic logic of reducing costs, but also forms a new image of the brand as a responsible participant in society. Apple invests in carbon-neutral supply chains and publicly reports on progress towards achieving emissions reduction goals [16]. The strategy of environmental transformation becomes part of the brand's positioning and strengthens it as a “future-oriented” leader.

In addition to these aspects, it is important to highlight geoeconomic changes, including new forms of regionalization, trade barriers, and sanctions regimes. These factors compel brands to rethink their globalization strategies - shifting the focus toward localization, adaptation to local demand, currency fluctuations, and cultural specificities. This shift also impacts logistics, pricing, and positioning strategies.

Thus, the economic context not only sets certain constraints but also opens up strategic opportunities for brands capable of transformation. Sustainability, technological advancement, transparency, and economic rationality are no longer just trendy buzzwords - they become the foundation of strategic thinking in building the brand of the future. It is at this intersection that brand strategy aligns with global economic and social trends, forming the basis for models adapted to the challenges of the times.

Based on the analysis of economic and social influencing factors, the author proposed the development of a branding strategy model as an adaptive brand management system, grounded in enduring values and a flexible structure. This model enables a brand to respond effectively to economic and social changes through the integration of innovation, personalized experiences, and social responsibility. It is not focused on static positioning but rather on continuous adaptation, ensuring the brand's relevance in times of global turbulence.

The model emphasizes active adaptation to:

- new consumer trends, including value-based consumption, digitalized experiences, and cross-cultural sensitivity;
- emerging consumer preferences influenced by changes in the social and economic environment, such as growing awareness, inclusivity, transparency, and trust.

This emphasis on active adaptation positions the FLEXI-BRAND model as a dynamic strategic tool rather than a static framework. By integrating responsiveness to value-based consumption and digitalized experiences, the model reflects the current evolution of consumer behavior, where emotional resonance, ethical alignment, and cultural relevance are critical factors influencing brand loyalty and engagement. Moreover, by addressing emerging preferences shaped by social and economic shifts - such as the demand for inclusivity, transparency, and trust - the model enables brands to go beyond surface-level adjustments. Instead, it encourages structural changes in how brands communicate, innovate, and define their long-term value. This approach ensures that brand strategies remain sustainable, credible, and competitive in an increasingly complex global marketplace.

The author developed the FLEXI-BRAND branding strategy model, which takes into account the impact of social and economic challenges in the global market, as illustrated in Figure 1.

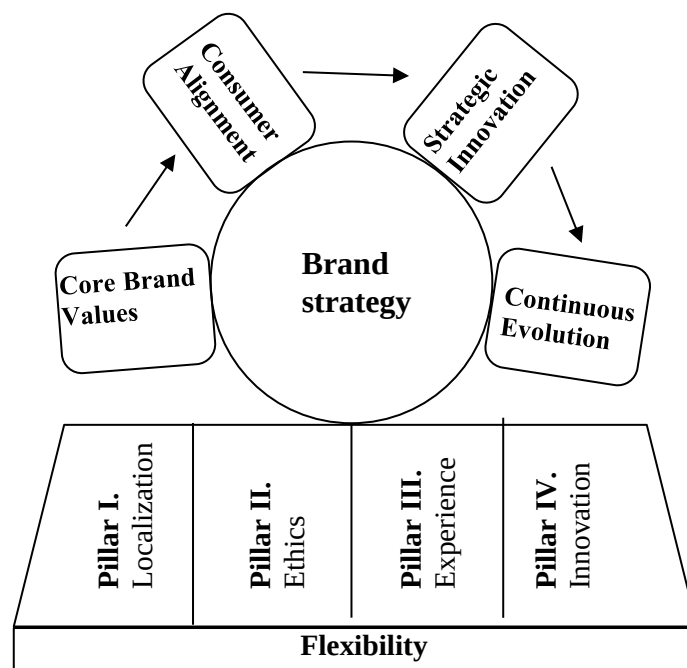


Figure 1. FLEXI-BRAND Branding Framework

Source: developed by the author

The presented FLEXI-BRAND model is an adaptive brand strategy architecture designed to operate in the context of global economic and social transformations. At its core lies the principle of flexibility, which enables the brand not only to respond to changes in the external environment but also to anticipate them. The model is built on four key pillars that form the foundation of the brand's strategic development: localization, ethics, experience, and innovation. These elements ensure the brand's resilience and its ability to adapt to cultural, technological, and economic contexts. The characteristics of the pillars are presented in Table 3.

Table 3. Pillars of the FLEXI-BRAND branding strategy model

Pillar	Definition
F – Flexibility	Modular brand positioning that adapts to different markets and conditions.
L – Localization	Incorporation of local cultural codes while maintaining a global identity.
E – Ethics	Integration of social and environmental responsibility principles.
X – Experience	Creation of a value-driven, emotional, and omnichannel customer experience.
I – Innovation	Use of new technologies to enhance relevance and adaptability.

Source: developed by the author

The FLEXI-BRAND model, whose name is an acronym derived from its foundational pillars, is built upon five interconnected pillars, each representing a key area of strategic brand management in the context of global change. Each pillar serves as a functional and value-driven vector that ensures the brand's resilience and adaptability when engaging with diverse audiences and navigating various market realities.

Flexibility is the basis of the entire model and is expressed in the brand's ability to modularly adapt its positioning to specific economic, cultural and technological conditions. Localization allows the brand to maintain a global strategy, while enhancing relevance in local markets by taking into account cultural characteristics. Ethics emphasizes the need to integrate the principles of sustainable development, inclusiveness and social responsibility, which is especially important for consumers of new generations. Experience becomes the basis of loyalty, forming emotional connections through omnichannel interactions and value-charged touchpoints. Innovation allows the brand to remain competitive by introducing modern technologies and developing new communication and product formats.

For a more visual understanding of the relationships in the model, the author presents a table reflecting the influence of social and economic global changes on the key elements of brand strategy, as well as the effects of such influence, which is reflected in Table 4.

Table 4. The influence of social and economic contexts on the structure of the branding strategy model

Element of the branding strategy model	Social context	Economic context	Expected impact on the brand
Core brand values	Ethical norms, consumer culture of generations Z/Alpha	Growing ESG and transparency expectations from investors and consumers	Building loyalty, increasing trust, brand identity as a bearer of values
Consumer alignment	New generations require personalization, ethical behavior	Use of Big Data, AI, automation for precise targeting	Increasing engagement, increasing consumer satisfaction, sustainable connections with the audience
Strategic innovation	Relevance of social platforms, new interaction formats	Need for technological transformation, investment in R&D	Increasing brand adaptability, industry leadership, strengthening competitiveness
Continuous evolution	Rapid change in social norms and trends	Economic instability, fluctuations in demand	Flexibility of strategies, minimization of reputational and market risks, readiness for transformation

Source: developed by the author

This table demonstrates that the key elements of brand strategy do not exist in isolation. Their development and functioning directly depend on the external context, and it is the ability to adapt to these changes that constitutes the strategic advantage of brands of the new era. Using the FLEXI-BRAND model allows companies not only to respond to challenges from the market and society, but also to proactively shape the agenda, strengthening their own role in socio-cultural and economic dynamics.

The central core of the model is the **Brand Strategy** block, which is based on **Core Brand Values** - a system of internal brand values, such as mission, vision, sustainable development guidelines and long-term principles of interaction with society. It is this module that sets the direction for the entire strategy and serves as a fulcrum for the transformation of other components. This module reflects the basic identity of the brand, its "core". In the context of increasing attention to environmental and social aspects, Core Brand Values forms the perception of the brand as a bearer of a mission, and not just a commercial offer. The social context - in particular, the values of generations Z and Alpha

- requires that the brand demonstrate a meaningful position: on issues of sustainability, fairness, ethics. At the same time, the economic context increases the pressure from investors and regulators on compliance with ESG standards and transparency. The module forms trust, long-term loyalty and a sustainable brand identity at all levels.

The Consumer Alignment module is responsible for aligning the brand with the current expectations and needs of the target audience. In the social dimension, this is personalization, openness, inclusiveness and the brand's readiness for dialogue. New generations demand from brands not only a product, but also participation in their value system. From an economic point of view, this is the use of digital technologies, Big Data algorithms and artificial intelligence for precise targeting, creating relevant offers and increasing the effectiveness of communication. The module ensures flexibility of positioning, increased engagement and the formation of stable connections between the brand and the consumer.

The Strategic Innovation module enables brands to strategically adapt in the context of rapid technological development and digitalization, when brands must continuously introduce innovations – both in products and services, and in strategic decisions. This module reflects the brand's ability to adapt new forms of communication, in particular through social platforms, and to quickly respond to behavioral changes. From an economic perspective, the module requires investments in scientific research, digital products, platform solutions, and R&D initiatives. It creates a brand's image as a leader, strengthens its competitive position, and enables strategic transformation in conditions of uncertainty.

Continuous Evolution - the continuous evolution module ensures the constant adaptation of the brand to a rapidly changing world. In the social context, it is responsible for sensitivity to trends, adjusting the agenda and transforming communications in accordance with changing norms and expectations of society. In the economic context, this is flexibility in the face of fluctuations in demand, market instability and the emergence of new regulatory frameworks. The module allows the brand to build anti-crisis scenarios, reduce reputational risks and quickly rebuild the strategy depending on new challenges.

The FLEXI-BRAND model ensures the strategic sustainability of the brand due to the built-in ability to adapt to complex and rapidly changing conditions of the external environment (social and economic). Its implementation allows not only to maintain the relevance of the brand, but also to actively form new standards of interaction with consumers in an era of uncertainty.

The FLEXI-BRAND model proposed by the author is an adaptive strategic system capable of responding to the challenges of global instability, rapidly changing values and technological transformations. It combines a structured foundation with a high degree of flexibility, making it particularly relevant in today's environment and in light of the growing influence of AI on business models. The model enables brands not only to survive, but also to remain relevant and in demand in the face of constant global turbulence.

While the FLEXI-BRAND model presents a conceptually robust and theoretically grounded framework for adaptive brand strategy development, it is important to acknowledge certain limitations. As the model is currently based on analytical synthesis and conceptual reasoning, future empirical validation is necessary to assess its practical applicability across different industries and cultural contexts. Further research could include case studies, comparative brand audits, and quantitative assessments to evaluate the effectiveness of the model's implementation. This would enhance the model's reliability and offer actionable insights for brand managers operating in volatile global environments.

Future studies should include case-based testing, cross-industry comparisons, and quantitative analysis to examine the model's adaptability and effectiveness in different socio-economic contexts. Such empirical work would serve multiple purposes: it would assess the model's predictive capacity, verify the strength of interrelations between its core pillars, and provide brand practitioners with evidence-based guidelines for implementation. Moreover, it would help refine the model in accordance with evolving market demands and technological innovations.

5. Conclusions

Today's global economic and social changes require companies to be flexible and innovative in their approaches to strategic branding. Adaptation to digitalization, a focus on sustainability, and personalization of customer experience are key factors for success in the changing economic and social environment of the global marketplace. This article contributes to the academic discourse on branding by presenting a comprehensive perspective on how global economic and social transformations affect brand strategies. It highlights the need for brands to move beyond rigid models and adopt a dynamic, values-aligned approach that appeals to today's ethically motivated consumers. In this context, the proposed FLEXI-BRAND framework provides marketers and company strategists with a pragmatic toolkit for navigating uncertainty. Theoretical implications include expanding branding theory to include macro-contextual sensitivity, while practical recommendations advocate innovation, ethics, and adaptability in strategic planning. Future research could focus on quantitatively testing the framework across different industries and examining consumer responses to flexible branding models in different cultural contexts.

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THE RELATIONSHIP BETWEEN FINANCIAL INFORMATION SECURITY MANAGEMENT AND CORPORATE RISK MANAGEMENT

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Abstract: In the globalized business world, financial information security management (FISM) and corporate risk management (CRM) have become critical elements for ensuring business sustainability and gaining a competitive advantage. The security of financial information not only protects the financial integrity of businesses but also supports long-term success by enhancing reputation management, regulatory compliance, and stakeholder trust. However, the necessity of addressing the relationship between financial information security and corporate risk management within a holistic framework has not been sufficiently emphasized in the literature, especially with the increasing threats in cybersecurity. This gap creates uncertainties regarding how businesses should integrate financial information security into their risk management strategies. The purpose of this study is to analyze the interaction between financial information security management and corporate risk management and to provide a practical and applicable framework for integrating financial information security into business risk management strategies. The study examines how financial information security management is integrated into corporate risk management processes (risk identification, assessment, response, and monitoring) and its impact on organizational performance (cost reduction, efficiency improvement, and competitive advantage). Considering major financial crises and cyberattacks, the global impact of financial information security threats on businesses, national economies, and the global financial system is increasingly being discussed. In this context, the study highlights the critical importance of FISM and CRM for businesses and presents concrete examples of the risks that may arise if these two concepts are not considered together (data breaches, financial losses, reputational damage, legal sanctions). The study systematically reviews existing approaches in the literature (such as ISO 27001 and the NIST Cybersecurity Framework) to contribute to the development of effective financial security and risk management policies for businesses. This study employs qualitative research methods, including a literature review and expert opinions. By analyzing current studies and industry reports, the relationship between financial information security and corporate risk management is examined in depth. In conclusion, integrating financial information security management with effective corporate risk management policies plays a crucial role in enhancing business sustainability, gaining a competitive advantage, and reducing costs. Businesses must adopt a holistic management approach that incorporates cybersecurity measures, financial risks, and regulatory requirements. This comprehensive approach is essential for ensuring long-term success and maintaining a competitive edge in today's dynamic business environment.

Keywords: Financial Information Security Management, Corporate Risk Management, Cybersecurity, Risk Assessment, Risk Management Strategies, Data Security, Regulations.

UDC: 005.934:005.334:657.1

Classification JEL: G32, M15, M42, G34

1. Introduction

In today's rapidly evolving digital economy, financial information security has become an indispensable pillar of corporate risk management. Organizations operate in an environment characterized by increasing complexity, regulatory scrutiny, and a growing number of cyber threats that pose significant risks to financial stability. Ensuring the confidentiality, integrity, and availability of financial data is no longer just a technological challenge but a fundamental component of corporate governance and strategic risk management. (Rampini et al., 2019)

At the core of this relationship lies the understanding that financial data is one of the most valuable assets an organization possesses, and its protection is crucial for maintaining operational continuity, stakeholder trust, and regulatory compliance. Traditionally, corporate risk management focused primarily on financial, operational, and market risks, with an emphasis on mitigating losses through insurance and internal controls. However, in recent years, the scope of risk management has expanded to include a more integrated, strategy-driven approach that encompasses digital threats, cyber risks, and financial information security. (Dhar, 2013)

To address these emerging risks effectively, organizations must implement robust financial information security management systems that align with broader Enterprise Risk Management (ERM) frameworks. A well-structured ERM approach enables companies to assess vulnerabilities, mitigate cyber threats, and ensure that financial data remains secure against unauthorized access, fraud, and disruptions caused by external events. (Managing Information Security Risk, 2011) This holistic integration not only strengthens cybersecurity resilience but also enhances an organization's ability to anticipate and respond to crises more effectively.

The necessity of this alignment has become even more apparent in the wake of global disruptions such as the COVID-19 pandemic, which exposed vulnerabilities in corporate financial systems and highlighted the importance of digital resilience. The evolving threat landscape now includes sophisticated cyberattacks, ransomware incidents, and large-scale data breaches that can cause financial and reputational damage. (Ismanu et al., 2021) In response, organizations must adopt a proactive stance, integrating financial information security into their corporate risk management strategies to ensure sustainable growth and long-term success.

By embedding financial information security into corporate risk management frameworks, organizations can achieve greater transparency, enhance decision-making processes, and safeguard their competitive advantage. A well-integrated approach fosters a culture of risk awareness and preparedness, enabling companies to navigate uncertainties with confidence. Moving forward, businesses must continue to invest in advanced security technologies, employee training, and regulatory compliance to mitigate evolving threats and ensure the resilience of their financial ecosystems.

2. Literature Review and Conceptual Framework: Financial Information Security and Corporate Risk Management

The literature review on the interplay between financial information security and corporate risk management reveals a progressive evolution of thought and practice in the domain of information security within corporate structures. The exploration begins with (Wu, 2007), who underscores the necessity for organizations to strike a balance between security and productivity. The author emphasizes the critical role of user training and the importance of presenting a business case for investments in information security,

particularly in light of regulatory pressures such as the Sarbanes-Oxley Act (SOX). This foundational work sets the stage for understanding the growing complexity of information systems and the legal ramifications of security breaches, thus highlighting the imperative for robust information security measures.

Hatsu, Ujapka, and Mpimwood (2015) build on this foundation by examining the implementation of information security systems within Ghanaian banks. Their study points to the necessity of proactive fraud risk assessments and emphasizes the relationship between effective information systems auditing and overall banking performance. This work illustrates the practical implications of governance frameworks in managing risks associated with cyber threats within the banking sector, aligning with the earlier insights of (Wu, 2007) regarding the critical need for rigorous information security protocols.

In the same year, (Horia IONESCU & Dana VILAG, 2015) delve into the integration of risk management within corporate governance, positing that the Board of Directors plays a pivotal role in overseeing the effectiveness of risk management strategies. Their analysis connects financial management with corporate governance, asserting that as globalization increases market volatility, the importance of financial risk management intensifies. This perspective broadens the understanding of risk management, framing it as an essential component of corporate strategy that influences financial performance.

Musa and Clift (2017) introduce a framework for managing cybersecurity risks, emphasizing the need for corporations to adopt flexible and repeatable processes. Their findings advocate for the incorporation of security considerations into the development cycle of organizational systems. This work aligns with the earlier discussions on the necessity of high-level oversight in risk management and the operationalization of security policies across the organization.

Continuing this trajectory, (Ionuț, 2017) shifts focus to the evolution of risk management practices in response to the dynamic nature of cyber threats. The author critiques traditional approaches and suggests a more strategic alignment between cybersecurity and business risk management. This perspective reinforces the notion that cybersecurity is not merely an IT concern but a strategic imperative that requires a comprehensive understanding of organizational risk.

Rios Insua et al. (2019) further contribute to the discourse by proposing an adversarial risk analysis framework for cybersecurity. They highlight the limitations of existing risk assessment methodologies, advocating for a more nuanced approach that considers intentional threats. This critical evaluation of current practices underscores the need for organizations to refine their risk analysis processes to better anticipate and mitigate cyber threats.

Brunner et al. (2020) expand on the conceptual frameworks by exploring the status quo of risk management practices in information security within the DACH region. Their research emphasizes the importance of asset inventory management and the systematic identification of security risks, providing a structured approach to implementing effective information security measures that align with organizational goals.

Uchendu et al. (2021) conduct a systematic review of cybersecurity culture, identifying key challenges and current practices in fostering a security-conscious environment within organizations. Their findings resonate with previous studies by highlighting the importance of cultivating a robust cybersecurity culture as a means of enhancing overall security posture.

Guerin (2022) addresses the implications of emerging governance issues and the heightened importance of cyber risk management for board directors. The author discusses the evolving role of digitalization in auditing and the necessity for organizations to

adequately prepare for cyber threats, particularly in sensitive sectors such as healthcare and extractive industries. This work reinforces the critical need for strategic oversight in managing cybersecurity risks.

Finally, (Klumpes, 2023) explores the coordination of cybersecurity risk management within the U.K. insurance sector, emphasizing the importance of integrated monitoring systems and the growing demand for cyber insurance. The author highlights the challenges faced by firms in balancing compliance with value-added services, thereby illustrating the complex landscape of cybersecurity risk management in contemporary business environments.

Through this comprehensive review of the literature, it becomes evident that financial information security and corporate risk management are increasingly interlinked, necessitating a strategic approach that encompasses both governance and operational practices. The evolution of thought reflected in these studies underscores the critical importance of adapting to the complexities of the modern digital landscape.

In today's interconnected business environment, Financial Information Security Management (FISM) and Corporate Risk Management (CRM) have become indispensable components of sustainable business practices. Financial information security involves safeguarding sensitive financial data from unauthorized access, cyber threats, fraud, and data breaches. It ensures the confidentiality, integrity, and availability of financial data, which is crucial for maintaining trust among stakeholders, ensuring regulatory compliance, and preserving competitive advantage.

On the other hand, corporate risk management encompasses a broader spectrum, including financial, operational, strategic, and compliance-related risks. Traditionally, risk management was viewed through the lens of financial controls and insurance mechanisms. However, with the increasing reliance on digital technologies, businesses are now exposed to more complex risks, including cyber threats, ransomware attacks, and digital fraud. As a result, corporate risk management has evolved into a holistic discipline that integrates financial security measures with strategic decision-making processes.

The relationship between FISM and CRM lies in the recognition that financial data is not just a transactional component but a strategic asset that must be actively protected. Integrating financial information security into corporate risk management enables organizations to proactively identify, assess, and mitigate cyber and financial risks in a cohesive manner. This integration helps businesses minimize financial losses, enhance resilience, and strengthen regulatory compliance.

Despite its significance, the synergy between FISM and CRM is often overlooked in both academic literature and practical applications. Many organizations still treat financial security as an isolated IT function rather than an integral part of enterprise-wide risk management. Addressing this gap requires a structured approach where financial information security is embedded within risk assessment frameworks, operational policies, and strategic decision-making.

By establishing a strong connection between financial security and risk management, organizations can create a robust defense mechanism against emerging threats. This study explores how businesses can systematically integrate FISM into CRM frameworks to enhance organizational performance, reduce costs, and ensure long-term sustainability.

3. The Need for an Integrated Approach to Financial Information Security and Risk Management

The literature surrounding the integration of financial information security and risk management highlights a growing recognition of the need for a cohesive approach to

address the multifaceted challenges posed by cyber threats and operational vulnerabilities within financial institutions. The studies reviewed span several years and geographical contexts, providing a comprehensive understanding of the evolving landscape of information security.

In 2015, (Hatsu et al., 2015) examined the implementation of information security systems and IT audits in Ghanaian banks, underscoring the necessity of proactive fraud risk assessments and management processes. Their findings revealed a significant relationship between information systems auditing and bank performance, yet they noted a lack of literature on the impact of these systems in Ghana, emphasizing the urgent need for improved controls.

(Loretta Collins, 2015) further contributed to the discourse by exploring the security risks associated with wireless networking. The study highlighted the vulnerabilities inherent in wireless systems, which are often exacerbated by inadequate risk management practices. The theoretical framework employed underscored the importance of assessing risks to protect valuable information assets, a theme that resonates with the findings of (Hatsu et al., 2015) regarding the necessity of robust security measures.

(Adonis & Sibongiseni Ngcamu, 2016) conducted an empirical investigation into information management systems at a South African financial institution, revealing significant deficiencies in training and preparedness among employees. Their study illustrated how a lack of understanding of information security policies could lead to detrimental consequences, echoing the need for comprehensive training programs and robust information management practices highlighted by (Hatsu et al., 2015) and (Loretta Collins, 2015).

(Reimers & B. Scheepers, 2016) shifted the focus to non-financial risk management within retail banks, identifying challenges in integrating these practices into strategic processes. Their qualitative research indicated that operational and business risks, often overlooked in favor of traditional financial risk assessments, require greater attention to enhance organizational performance. This highlights an essential gap in the existing literature, suggesting that a more integrated approach to risk management could yield significant benefits.

(Cole et al., 2017) brought attention to the economic implications of security breaches, particularly in the context of the EU General Data Protection Regulation (GDPR). Their findings emphasized the importance of understanding information security within a broader economic framework, reinforcing the notion that effective risk management is crucial for maintaining customer trust and organizational integrity.

The study by (Sirma et al., 2019) on information security policies among SACCOS in Kenya further emphasized the role of employee training and awareness in mitigating insider threats. Their research underscored the necessity of fostering a culture of security within organizations, aligning with the earlier findings that highlighted the critical role of training in effective risk management.

(Brunner et al., 2020) investigated the status quo of information security risk management practices in the DACH region, revealing a tendency for ad-hoc approaches among employees. Their empirical findings pointed to significant challenges in the reliable evaluation of risk exposure, suggesting that a more systematic and integrated approach is essential for effective decision-making in information security.

Recent contributions by (Wan et al., 2023) and (Javaheri et al., 2023) have focused on the specific risks associated with fintech lending and cybersecurity threats in the financial sector. (Wan et al., 2023) highlighted the necessity for fintech firms to comprehensively identify and manage various risks, including technological and regulatory risks, while (Javaheri et al., 2023) called for an urgent update of defense mechanisms to

counter the rapidly evolving cyber threat landscape. Both studies reinforce the imperative for an integrated approach that encompasses all facets of risk management within financial information security.

Collectively, these articles illustrate a critical need for financial institutions to adopt an integrated approach to information security and risk management, recognizing that the complexities of modern threats demand a cohesive and comprehensive strategy.

In an era of increasing digitalization and interconnected business operations, financial information security and corporate risk management can no longer be treated as separate disciplines. The complexity and frequency of cyber threats, such as data breaches, ransomware attacks, and financial fraud, have made it essential for businesses to integrate financial information security into their broader risk management strategies. However, many organizations still approach these areas in isolation, leading to inefficiencies, vulnerabilities, and heightened risks.

A fragmented approach to financial information security and risk management can result in gaps in risk identification, delayed responses to security threats, and increased regulatory non-compliance. For instance, while corporate risk management frameworks may address financial risks such as credit and market risks, they often fail to incorporate cybersecurity threats that directly impact financial stability. Conversely, financial information security strategies tend to focus on technical measures such as encryption, firewalls, and access controls without aligning these efforts with broader corporate risk management objectives. This disjointed approach prevents organizations from developing a comprehensive risk mitigation framework that accounts for both financial and cyber threats.

An integrated approach to financial information security and corporate risk management ensures that organizations can identify, assess, and mitigate risks holistically. By embedding financial security measures into enterprise risk management (ERM) frameworks, businesses can enhance their ability to detect financial vulnerabilities, prevent fraud, and ensure business continuity. This approach also improves decision-making by providing a more accurate risk assessment that includes both cyber and financial threats, ultimately reducing potential losses and operational disruptions.

Regulatory bodies and industry standards, such as ISO 27001 and the NIST Cybersecurity Framework, emphasize the importance of aligning information security with enterprise risk management practices. Compliance with these standards requires businesses to integrate cybersecurity measures into their financial governance policies, ensuring a proactive rather than reactive approach to risk mitigation. Furthermore, organizations that adopt an integrated approach are better positioned to protect their reputation, enhance stakeholder trust, and gain a competitive advantage in an increasingly volatile business environment.

The need for an integrated approach to financial information security and corporate risk management has never been more critical. Organizations must transition from siloed risk management strategies to a unified, proactive, and strategic framework that addresses both financial and cybersecurity risks comprehensively. This study explores how businesses can achieve this integration to improve resilience, ensure regulatory compliance, and strengthen financial performance in the long run.

4. Integration of Financial Information Security into Corporate Risk Management Processes

The integration of Financial Information Security Management (FISM) into Corporate Risk Management (CRM) is essential for ensuring a comprehensive and proactive approach to organizational risk. Financial data is one of the most critical assets of any business, and its protection is directly linked to corporate stability, regulatory

compliance, and stakeholder confidence (Analyst1, n.d.). However, in many organizations, financial security measures are implemented as standalone IT functions rather than being embedded within a broader risk management strategy. To effectively mitigate risks and ensure business resilience, companies must integrate financial information security into corporate risk management processes at every stage, including risk identification, assessment, response, and monitoring.

The first step in integrating financial information security into corporate risk management is to identify potential threats that could compromise financial data integrity. This includes both internal threats, such as employee fraud, human error, and system failures, and external threats, such as cyberattacks, ransomware, and financial fraud (UpGuard, 2024). A risk assessment framework should be employed to evaluate the likelihood and potential impact of these threats on business operations. Techniques such as vulnerability assessments, penetration testing, and predictive analytics can help organizations gain a clearer picture of their risk exposure (NIST, 2020).

Once risks are identified, businesses must develop and implement mitigation strategies that align financial information security with corporate risk management goals. This includes deploying strong encryption methods, multi-factor authentication, real-time monitoring systems, and incident response plans (NIST, 2020). Additionally, access control mechanisms should be established to limit data access only to authorized personnel, reducing the risk of internal fraud and data manipulation. A well-defined cybersecurity policy should also be integrated into the company's overall Enterprise Risk Management (ERM) framework, ensuring that financial security risks are managed alongside other corporate risks, such as operational, strategic, and compliance risks (UpGuard, 2024).

Financial information security risks are constantly evolving due to advancements in technology and changes in regulatory requirements. Therefore, continuous risk monitoring and compliance management are critical to sustaining an integrated approach (Analyst1, n.d.). Organizations should leverage Artificial Intelligence (AI) and Machine Learning (ML) to enhance their monitoring capabilities and detect anomalies in financial transactions. Furthermore, adherence to global standards such as ISO 27001, NIST Cybersecurity Framework, GDPR, and the Sarbanes-Oxley Act (SOX) ensures that financial security policies remain aligned with international best practices (UpGuard, 2024).

By embedding financial information security into corporate risk management processes, organizations can minimize financial losses, enhance resilience, and improve decision-making capabilities. An integrated approach not only strengthens a company's financial stability but also safeguards its reputation and long-term success in an increasingly volatile business environment.

5. Global Financial Crises, Cyber Threats, and Their Business Implications

In today's interconnected world, businesses face unprecedented challenges due to the increasing frequency and complexity of global financial crises and cyber threats. These risks not only disrupt financial markets but also pose significant threats to corporate stability, operational efficiency, and long-term sustainability. The integration of financial information security management (FISM) with corporate risk management (CRM) has become imperative in mitigating these risks and ensuring business resilience.

The Impact of Global Financial Crises

Global financial crises, such as the 2008 financial crisis and the economic disruptions caused by the COVID-19 pandemic, have highlighted the vulnerability of businesses to external financial shocks. These crises often lead to:

- Liquidity constraints and capital shortages, making it difficult for businesses to sustain operations.
- Regulatory changes, requiring companies to enhance transparency and compliance measures.
- Market volatility, increasing the risks associated with financial transactions and investments.

During financial crises, the need for robust financial information security becomes even more critical, as companies must protect their assets from fraudulent activities, cyber exploitation, and insider threats that tend to rise during economic downturns.

The Growing Threat of Cyber Attacks

While financial crises present macroeconomic risks, cyber threats introduce operational and reputational dangers that can severely impact business continuity. High-profile cyberattacks, such as ransomware incidents and data breaches, have demonstrated how vulnerable financial data is to exploitation. Key cyber threats include:

- Data breaches, leading to financial losses, legal penalties, and reputational damage.
- Ransomware attacks, where businesses are forced to pay large sums to regain access to their critical financial data.
- Phishing and social engineering, targeting employees to gain unauthorized access to corporate financial systems.

Cyber threats are no longer just IT concerns; they are strategic risks that demand an integrated approach within corporate risk management frameworks.

Business Implications and the Need for a Resilient Strategy

The convergence of financial crises and cyber threats requires businesses to adopt a proactive and adaptive risk management approach. Organizations must:

- Develop comprehensive risk assessment models that incorporate both financial and cybersecurity risks.
- Enhance data encryption, multi-factor authentication, and real-time threat detection to protect financial information.
- Align regulatory compliance frameworks with international financial security standards to mitigate legal and financial repercussions.

By integrating financial information security into corporate risk management, businesses can enhance their resilience, maintain market confidence, and secure long-term growth in an unpredictable economic and digital landscape.

6. Key Best Practices in Financial Information Security and Risk Management

Risk-Based Approach to Security

Organizations should conduct regular risk assessments to identify vulnerabilities in their financial systems. Implementing a tiered security strategy ensures that high-risk areas receive greater protection.

Data Encryption and Access Control

End-to-end encryption protects financial data from unauthorized access during transmission and storage. Role-based access control (RBAC) limits access to sensitive information based on user roles and responsibilities.

Continuous Monitoring and Incident Response

Real-time threat detection systems can identify anomalies before they escalate into serious breaches. A structured incident response plan (IRP) ensures quick containment and mitigation of cyber threats.

Regulatory Compliance and Governance

Companies must adhere to international financial security regulations, such as GDPR, SOX, and PCI-DSS, to avoid legal and financial penalties. Regular compliance audits help organizations align with evolving regulatory frameworks.

Employee Awareness and Training

Since human error is a major factor in security breaches, cybersecurity training programs should be implemented to educate employees about phishing, social engineering, and secure data handling practices. International Standards in Financial Information Security and Risk Management ISO/IEC 27001 – Information Security Management System (ISMS):

- Provides a structured framework for managing sensitive information securely.
- Helps organizations implement a risk-based approach to financial data protection.

NIST Cybersecurity Framework

A widely adopted framework for improving cybersecurity risk management in organizations. Defines five core functions: Identify, Protect, Detect, Respond, and Recover.

Basel III Regulations

Focuses on strengthening financial institutions' resilience to economic and operational risks. Includes requirements for liquidity risk management and stress testing to prevent financial instability.

COBIT (Control Objectives for Information and Related Technologies)

A framework that aligns IT security with business risk management.

Helps organizations ensure data integrity, availability, and confidentiality.

GDPR (General Data Protection Regulation) & PCI-DSS (Payment Card Industry Data Security Standard)

- GDPR emphasizes data privacy and protection for financial transactions.
- PCI-DSS ensures secure handling of cardholder data in financial institutions.

The Role of Standards in Strengthening Corporate Risk Management

By adhering to these best practices and standards, organizations can:

- Enhance financial data protection and reduce the risk of cyber incidents.
- Improve regulatory compliance, avoiding penalties and reputational damage.
- Strengthen corporate resilience, ensuring financial stability and business continuity.

A proactive and standardized approach to financial information security is no longer optional but a necessity for businesses aiming to stay competitive and secure in an increasingly digital world.

7. Methodology

This study employs qualitative research methods to explore the relationship between Financial Information Security Management (FISM) and Corporate Risk Management (CRM). A systematic literature review and expert opinions form the foundation of the research, providing a comprehensive analysis of existing frameworks,

challenges, and best practices in integrating financial security with corporate risk management strategies.

Qualitative Research Approach

Given the complexity of financial security and risk management, a qualitative approach was chosen to gain in-depth insights into how organizations manage financial data security while addressing corporate risks. This method allows for an exploratory and interpretative examination of various factors influencing financial security practices in organizations.

Data Collection Methods

1. Literature Review

- A systematic review of academic journals, industry reports, and regulatory guidelines was conducted to identify prevailing theories, frameworks, and standards (e.g., ISO 27001, NIST Cybersecurity Framework).
- Peer-reviewed sources from Scopus, Web of Science, and Google Scholar were analyzed to ensure credibility and relevance.
- The review focused on case studies illustrating real-world applications of financial information security management in corporate risk strategies.

2. Expert Opinions

- Semi-structured interviews were conducted with financial security experts, risk management professionals, and IT security specialists to gain practical insights into industry challenges and solutions.
- The experts were selected based on their professional experience (minimum 10 years) and involvement in cybersecurity or risk management in financial institutions or multinational corporations.
- Key themes emerging from these discussions included cyber risk trends, regulatory compliance challenges, and effective mitigation strategies.

Data Analysis Process

1. Thematic Analysis

- The collected qualitative data (literature findings and expert interviews) were analyzed using thematic coding to identify patterns and emerging trends.
- Thematic categories included financial data security challenges, risk mitigation strategies, regulatory frameworks, and corporate governance influences.

2. Comparative Analysis

- Findings from different industries (financial services, technology firms, and manufacturing companies) were compared to understand variations in financial security risks and management approaches.
- International best practices and regulatory requirements were evaluated to develop a practical integration model for businesses.

Sampling and Selection Criteria

- The literature review focused on studies published between 2010 and 2024, ensuring that both foundational theories and recent developments were covered.
- Experts were selected using purposive sampling, targeting professionals from finance, cybersecurity, and risk management fields with significant experience in corporate governance and regulatory compliance.

- Industry reports from organizations such as ISO, NIST, and the Basel Committee on Banking Supervision were also incorporated to provide a broader perspective on financial risk management.

Conclusion on Methodology

By integrating systematic literature review and expert perspectives, this research aims to develop a practical and applicable framework for aligning financial information security management with corporate risk management. The combination of thematic and comparative analysis ensures a comprehensive and multi-dimensional understanding of the subject, bridging the gap between academic research and real-world business practices.

8. Findings and Discussion

The findings of this study reveal that the integration of Financial Information Security Management (FISM) with Corporate Risk Management (CRM) is not only essential but increasingly urgent in today's complex business environment. The analysis of the literature and expert opinions suggests that financial data security and corporate risk management are two interdependent domains that, when properly aligned, can create a more resilient, competitive, and sustainable organization.

Key findings include:

1. Increasing Complexity of Financial Information Security Risks

The growing number and sophistication of cyber threats, such as ransomware attacks, data breaches, and phishing, were identified as significant challenges facing businesses. Financial institutions, in particular, are high-risk targets, as they manage sensitive financial data and are prime candidates for cyberattacks aimed at exploiting vulnerabilities. A significant number of experts reported that the risks associated with financial data breaches have escalated in recent years, creating a higher demand for integrated risk management frameworks.

2. Inadequate Integration between FISM and CRM

Despite the critical need for aligning FISM with CRM, many organizations still manage these two domains as separate silos. This fragmented approach leads to inefficiencies in risk mitigation strategies, particularly in terms of cybersecurity. The study found that many organizations were focused on financial performance and traditional risk management practices without addressing the growing significance of cyber risks in their overall risk management strategy.

3. Lack of Comprehensive Frameworks for Integration

Although there are numerous frameworks and standards available (e.g., ISO 27001, NIST Cybersecurity Framework), the research revealed that many organizations still struggle to implement these frameworks in a holistic manner. A recurring theme among experts was the need for a tailored, organization-specific approach to integrate financial information security seamlessly into the broader corporate risk management strategy.

4. The Role of Regulatory Compliance in FISM and CRM Integration

Regulatory pressures, such as GDPR and Basel III, have been recognized as catalysts for the integration of financial information security into corporate risk management practices. Experts highlighted that compliance requirements force organizations to adopt more comprehensive security and risk management strategies, thus making the connection between FISM and CRM more explicit. However, many companies face challenges in meeting compliance requirements due to insufficient integration between these two domains.

Interpretation of Findings and Business Implications

The findings from this research have significant implications for businesses, particularly those operating in industries with high exposure to financial and cyber risks. The following key points offer actionable insights:

1. The Need for a Holistic Risk Management Approach

Businesses must adopt a holistic approach to risk management, where financial information security is embedded within the broader corporate risk management strategy. As cyber threats continue to evolve, it is no longer sufficient for organizations to treat financial information security as a stand-alone function. Financial data breaches can lead to reputational damage, legal consequences, and significant financial losses. Therefore, organizations should establish integrated enterprise risk management frameworks that incorporate both traditional risks (e.g., financial, operational) and cyber-related threats.

2. Improved Resilience through FISM-CRM Integration

When FISM and CRM are effectively integrated, organizations are better equipped to identify, assess, and mitigate financial and cyber risks simultaneously. This integration enhances an organization's resilience to cyberattacks, reduces potential financial losses, and improves decision-making processes. For example, organizations can use data from financial risk assessments to enhance their cybersecurity strategies, thereby reducing the likelihood of cyber threats affecting financial performance.

3. Competitive Advantage and Stakeholder Trust

Organizations that successfully integrate financial information security with risk management can gain a competitive advantage. By demonstrating a commitment to data security and regulatory compliance, businesses build stakeholder trust, which is crucial in maintaining customer loyalty and reputation. Moreover, companies that prioritize integrated risk management are better positioned to respond to emerging risks, thus ensuring long-term sustainability and adaptability in a fast-changing business environment.

4. Adopting Best Practices and Regulatory Compliance

The study underscores the importance of adopting recognized best practices and complying with regulatory frameworks to manage both financial and cyber risks. Businesses that align with standards such as ISO 27001 and NIST are not only enhancing their security posture but are also positioning themselves to meet evolving compliance requirements. In highly regulated industries, such as finance and healthcare, aligning FISM and CRM ensures that businesses can meet legal and regulatory obligations while safeguarding financial and customer data.

5. Challenges and Future Research Directions

One of the challenges highlighted in this study is the lack of a unified framework that guides organizations in integrating FISM and CRM effectively. Future research could explore the development of such frameworks, as well as case studies of businesses that have successfully integrated these domains. In addition, there is a need for further exploration of the relationship between organizational culture, leadership commitment, and the success of FISM-CRM integration.

The findings from this study reinforce the necessity of integrating Financial Information Security Management (FISM) into Corporate Risk Management (CRM) to build resilient, competitive, and compliant organizations. As businesses continue to face increasing risks from cyber threats, economic instability, and regulatory pressure, the integration of these two critical domains is imperative for long-term success. By adopting a holistic approach and aligning financial security with corporate risk management strategies, businesses can enhance their resilience, protect their assets, and maintain a competitive edge in an increasingly complex and volatile business environment.

9. Conclusions and Recommendations

This study highlights the critical importance of integrating Financial Information Security Management (FISM) into Corporate Risk Management (CRM). The findings clearly show that the risks associated with financial information security are no longer isolated to the IT department but must be recognized as integral components of an organization's broader risk management strategy. The complex, rapidly evolving nature of cyber threats, coupled with increasing regulatory requirements, makes it imperative for organizations to adopt a more comprehensive, unified approach to risk management.

The study also underscores the significant gap in existing literature regarding the integration of these two domains. Although individual practices and standards, such as ISO 27001 and NIST, are widely used, the integration of FISM and CRM remains underdeveloped in practice, particularly for organizations that have yet to bridge the gap between cybersecurity and broader risk management processes. This gap not only exposes organizations to substantial financial and reputational risks but also inhibits their ability to respond proactively to emerging threats.

Recommendations for Businesses

Based on the findings, the following key recommendations are provided for businesses aiming to strengthen their risk management frameworks and enhance their resilience against financial and cyber risks:

Adopt an Integrated Risk Management Approach

Organizations must move beyond treating financial information security and corporate risk management as separate entities. A more integrated and holistic approach should be adopted, where financial information security is embedded within the organization's overall corporate risk management strategy. This integration should include risk identification, assessment, response, and continuous monitoring across both financial and cybersecurity domains.

Invest in Employee Training and Awareness

One of the most significant vulnerabilities in financial information security is human error. Businesses must invest in regular training and awareness programs for employees to recognize potential risks, follow best practices for data security, and comply with regulatory requirements. Building a culture of security within the organization will not only reduce risk exposure but also empower employees to take ownership of safeguarding organizational data.

Implement Robust Frameworks and Standards

To effectively manage both financial and cyber risks, businesses should align their risk management processes with recognized frameworks and standards such as ISO 27001, NIST Cybersecurity Framework, and COBIT. These frameworks provide a structured approach to identify, assess, and mitigate risks and can be tailored to meet the specific needs of the organization. Adopting these standards also helps businesses stay compliant with legal and regulatory requirements.

Leverage Technology for Continuous Monitoring and Risk Assessment

Organizations should invest in advanced technologies that enable continuous monitoring of financial data and cybersecurity systems. Technologies such as artificial intelligence (AI), machine learning (ML), and blockchain can help detect anomalies, predict potential threats, and improve real-time risk assessment. By utilizing these technologies, businesses can respond quickly to emerging risks and reduce the potential impact of cyberattacks or financial fraud.

Strengthen Incident Response Plans

Businesses must have a well-defined and tested incident response plan that addresses both cybersecurity and financial risks. This plan should include clear procedures for detecting, reporting, and responding to data breaches, financial fraud, and other security incidents. Regular drills and scenario-based exercises should be conducted to ensure preparedness in the event of a crisis.

Establish Clear Accountability and Governance Structures

It is essential for organizations to designate clear accountability and governance structures for managing financial information security and corporate risk management. Senior leadership should be actively involved in the risk management process, ensuring that security policies are aligned with strategic business goals. An empowered risk management team with cross-functional representation can facilitate the integration of financial security and risk management efforts across the organization.

Potential Areas for Future Research

As the business landscape continues to evolve, future research should focus on several areas to further advance the understanding and integration of financial information security and corporate risk management:

Development of a Unified Framework

Future studies could explore the development of a unified framework that integrates financial information security management and corporate risk management. This framework could be designed to provide a step-by-step guide for organizations to align their risk management strategies across both domains.

Impact of Emerging Technologies on FISM and CRM

With the rise of blockchain, artificial intelligence, and machine learning, there is a need to explore how these emerging technologies can enhance the integration of financial information security with corporate risk management. Research could focus on how businesses can leverage these technologies to better predict, detect, and mitigate financial and cybersecurity risks.

Industry-Specific Approaches to FISM and CRM

Research could investigate how different industries, such as banking, healthcare, or manufacturing, approach the integration of FISM and CRM. Understanding sector-specific challenges and solutions could provide valuable insights for developing tailored risk management strategies for organizations operating in distinct industries.

Exploring the Role of Leadership in FISM and CRM Integration

Another potential area for future research is to explore the role of leadership and organizational culture in the successful integration of financial information security and corporate risk management. How does leadership commitment to risk management influence the effectiveness of FISM-CRM integration? This area could provide insights into the organizational factors that contribute to successful risk management practices.

Long-Term Impact of FISM-CRM Integration on Business Performance

Future studies could examine the long-term impact of integrating FISM with CRM on business performance and sustainability. This could involve a longitudinal analysis to determine whether organizations that adopt integrated risk management frameworks outperform their competitors in terms of profitability, growth, and reputation.

The integration of Financial Information Security Management (FISM) with Corporate Risk Management (CRM) is essential for safeguarding organizational assets, ensuring regulatory compliance, and achieving long-term business success. This study has highlighted the critical need for businesses to adopt a holistic approach to risk management, emphasizing the importance of cybersecurity and financial risk management as interconnected, rather than separate, domains. By implementing the recommendations

provided, organizations can not only reduce risk exposure but also enhance their competitive advantage in an increasingly complex and volatile global business environment.

Future research in this area will continue to shape how organizations approach the integration of FISM and CRM, providing further insights into best practices, industry-specific challenges, and the role of emerging technologies in enhancing organizational resilience.

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BACKBONE STRUCTURES IN COLLECTIVE IMPACT INITIATIVES: THEORY AND PRACTICAL IMPLEMENTATION IN MOLDOVA

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Abstract: *This article examines application of Collective Impact (CI) framework to advance childcare reform in Moldova, focusing on the pivotal role of "backbone" structures in coordinating multi-stakeholder initiatives. Using a mixed-methods approach, including analysis of reports, participant databases, etc., and in-depth interviews with key stakeholders, research identifies the National Programme for Child Protection (NPCP) 2022–2026 as a potential common agenda for CI initiative. The article highlights the essential functions of backbone structures, such as strategic direction, stakeholder facilitation, data management, and resource mobilisation, while emphasising the need for strong leadership, clear governance, and dedicated resources to ensure effective coordination. Findings reveal that while Moldova's National Council for Child Rights Protection (NCCRP) has historically played a central role in child protection, its decline in activity underscored the need for revitalisation. Alternative backbone models, including civil society alliances or dedicated coordinators, are proposed, describing unique strengths and challenges. The research underscores the importance of inclusive stakeholder engagement, adaptive leadership, and robust monitoring mechanisms to sustain long-term impact. The article contributes to the broader discourse on CI by offering practical insights into the design and implementation of backbone structures in complex, multi-sectoral reforms. It provides actionable recommendations for policymakers, including the formalisation of a backbone structure, capacity-building for leaders, and enhanced stakeholder collaboration. By aligning the NPCP with CI principles, this research offers a roadmap for achieving systemic change in Moldova's childcare system.*

Keywords: *Collective Impact, Backbone structure, childcare system, childcare reform, Moldova.*

UDC: 316.42:364.4-053.2(478)

Classification JEL: Z13

1. Introduction

Collective Impact (CI) is a structured approach to solving complex social problems through the coordinated efforts of multiple stakeholders from different sectors. First articulated by Kania and Kramer (2011), CI has gained traction globally as a framework for achieving large-scale social change. The approach suggests there are five key conditions, including common agenda, continuous communication, shared measurement systems, mutually reinforcing activities and backbone support. At the heart of CI initiatives is the backbone structure, an organisation or entity responsible for guiding the initiative, facilitating collaboration, and ensuring that all participants work towards a shared goal. Starting with 2021 for the first time in Moldova, CI was applied to continue reforming childcare sector at the

national level. [1] By this time, the childcare system in Moldova has already undergone significant reform over the past decades, yet persistent challenges necessitate more integrated approaches. This paper explores the forms backbone structure can take to support CI initiative as well as peculiarities of mobilizing and coordinating key actors in child protection in Moldova. Basing on the results of mixed method analysis including document review and key informant interviews authors try to come with potential scenarios and recommendations for setting up backbone support structure within a CI initiative.

2. Literature Review

2.2. Types of Governance Structures for Collective Impact

In 2021 Collective Impact Forum and FSG Reimagining Social Change defined backbone support as follows: “An independent, dedicated staff provides support and key functions for the sustained operation of the collective impact initiative.”[2] The structure or organization that serves as a "backbone" ensures that the initiative progresses toward achieving the common agenda by facilitating the other three conditions of CI, including continuous communication, shared measurement systems, and mutually reinforcing activities. It is tempting to say that there are as many "backbone" models as there are CI initiatives. However, we have found that, at a certain level, there is a common theory of change for "backbone" organizations that ultimately seeks to improve social outcomes by organizing cross-sector groups of partners to transform an often inefficient and fragmented system. "Backbone" organizations play six key roles in driving this vision forward, regardless of their sector. They set strategic direction, foster collaboration between partners, and manage data collection and analysis. Additionally, they oversee communications, coordinate community outreach, and secure funding. By handling these essential functions, they ensure the initiative's success. The "backbone" structure builds trust among partners by remaining neutral and providing ongoing support. [3]

To create consensus, the following aspects are important for the "backbone" organization or structure:

- Competence: Knowledge, strategic vision, problem-solving skills, and interpersonal abilities.
- Commitment: Solid experience and demonstrated commitment to the issue.
- Objectivity: Focus on the common good, creating a safe space for all opinions, not driven by individual organizational interests.
- Data and Information: Using tools such as research, data, and media to inform and/or drive the initiative.
- Network: Strong connections with cross-sector actors and community members.
- Visibility: Creating sufficient recognition of contributions within the initiative to achieve successful influence. [4]
- Additionally, a 2018 study found that the most effective "backbone" organizations focused on building the network rather than leading change. The "backbone" structure should be composed of well-trained leaders with a specific focus on equity within the initiative.[5] Funders, non-governmental organizations (NGOs), government agencies, or a combination of these actors can fulfil the role of the "backbone" structure.[3] Depending on the flexibility of funders, the way the initiative was created, and which organizations within

the existing community of practitioners are best positioned to fulfil this function, the "backbone" organization will be determined.

- When a donor initiates the use of the CI methodology, there are advantages and disadvantages for the donor, both in the role of funder and as the "backbone." Donors offer a broad perspective, as they often work across multiple sectors. They have the ability to connect partners who might not traditionally work together and can be considered the natural choice for a "backbone" structure, as they have the authority and responsibility to disburse funds. However, while donors have a "big picture" view as funders, they may lack local knowledge and technical expertise. Funders can become a barrier to collaboration and progress if they are not perceived as neutral or open to learning from failures. Non-profit organizations may become closed to collaboration or inactive due to the perception that the funder has a pre-determined vision, strategy, or expected outcomes. The power dynamics between funders and beneficiaries can interfere with the ability to act as a neutral facilitator.
- In some cases, donors select and fund intermediaries to serve as a neutral organization to convene multiple stakeholders, build capacity, distribute funds, and conduct evaluations. Intermediaries are selected to act as funders when the donor lacks sufficient capacity and expertise to fulfil this role. While this adds a layer of subordination between the donor and the funded stakeholders, perceptions of inequality can cause tension. When the roles of intermediary and "backbone" are combined, the tasks of the "backbone" structure can be perceived as controls over fund accountability. [5] When the roles of intermediary and "backbone" are not combined, confusion about roles and responsibilities can cause disruptions within the initiative and tensions between these two organizations or structures.
- To address these challenges, intermediary organizations have established processes to ensure a prominent level of transparency in decision-making, detailed reporting between partners, and open discussions about equity. Roles and responsibilities among initiative leaders must be clearly defined from the outset, [6] with periodic evaluations and updates as the initiative evolves. The "backbone" organization must be credible among stakeholders and have facilitation and capacity-building skills to create strong leaders or champions with a long-term vision for change and the ability to achieve it. Given the need for credibility, whenever possible, the community of leaders and practitioners in the sector should be consulted regarding the selection and creation of the "backbone".[5]

2.2. Leadership Skills Required for a "Backbone" Structure

Leadership skills demonstrated by the staff of a "backbone" structure are essential for the success of any collective impact initiative. As Hanleybrown and colleagues noted in their 2012 article, *"Backbone organizations must strike a delicate balance between the strong leadership needed to hold all parties together and the invisible 'behind-the-scenes' role that allows other stakeholders to take ownership of the initiative's success."*[3] Backbone structures work best when they use an adaptive, systems-oriented leadership style. According to Senge, Hamilton, and Kania (2015), system leaders need to have a specific set of skills to be successful. They need to have an ability to see bigger picture and recognize there exist hidden dynamics and interconnections within a system. Leaders need

to help others grasp this complexity even beyond immediate view. Plus, they need to be able to facilitate deep reflective conversations that would help participants unlocking new insights, bridge perspectives and spark innovation. Finally, they need to support groups on shaping the future rather than fixing immediate problems.[8]

Kania and Kramer described this leadership orientation in different terms: *"In the best circumstances, backbone organizations embody the principles of adaptive leadership: the ability to focus people's attention and create a sense of urgency, the ability to apply pressure to stakeholders without overwhelming them, the competence to frame problems in a way that presents both opportunities and challenges, and the power to mediate conflicts between stakeholders."*[3] Ross Meyer, former leader of the "backbone" organization for the initiative *Partners for a Competitive Workforce*, noted: *"I think backbone leaders require a diverse skill set. The most important skills are listening, facilitating, developing relationships and trust with individuals and partners, being able to communicate a compelling vision... and the ability to execute toward that vision."*[9]

Leadership must be collaborative and relationship-oriented within a collective impact initiative, often requiring being both diplomatic and humble. Successful leaders have also been described as visionary, charismatic, and influential communicators, results-oriented and focused, yet adaptable. Liz Weaver, Vice President of the Tamarack Institute, has worked closely with many backbone leaders and was herself a leader of a "backbone" structure for the collective impact initiative - the Hamilton Roundtable in Ontario, Canada. She believes that leaders must focus not only on building relationships but also on inclusive conversations. *"You have to go slow to go fast. Too often, we only talk to the people we know. Until you bring in those people you don't know, you'll have the same conversation you've always had."*

As the work evolves, successful leaders in the "backbone" organization or structure continue to prioritize coordination by considering the interpersonal dynamics of partnership and collaboration. For example, Chekemma Fulmore-Townsend of Project U-Turn consults key stakeholders before publishing reports: *"We vet the data with leaders in the system [before releasing important reports]. Of all the things we do to advance partnerships and align to the common goal, vetting reports with system leaders prior to publication is the most powerful approach we have."* [10] To generate deep dialogue and co-create sustainable solutions, the leader must be able to speak freely and fluently with all partners in the system. This may require communication that can reach different sectors or partners. It is important to note that different organizations within a certain category need to be approached differently depending on their preferences. Gabriel Guillaume of LiveWell Colorado explains the approaches to structuring his conversations with them as follows: *"Some funders want to hear the 'collective' part of collective impact, such as how partnerships are formed. But others want to hear the 'impact' part, such as what you are achieving and what the return on investment is."* [10]

The process of selecting the type of "backbone" structure requires careful analysis and design for the local context. "Backbone" structures are neither self-appointed nor predetermined, as this could diminish trust, transparency, and credibility as a fair and honest intermediary between the partners of the effort. Rather, the coordinating committee develops a process through which its members and key stakeholders provide input and select the structure, staff, and partner to provide support for the collaborative. Depending on the local context, initiatives may choose an open, semi-open, or closed selection process. Among the advantages of an open selection process are its transparency, the

ability to build the initiative's credibility among stakeholders, and openness to a wide range of organizations with different skill sets, including those that are not part of the most prominent organizations or have the most resources, which may not always be the best choice for promoting inclusion and equity within the initiative. The disadvantages of an open initiative include the fact that the open approach usually requires a longer period of time to establish the coordinating structure, and the potential for controversial discussions within the coordinating committee.

Communities that emphasize inclusion often choose to design an open and transparent selection process to further build trust. An open process can be particularly useful for building trust in communities where a certain population or group may feel historically marginalized. However, a more closed selection process may make sense in certain cases. For example, in communities with more limited resources, there may be only one organization with the size and capacity to host the "backbone" structure. In such a context, that organization is the obvious choice, and therefore an open selection process is not necessary.[10]

3. Methodology

As part of the research, the following methods were applied:

- Key informant interviews with experts, equalling six detailed one-on-one discussions.
- Document analysis, which involved reviewing secondary data, including meeting notes, reports, and quantitative data related to meetings, events, and participants.

The number of in-depth interviews was limited due to the relatively small pool of individuals with the necessary knowledge and experience relevant to the study. While there is an understanding that the socio-ecological model can be applied to study CI, it is challenging to identify behavioural changes across different levels. That said, the methodology provides a structured framework, including critical components and phases, which served as the foundation for exploring and documenting the experience of applying CI to advance childcare system reform in the Republic of Moldova.

4. Results and Discussion

4.1. Coordination Structures within the Child Care and Protection System in the Republic of Moldova

In the Republic of Moldova, there is an urgent need to finalize childcare reform to ensure that all children grow up in families or family-like environments and have access to quality community services at the rayon level. The global initiative Changing the Way We Care has brought a bold solution to these challenges by introducing the CI approach to unite all key stakeholders in the field. The success of previous reforms in childcare - such as reducing the number of children in residential institutions from 17,000 [12] in 1995 to 600 by the end of 2023 [13] was driven by effective collaboration between central and local public authorities, development partners, donors, and civil society organizations. The key coordination structure is the National Council for Child Rights Protection, established in 1998 and chaired by the Prime Minister, with the Deputy Head represented by the Minister of Labour, and Social Protection [14].

The implementation of policies in the field of child protection requires active involvement of the National Council for Child Rights Protection (NCCRP). This body

plays a pivotal role in fostering intersectoral collaboration among government structures and facilitating interaction with the associative sector, which is equally vital for the development of the child protection system. Over the years, the NCCRP has demonstrated its viability by coordinating the development of policy documents in this domain, serving as a platform for dialogue on child-related issues between governmental and non-governmental entities, and strengthening professional partnerships.

Due to multiple contextual challenges as well as government structural changes, the Council's activities were deprioritized and according to its official website, there have even been no publicly available action plans between 2020 and 2022. Consequently, new initiatives and entities have emerged to support the promotion of reforms within the care system. In the autumn of 2020, key governmental and non-governmental stakeholders initiated the development of a National Programme for Child Protection for the years 2022-2026. The programme includes provisions and recommendations for a coordination mechanism to support the implementation of its objectives: *The coordination of child protection policy in the Republic of Moldova is the responsibility of the Ministry of Labour and Social Protection, facilitated through the National Council for Child Rights Protection (NCCRP). Established in 1998 and reactivated in 2010, the Council plays a central role in ensuring intersectoral collaboration among government structures and fostering interaction with civil society organisations and development partners in the field. These stakeholders represent a critical resource for the advancement of the child protection system. In accordance with its mandate, the NCCRP is tasked with promoting dialogue and cooperation between governmental and non-governmental entities, thereby strengthening the framework for child rights protection. Its efforts are instrumental in aligning policies, strategies, and actions to address the needs of children effectively and to uphold their rights as a national priority.* [15] The transition towards a more robust and inclusive child protection framework underscores the importance of revitalizing the NCCRP's role. By doing so, it can continue to serve as a cornerstone for policy development and intersectoral collaboration, ensuring that the rights and welfare of children remain at the forefront of national priorities.

Another significant role is played by sectoral alliances and platforms, often led by civil society organisations (CSOs), which facilitate collaboration among multiple stakeholders. Among these are the Alliance of NGOs Active in the Field of Child and Family Social Protection (APSCF), the Alliance of Organisations for People with Disabilities in the Republic of Moldova, the Joint Platform of Civil Society Organisations Promoting the Rights of Persons with Disabilities, and the Aid Management Platform (an automated information system where data on external assistance is stored), coordinated by the State Chancellery. Interestingly, these entities are largely regarded as platforms for information exchange and advocacy rather than as coordination mechanisms. On occasion, they undertake joint initiatives that require coordination - such as the APSCF's efforts in developing the National Child Protection Programme - but their primary function is not coordination. Instead, they serve as vital spaces for dialogue, knowledge-sharing, and collective action, contributing to the broader goals of child protection and social inclusion. Their work underscores the importance of multi-stakeholder engagement in addressing complex social challenges, even if their core mandate lies in fostering collaboration rather than direct coordination.

To confirm the list of coordination mechanisms in the field of child protection, as well as to identify their strengths, weaknesses, lessons learned, and suggestions for improvement, we conducted in-depth individual interviews with leaders in the field. As a

result, we identified that certain elements of the methodology were present in successful mechanisms. Interviewees mentioned two mechanisms that coordinated activities within the care system, though neither is currently active, as they have fulfilled their respective functions. These are: the National Council for Coordinating the Reform of the Residential Childcare System and the Development of Inclusive Education, and the Country Core Team, which conducted an evaluation of alternative care in Moldova. According to experts, these mechanisms had common agendas, coordination structures, and elements of shared measurement systems.

Successful mechanisms played a significant role in reforming the care system, improved collaboration among stakeholders, and benefited from more efficient relationships between partners. Among the factors that influenced the effectiveness of these coordination mechanisms were the presence of a clear strategy and action plan, the fact that most residential institutions undergoing deinstitutionalisation were subordinated to the Ministry of Education (where the coordination mechanism was also located), and the sense of ownership among stakeholders. Additionally, influential leaders with strong advocacy skills were considered crucial.

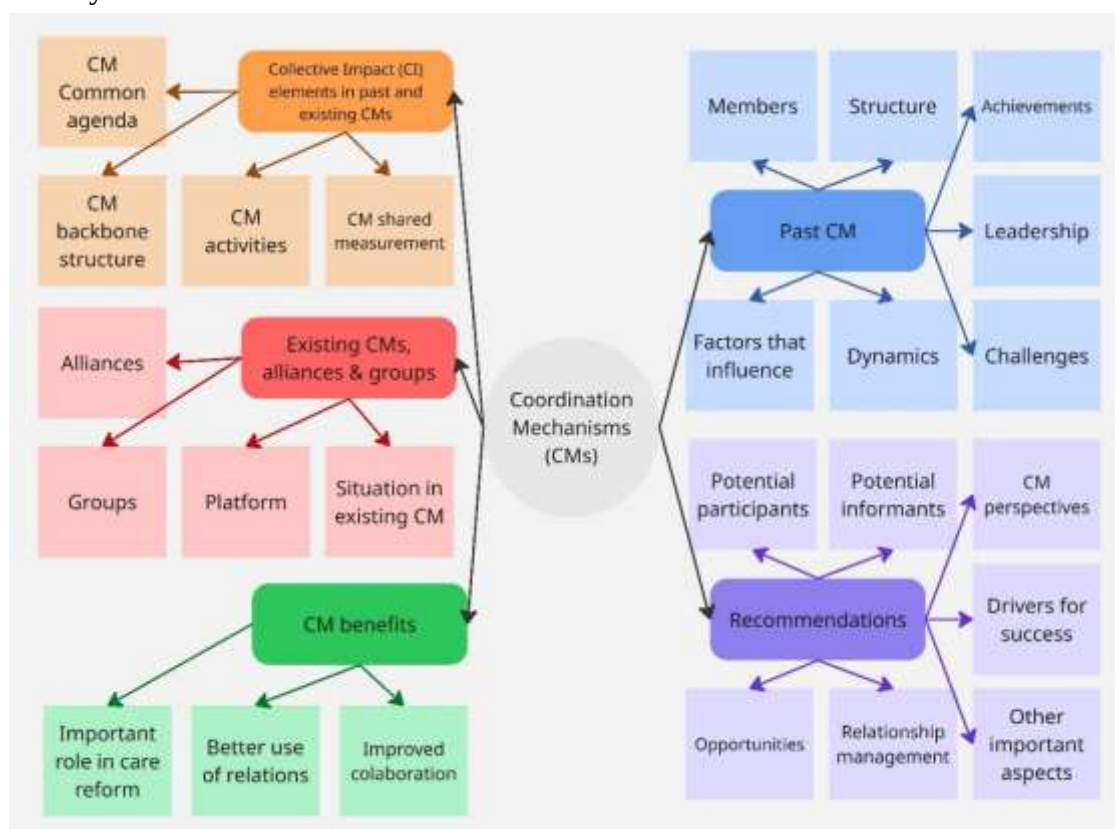


Figure 1. Results of analysis of key informant interviews on the topic of coordination in the field of childcare in Moldova.

Source: Analysis matrix of key informant interviews, 2021

Champions in the field provided recommendations for establishing backbone structures. One of the most interesting suggestions was to link the collective impact initiative with the implementation of the care system reform, particularly through the development of the National Programme for Child Protection for 2022-2026. It was also noted that a clear list of tasks is essential, as well as involving different collaborators in separate working groups to avoid partner fatigue and demotivation. These insights

highlight the importance of strategic planning, inclusive leadership, and structured collaboration in achieving sustainable reforms in child protection.

In May 2023, the Government of Moldova approved updated Council Regulations and renewed the list of organizations-members. The composition and structure of the National Council for Child Rights Protection (CNPDC) are formally established under Annex No. 1 to Government Decision No. 338/2023 [16] Previously the regulations were approved in 2003, in other words 20 year ago and required updates considering the changing landscape. Due to advocacy efforts in the frame of CI collaborative, the council remains chaired by the Prime Minister.

A brief analysis of secondary sources indicates that a significant amount of financial, human, institutional, and other resources is concentrated in the areas of family support, childcare and protection, as well as support for children and persons with disabilities. Evaluations and assessments conducted by development partners and international organisations highlight the need for improved coordination, strengthened monitoring practices, and greater mutual accountability. Furthermore, the inclusion of the voices of target groups in coordination efforts remains challenging but presents opportunities for achieving greater impact.

4.2. Common Agenda and Identification of a "Backbone" Structure for the Initiative

Between 2020 and 2021, the Government of the Republic of Moldova, in collaboration with development partners, civil society organizations, and domain experts, engaged in the development of the National Programme for Child Protection (NPCP) for the period 2022–2026. This programme, along with its action plan, plays a pivotal role in advancing the childcare system in Moldova and promoting the reform of the childcare system. Two out of three strategic objectives of Changing The Way We Care (CTWWC) initiative are closely aligned with the objectives of the NPCP. For instance: Strategic Objective 1 of CTWWC: *1: Governments advocate for family based care and the transition/ closure residential care facilities , and lead, organize, manage and fund related policies and programs in alignment with United Nations endorsed Guidelines on the Alternative Care for Children*, is similar to General Objective 1 of the NPCP: *The child protection system responds promptly and effectively to the needs of every child*. Strategic Objective 2 of CTWWC: *Children/youth remain or are reintegrated into a safe and nurturing family care*, aligns with General Objective 3 of the NPCP: *Children grow up in a safe and protective family environment that ensures their well-being*. Drawing from the methodology, which emphasizes a common agenda that is consulted upon and agreed to by key stakeholders, it was considered a logical option to adopt the National Programme for Child Protection and its action plan as the common agenda for the CI collaborative. To coordinate activities within the programme and ensure the implementation of actions and achievement of objectives, it is deemed necessary to establish a coordination mechanism. From the perspective of applying CI methodology, this mechanism would serve as the backbone structure.

In line with CI methodology, the second phase of the initiative requires the establishment of a 'backbone' structure to effectively coordinate activities and drive collaborative actions. [3] During in-depth individual interviews, we discussed potential perspectives for identifying this structure with CTWWC Moldova. In 2021, there was some uncertainty regarding the decision-making factors that could influence the final decision. Additionally, the physical location, subordination, and level of influence of the coordination structure remained unclear.

Potential options include establishing a "backbone" structure to coordinate the initiative or to oversee the implementation of the entire action plan for the National Programme for Child Protection. There are certain expectations from key stakeholders in the field, such as the need for the decision to be made at a high level by government representatives. Some opinions suggest that the decision regarding the establishment of the "backbone" structure should be made by CTWWC managers. Several stakeholders believe there is an urgent need for a decision in this regard. The CTWWC Director mentioned various possibilities, emphasizing that none of them are ideal. Among the potential scenarios discussed were:

- National Council for Child Rights Protection (NCCRP) oversees continuation of care reform as a government entity with experience and credibility.
- The Alliance of NGOs Active in the Field of Child and Family Social Protection (APSCF) - a coalition of non-governmental organizations with expertise in the field.
- CTWWC appoints a dedicated coordinator, who either works as a part of the Ministry or operates independently.

Each model has its strengths and weaknesses, such as sustainability in the face of changes within the government and ministries. For example, while the NCCRP offers institutional legitimacy, it may face challenges related to bureaucratic inefficiencies. On the other hand, a dedicated coordinator hired by CTWWC could provide flexibility and focus but might lack the broader institutional support needed for long-term sustainability.

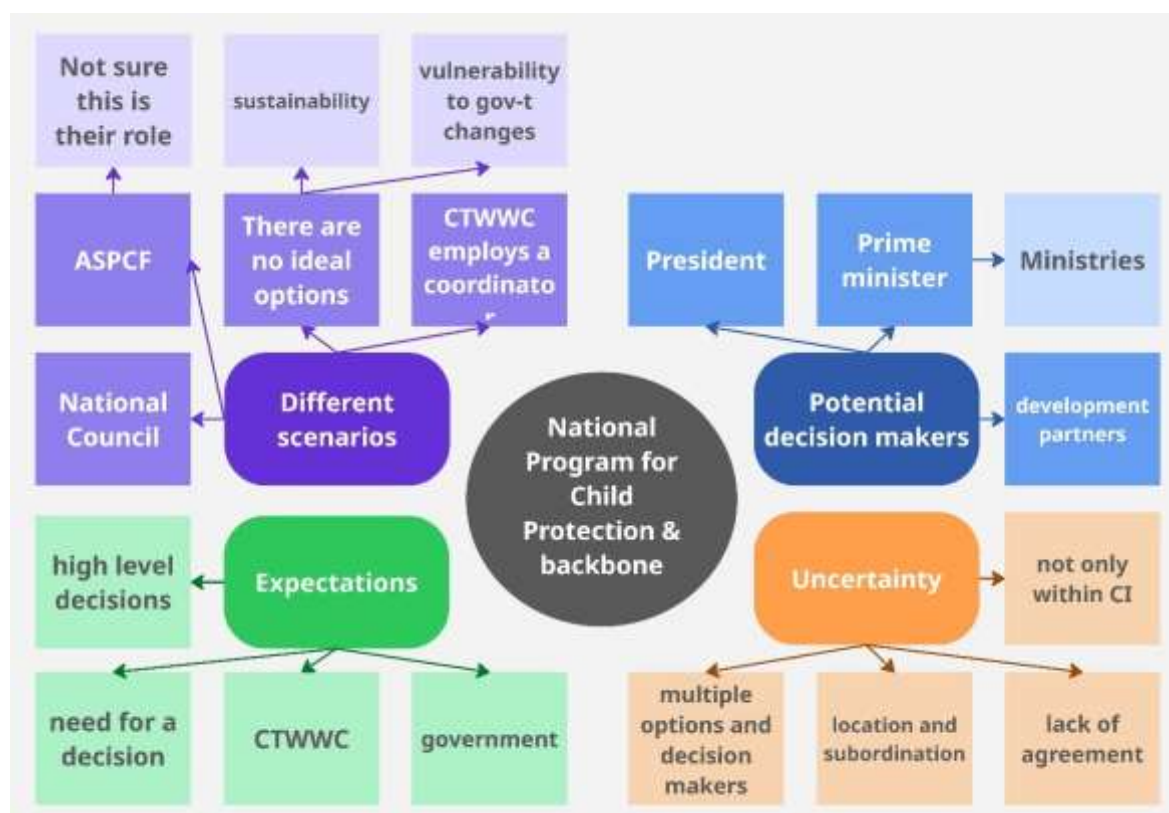


Figure 2. Results of analysis of key informant interviews on the topic of establishing backbone structure for collective impact.

Source: Analysis matrix of key informant interviews, 2021

The establishment of a "backbone" structure is critical to ensure the effective coordination and implementation of the CI initiative. While several options are under consideration, the decision must balance stakeholder expectations, institutional capacity, and long-term sustainability. The final choice will significantly influence the success of the initiative in achieving its goals and advancing the reform of Moldova's childcare system.

5. Conclusions

The concept of backbone structures or organisations plays a pivotal role in the successful implementation of CI initiatives. These structures handle essential functions such as promoting strategic direction, facilitating communication among partners, managing data collection and analysis processes, coordinating community engagement activities, and mobilising funding. Backbone structures can take various forms, including existing or newly created non-profit organisations, shared responsibilities among multiple entities, or entities supported by funders, government bodies, donors, or coordination committees. Effective leadership within these structures requires a diverse skill set, including strategic vision, communication and facilitation abilities, and the ability to coordinate actors across different sectors.

A well-coordinated CI collaborative requires strong leadership, a clear structure, a shared identity, and dedicated resources specifically allocated to the coordination function. In the context of child protection in Moldova, the National Programme for Child Protection (NPCP) and its action plan can serve as a common agenda for CI initiative. Furthermore, the coordination mechanism within the NPCP could function as the backbone structure. However, there still remained a pressing need to identify and establish a suitable backbone structure to effectively promote activities under the common agenda.

5.1. Theoretical and Practical Implications

The findings underscore the importance of backbone structures in fostering collaboration and ensuring the success of CI initiatives. From a theoretical perspective, this aligns with the principles of collective impact, which emphasise the necessity of a centralised entity to guide and sustain multi-stakeholder efforts. The study highlights the critical role of leadership and organisational design in achieving systemic change, contributing to the broader discourse on governance and coordination in public policy implementation.

From a practical standpoint, the findings offer actionable insights for policymakers and practitioners involved in child protection reforms. The identification of the NPCP as a potential common agenda and its coordination mechanism as a backbone structure provides a concrete framework for enhancing collaboration among stakeholders. This approach could streamline efforts, reduce duplication, and ensure that resources are utilised more effectively. Additionally, the emphasis on leadership competencies and resource allocation underscores the need for capacity-building initiatives to equip backbone organisations with the skills and tools required to fulfil their roles effectively.

5.2 Recommendations for Future Research and Policymaking

- **Establish a Clear Backbone Structure:** Policymakers should prioritise the identification and formalisation of a backbone structure to coordinate the NPCP. This structure should be designed to reflect the unique context of Moldova's child protection system, ensuring it has the authority, resources, and legitimacy to drive collective action.

- Invest in Leadership Development: Future initiatives should focus on developing the transversal competencies of backbone leaders, particularly in strategic vision, cross-sector collaboration, and stakeholder engagement. Training programmes and mentorship opportunities could be instrumental in building this capacity.
- Enhance Stakeholder Engagement: Efforts should be made to ensure that the backbone structure actively involves all relevant stakeholders, including government agencies, civil society organisations, and community representatives. This inclusive approach will foster a sense of ownership and commitment to the common agenda.
- Conduct Further Research: Future research could explore the long-term sustainability of backbone structures, particularly in contexts with frequent political or institutional changes. Comparative studies across different countries or sectors could also provide valuable insights into best practices and potential pitfalls.
- Monitor and Evaluate Impact: Robust monitoring and evaluation mechanisms should be integrated into the backbone structure to track progress, measure impact, and adapt strategies as needed. This will ensure accountability and continuous improvement.

5.3. Contributions and Applications of the Findings

This study contributes to the growing body of literature on collective impact by providing a practical framework for implementing backbone structures in the context of child protection reforms. The findings offer a roadmap for policymakers and practitioners seeking to enhance coordination and collaboration in complex, multi-stakeholder initiatives. By identifying the NPCP as a common agenda and proposing its coordination mechanism as a backbone structure, the study provides a tangible application of CI principles in a real-world setting. This approach has the potential to not only improve outcomes for children in Moldova but also serve as a model for other countries facing similar challenges.

In conclusion, the findings highlight the transformative potential of well-designed backbone structures in driving systemic change. By addressing the theoretical and practical implications of these findings, this study lays the groundwork for more effective and sustainable child protection systems, ultimately contributing to the well-being and rights of children in Moldova and beyond.

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ECONOMIC INTEGRATION OF UNEMPLOYED AND DISABLED PEOPLE IN THE CONTEXT OF GLOBAL SYSTEMIC TRANSFORMATIONS

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Abstract: *In recent decades, labor markets have undergone profound transformations due to rapid digitalization, recurrent economic crises, intensified migration flows, global health emergencies, and the shift toward a green economy. These systemic changes have led to structural imbalances between labor supply and demand, with disproportionate impacts on the most vulnerable segments of the population. This study investigates the economic integration of the long-term unemployed and persons with disabilities, focusing on the Republic of Moldova while situating the analysis within broader European trends. Combining qualitative and quantitative research methods, the paper draws on official datasets and policy documents to identify structural barriers to employment, such as inadequate access to education, healthcare, and inclusive infrastructure. The findings highlight persistent disparities in employment rates, education outcomes, and exposure to poverty among persons with disabilities. The comparative analysis further reveals Moldova's relative lag in aligning with EU standards on inclusive labor market practices. The study emphasizes the need for coordinated, multisectoral policy responses, targeting both institutional and attitudinal barriers. It concludes that sustainable socio-economic reintegration requires more than employment-focused measures - it demands a systemic shift toward inclusive public policy, accessible environments, and equitable access to opportunity.*

Keywords: *unemployment, persons with disabilities, economic integration, systemic transformations*

UDC: 331.5:364-056.26(100)

Classification JEL: J11, J14.

1. Introduction

Global labor markets are experiencing a period of profound transformation, shaped by a convergence of structural shifts including digital innovation, migration, environmental transitions, demographic changes, and the cascading effects of recent global crises. These dynamics unbalanced the relationship between labor demand and supply, placing increasing pressure on vulnerable population groups - most frequent, persons facing long-term unemployment and people with disabilities. For people with disabilities, participation in economic life remains frequently limited by persistent social and institutional barriers. These include limited access to education and different trainings, insufficient healthcare services, and reduced employment opportunities. The relationship between poverty and disability is cyclical, with each reinforcing the other through constrained physical movement, inaccessible infrastructure - an obstacle for autonomy and personal development, and long-lasting social isolation. The effects are not simply personal, but systemic, affecting families, communities, and overall socio-economic resilience. In the same way, long-term unemployment continues to create difficulties, at the individual level - where it weakens professional

skills and independence, autonomy, and at the macroeconomic level, through its negative impact on productivity, public finance, and societal integration. Successful integration or reintegration into the labor market for affected individuals requires measures as harmonized and evidence-based intervention through sustainable strategies.

2. Literature Review

According to World Bank Group, „over one billion people, or 16% of the world’s population, experience some form of disability, and disability prevalence is higher for developing countries” [1]. People living with disabilities are facing social and economic disadvantages, including reduced access to quality education, health services, limited employment accession, and a significantly increased risk of poverty. Poverty itself can act as a cause and as a consequence of disability. It can arise from malnutrition, insufficient access to healthcare and education, exposure to hazardous work environments, environmental degradation, and inadequate water and sanitation services. Conversely, people with disabilities can face poverty being limited of educational achievements, restricting access to the labor market, limited earning opportunities, and increasing living costs generated by disabilities *that negatively also, affecting their mental health*. The full inclusion remains blocked by various barriers that includes: non-accessible infrastructure, and public transport not adapted to the needs of people with disabilities, reduced availability of assistive technologies because they are very expensive, deficiency of accessible communication formats, deficiencies in service delivery, and constant negative social perception and discrimination. Furthermore, families with members with disabilities often face higher levels of food insecurity according to insufficient financial resources, generated by lower employment rates and poverty. In case of humanitarian crises or armed conflict, persons with disabilities are exposed to greater risk of harm, including violence, exploitation, and abuse, with mortality rates reported to be two to four times higher than people outside vulnerable groups [1].

On the other side, a meaningful percentage of non-employed individuals remain jobless for extended duration - specifically, for more than one year, that place them in the category of long-term unemployed. This condition has significant long-term impacts, not only for those most impacted, who often face social marginalization and reduced perspectives for reintegration, but also for the entire society, that puts additional pressure on public finances. Long-term unemployment is strongly connected to the persistence of poverty and social exclusion. Confronting this problem remains a major policy priority within the European Commission’s broader agenda for employment and economic resilience, reflecting the need for sustained and coordinated efforts to reintegrate the long-term unemployed into the labor market. Addressing long-term unemployment is a key employment challenge of the Commission’s jobs and growth strategy [2]. The Council of the European Union presented some recommendations on the integration of the long-term unemployed in the labour market: „encouraging the registration of long-term unemployed with an employment service; providing each registered long-term unemployed with an individual in-depth assessment to identify their needs and potential at the very latest at 18 months of unemployment; offering a job integration agreement to all registered long-term unemployed at the very latest at 18 months” [2].

3. Methodology

This study is combining both qualitative and quantitative research methods, in order to examine the mechanisms of economic integration for the unemployed and persons with disabilities in the context of systemic transformations. The primary research methods applied include document analysis, comparative statistical analysis, inductive reasoning, and analytical

deduction. Relevant data were collected from official public sources, such as the National Bureau of Statistics of the Republic of Moldova, Eurostat, and the International Labour Organization. The datasets include time-series data on employment, unemployment rates, and the socio-economic status of persons with disabilities between 2020 and 2025. Descriptive statistical methods were used to analyze trends and structural imbalances, while comparative analysis allowed the evaluation of Moldova's position relative to EU averages and member states. In order to interpret the underlying causes and systemic patterns, the research also relied on thematic content analysis of European and national policy frameworks, legal documents, and strategic action plans concerning the labor market and disability inclusion.

4. Results and Discussion

According to a publication issued by the National Bureau of Statistics of the Republic of Moldova, the data as of January 1, 2024, provided by the National Office of Social Insurance, indicate that "the number of persons recognized as disabled in the Republic of Moldova was 161.9 thousand people, including 11.4 thousand children aged 0-17. Persons with disabilities represented 6.7% of the population with usual residence, and children with disabilities constituted 2.2% of the total number of children (up to 18 years old) with usual residence in the Republic of Moldova. (Figure 1). Persons recognized as disabled (beneficiaries of disability pensions and state social disability allowances) represent about 7 percent of the country's usual resident population." [3].

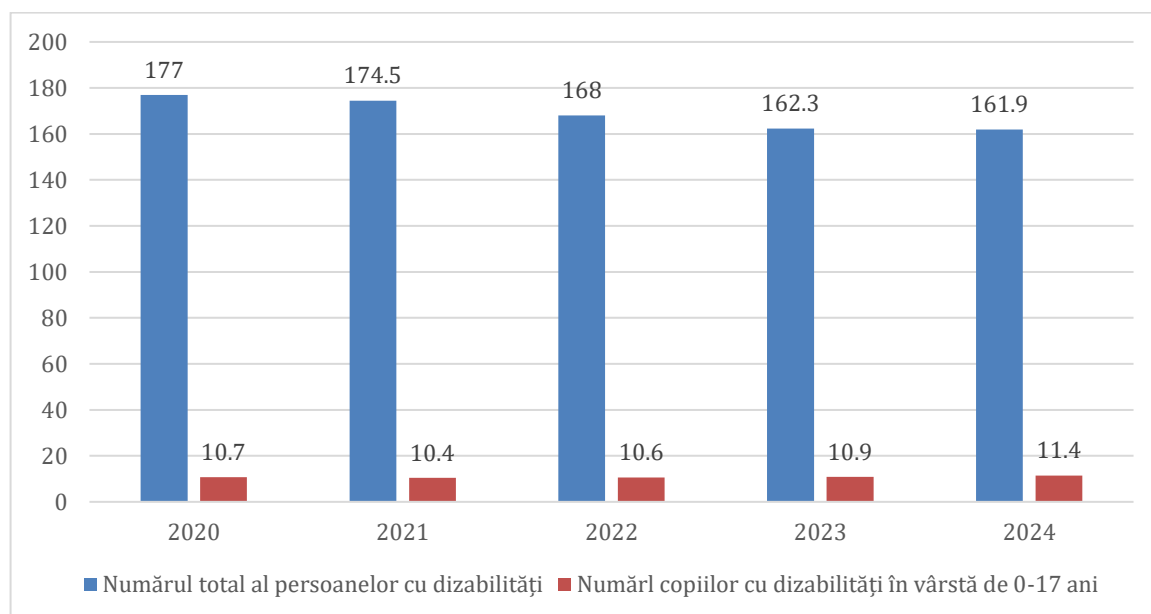


Figure 1. Number of recognized persons with disabilities in the Republic of Moldova, 1 January 2024 (thousands)

Source: *statistica.gov.md*

According to recent researches, people with disabilities continue to deal with significant barriers to full social inclusion. These challenges consist of restricted access to essential services such as healthcare, education, social assistance, career guidance, and employment opportunities. Additionally, physical accessibility remains deficient, as public infrastructure is often insufficiently adapted to the needs and requirements of persons with disabilities. Also, limited access to public information and negative social perception and discrimination intensify their exclusion.

Researches indicate that people with disabilities - specifically those living in rural areas - are at an increased risk of poverty.

”In 2023, 27% of the EU population over the age of 16 had some form of disability. According to Eurostat estimates, that equals to 101 million people or one in four people adults in the EU. [4]” A significant number of disabled still face barriers to access healthcare, education, careers, entertainment, and to participate in political life. Almost half of the EU population think that discrimination based on disability is common in their country. [4]

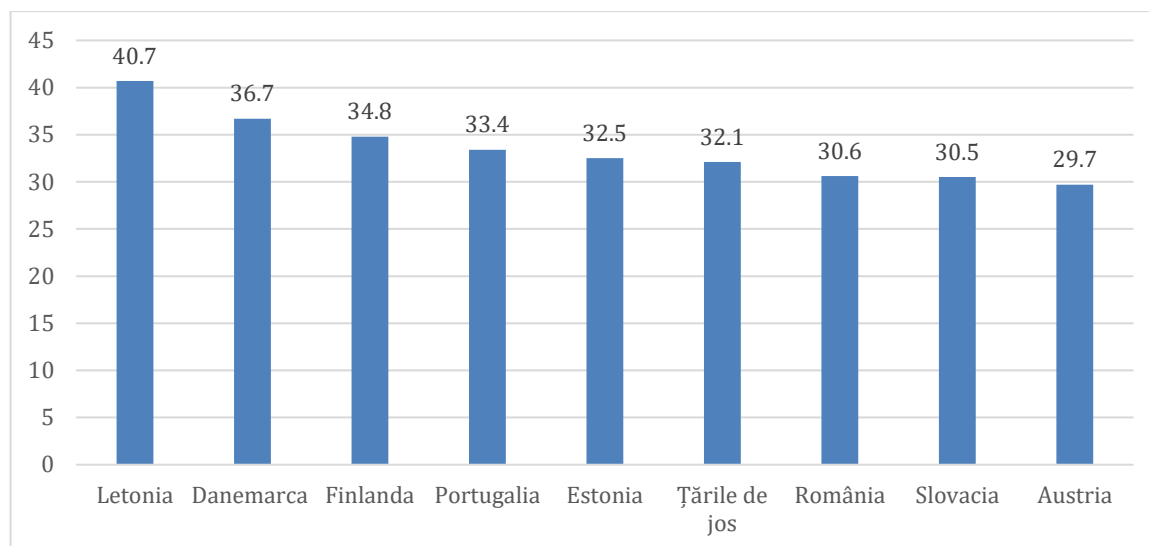


Figure 2. EU countries with the highest share of people with disabilities in 2023 (%)

Source: *consilium.europa.eu*

People with disabilities face a lot challenges affecting their social and economic integration:

- **1 in 2 feel discriminated against** – many people with disabilities continue to experience unfair treatment and discriminatory attitudes because of their condition. According to a Eurobarometer survey conducted in 2019, 52% of respondents (with disabilities) – reported having felt discriminated in a social, professional, or institutional context. This indicator suggest that the economic integration of people with disabilities cannot be realized just through employment measures but also, must be supported by cultural changes and changes in attitudes and educating the population in order to achieve a greater degree of tolerance and acceptance.
- **Almost 1 in 5 are unemployed** – ”17.7% of people with disabilities aged 20-26 were unemployed in 2020, compared with 8.6% of people without disabilities from the same age group.” [4] This difference not only reflects inequalities in access to the labor market but also contributes directly to the lowered financial autonomy of people with disabilities. The lack of stable employment opportunities restricts their capacity to achieve economic independence and reinforces a cycle of social and economic exclusion.
- **1 in 3 are at risk of poverty or social exclusion** - in 2023, disabled people faced a higher risk of poverty or social exclusion, with 28.8% affected, compared to 18% among those without disabilities. This gap represent persistent socio-economic disparities and indicates that persons with disabilities remain unfairly vulnerable to marginalization. The data underscores the necessity for targeted social protection measures and inclusive economic policies aimed at reducing inequality and fostering social participation for all.

- **1 in 5 leave school early** - the early school-leaving rate among persons with disabilities is nearly twice as high as that of their non-disablee people, reflecting barriers in accessing and completing education and training. A considerable number of young people with disabilities are enrolled in special education institutions, which often limits their transition to mainstream education. As a result, their participation in higher education remains lower: only 29% of persons with disabilities earn a higher education degree, compared to 44% among those without disabilities.
- **4 times more likely to have unmet healthcare needs** - access to medical treatment is a fundamental human right, however, individuals with disabilities frequently confront important obstacles in exercising this right. For many, healthcare services remain financially inaccessible, geographically distant, or excessively long waiting periods. These limitations not only compromise their overall well-being but also intensify health inequalities, marginalizing persons with disabilities within healthcare systems.
- **1 in 5 are victims of violence** - persons with disabilities - especially women, older adults, and children—are exposed to violence and abuse, both in domestic environments and within institutional care settings. Statistical data reveals that 17% of individuals with disabilities report being victims of violence, a rate more than double that of non-disabled people, among whom the figure stands at 8%. [4]

According to the data published by the National Bureau of Statistics, based on the findings of the Labour Force Survey (LFS) for the fourth quarter of 2024, the national unemployment rate stood at 3.9%. This represents a decrease of 1.0 percentage point compared to the same period in 2023, when the rate was recorded at 4.9%. The number of unemployed, estimated according to the definition of the International Labor Office (ILO), was 32.8 thousand persons, down by 27.1% compared to the level of the fourth quarter of 2023 (45.0 thousand persons). Unemployment affected a higher proportion of women, who accounted for 51.7% of the total unemployed, and urban - 55.0%. Unemployment rate in the population aged 15 and over (share of unemployed BIM aged 15 and over in the labor force of the same age group) was 3.9%, down by 1.0 p.p. compared to the fourth quarter of 2023 (4.9%) (SDG indicator 8.5.2) (Figure 3). The unemployment rate for men was 3.8%, for women - 3.9%, in urban areas - 4.1% and in rural areas - 3.6%. The unemployment rate for the population aged 20-64 was 3.6%, decreasing by 1.2% compared to Q4 2023. By age, the highest unemployment rate is among 15-24 year olds (17.6%) [5].

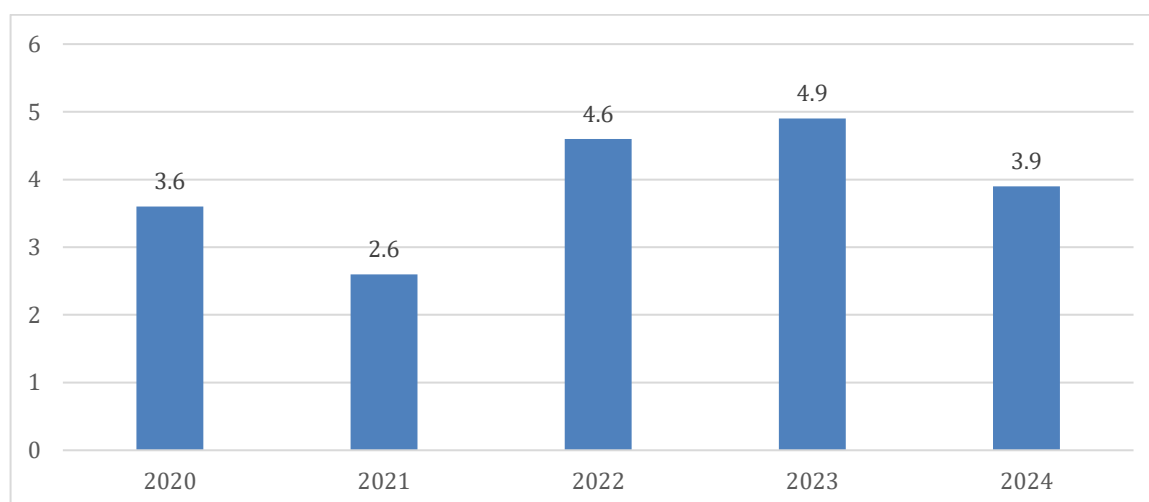


Figure 3. Unemployment rate (%), fourth quarter, 2020-2024

Source: *statistica.gov.md*

The EU unemployment rate was 5.9% in December 2024, up from 5.8% in November 2024 and down from 6.0% in December 2023 (Table 1). Eurostat estimates that 12.978 million persons in the EU, of whom 10.830 million in the euro area, were unemployed in December 2024. In December 2024, the unemployment rate for women was 6.1% in the EU, stable compared with the previous month, and the unemployment rate for men was 5.7%, also stable compared with November 2024. [6]

Table 1. Seasonally adjusted unemployment, totals (EU)

	Rates (%)						
	2023	2024				2025	
	Dec.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
European Union	6,0	5,9	5,9	5,8	5,9	5,8	5,7

Source: *ec.europa.eu*

„Based on the ILO definition, Eurostat defines unemployed persons as persons aged 15 to 74 who:

- are without work;
- are available to start work within the next two weeks;
- and have actively sought employment at some time during the previous four weeks.” [6]

The unemployment rate represents the proportion of unemployed individuals within the total labour force, where the labour force includes all employed and unemployed persons. In the context of this news release, the unemployment rates are calculated based on data for individuals aged between 15 and 74 years. The youth unemployment rate specifically reflects the percentage of unemployed individuals aged 15 to 24 within the labour force of the same age group. It is important to note that this indicator does not represent the share of unemployed within the total youth population. According to Eurostat estimates, approximately 12.677 million people in the European Union were unemployed in February 2025. This figure marks a decrease of 131,000 compared to January 2025. When compared to February 2024, unemployment fell by 643,000 individuals, both at the EU level and within the euro area. The EU’s unemployment rate stood at 5.7% in February 2025, showing an improvement from 5.8% in January 2025 and from 6.1% recorded in February 2024. [7]

5. Conclusions

This study sheds light on the persistent and multifaceted barriers impeding the economic integration of the long-term unemployed and persons with disabilities, particularly within the context of the Republic of Moldova. While structural improvements in employment statistics have been observed in recent years, they fail to reflect the deep-rooted exclusion faced by vulnerable populations. The data reveal stark disparities in access to employment, education, healthcare, and basic services—especially for individuals with disabilities and for young people struggling to transition into the labor market. Theoretically, the findings reinforce the notion that socio-economic integration cannot be reduced to job placement alone. Instead, integration must be conceptualized as a multi-dimensional process requiring accessible infrastructure, inclusive education systems, supportive social policies, and a cultural shift in societal attitudes toward disability and long-term unemployment. Practically, this research highlights the urgency of implementing comprehensive, cross-sectoral strategies tailored to the specific challenges faced by these groups. Policymakers are encouraged to prioritize individualized support services, expand vocational training opportunities, and align national policies with EU frameworks that promote labor market inclusiveness and human rights protection.

Endnotes: *The paper was elaborated within the framework of Subprogram 030101 „Strengthening the resilience, competitiveness, and sustainability of the economy of the Republic of Moldova in the context of the accession process to the European Union”, institutional funding.*

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INCOME INEQUALITY IN THE REPUBLIC OF MOLDOVA: A CHALLENGE FOR SUSTAINABLE SOCIAL DEVELOPMENT

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Abstract: *Income inequality is a major challenge for the sustainable social development of the Moldova, with significant implications for social cohesion, economic stability, and the standard of living of the population. This article analyzes the level and evolution of income inequality using relevant statistical indicators such as the Gini coefficient and income distribution by quintiles. It examines the main sources of income, regional and sectoral disparities, and their effects on economic growth and social equity. The findings highlight the urgent need for measures to reduce income gaps, including increasing the minimum wage, strengthening the social protection system, and implementing progressive tax policies. The conclusions emphasize the importance of effective interventions to promote fair income distribution and ensure sustainable development in Moldova.*

Keywords: *Income inequality, wage disparities, Gini coefficient, social policies, sustainable development.*

UDC: 316.42:330.564.22(478)

Classification JEL: D63, I32, R11

1. Introduction

Income disparities represent a significant challenge for the sustainable development of society in the Republic of Moldova, with repercussions on economic stability, social cohesion, and equity in resource allocation. The degree of income inequality and its evolution play a crucial role in shaping the country's economic and social policies.

On the one hand, income differences may have objective causes, being influenced by factors such as profession, educational level, individual skills, field of activity, geographical region, or initial conditions of social integration. In this regard, a certain variation in income can have a stimulating effect, encouraging individuals to develop their skills and improve their socio-economic status.

On the other hand, when disparities become excessive, they can negatively impact social cohesion and economic balance. An inequitable income distribution can lead to a decline in domestic demand, political instability, heightened social tensions, and even an increase in crime rates. In the Republic of Moldova, this issue is exacerbated by structural, political, and economic factors, further amplified by labor migration, the considerable size of the informal economy, and limited access to economic opportunities for certain social categories.

In this context, maintaining a balance between a reasonable differentiation of incomes and avoiding excessive social polarization represents a major challenge for policymakers. A thorough assessment of the causes and impact of income inequality, along with the formulation of effective economic and social policies to reduce it, is essential for ensuring sustainable social development in the Republic of Moldova.

2. Literature review

The literature review on income inequality in the Republic of Moldova highlights both the causes and effects of this phenomenon. Stiglitz (2012) argues that extreme inequality can reduce economic mobility and destabilize society, affecting economic growth. In the Republic of

Moldova, Balan (2020) identifies the main causes as unequal access to education and forced migration for higher wages. The National Bureau of Statistics (2023) reports income polarization between regions, with higher income in Chisinau and lower income in rural areas. International studies, such as those by OECD (2023) and Eurostat (2023), confirm the trend of rising inequality in European countries, including in the Republic of Moldova, linked to economic structures and population migration.

3. Methodology

For this research, several scientific methods were used, tailored to the specifics of analyzing income inequality in the Republic of Moldova. First, a literature review was conducted, exploring both international and national sources to understand the causes and effects of income inequality. The comparative method was applied to compare data from the Republic of Moldova with those from other European countries, identifying differences and common trends.

Additionally, scientific abstraction was used to extract the essence of the phenomenon from various sources and build a coherent theoretical framework. The inductive method facilitated the transition from empirical data to general conclusions about income inequality.

4. Results and discussion

Income disparities in the Republic of Moldova represent an obstacle to sustainable social development, influencing social cohesion, access to economic opportunities, and the population's standard of living. The study of income sources and their distribution highlights both favorable trends and challenges that require appropriate economic and social measures.

The income structure among the population of the Republic of Moldova indicates significant differentiation between various social groups. Salaries constitute the main source of income (52.5%), followed by social benefits (20.7%, of which 16.5% are pensions) and income from individual agricultural activities (6.4%). Additionally, remittances from abroad contribute 11.1% to household disposable income, underlining the essential role of remittances in balancing financial resources. This dependence exacerbates the economic vulnerability of Moldovan households to external fluctuations and increases the risk of perpetuating long-term structural inequalities.

To measure the level of income inequality, one of the most relevant statistical indicators is the Gini Coefficient, which reflects the degree of deviation of actual income distribution from a perfectly equal distribution. This coefficient ranges from 0 (representing absolute equality) to 1 (indicating extreme inequality). Generally, a Gini coefficient above 0.4 is considered problematic, signaling a significant disparity in income distribution.

In the case of the Republic of Moldova, the evolution of the Gini coefficient for disposable income during the period 2018-2023 is illustrated in Figure 1.

Although the Gini coefficient in the Republic of Moldova does not exceed the critical threshold of 0.4, data indicate a gradual increase in income inequality in recent years, reaching a peak of 0.3356 in 2023. This upward trend suggests a progressive widening of economic disparities, with negative effects on sustainable development, social stability, and the population's standard of living. The main causes of this phenomenon include increasing wage disparities across economic sectors, unequal access to resources and economic opportunities, as well as the influence of social and fiscal policies on vulnerable groups.

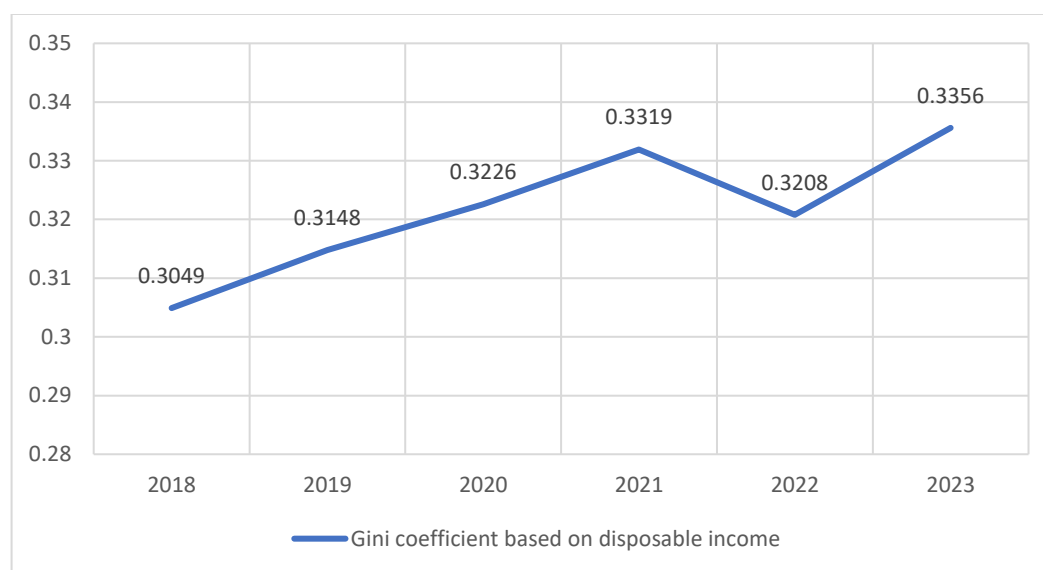


Figure 1. Evolution of the Gini Coefficient in the Republic of Moldova, 2018-2023

Source: developed by the author based on data from the National Bureau of Statistics [6]

Compared to other countries in the region, the Republic of Moldova is in an intermediate position. For instance, in 2023, the Gini coefficient in Romania was approximately 0.34, while in Ukraine, it stood at 0.29, indicating a relatively more balanced income distribution in Ukraine. Conversely, in countries such as Bulgaria or Georgia, the Gini coefficient exceeds 0.36, highlighting more pronounced inequality. Relative to the European Union average, which is around 0.30, the Republic of Moldova exhibits a slightly higher level of income inequality.

Table 1. Gini Coefficient in the Republic of Moldova and Selected European Countries (2023)

Country	Gini Coefficient
Republic of Moldova	0.336
Romania	0.34
Ukraine	0.29
Bulgaria	0.37
Georgia	0.36
Hungary	0.30
Poland	0.29
Germany	0.31
Sweden	0.28
European Union (average)	0.30

Source: developed by the author based on data from the National Bureau of Statistics [6], OECD [7], Eurostat [8]

Another relevant indicator for assessing income inequality is the income quintile ratio, which reflects the degree of financial resource concentration across different population segments. According to data from the National Bureau of Statistics (NBS) for 2023, the distribution of disposable income reveals considerable polarization: the wealthiest 20% of citizens (quintile V) hold 42.3% of total income, while the poorest 20% (quintile I) account for only 7.5%. This discrepancy results in a quintile ratio of 5.6, underscoring a significant gap in access to financial resources.

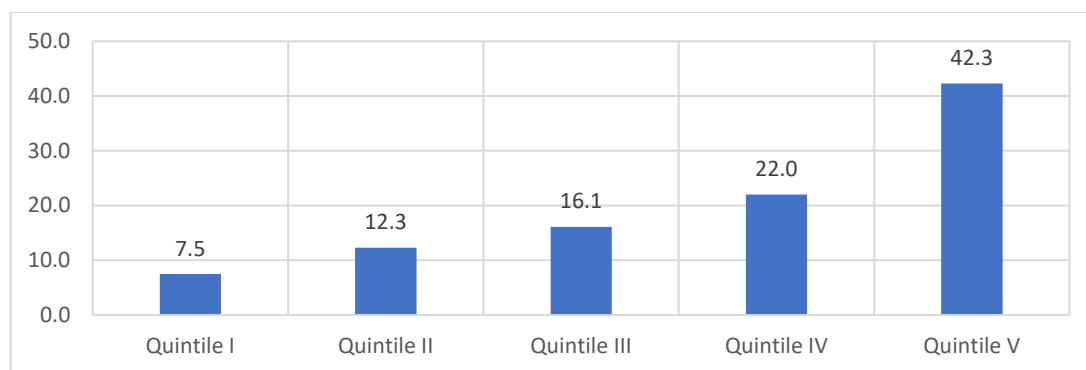


Figure 2. Distribution of Disposable Income by Quintiles in 2023 (% of Total Income)

Source: developed by the author based on data from the National Bureau of Statistics [6]

A detailed analysis of income distribution shows that income growth is not uniform across population segments. For instance, the gap between quintiles III and IV (16.1% → 22.0%) is significantly smaller than that between quintiles IV and V (22.0% → 42.3%), indicating a disproportionate concentration of income among the wealthiest individuals.

Compared to developed economies, where the ratio between the highest and lowest quintiles is around 3-4, the Republic of Moldova exhibits a higher level of income inequality than the European Union average. This situation reflects structural vulnerabilities in the Moldovan economy, including a high dependence on remittances, unequal distribution of economic opportunities, and the impact of social policies on disadvantaged groups.

Beyond inequalities between social categories, regional wage disparities also play a crucial role in the analysis of income distribution in the Republic of Moldova. Data for the fourth quarter of 2024 show that the average gross monthly salary in the economy was 15,024.5 MDL, but this figure masks significant variations across regions.

Chisinau Municipality recorded the highest salary levels, with an average of 17,702.5 MDL, exceeding the national average by 17.8%. In contrast, the lowest wages were reported in Briceni (9,562.7 MDL, 36.4% below the national average), Falesti (9,809.4 MDL, 34.7% lower), and Causeni (9,806.7 MDL, also 34.7% lower). This significant disparity reflects both the economic structure of the regions and the level of urbanization and access to well-paid jobs.

Compared to other countries in the region, this gap between the capital and the rest of the country is a common trend. However, in more developed economies, redistribution mechanisms, regional investments, and balancing policies contribute to reducing disparities. For example, in Romania, the wage difference between Bucharest and less developed regions is approximately 20-25%, lower than in the Republic of Moldova. In the European Union, cohesion policies and structural funds have played a key role in reducing regional inequalities, fostering uniform development in less advantaged areas.

Wage disparities are also observed between economic sectors. In general, sectors with a high degree of specialization and high added value, such as information technology or financial services, offer higher salaries, while low-productivity fields, such as agriculture, remain significantly below the national average.

According to data for the fourth quarter of 2024, the highest average monthly salaries were recorded in: the information and communications sector – 36,370.9 MDL, approximately 142.6% higher than the national average (15,024.5 MDL), and in the financial and insurance sector – 28,179.7 MDL, 87.3% higher than the national average. On the other hand, the lowest salaries were recorded in agriculture, forestry, and fishing – 10,066.8 MDL, 32.9% lower than the national average.

This income polarization by sector is not specific to the Republic of Moldova but is also present in other economies in Eastern Europe. The European Union average indicates a ratio of approximately 2.5:1 between salaries in the IT sector and those in agriculture, highlighting that Moldova faces a more pronounced sectoral disparity. Income inequality and high poverty levels negatively impact the well-being of the population, limiting access to decent housing, essential services such as education and healthcare, and the economic opportunities necessary for social mobility. Moreover, the unequal distribution of income amplifies vulnerability to social and economic risks, such as retirement, illness, or periods of unemployment, creating a vicious cycle of social exclusion.

An important aspect of income inequality is that it is not only reflected in differences in current earnings but also in the population's ability to accumulate assets and savings. People with lower incomes have limited savings opportunities, making them more exposed to economic shocks. Thus, income inequality leads, in the long run, to an even greater polarization of the population's well-being.

In the Republic of Moldova, the aging population significantly contributes to increasing income inequalities, as elderly individuals face a higher risk of poverty. This issue is becoming more pronounced due to the constant increase in the number and share of seniors in the country's demographic structure. Their standard of living largely depends on income earned during their professional activity, as well as on social transfers, particularly pensions, which represent the primary source of subsistence for most of them. While some pensioners benefit from relatively high pensions, especially those who worked in well-paid sectors, the majority of retirees in rural areas or in low-wage fields (e.g., agriculture) struggle with insufficient income to ensure a decent standard of living.

Income inequality has profound consequences on the development of a society, influencing the economy, social structure, and political stability. These effects not only limit overall well-being but can also exacerbate structural imbalances and hinder economic and social progress. From an economic perspective, the unequal distribution of income affects consumption and the dynamics of the domestic market. High-income individuals tend to allocate a significant portion of their earnings to luxury purchases, often from imports, which reduces the multiplier effect on the national economy. At the same time, a considerable share of internally generated financial resources is transferred to external markets, either through investments or consumption, thereby limiting the expansion of the domestic productive sector. Moreover, an unequal income distribution weakens the purchasing power of middle- and low-income populations, potentially leading to insufficient aggregate demand and slower economic growth. A strong middle class with stable incomes is essential for maintaining long-term economic balance and fostering innovation and entrepreneurship.

On a social level, income inequality deepens societal stratification, reducing social mobility and restricting vulnerable groups' access to educational and professional opportunities. Low-income individuals face difficulties in accessing essential services such as quality education and healthcare, which perpetuates the cycle of poverty and diminishes personal and professional development prospects. Furthermore, economic disparities can lead to high levels of social discontent and increased tensions among different segments of the population. Numerous studies indicate a direct link between income inequality and crime rates, particularly in societies where access to economic opportunities is unevenly distributed. As a result, social cohesion becomes increasingly fragile, and the risks of social exclusion intensify.

Politically, a society characterized by major economic disparities is prone to instability and frequent challenges to social order. Significant differences between income groups can amplify distrust in state institutions and contribute to the rise of populist or extremist movements. In the long run, such imbalances may lead to political polarization and difficulties in implementing sustainable economic and social reforms. Additionally, the unequal distribution of

resources can affect democratic participation, as disadvantaged groups have more limited access to decision-making processes and political representation.

To reduce economic disparities, a combination of fiscal and social measures is necessary to ensure a more equitable distribution of resources and to support vulnerable groups in the Republic of Moldova, such as:

- *Progressive income taxation* – In many developed economies, the tax system includes progressive tax rates, allowing for a fairer redistribution of income. For example, in countries like Sweden and Denmark, income tax can exceed 50% for high earners, helping to balance social inequalities and finance social protection programs. In contrast, since 2019, the Republic of Moldova has adopted a flat tax rate of 12%, which reduces the state's capacity to intervene in income redistribution. This approach particularly benefits high-income individuals and limits support for those with lower financial resources. While a flat tax simplifies fiscal administration, it can exacerbate social inequalities, which is why many countries combine it with additional deductions for disadvantaged groups.
- *Capital income taxation* – Another essential tool for reducing inequality is the taxation of income derived from dividends and other capital gains. In countries like Belgium, this tax is 15%, while in Japan, it can reach 50%, playing a crucial role in redistributing wealth and combating excessive capital concentration in the hands of a small elite. In the Republic of Moldova, according to Article 90¹ (3¹) of the Fiscal Code, as of January 1, 2024, a 6% tax applies to dividends paid to resident individuals. While this measure partially contributes to income balance, the rate remains significantly lower than in other countries, thus limiting its redistributive impact.
- *Tax deductions and benefits for low-income individuals* – A mechanism used in advanced economies, as well as in Moldova, is the establishment of a tax-free minimum income, ensuring that individuals with limited financial resources are not burdened by excessive taxes. This system helps improve the living standards of taxpayers in the lower income brackets and stimulates domestic consumption, positively impacting the economy. In the Republic of Moldova, a system of personal exemptions operates similarly to a tax-free minimum income, providing certain tax reliefs for low-income taxpayers. However, the value of these exemptions remains relatively low compared to the actual needs of the low-income population. Increasing these exemptions could be an effective measure to reduce inequalities and support vulnerable groups.
- *Social protection programs* – Support for vulnerable groups through allowances, social assistance, and subsidies for essential services (education, healthcare, housing) is a central pillar in combating inequality. In developed European countries, social protection expenditures represent significant percentages of GDP: 29% in the United Kingdom, 25% in Germany, 30% in Italy, and 32% in France. In the Republic of Moldova, social protection expenditures account for approximately 15% of GDP, reflecting the state's limited resources in supporting vulnerable populations. These figures suggest that while efforts are being made to support disadvantaged groups, allocated funds are significantly lower compared to developed European economies, limiting the effectiveness of inequality reduction measures.

Therefore, a more effective strategy for reducing economic inequalities in the Republic of Moldova should include a combination of more progressive fiscal measures, increased benefits for low-income individuals, and more substantial funding for social protection programs. These adjustments could contribute to a fairer distribution of resources and strengthen social cohesion.

5. Conclusions

The analysis of income inequality in the Republic of Moldova shows that, while income differentiation is a normal phenomenon in a market economy, excessive polarization can have negative effects on economic and social development. The study highlighted that the main sources of income for the population are wages, social benefits, and remittances from abroad, with their distribution varying significantly at both regional and sectoral levels.

The Gini coefficient indicates a slight increase in income inequality, necessitating the adoption of measures to prevent excessive societal polarization. Among the negative effects of excessive inequality are the reduction of aggregate demand, limited access to essential services, and the intensification of external migration:

- To address these challenges, well-founded public policies are needed, including: Increasing wage incomes by adjusting the minimum wage and stimulating employment in strategic sectors;
- Improving the social protection system for vulnerable groups;
- Promoting a progressive fiscal policy to reduce economic disparities;
- Investing in education and professional training to reduce skill gaps and improve labor market opportunities.

Reducing income inequality in the Republic of Moldova requires a complex and sustainable approach, based on balanced economic and social policies aimed at ensuring both economic growth and a fairer distribution of resources in society.

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GENDER GAPS IN THE LABOR MARKET IN EU MEMBER STATES. EVOLUTIONS AND DIRECTIONS

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Abstract: *The aim of the paper is to present a comparative analysis of gender inequalities in the labor market in the EU member states, namely the employment rate of women and men in the labor market, the time allocated to unpaid domestic work and the wage differences, as well as the directions/perspectives pursued by these states to improve these gaps. In this sense, we use a methodology of both descriptive and empirical type, by referring to bibliographic resources from the specialized literature, as well as statistical data provided by the relevant institutions (Eurostat, European Institute for Gender Equality, World Economic Forum).*

Keywords: *Labor market, gender pay gap, gender employment gap, time allocated to domestic work, legislative regulations (labor and fiscal measures).*

UDC: 331.5:316.346.2(4EU)

Jel Classification: J16, J21, J31

1. Introduction

Promoting equality between women and men is a task of the European Union in all its activities, as provided for in the Treaties; gender equality is a core value, a fundamental right and a key principle of the European Pillar of Social Rights [1]. It is a value that represents us and, at the same time, an essential condition for an innovative, competitive and prosperous European economy. Gender equality creates jobs and generates increased productivity, a potential that must be harnessed at a time when we are preparing for the transition to a green economy and the digital transition and when we have to face demographic challenges.

According to the Draft Council Conclusions on the Joint Employment Report 2025 [2], in 2023 the EU employment rate reached 75,3% (up by 0,7 percentage points compared to 2022, 80,4% for men and 70,2% for women), and the EU unemployment rate reached a level of 6,1% (down by 0,1 percentage points compared to 2022, 5,8% for men and 6,4% for women). It should be noted that around 90% of the employment growth in 2023 resulted from an expansion of the employment force, including a further reduction of the gender gap in employment to 10,2 percentage points.

It should be noted that labour and skills shortages have increased significantly in most Member States over the last decade and that, despite a moderate decrease in 2024, they remain a major obstacle to productivity and economic growth. It is also necessary to consider significant improvements in working conditions in certain sectors, given the current situation on the labour market of underrepresented groups, namely women, older workers, young people, people with disabilities, low-skilled people and third-country nationals, and that significant regional disparities persist within Member States.

In the paper, we realize a comparative analysis of gender inequalities on the labour market in EU Member States in the post-pandemic period, namely the employment rate of women and men on the labour market, the time allocated to unpaid domestic work and the

wage gap, as well as the directions/perspectives pursued by these states to improve these gaps. In this sense, we use a methodology of both descriptive and empirical type, by using bibliographic resources from the specialized literature, as well as statistical data provided by relevant institutions (Eurostat, European Institute for Gender Equality).

2. Methodology

As mentioned above, in this paper, we use an empirical and descriptive methodology to analyze gender inequalities at the European Union level. The indicators we consider are the employment rate of women and men on the labour market (employment rates age 20–64), the time allocated to unpaid domestic work and the wage gap (remuneration between women and men) and we also take into consideration some factors that influence this gap, for example the relevance of having children, which seems to be important in the tendency of women to work part-time.

The statistical data used in the paper (empirical analysis) aimed to determine some developments and comparative situations regarding gender inequalities on the labor market during the period 2014-2023 at the level of the European Union. More precisely, the employment rates and the highlighting of the year 2023 were taken from the EU Gender Equality Report, for the period 2014-2023, respectively from the latest report prepared by the European Institute for Gender Equality, The Gender Equality Index 2024. Eurostat is the main source of data regarding the gender pay gap during the period 2022-2023; as for the reference period, we considered the years 2014-2023, with an emphasis on the last years, 2022-2023, in order to highlight the dynamics of the analyzed indicators.

3. Analysis of gender inequalities in the labor market

According to the EU Gender Equality Report [3], the year 2024 showed encouraging economic trends for gender equality. The latest available data, for 2023, showed that female employment in the EU exceeded the 70% threshold for the first time, a development that occurred on the background of an overall increase in the EU employment rate to 75,3%. In addition, while the growth rate for women was lower than in the previous two years, it outpaced growth for men, resulting in the lowest employment gender gap in the last decade of 10,2 pp (-0,5 pp from 2023). This development is in line with a long-term trend since 2009, although with marked differences between countries.

According to the report, in all Member States, employment rates are higher for men than for women. As a general pattern, the lower the female employment rate in a country, the wider the gender gap. In 2023, the male employment rate was 80,4% in the EU, while for women it was 70,2%, resulting in a gender employment gap of 10,2 pp.

Gender gaps in employment vary greatly across countries and regions in the EU. As part of its commitment to promoting inclusive employment, the Action Plan for the European Pillar of Social Rights set the target of achieving an overall increase in employment in the EU to 78% by 2030, which seems achievable, given that in 2023, the EU employment rate for people aged 20-64 was 75,3%.

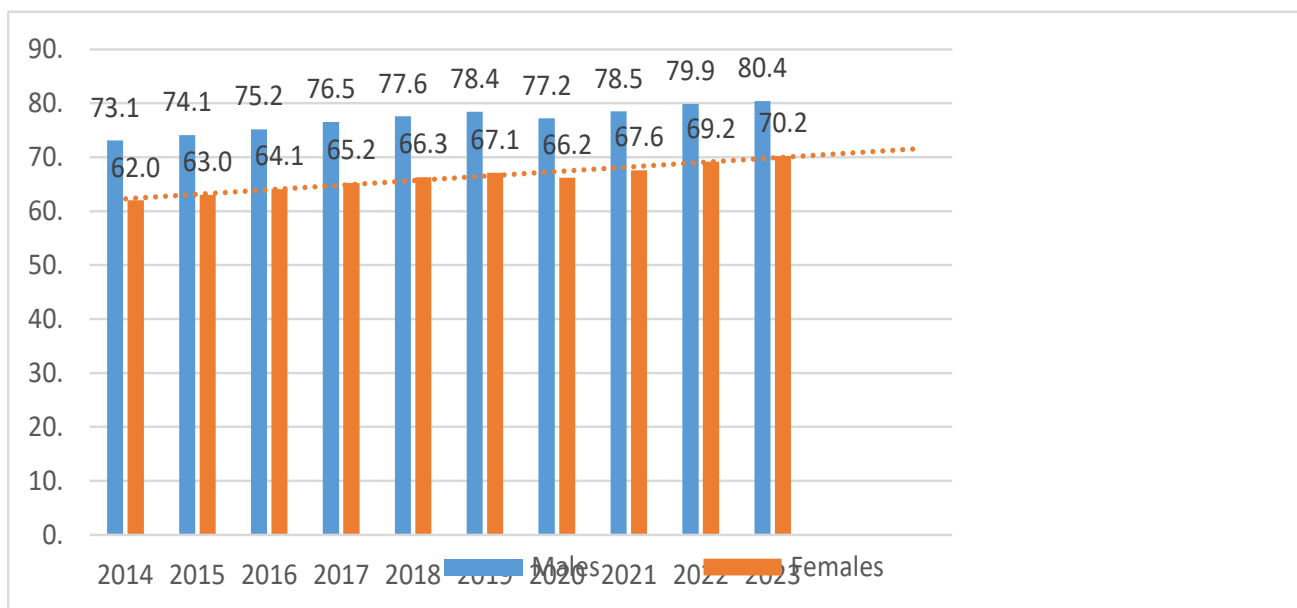


Figure 1. Employment rates age 20–64 by sex in 2014–2023

Source: European Commission, <https://commission.europa.eu/strategy-and-policy/policies/justice-and-fundamental-rights/gender-equality>

As a result, in 2023, seven EU Member States (Spain, Poland, the Czech Republic, Malta, Romania, Italy and Greece) had employment gaps wider than the gap for the EU as a whole. In Italy, Greece and Romania, female employment rates were particularly low, below 60% (56,5%, 57,6% and 59,1% respectively), compared to those for men (76,0%, 77,4% and 78,2% respectively).

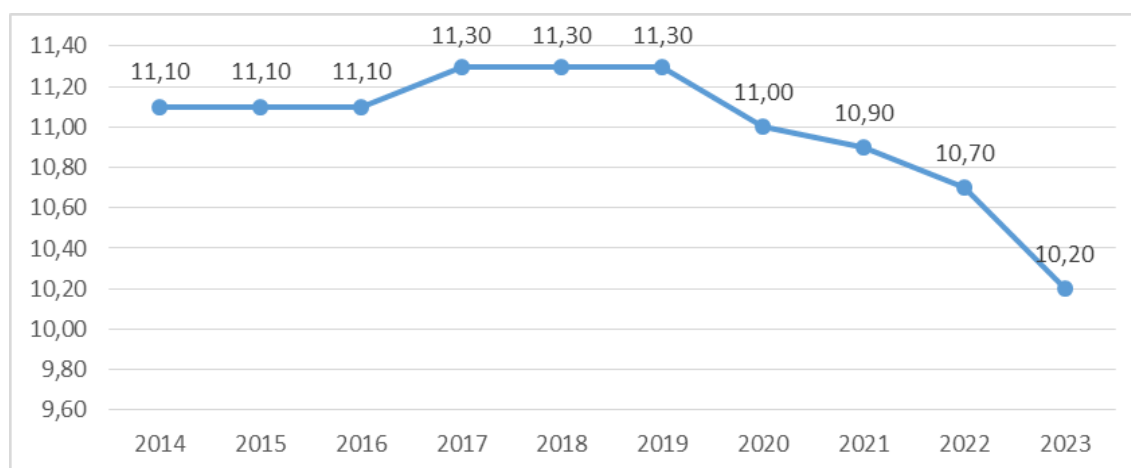


Figure 2. Gender employment gap in EU in the period 2014- 2023

Source: European Commission, <https://commission.europa.eu/strategy-and-policy/policies/justice-and-fundamental-rights/gender-equality>

We observe an increasing trend in women's employment in the years 2014- 2024, compared to a decreasing trend for men. The most significant increase is recorded in 2022, + 1,6 pp compared to the previous year, for women's employment. As for the gap (Figure

2), it decreases in the mentioned period, the reduction starting from 2019, and in 2023 it registered a decrease of 0,5 pp.

The narrowing of the gender employment gap in most countries since 2010 reflects an increase in overall employment rates, with male employment growing less than that of women. In Malta, employment for women has increased by over 32 pp in 13 years, although the gender employment gap remains high. This change has been supported by policy measures to attract more women to the labour market, such as tax and national insurance exemptions for years of childcare, training programmes, free childcare and free school transport.

There are *significant differences in the gender employment gap* between EU regions and these are persistent over time, as shown by the data of the EIGE report, Gender Equality Index 2024 [4]. In the less developed regions of the EU, the gender gap in employment in 2022 (16 pp) was about double that in the more developed (8 pp) and transition regions (9 pp). The gap was much higher in the southern Member States (15 pp) than in the north-western (7 pp) and eastern ones (12 pp). It was more than 20 pp in all regions of Greece, southern Italy and eastern regions of Romania. The employment rate of women increased compared to that of men in the more developed and transition regions between 2013 and 2022, as well as in the north-western Member States. By contrast, it decreased in the less developed regions and in the southern countries, where employment rates are lower and high-quality and affordable childcare is lacking.

The gender employment gap varies widely by age group: among young people aged 15-24, the gap continues to be the smallest, at 4,3 pp in 2023. In some countries, it was even negative, meaning that the employment rate was higher among young women than among young men (Ireland, Lithuania, Denmark, Finland and Estonia). It is worth noting, however, that there are marked differences between countries in the employment rate of women in this age group, ranging from 76,2% in the Netherlands to 13,7% in Romania.

For people aged 20-24, it increases to 6,3 pp and reaches 12,1 pp for *the 55-64 age group*, with large differences between countries. This is driven by the increase in the average working life expectancy for men in the EU: with 39,0 years of expected working life expectancy for men and 34,7 years for women, the gender gap was 4,3 years in 2023, largely due to a higher share of informal care responsibilities, which affected women more than men.

At the same time, the gender gap in the effective retirement age has narrowed substantially over the past decade, with the effective retirement age increasing in most countries between 2014 and 2023 for both sexes. Overall, the effective retirement age for women increased more than for men in 18 countries (BE, CY, CZ, DK, EE, EL, HR, HU, IE, IT, LT, LU, LV, NL, RO, SE, SI, SK). Seven countries have lower retirement ages for women than for men (AT, BG, CZ, HR, PL, RO, SK).

These gender differences are even greater for people with children; in 2023, at EU level, the employment rate for women aged 25-54 with children was 74.9%, compared to 91,9% for men with children. The gender employment gap thus reached 17,0 pp among those with children, while it stood at 4 pp among those without children.

The gender gap in employment is also larger in full-time equivalent (FTE) employment, as the share of part-time work is much higher among women than men (27,9% compared to 7,7% in 2023). The gender gap in part-time employment has remained stable in recent years (20,6 pp in 2021 and 20,2 pp in 2022). In 2023, the largest gender gaps in part-time employment were recorded in the Netherlands (42,3 pp), Austria (41,8 pp), Germany (36,9 pp) and Belgium (27,4 pp).

Regarding *the incidence of part-time work*, in 2023, 17,1% of employed people in the EU were part-time workers. In 2023, the growth rate of part-time employment (+2,0%) exceeded that of full-time employment (+0,8%) for the first time in a decade. However, the overall share of part-time work is gradually decreasing.

The reasons reported by part-time workers aged 25-64 for arranging their working time show which factors influenced this choice: for women, caring for disabled adults or children is the most relevant (29,5% of part-time women versus 8,2% of part-time men); for men, they cannot find a full-time job (18,1% of women versus 27,5% of men).

The relevance of having children appears to be a factor in the tendency to work part-time depending on the number of children of *people aged 25-54*: almost a third (31,8%) of employed women with children in the EU worked part-time in 2023, compared to 5,0% of men, with the highest shares in Austria (69,2%), the Netherlands (69,2%), the Netherlands (69,2%), the Netherlands (47,9%). This share is higher than among women without children at all educational levels. Similar to what happens for full-time work, the situation is the opposite for men: the share of part-time men with children was lower than the share of those without children for all educational levels. In most countries, the impact of parenthood is reflected in both women's employment rate and the share of part-time employment among women – Germany, Austria and Italy combining a high impact on both employment rate and working hours.

Therefore, in most countries, *having children has an impact on women's employment rates and their propensity to work part-time compared to men*.

In addition, national tax systems can discourage the labour market participation of second earners, who are predominantly women. For example, joint taxation reduces the incentives of second earners to work or extend their working hours (for example, by moving from part-time to full-time work). In 2023, the largest “inactivity traps” were observed in Lithuania, Slovenia, Denmark, Luxembourg, Belgium and Germany.

Most EU countries have developed specific strategies or projects to encourage equal sharing of care responsibilities between men and women, allowing women to participate in employment on a more equal basis compared to men, as salaried employees or as entrepreneurs.

The availability of flexible working arrangements can encourage such increased participation of women with care responsibilities, as it allows them to better combine private and professional life. During the pandemic, flexible working measures were implemented to prevent mass unemployment, with many employers continuing these practices to some extent. Also, to enable parents and people with care responsibilities to better balance their work and family life and to encourage a better sharing of care responsibilities, paid paternity leave, enhanced parental leave, carers' leave and the extension of the right to request flexible working arrangements were introduced.

4. Inequalities regarding remuneration between women and men

We refer to the difference between the average gross hourly earnings of men and women, expressed as a percentage of the average gross hourly earnings of men; the difference varies significantly across EU countries, according to Eurostat [5]. Specifically, in 2023, women's gross hourly earnings were on average 12,0% lower than men's in the European Union (EU), and the gender pay gap ranged by 20,0 pp, from -0,9% in Luxembourg to 19,0% in Latvia (Figure 3).

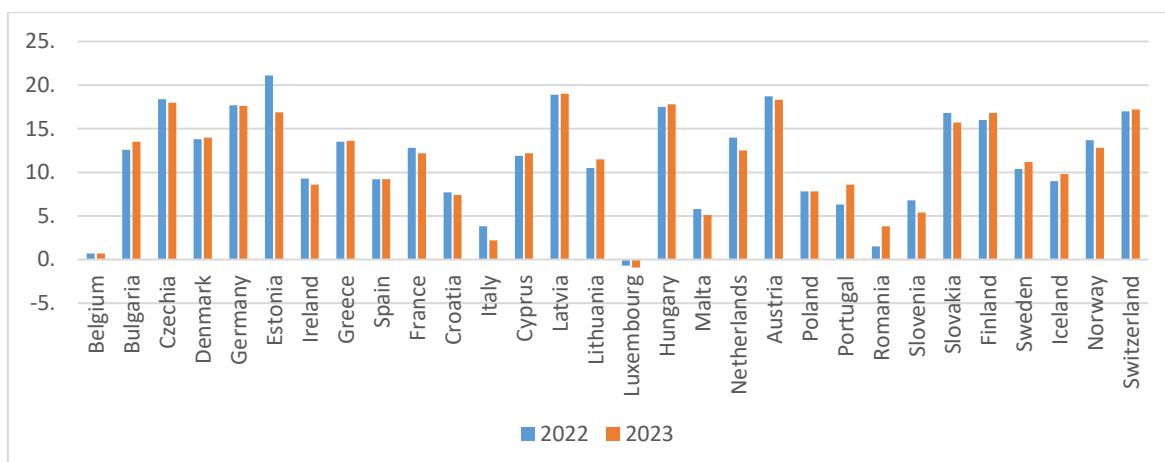


Figure 3. Gender pay gap in EU in 2022 and 2023

source: Eurostat, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Gender_pay_gap_statistics

If we consider *the perspective of part-time or full-time employment* (Figure 4), in 2023 the gender pay gap for part-time workers varied from -6,0% in Bulgaria to 27,3% in Slovenia. A negative gender pay gap means that, on average, women's gross hourly earnings are higher than those of men. This is often due to a selection bias, especially when the employment rate is lower for women than for men: women entering the labour market may have comparatively higher levels of skills and education than men. For full-time workers, the pay gap also varied widely across EU countries, from -8,1% in Belgium to 20,7% in Latvia.

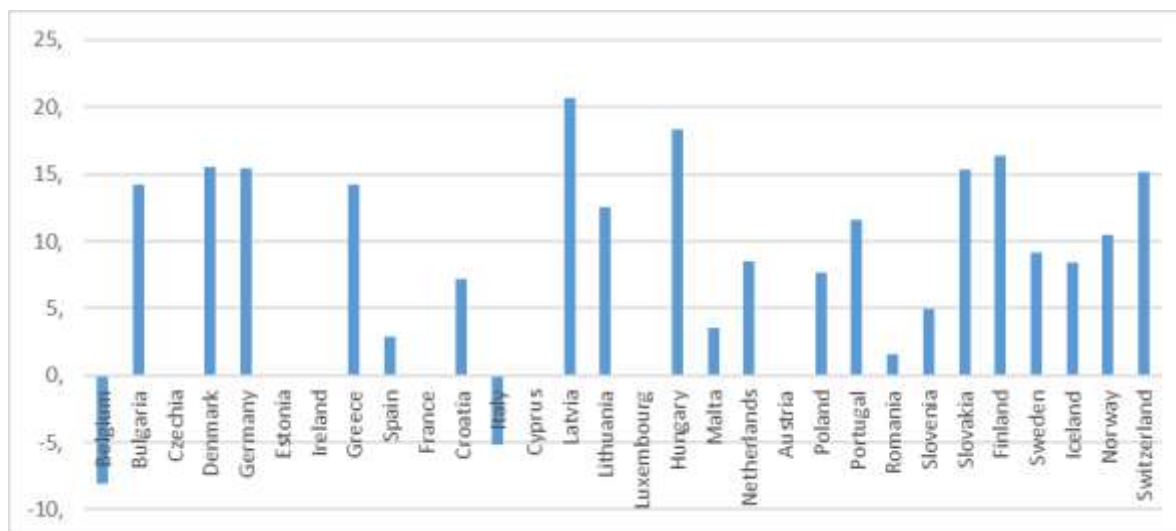


Figure 4. Gender pay gap in 2023 in EU by working time

Source: Eurostat, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Gender_pay_gap_statistics

The gender pay gap is generally much smaller for new entrants to the labour market and tends to widen with age. However, these age-related differences may have different patterns across EU countries. The gender pay gap could increase with age as a result of the career breaks that women may experience during their working lives.

Table 1 shows the full-time employment (FTE) rates for women and men in the EU for 2023; we note that the largest differences are recorded in Italy, Greece, Austria,

Romania, Malta, Czech Republic, with values significantly higher than the EU average (14,9 points), and the smallest values in Lithuania, Sweden, Finland.

Table 1. FTE employment and Duration of working life in EU, 2023

Member states	FTE employment (aged 15–89)				Duration of working life (years)			
	Women	Men	Total	Gap	Women	Men	Total	Gap
EU	43.5	58.4	50.6	– 14.9	34.2	38.6	36.5	– 4.4
BE	42.1	54.4	47.9	– 12.3	32.7	36.2	34.5	– 3.5
BG	48.6	60.9	54.4	– 12.3	32.3	34.8	33.6	– 2.5
CZ	49.0	66.3	57.4	– 17.3	33.3	39.3	36.4	– 6.0
DK	50.4	60.1	55.0	– 9.7	39.4	42.4	41.0	– 3.0
DE	43.6	60.8	51.8	– 17.2	37.4	41.2	39.3	– 3.8
EE	55.4	66.8	60.7	– 11.4	40.7	39.9	40.3	0.8
IE	49.3	63.9	56.2	– 14.6	36.3	42.3	39.4	– 6.0
EL	36.2	56.0	45.7	– 19.8	30.3	37.3	33.9	– 7.0
ES	42.5	56.6	49.3	– 14.1	34.1	37.8	36.0	– 3.7
FR	45.2	54.5	49.5	– 9.3	35.2	37.9	36.6	– 2.7
HR	42.4	54.4	48.1	– 12.0	32.1	35.7	34.0	– 3.6
IT	32.3	52.4	41.8	– 20.1	27.6	36.5	32.2	– 8.9
CY	52.1	64.5	58.0	– 12.4	35.4	41.7	38.7	– 6.3
LV	52.5	63.3	57.4	– 10.8	36.6	36.6	36.6	0.0
LT	56.1	64.6	60.0	– 8.5	38.1	36.5	37.3	1.6
LU	51.7	62.4	56.9	– 10.7	33.2	36.2	34.7	– 3.0
HU	50.9	64.8	57.5	– 13.9	34.4	37.9	36.2	– 3.5
MT	51.3	68.9	60.4	– 17.6	34.8	41.6	38.4	– 6.8
NL	46.5	62.6	53.8	– 16.1	41.1	45.1	43.2	– 4.0
AT	42.6	60.7	51.2	– 18.1	36.2	40.3	38.3	– 4.1
PL	47.4	63.1	54.8	– 15.7	32.2	36.8	34.6	– 4.6
PT	51.6	61.1	56.0	– 9.5	37.4	39.4	38.4	– 2.0
RO	40.0	57.9	48.7	– 17.9	28.0	34.9	31.5	– 6.9
SI	49.5	60.4	54.9	– 10.9	35.5	37.9	36.7	– 2.4
SK	52.5	64.1	58.1	– 11.6	33.8	36.4	35.2	– 2.6
FI	49.6	56.8	53.0	– 7.2	39.7	40.1	39.9	– 0.4
SE	54.0	62.6	58.2	– 8.6	41.4	43.8	42.6	– 2.4

Source: European Institute for Gender Equality, <https://eige.europa.eu>

Family composition, age, education, migration status and ability contribute to the employment gap between women and men. FTE employment rates for women range from 3% for those aged 65+ to 70% for those aged 25– 49. In contrast, the lowest FTE employment rate for men is 6% for those aged 65+ and the highest is 92% for men in couples with children. Fewer women than men work full-time, especially in couples with children. This gap is significantly larger than the FTE employment gap for the general population, of 14 pp.

Other substantial gaps include a 24 pp gap between single women and men and a 22 pp gap between foreign-born women and men. People with low educational qualifications face both a large gap in FTE employment (20 pp) and low full-time employment rates for both women and men, of 18% and 38% respectively.

Table 2 presents the average monthly earnings and net earnings for women and men. We note that significant gaps, in the case of average monthly earnings, are in Denmark and Germany, Austria, France, and the smallest are in Bulgaria, Hungary, Croatia, Romania (the difference between women's vs. men's earnings is 50 pps, the lowest level). Regarding Mean equivalised net income, significant differences are in Lithuania, Latvia, Luxembourg, and the smallest in Romania, Slovakia, Portugal.

Table 2 Mean monthly earnings and Mean equivalised net income in EU, 2023

Member State	Financial resources							
	Mean monthly earnings (PPS, working population)				Mean equivalised net income (PPS, aged 16+)			
	Women	Men	Total	Gap	women	Men	Total	Gap
EU	2 321	2 818	2 581	– 497	20 859	21 967	21 395	– 1 108
BE	2 778	3 075	2 927	– 297	25 684	26 778	26 220	– 1 094
BG	1 078	1 256	1 168	– 178	11 916	12 924	12 399	– 1 008
CZ	1 463	1 845	1 669	– 382	16 629	17 914	17 254	– 1 285
DK	2 868	3 479	3 160	– 611	25 770	26 689	26 223	– 919
DE	2 765	3 461	3 135	– 696	26 209	27 383	26 784	– 1 174
EE	1 461	1 896	1 653	– 435	18 653	19 688	19 136	– 1 035
IE	2 597	3 084	2 833	– 487	22 825	23 991	23 400	– 1 166
EL	1 524	1 802	1 672	– 278	12 272	12 643	12 451	– 371
ES	1 961	2 290	2 135	– 329	19 581	20 378	19 969	– 797
FR	2 282	2 798	2 548	– 516	23 155	24 630	23 859	– 1 475
HR	1 572	1 783	1 681	– 211	13 109	13 875	13 474	– 766
IT	2 201	2 620	2 435	– 419	20 946	22 204	21 554	– 1 258
CY	1 941	2 303	2 123	– 362	22 635	23 456	23 031	– 821
LV	1 349	1 697	1 514	– 348	14 124	15 847	14 897	– 1 723
LT	1 316	1 549	1 427	– 233	16 637	18 553	17 512	– 1 916
LU	3 497	3 625	3 576	– 128	36 469	38 318	37 415	– 1 849
HU	1 408	1 677	1 546	– 269	11 183	11 943	11 542	– 760
MT	2 238	2 662	2 475	– 424	24 133	24 744	24 451	– 611
NL	2 374	2 938	2 663	– 564	26 577	27 816	27 190	– 1 239
AT	2 343	3 018	2 738	– 675	27 838	28 969	28 391	– 1 131
PL	1 677	2 018	1 855	– 341	16 368	16 898	16 622	– 530
PT	1 367	1 541	1 452	– 174	14 654	15 027	14 829	– 373
RO	1 732	1 782	1 758	– 50	11 217	11 455	11 332	– 238
SI	1 847	2 084	1 972	– 237	19 883	20 449	20 167	– 566
SK	1 285	1 628	1 461	– 343	10 284	10 517	10 397	– 233
FI	2 419	2 953	2 667	– 534	22 847	24 147	23 484	– 1 300
SE	2 628	3 024	2 822	– 396	22 102	23 276	22 690	– 1 174

Source: European Institute for Gender Equality, <https://eige.europa.eu>

At EU level, key actions under the 2020-2025 *Gender Equality Strategy* [6] concern ensuring equal opportunities and fair treatment for both women and men in the labour market, such as employment conditions and career progression. New EU initiatives on pay transparency adopted in 2023 under the Pay Transparency Directive give employees the right to request information on their individual and average pay levels, broken down by gender. Employers are also required to publicly report data on the average

pay gap between female and male employees. These directives aim to create a fairer labour market and contribute to the wider objective of gender equality in the EU.

5. Measures to reduce gender disparities in the labor market

Increasing women's participation in the labour market has a strong positive impact on the economy, especially in the context of shrinking labour force and skills shortages. It also enables women to lead their own lives, play a role in public life and be economically independent.

In the EU, the employment rate among women is currently higher than ever before, but many women still face obstacles when it comes to entering and remaining in the labour market. Some women are structurally underrepresented in the labour market, often due to the intersection of gender and additional aspects that make them vulnerable or marginalised, such as belonging to an ethnic or religious minority or having a migrant background.

As mentioned in the 2020-2025 strategy, *improving work-life balance* is one way to close gender gaps in the labour market. The Work-Life Balance Directive introduces minimum standards on family leave and flexible working arrangements for workers, while promoting the fair sharing of caring responsibilities between parents.

Another necessary measure is *to ensure equal participation of women and men in different sectors of the economy*. Although there are more women with university degrees in Europe, they remain underrepresented in the better-paid professions. More women than men are employed and work in low-paid sectors and in lower-level positions. Factors that contribute to this include discriminatory social norms and stereotypes regarding women's and men's skills and the undervaluation of women's work.

To eliminate the gender pay gap, it is necessary to address all the root causes of this phenomenon, including women's lower participation in the labour market, invisible and unpaid work, the wider use of part-time work and career breaks, as well as horizontal segregation based on gender stereotypes and discrimination. When information on pay levels is available, it is easier to detect gaps and discrimination. Because of the lack of transparency, many women do not know or cannot prove that they are at a wage disadvantage.

Such an initiative will strengthen employees' rights to obtain more information on pay levels, although it may increase the administrative burden for employers. The Commission has carried out an in-depth evaluation of the existing framework on equal pay for equal work or work of equal value. Alongside the adoption of this strategy, the Commission is launching a broad and comprehensive consultation process with citizens, Member States and social partners. More broadly, the Commission will relaunch discussions with social partners on how to improve gender equality in the labour market, including within their structures, and will encourage them to step up their efforts to tackle the gender gap in employment and pay.

The elimination of gender discrepancies regarding the assumption of family responsibilities represents another initiative to increase women's participation in the labour market, and their career development, while managing family responsibilities. Women often align their decision and ways of working with their family responsibilities and whether or not they share them with their partner. This is particularly challenging for single parents, the majority of whom are women, and for people living in remote rural areas, where support solutions are often lacking. Women also bear a disproportionate burden of unpaid work, which constitutes a significant part of economic activity. It is essential that family responsibilities are shared equally, as is the provision of childcare, social assistance and domestic services, especially for single

parents. Insufficient access to quality and affordable formal care services is one of the determinants of gender inequality in the labour market. It is therefore important to invest in care services to support women's participation in paid work and their professional development. This also has the potential to create jobs for both women and men. Statistically, in the EU, women spend 22 hours a week on care and domestic tasks, while men spend only 9 hours.

In conclusion, women's participation in the labour market has not only economic implications but also social effects; it improves a person's perception of their overall quality of life and improves the quality of society. Employed women evaluate their lives more positively than those outside the labour market, have higher levels of economic security and social inclusion, and are more empowered. However, in general terms, the effects of employment on these dimensions are greater for men than for women.

Policies to promote women's participation in the labour market vary considerably in how they support individuals to take up employment or increase their working hours, including the provision and flexibility of childcare services, flexibility in parental leave and other leave arrangements, a workplace culture that supports flexible working, and responsiveness to changing needs throughout the life course.

According to Eurofound report [7], in some EU member states (Denmark, France, Germany, the Netherlands, Sweden and the United Kingdom) there have been taken policy measures and initiatives which have been identified as good practice examples for encouraging and supporting female labour market participation. The policy measures have been organised in four categories:

- labour market policy measures: active labour market policies, benefits and taxation measures;
- childcare support policies;
- leave policies (maternity, parental, childcare and adult care leave);
- flexible working and work–family reconciliation.

Over the past few decades, women's participation in the labour market has significantly increased throughout the European Union. However, the extent and timing of this increase varies greatly across countries, and appreciable gender gaps in the labour market and economic status are still present. Moreover, and despite higher levels of female participation, significant gender differences in the quality and form of employment are apparent. These persistent disparities and significant cross-country differences represent an economic and social challenge and explain the emphasis policymakers put on women's integration into the labour market.

6. Conclusions

Levels of gender equality vary considerably between Member States, from 82 points in Sweden to 57,5 points in Romania. Although Sweden leads the EU gender equality rankings, its score has fallen slightly in recent years. Denmark and the Netherlands are next in line, both with a score of 78.8 points, while Spain has consistently maintained its fourth place. Malta, the Czech Republic and Lithuania have recorded the biggest gains, of 2,3, 2 and 1,7 points respectively. Improvements are needed in Romania, Hungary and Greece, although the scores for all three countries have increased in this edition. Meanwhile, gender equality has regressed in Croatia, Bulgaria and Sweden, with scores falling by 1 point, 0,6 points and 0,2 points respectively.

Although the gender gap is trending downward at EU level, there are significant regional differences, which depend on labour market characteristics, national policies and

culture. For example, in the northern countries, especially in Finland, the gender pay gap is quite small. In Eastern Europe, for example in the Baltic countries, there is a more equal working environment, both in terms of employment rates and hours worked, which is attributed to the legacy of socialism, which promoted the economic inclusion of women. In Western Europe, male and female employment rates have converged, with many women entering the workforce, often in part-time jobs, and particularly in Austria, Germany and the Netherlands. Meanwhile, in Southern Europe, the gender gap in employment has also narrowed significantly, due to a higher share of women in full-time rather than part-time employment. Portugal, which has historically had small gender gaps in employment, is a particularly successful case in this region.

If governments aim to reduce the gender gap in labour markets, public policies should target the obstacles faced by girls and women, for example through paid parental leave policies and investment in childcare. It is well known that fathers play a key role in caring for children, especially in the early years, in supporting women and encouraging their participation in the labour market.

Also, steering women and young girls towards more scientific careers, for example, could help reduce existing gender gaps by opening up alternatives that women traditionally do not consider. Institutional initiatives (mentoring programs, networking opportunities, and training and development programs) can also help empower women and give them the tools they need to succeed.

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ENHANCING DIGITAL SECURITY IN THE FINANCIAL SECTOR WITH AI, IOT, AND BLOCKCHAIN

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Abstract: *Integration of Artificial Intelligence (AI), the Internet of Things (IoT), and blockchain technology represents a significant step towards enhancing digital security in the financial sector. AI enables the identification of suspicious behavior patterns by real-time analysis of large amounts of data, thereby improving fraud detection and automating threat response. Based on historical data, the AI's predictive analytics assist in forecasting potential threats and enhancing proactive security measures. IoT devices gather real-time data, enabling financial institutions to swiftly respond to changes and make informed decisions while at the same time enhancing transaction security by monitoring network activities and recognizing suspicious patterns. Blockchain technology provides data integrity and transparency through decentralized ledgers, reducing the likelihood of fraud and increasing resilience to cyber-attacks. Smart contracts automate transactions, minimizing the risk of human error and fraud. By combining these technologies, financial institutions establish a robust framework for protecting their systems and processes, reducing the risk of fraud and cyber-attacks, and increasing user's trust. Security measures such as encryption, authentication, and regular software updates further ensure the safety of IoT devices and blockchain networks, thereby strengthening the overall digital security infrastructure in the financial sector. In this paper, the authors analyze the potential of each of these technologies and the synergy of their integration.*

Keywords: *Artificial Intelligence (AI), Internet of Things (IoT), Blockchain, Digital Security, Financial Sector, Decentralization, Smart Contracts.*

UDC: [004.056:336]:004.8

Classification JEL: G21, G32, G34, G38, K24, L86, O33, O38

1. Introduction

General Introduction

Digital transformation has facilitated faster and more efficient information exchange but opened the door to new threats and risks. In today's globally connected digitalized world, digital security has become crucial in protecting data, resources, and privacy. Therefore, digital security has become imperative for all organizations, from small and medium-sized enterprises (SMEs) to large corporations, banks, and state financial institutions.

The level of protection largely depends on the size, significance, and levels of the protection knowledge of those who need to be protected. Large companies can afford complex infrastructures and teams of experts. SMEs have fewer resources and cannot invest in advanced security systems. This resource disparity makes SMEs more vulnerable to cyber-attacks, which can have significant economic and reputational consequences.

They frequently can apply only basic security measures that prove inadequate against advanced attacks [1].

Banks and government financial institutions hold valuable information and economic assets, and they are among the most attractive targets for cybercriminals. Such entities must maintain high-security standards to combat increasingly sophisticated threats, including phishing attacks, ransomware, and network infrastructure attacks. Successful implementation of digital security in the banking sector is crucial for maintaining client trust and financial stability.

The levels of digitalization vary worldwide. That affects different regions' ability to overcome cyber threats. Developed countries have advanced digital infrastructure and sophisticated security protocols, but many developing countries struggle with fundamental digitalization problems. That includes internet access and cybersecurity. This disparity can lead to uneven levels of protection, spillover risks from region to region, and increased global vulnerability.

Objective

This paper aims to present the capabilities of AI, IoT, and blockchain technologies and the synergistic effects of their integration that can significantly improve digital security through more effective threat detection, secure data storage, and better protection of network activities. That is significant because these technologies represent the future of digital security and can transform how we combat cyber threats. Additionally, the paper examines benefits such as enhanced proactive security and reduced risks. It also addresses potential challenges related to the implementation of these technologies. This paper enhances comprehension of how integrating these technologies can improve digital security in the financial sector by reviewing existing research and new findings.

2. Methodology

The authors prepared this paper using research methods commonly employed in review articles. These methods include searching, selecting, analyzing, and synthesizing literature. The literature review involved searching databases such as Google Scholar, IEEE Xplore, SpringerLink, and MDPI. Due to the specificities related to the topic, we also searched relevant websites that deal with information system security issues. Keywords such as "quantum cryptography," "digital security," and "critical evaluation" were used. Papers were included based on relevance, quality, and publication in the last eight years. The authors included some of their previous papers about IoT, blockchain technology, and digital security. The collected papers were critically reviewed and analyzed using methodological standards such as the validity and reliability of sources and the significance of findings for the current topic. The authors organized and synthesized collected information using thematic analysis. They identified key themes and patterns and created a conceptual framework integrating existing knowledge. To reduce the length of the article, we often utilized bullet text. Based on the analysis, we identified existing gaps in the literature and proposed directions for future research in digital security.

Research Question and Hypotheses

The authors based their research on the following research question and hypotheses:

- *Research Question:* How does the integration of Artificial Intelligence (AI), the Internet of Things (IoT), and blockchain technology impact the enhancement of digital security in the financial sector?

- *Null Hypothesis (H_0):* The integration of AI, IoT, and blockchain technology does not significantly affect the enhancement of digital security in the financial sector.
- *Alternative Hypothesis (H_1):* The integration of AI, IoT, and blockchain technology significantly improves digital security in the financial sector by enhancing fraud detection, automating threat responses, and ensuring data integrity.

3. Technological Innovations in Digital Security

Technological innovations in digital security are crucial in today's digitalized world. They play a key role in protecting data and systems. With the increase in threats, developing new technologies and strategies is becoming more significant. These innovations help to combat threats and enable organizations to enhance their security postures and protect resources efficiently. Although numerous and necessary, innovations are not accessible to everyone. The larger and more significant the organization is, the more interested it is in quickly adopting each innovation to increase security, as potential attackers also closely monitor innovations for opposite purposes. Financial institutions are always among the first adopters of all technological innovations to improve digital security, as potential attackers watch innovations closely to stay ahead. It is a continuous race. Some of modern, key innovations include:

1. *Artificial Intelligence (AI) and Machine Learning:* They can independently or within software packages process large datasets and identify patterns that suggest potential threats.
2. *Blockchain Technology:* This technology is well-known for its application in cryptocurrencies, but its security application is much broader [2]. It allows decentralized and secure transaction recording, reducing the risk of data manipulation.
3. *Cryptography:* Cryptography ensures that data is inaccessible to unauthorized users. Advanced cryptographic algorithms have become a standard practice for data protection during transactions. One of the advanced innovations is quantum cryptography, which uses principles of quantum physics to create unbreakable encryption systems. Quantum key distribution allows secure transmission of encryption keys, and any eavesdropping attempts are immediately detected. [3]
4. *Biometric Authentication:* It uses physical characteristics such as fingerprints, facial recognition, or iris scanning to verify user identities and provide additional protection for user accounts. These methods are more secure than traditional passwords, as they are unique to each individual and highly resistant to misuse, providing a high level of security. Biometric authentication is increasingly used in smartphones, banking applications, and access control systems.
5. *Zero Trust Architecture:* This security approach assumes that no user, person, or device, whether inside or outside the organization's network, can be trusted automatically. This approach requires constant verification of each user and device before granting access to resources. The Zero Trust model uses techniques such as multi-factor authentication, micro-segmentation, and

continuous monitoring of activities to ensure security [4] It is increasingly used in various industries, most notably at airports.

6. *Cloud Security*: The banking sector increasingly relies on cloud computing to enhance scalability and efficiency. This technology allows centralized data protection and better resource management [5]. As more organizations move to the cloud, cloud security becomes crucial. Cloud service providers employ advanced security measures such as data encryption in transit and at rest, as well as role-based access control. Additionally, cloud security tools allow organizations to monitor activities and identify threats in real time [6].
7. *Internet of Things (IoT) Security*: With the growing use of IoT devices, their security becomes critical. IoT devices often have limited protection capabilities, making them vulnerable to attacks [7] Innovations in IoT security include improved device authentication, communication encryption, and proactive monitoring of network activities to detect and neutralize threats.
8. *Behavioral Analytics*: It uses user behavior data to identify suspicious activities. For example, if the system recognizes unusual patterns in system usage (such as accessing sensitive data at unusual times), it can automatically trigger security checks. This technology helps to identify internal threats and insider attacks. [8]
9. *Secure Access Service Edge (SASE)*: This architecture combines network security and optimization capabilities into a single platform. This technology allows organizations to provide secure access to resources regardless of user location. SASE includes functions such as secure internet access, private cloud networks, and threat protection [9]
10. *Identity and Access Management (IAM)*: These technologies enable organizations to manage user identities and access control. This includes user authentication methods, permission management, and access tracking. IAM tools ensure that only authorized users have access to sensitive information. [10]
11. *Automated Systems*: They use algorithms to monitor network activities and detect unknown or suspicious events. They enable rapid response to potential threats.
12. *Data Loss Prevention (DLP)*: DLP enables monitoring and control of data to prevent unauthorized use. These systems can detect and block data attempting to be transferred outside closed networks.

As can be seen, innovations are numerous and diverse. However, each of these innovations brings uncertainties regarding their reliability and resilience to attacks. Comprehensive verification requires resources and time, both of which are limited due to the rapid pace of digitalization processes.

4. AI, IoT, and Blockchain Technologies for Digital Security

Artificial Intelligence (AI)

AI is one of the most mentioned terms in modern communications, perceived as a technology that enables computers and machines to perform tasks that would otherwise require human intelligence, and perform these tasks in the same way humans would. It plays a crucial role in enhancing digital security, especially in the context of banks and state institutions, but also on the side of malicious attackers. Using machine learning algorithms, AI systems can analyze vast amounts of data to detect threats and anomalies in real-time. From the perspective of AI's positive impact on security, the following points stand out [11, 12]:

- *Threat Detection*: AI can quickly, in real-time analyze vast amounts of data and identify suspicious activities, such as unknown accesses or unusual usage

patterns. AI can detect anomalies in network traffic that might indicate hacking attempts. Machine learning can help detect and block malware before it causes damage [13].

- *Identity Management:* AI enables precise management of user identities and access control, which is crucial for accessing sensitive information.
- *Automation of Security Checks:* AI can automate security checks and responses to security incidents, reducing reaction time and increasing the efficiency of security teams.
- From the perspective of threats to users, the following risks stand out:
- *Malicious attackers* can use AI to create sophisticated attack methods, such as phishing campaigns, attack software that adapts, and deep-fake technologies.
- *Privacy and Data Security:* Using AI to analyze data can compromise confidentiality and security, especially if appropriate protection measures are not used.
- *Ethical Issues:* The application of AI in security also raises ethical questions, such as transparency and accountability in AI-based decision-making.

Artificial intelligence can be a powerful tool for improving digital security, but it also represents a new dimension of risk that requires careful management and constant improvement of defense strategies. Therefore, when analyzing AI application possibilities, it is always essential to consider the most unfavorable scenarios. Table 1 presents a comprehensive framework for understanding defensive and offensive artificial intelligence.

Table 1. Prevalence of AI in Digital Security

Type of AI in Cybersecurity	Goal	Examples
Defensive AI	Leverages AI techniques to protect computer systems and networks from attack	Anti-malware; Intrusion detection systems (IDS)
Offensive AI	Deploys AI techniques to attack computer systems and networks	Developing new cyberattacks. Automating the exploitation of existing vulnerabilities
Adversarial AI	Maliciously exploits and/or attacks AI/ML systems and data	Poisoning training data; Manipulating input data

Source: Malatji, M., Tolah, A. [12]

Analyses of offensive AI cyber-attacks reveal their complex and dynamic nature. Accordingly, adaptive defensive mechanisms, also supported by artificial intelligence, are necessary. Each AI-driven attack is multidimensional and encompasses many implications, strategies, motivations, and social impacts. This makes protection challenging and underscores the need for even more sophisticated defense methods.

Internet of Things (IoT) and Its Impact on Financial Operations

The Internet of Things (IoT), a set of technologies that connect and exchange data via the Internet or other networks, is becoming increasingly significant in the economy. IoT enables real-time data collection and exchange, which is crucial for financial transactions. It helps analyze clients' assets and digitalize the operations of financial companies, improving services and customer experience. IoT supports data transmission across various devices connected via Bluetooth, WiFi, or USB. IoT devices also allow

monitoring of network activities and threat detection, enhancing digital security. Ensuring their security is crucial because of their network connectivity and commonly inadequate security protocols, which make them frequent targets for attacks.

The global IoT market in the BFSI sector reached \$2.03 billion by 2023, up from \$249.4 million in 2018, with an annual growth rate of 52.1% [14].

How IoT Affects Financial Operations

The Internet of Things (IoT) has numerous applications in financial operations that can enhance efficiency, security, and quality of service. Some of the key applications are:

1. *Real-time Data Collection:* Real-time data collection facilitates quick analysis and decision-making based on information. For example, clients can be immediately notified when an unexpectedly large sum of money is spent. Smart devices in branches can monitor queues, enable appointment scheduling, and inform clients about waiting times. They can assist clients in finding the nearest branch. Branches can quickly share customer data for personalized services. By using data, banks can make key decisions to save money and optimize branch operations [15]
2. *Enhanced Security and Fraud Detection:* Financial companies invest in IoT to prevent potential fraud and protect user accounts. IoT promptly detects unusual behavior and controls account access, providing additional security. Analytics provide insights into the bank's website and mobile app use, helping quickly respond to suspicious activities and prevent fraudulent transactions [16]. IoT technology is integrated into biometric authentication.
3. *Process Automation:* IoT technology can automate various operations such as opening accounts, deactivating credit cards, processing client requests, reducing costs, and increasing efficiency. Automated data collection and analysis can speed up loan approval processes and other administrative tasks. [17]
4. *Improved Customer Service:* IoT enables financial institutions to gain deeper insights into client needs and offer tailored services. IoT devices collect data that enhances financial services throughout the customer lifecycle. Banks can send customized offers and reminders proactively and streamline tasks such as onboarding new users and resolving complaints. IoT provides real-time data to support teams, enabling informed decision-making. Data analytics help employees manage clients' money and develop valuable reports. [17]
5. *Intelligent Asset Tracking:* IoT enables real-time asset tracking, improving asset management and protection. Banks use IoT devices to track equipment, optimize usage and efficiency, and reduce costs. Collected data helps manage capacities, identify locations, and record performance, lowering costs and downtimes. IoT networks improve security and enable real-time data sharing, while equipment monitoring provides accurate information on the condition and performance of devices. [15]
6. *Market Data:* IoT enables better tracking and market data analysis, optimizing investments. Private investors and corporations use real-time data for informed decision-making. The analysis of collected data helps build profitable strategies and investment plans, as well as train autonomous trading systems [15]

7. *Inventory Management*: IoT automatically collects and analyzes data for inventory management. Smart collateral management allows banks to remotely monitor clients' assets, such as car, home, and equipment mortgages. Sensors monitor asset conditions and enable automatic issuance of repair loans or remote car disabling in case of non-payment. [15]
8. *Wireless Payments*: IoT enables wireless payments via devices like smartwatches and phones, transforming banking and providing users with access to funds anywhere, anytime. IoT devices facilitate payments and detect wearable devices within range, thereby enhancing the connection with clients. Data from wearable devices helps insurance companies calculate premiums based on health statistics. They are also used for contactless payments and account balance checks. [15]

Examples of IoT Applications in Financial Operations

Fintech, or financial technology, uses new technologies to enhance and automate financial services, enabling faster, more efficient, and secure transactions and services. Banking has been using the concept of the Internet of Things for decades. Numerous examples of IoT applications in financial operations include [15]:

- *Smart ATMs*: ATMs are examples of IoT devices that use technologies for improved security and functionality.
- *Wireless Payments and Transactions*: Payments via smartphones and smartwatches allow users to access their bank services remotely.
- *Mobile-based Point-of-Sales (mPOS) Systems*: Allow companies to accept payments via mobile devices such as smartphones and tablets, providing greater flexibility and mobility in sales operations.

There are also many other less noticeable but significant and widespread applications [14]:

- *Smart Devices for Financial Monitoring*: IoT devices automatically collect and analyze data on expenses, income, and users' financial status.
- *Smart Banking Machines*: Track user transactions and provide additional security measures.
- *Inventory Tracking*: IoT sensors monitor product levels and automatically notify managers about the need for restocking. [18]
- *Smart Security Alarms*: Detect unknown activity and automatically notify owners or the police [19].

Fintech also uses new technologies to improve and automate financial services, such as [17]:

1. *Mobile Banking*: Includes apps for banking transactions via smartphones, which enable financial management regardless of the bank and client locations.
2. *P2P (Peer-to-Peer) Lending*: Platforms connect lenders and borrowers directly, allowing lower interest rates and higher returns for users.
3. *Cryptocurrencies*: Digital currencies like Bitcoin and Ethereum use blockchain technology for secure and decentralized transactions.
4. *Robo-Advisors*: Automated systems for investment advice and portfolio management, financial planning, and automated transactions. They offer affordable, personalized, and adaptable investment services.

5. *Payments*: Digital or e-wallet, a software application or online service that allows users to store and manage their financial information and funds electronically.
6. *Insurance (Insurtech)*: Technologies to improve processes, reduce costs in the insurance sector, and adjust premiums.

Fintech is transforming the way financial operations are conducted, making them more accessible, transparent, and efficient. IoT technology has revolutionized financial operations, enabling financial institutions to provide faster, more secure, and personalized services to their clients [17].

Can IoT Be a Victim of Attacks?

All electronic data can be targeted, no matter where it is located. It is easier to attack data that is somehow connected to the Internet [20]. The Internet of Things (IoT) devices can be compromised by attacks that may be transferred to the associated blockchain. Hence, financial IoT devices and networks can be exposed to various types of attacks, including [21, 22, 23]:

1. *Unauthorized Device Access*: Attackers exploit weaknesses in device passwords or firmware to gain unauthorized access, allowing them to manipulate device functionalities or infiltrate the network.
2. *Man-in-the-Middle (MitM) Attacks*: Attackers intercept communication between devices and servers, injecting malicious content, stealing data, or manipulating information. Targeting financial IoT devices, MitM attacks can be especially hazardous as they may enable attackers to steal sensitive information, including financial transactions or authentication details [24].
3. *Denial of Service (DoS) Attacks*: Attackers use botnets to flood services with requests, which can lead to service disruption or downtime.
4. *Firmware Hijacking*: Attackers install malicious software on the device if the firmware is poorly maintained, taking control of the device.
5. *Physical Attacks*: Attackers physically access devices and implant malicious code via USB devices or other physical methods.
6. *Encryption Attacks*: Attackers can decrypt encrypted data if they can access encryption keys, stealing sensitive information.
7. *Credential Attacks*: Attackers exploit password weaknesses, such as default passwords, to gain unauthorized access to devices.
8. *Side-Channel Attacks*: Attackers use power consumption or sound to gain information about encrypted data.
9. *Brute Force Password Attacks*: Attackers use brute force methods to try all possible password combinations until they find the correct one.
10. *Update Vulnerability Exploits*: Attackers exploit weaknesses in software updates or the lack of them, which can allow unauthorized access or control of the device.

These attacks require careful defense management and continuous improvement of strategies to ensure the security of financial IoT devices and networks.

Blockchain Technology

The intangible assets, such as licenses, trademarks, patents, and cryptocurrencies, are not new in the financial sector. Blockchain, known thanks to Bitcoin, enables decentralized and transparent data protection, ensuring data integrity and authenticity. It is ideal for secure storage and verification of transactions, reducing the risk of fraud and data manipulation [25].

Blockchain plays a significant role in finance, allowing transactions without time constraints and independent of banks and states. Improvements in hardware and communications speed up transactions, while increased market capitalization stabilizes the value of cryptocurrencies. Blockchain reduces transaction costs by eliminating intermediaries and reducing administrative efforts [26]

Blockchain technology is resistant to many types of attacks, including MITM attacks. However, IoT devices connected to the blockchain can be compromised if not properly secured. That can impact the blockchain. It can happen because of:

- *Compromised data.* Compromised IoT devices can send compromised data to the blockchain. That undermines data integrity.
- *Smart contract attacks.* Attackers can manipulate smart contracts on the blockchain if they gain control of the IoT device.
- *Distributed Denial of Service (DDoS) Attacks:* Compromised IoT devices can be used for DDoS attacks, overwhelming the network.
- *Identity Theft and Authentication:* Attackers can take control of IoT device identifiers and authentication data, gaining unauthorized access to the blockchain.
- *Ransomware Attacks:* Attackers can lock IoT device data and demand ransom, complicating the situation.

Due to these risks, it is essential to implement robust security measures to protect IoT devices and networks, as well as effective strategies to ensure the integrity and security of blockchain systems.

Attacks can be prevented or mitigated by implementing the following protective measures:

1. *Pre-blockchain Communication Security:* Well-secured communication between IoT devices and the blockchain network makes it difficult for attackers to manipulate data before it reaches the blockchain.
2. *Using Encryption:* Strong encryption methods for communication between IoT devices and the blockchain network reduce the risk of MITM attacks, ensuring that the data remains unreadable to attackers.
3. *Device Authentication:* Strong authentication methods between IoT devices and the blockchain network prevent unauthorized devices from communicating with the network.
4. *Secure Boot and Firmware Verification:* Ensuring IoT devices use secure boot and firmware verification protects devices from being compromised.
5. *Regular Software Updates:* Regularly updating software on IoT devices and the blockchain network protects against known vulnerabilities that attackers might exploit.

In preventing attacks, the identification of IoT devices is crucial. The identification process involves uniquely recognizing devices in the network using serial numbers and MAC addresses. Authentication includes using certificates, digital signatures, or other cryptographic methods to ensure the device's authenticity. Verifying device characteristics involves checking relevant data, such as sensor type, software version, security settings, and compliance with network security policies.

When a device with the necessary certificate accesses the blockchain network, there are several possibilities for data verification:

- *Initial Verification:* Involves thorough authenticity checks when the device first connects to the network.
- *Continuous and Periodic Checks:* Include certificate validation, security setting checks, and activity monitoring.
- *Transaction Verification:* Involves cryptographic methods for transaction verification, including digital signing and data hashing.
- *Smart Contracts:* Enable automated data verification processes during each transmission, including data authenticity checks and security policy implementation.

Proper security measures help reduce risks and ensure the safety of IoT devices and the blockchain network.

5. Integration of AI, Blockchain, and IoT for Enhancing Digital Security

The integration of Artificial Intelligence (AI), blockchain, and the Internet of Things (IoT) can significantly contribute to improving digital security, especially in the context of protecting financial systems and processes. Here are some key functions that these three areas can undertake when working together:

Artificial Intelligence (AI):

- *Pattern Recognition:* AI can analyze large amounts of data in real time to recognize suspicious behavior patterns indicative of fraud or attacks.
- *Automated Response:* AI can automatically respond to identified threats, enabling faster and more efficient incident responses.
- *Predictive Analytics:* Using historical data, AI models can predict potential threats and provide early risk warnings.

Blockchain:

- *Transparency and Data Integrity:* Blockchain provides immutable transaction records that are transparent and verified, reducing the likelihood of fraud.
- *Decentralized Security:* Instead of storing data in centralized locations vulnerable to attacks, blockchain distributes information across the network, increasing resilience to hacking.
- *Smart Contracts:* These self-executing contracts can automatically carry out transactions when conditions are met, reducing the possibility of human error and fraud.

Internet of Things (IoT):

- *Device Connectivity:* IoT enables the connection of various devices, ensuring that data from the physical world is integrated into digital processes. This can improve transaction efficiency and security.
- *Threat Monitoring and Detection:* Smart sensors can monitor activities and the current state of devices or systems, enabling quick detection and response to security threats.
- *Data Collection:* IoT devices generate large amounts of data that can be used for analysis and threat detection.

By combining AI, blockchain, and IoT technologies, organizations can create a robust framework for protecting their financial systems and processes. These technologies complement each other, enhancing predictive and reactive security measures, and reducing

the risk of fraud and hacking. Additionally, such a system can increase trust among users and clients, thereby strengthening the overall digital security infrastructure.

6. Examples of AI, IoT, and Blockchain Integration

Most studies have focused on IoT and AI or IoT and blockchain integration [27]. The development of AI allows the integration of all three technologies, ensuring the security of the IoT network. Blockchain is immutable and distributed, making it resistant to hacking. AI and blockchain complement each other and reduce risks. An example of solutions that enhance digital trust by integrating AI, blockchain, and quantum-resistant security are the WISeKey solutions [28]:

- *WISeID*: A platform for digital identity and security (certification, e-signatures, and email protection).
- *SEALSQ*: A platform for secure digital identities and services.
- *WISeCoin*: A platform for tokenization and authentication.
- *SEALCOIN*: A platform for transactions between IoT devices.

Although according to ZACKS' ratings, WISeKey currently does not appear to be the most favorable investment option, the principles and technologies they are developing will still be relevant in the broader context of digital security and advanced technologies.

Products from other well-known manufacturers that integrate blockchain, AI, and IoT are:

1. *IBM*: IBM Watson, IBM Blockchain, IBM IoT.
2. *Microsoft*: Azure Blockchain Service, Azure AI, Azure IoT Hub.
3. *Intel*: Intel SGX, Intel IoT.
4. *Amazon Web Services (AWS)*: Amazon Managed Blockchain, Amazon SageMaker, Amazon IoT Core.
5. *Huawei*: IoT devices and platforms.
6. *Cisco Systems*: Cisco Kinetic for IoT, Cisco Blockchain.

All these innovative solutions contribute to the field of digital security and efficiency.

7. Conclusions

The development of computer applications in finance brings benefits but poses security risks, necessitating continuous enhancement of protection measures. Improving digital security in the financial sector is possible using AI, IoT, and blockchain technology, and is most effective through their integration.

Artificial intelligence enables the recognition of suspicious behavior patterns through real-time analysis of large amounts of data, enhancing fraud detection. The AI's ability to automate threat responses allows faster and more efficient incident management. AI's predictive analytics can foresee potential threats based on historical data, enhancing proactive security measures.

The Internet of Things enables real-time data collection, helping financial institutions respond swiftly to changes and make data-driven decisions. IoT technology improves the security of financial transactions by monitoring network activities and identifying suspicious occurrences. Smart sensors track activities and the current state of devices, enabling quick detection and response to security threats.

Blockchain technology provides data integrity and transparency through decentralized ledgers, reducing the likelihood of fraud. The distributed nature of

blockchain enhances resilience to hacking attacks. Smart contracts enable transaction automation, minimizing the risk of human error and fraud.

Integration of AI, blockchain, and IoT technologies allows financial institutions to create a robust framework for protecting their systems and processes. These technologies complement each other, enhancing predictive and reactive security measures, and lowering the risk of fraud and hacking. Their integration increases trust among users and clients, strengthening the overall digital security infrastructure.

Based on the research and analysis, there is sufficient evidence to reject the null hypothesis. The findings support the alternative hypothesis, which states that integration of AI, IoT, and blockchain technology significantly improves digital security in the financial sector by enhancing fraud detection, automating threat responses, and ensuring data integrity.

Key Protection Recommendations

Each of these technologies offers many benefits to users, but none is perfect or immune to security weaknesses. The reasons are numerous, ranging from the rapid pace at which technologies develop, and the inability to comprehensively address every problem, to fundamental errors in the underlying solution concepts. It is also important to consider that specific software is developed by a small group of people, while software errors are explored by an army of attackers. However, there are effective protective solutions, such as:

- Using strong encryption methods for communication between IoT devices and the blockchain network.
- Implementing strong authentication methods between IoT devices and the blockchain network.
- Regularly updating software on IoT devices and the blockchain network to protect against known vulnerabilities.
- Applying security policies and verifying transactions using cryptographic methods.
- Automating data verification with smart contracts.

Implementing these solutions significantly reduces risks and complicates attackers' efforts.

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HOW ARTIFICIAL INTELLIGENCE AND DATA-DRIVEN SYSTEMS CAN IMPROVE CHILD PROTECTION SERVICES

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Abstract: AI and data-driven systems are transforming child protection as they enable early detection of risk factors and more effective intervention. AI-driven tools survey online conversations, behavior patterns, and real-time whereabouts to enhance child safety, while cybersecurity and blockchain technology are increasingly used to protect the identity and personal data of children. Virtual reality supports safety education by simulating dangerous scenarios in controlled environments, and big data analytics help predict and prevent abuse or neglect through early warning systems. These innovations are particularly promising in contexts with limited human resources, where automated systems can augment decision-making and optimize resource allocation. However, challenges such as data privacy, algorithmic bias, inconsistent data quality, and lack of transparency remain significant barriers to full-scale implementation. This paper presents a review of academic literature, institutional reports, and real-world case studies, including tools like the Allegheny Family Screening Tool and mobile health platforms, to evaluate the effectiveness and limitations of current AI applications in child welfare. It also explores the ethical implications of predictive modeling and decision support systems, especially their impact on marginalized communities. Based on policy analysis and best practices, this research highlights key recommendations to improve the design, governance, and accountability of AI in child protection services. The work was developed within the framework of Subprogram 030101 „Strengthening the resilience, competitiveness, and sustainability of the economy of the Republic of Moldova in the context of the accession process to the European Union”, institutional funding.

Keywords: Child, protection, data, tool, system, service.

UDC: 004.8:364.4-053.2(478)

Classification JEL: A13, C55, K36, M15, O33

1. Introduction

In an increasingly digital world, artificial intelligence and data-driven systems are emerging as transformative tools in the realm of child protection. These technologies offer unprecedented opportunities to enhance the efficiency, accuracy, and responsiveness of services aimed at safeguarding vulnerable children. From early identification of at-risk individuals to the optimization of social services and resource allocation, AI has the potential to revolutionize how governments, NGOs, and communities protect children from harm. However, alongside the promise of innovation comes the responsibility to ensure that these systems are ethical, transparent, and centered on the best interests of the child. This paper explores the ways in which AI and data-driven solutions can contribute to more effective child protection services, while also addressing the critical challenges of privacy, bias, and equitable access.

2. Literature Review

Artificial intelligence and data-driven systems have the potential to significantly enhance child protection services by improving risk assessment, streamlining decision-making processes, and facilitating the early identification of abuse and neglect cases. AI models, including artificial neural networks and natural language processing techniques,

have been developed to predict instances of child abuse and neglect. However, a systematic review highlighted that these implementations are still in nascent stages and often suffer from high risks of bias due to factors such as small sample sizes and overfitting [1]. The integration of machine learning-based risk models in child protection raises several ethical concerns, including data biases, lack of standardized documentation, and challenges in model evaluation. Addressing these issues is crucial to ensure the responsible deployment of AI in this sensitive field [2]. AI and mobile health (mHealth) approaches offer substantial potential in preventing and addressing violence against children on a large scale. These technologies can be particularly effective in low- and middle-income countries, provided they are implemented with caution to avoid exacerbating existing inequalities [3]. While AI and data-driven systems hold promise for improving child protection services, their current application is limited and fraught with challenges. Future research needs to focus on developing robust, unbiased models and addressing ethical considerations to fully harness the potential of AI in safeguarding children's welfare. In the scientific literature intelligence can be seen as "the ability to learn from experience (acquire and retain new knowledge), and to subsequently apply that new knowledge with flexibility to manipulate or adapt to a changing environment" or it can be seen as "the ability to create abstract thought, beyond instinct or responses to sensory input" [4]. In contrast, artificial intelligence is "the capacity of a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations or decisions influencing real or virtual environments" [5]. A data-driven system is a "collection of analytical systems that stores data from various processes and converts it into meaningful information needed for decision-making (often using third-party data sources)" [6].

3. Methodology

This research adopts a qualitative, exploratory approach to assess how artificial intelligence (AI) and data-driven systems enhance child protection services. The study is grounded in an integrative literature review of academic publications. Key sources include peer-reviewed journals, systematic reviews, and case studies from child welfare agencies and international organizations. Case examples, such as the Allegheny Family Screening Tool and predictive models developed by institutions like the University of Georgia and MIT, were analyzed to identify practical implementations, ethical concerns, and effectiveness outcomes. Additional insights were drawn from expert interviews and stakeholder commentaries featured in public reports and digital platforms. The analysis focused on four dimensions: technological capabilities of AI in risk prediction and intervention; ethical and human rights considerations; practical barriers to adoption; and policy and governance implications.

4. Results and Discussion

AI tools oriented towards children can be of various types, like educational apps (Duolingo, DreamBox), virtual assistants (Alexa), AI-powered games (Minecraft, Roblox), smart toys (Cozmo, Hello Barbie). With regard to social protection of children AI is frequently used in predictive risk assessment tools. A 4-year study by Daniel Gibbs (University of Georgia, US) examined AI algorithms that assign risk scores (1–20) to predict foster care placement likelihood within two years [7]. These tools aimed to reduce false negatives (missed risks) and false positives (unnecessary interventions) in child welfare investigations. However, their effectiveness remains debated due to concerns about data quality and algorithmic bias. AI tools don't make final decisions, only provide a risk score (1–20) based on public data. Data sources were public assistance, criminal records,

medical and mental health records, welfare, education records, etc. Social workers used the score as an additional piece of information to support their judgment. It needs to be added, that AI tool supplements, not replaces, human judgment in screening child maltreatment reports. D.Gibbs argued that “either we miss the needle in the haystack and a child or family experiences some sort of harm, or we grab too much hay and families get this intrusive intervention.” [8].

One of the problems of using AI in social protection of children is the insufficient, inconsistent data or record duplication may make AI tools unsuitable. Research in Canada identified record duplication as a major obstacle to AI implementation in child protection. Centralized case management systems require high-quality administrative data to train AI models, but inconsistent data practices undermine reliability. AI models for child abuse/neglect often use heterogeneous datasets and have high bias risks, emphasizing the need for larger, validated datasets to improve accuracy. The implementation of AI in the child abuse and neglect field lags compared to other medical fields. Tools like Save the Children’s “Ask Save the Children” use generative AI to provide real-time child protection guidance in emergencies, though their effectiveness depends on rigorous training data.

In using AI tools there are a number of ethical and human rights considerations. A chapter in the Handbook on Public Policy and Artificial Intelligence critiques AI’s role in child protection, arguing that predictive models risk exacerbating discrimination against marginalized groups [9]. It stresses balancing risk analysis with human rights, particularly in decisions involving family integrity and child safety.

Also, there are a number of benefits of AI. It could help reduce harmful errors, it may help identify high-risk cases more reliably, it can provide structure and objectivity to complex decisions. AI tools also have limitations. They can reflect only those data known to public systems and may leave out crucial context. Over-policing and poverty can lead to racial or socioeconomic discrimination. Workers sometimes distrust the AI risk prediction tools, especially when scores are ambiguous (for example, when score = 10). Some workers don’t understand how the algorithm works, reducing its effectiveness and adoption. Transparency is lacking - parents often don’t know that an algorithm was used in their case. It’s not about math - it’s about how the tool is used. Tools can be very useful at score extremes (for example, 1/20 or 20/20), but not helpful in middle-range cases. AI use is likely inevitable in child welfare due to limitations of human decision-making. Tools must be context-sensitive, explainable, and trusted to be adopted. AI can amplify both good and bad decisions - its impact depends on human use.

MIT Researchers [10] partnered with Colorado’s child welfare department to develop visual analytics tools that explain AI predictions for case screeners. Their work emphasized transparency in machine learning models, focusing on how factors like child age influence risk assessments. Screeners value factor-specific insights over technical explanations of the model. Simple models can still confuse users if features aren’t clearly explained in plain language. Screeners were more interested in validating or reconciling model predictions with their intuition. Four interfaces were built, including one comparing current cases to past similar ones. Case-specific details interface were found useful by 90%+ of screeners, increasing trust in predictions. Case comparison interface was not trusted - screeners worried it might lead to biased decisions based on past cases, rather than current evidence. Researchers modelled, designed and supported implementation of this world-first child welfare predictive analytics tool. The Allegheny Family Screening Tool (AFST) uses rich administrative data to generate a screening score for incoming calls alleging child maltreatment and neglect. The score is an additional piece of information that helps call screeners as they decide whether to open an investigation. Allegheny County

introduced this decision support tool with the aim of improving accuracy and consistency of call screening decisions. The evaluators' findings included that use of the tool improved the accurate identification of children in need of services and was associated with a modest reduction in racial disparities in case openings.

European Commission's Joint Research Centre (JRC) published a report analyzing AI's impact on children's rights, including risks from conversational agents and recommender systems. It underscores the need for transparency, accountability, and non-discrimination in AI design. It advocates for multistakeholder collaboration and ethical frameworks to balance innovation with child rights. The report data present a comparative overview of the types of questions raised by different stakeholder groups - policymakers, experts, and children/youth - on issues related to AI, children's rights, and digital technology [11, p.61]. Each group demonstrated distinct priorities and concerns, offering insights into how different perspectives shape the discourse on AI and child well-being. The input from policymakers (N=28), shows that highest percentage of questions were related to inclusion (25%) and education (25%), reflecting a strong emphasis on ensuring equitable access and learning opportunities. This was followed by cognition and development (21.4%), suggesting interest in how AI impacts children's growth and mental processes. Other concerns included exploitation (14.3%) and privacy (10.7%), with explainability (3.6%) being the least addressed topic, indicating limited focus on how understandable AI systems are. Findings from expert discussions (N=22) show that while education (22.9%) again ranked high, experts placed greater emphasis on privacy (17.1%) and evaluation/monitoring (17.1%), showing concern for ethical oversight and system accountability. They also raised issues related to cognition/development (11.4%), trust (8.6%), conflicting rights (8.6%), and employment (2.9%), suggesting a broader and more technical or ethical consideration of AI's impact. The topics raised by children and youth (N=35) demonstrate that their dominant concerns were cognition and development (27.3%) and inclusion (22.7%), followed by evaluation (13.6%) and explainability (13.6%). This group placed significantly more importance on understanding how AI systems work compared to policymakers and experts. Meanwhile, education (9.1%), conflicting rights (9.1%), and privacy (4.5%) were less frequently mentioned, possibly reflecting differences in awareness or perceived relevance. When comparing across the three groups we identify that inclusion was a top concern for both policymakers and children/youth, but not explicitly highlighted by experts; education was consistently important for policymakers and experts, though less so for children; cognition and development was highly valued by children and policymakers, with moderate attention from experts; explainability was scarcely addressed by policymakers and not by experts, but was relatively important to children, underscoring their desire to understand AI; privacy and evaluation were notably more emphasized by experts than by children or policymakers. These differences reveal how each group's perspective - policy-driven, technical/ethical, or experiential - shapes the framing of issues around AI and children's rights.

In order for children to safely engage with AI they need age-appropriate introduction, clear limits on their smart tech usage and prioritization of real-world social interactions, monitoring of app content and privacy settings, being taught about data privacy, encouragement of critical thinking skills, involvement of adults in their AI interactions, discussion about the (un)emotional side of AI, encouragement of a variety of learning and play. At the same time AI potential can benefit kids through building creativity, skill development, accessible learning to children with special needs, personalized learning, while there are risks related to privacy, over-reliance on technology,

exposure to inappropriate content, impact on emotional development, screen time and health concerns, bias in AI systems.

Current AI policy implementations in child protection lag behind other fields, with studies often plagued by small sample sizes and methodological flaws. The UNICEF and European Commission reports advocate for multistakeholder collaboration, children's participation, and policy frameworks that prioritize child rights over managerial efficiency. In this regard it is recommended to improve data quality and reduce duplication to support AI training, to ensure transparency, explainability, and accountability in AI systems, to develop guidelines that address conflicting rights (for example, privacy vs. protection) and to involve children in AI design.

The Alan Turing Institute from UK on 4th February 2025 organized Children's AI Summit: Putting children at the centre. The Manifesto of the AI Summit has set a series of demands for the world leaders formulated from the perspective of children. It highlights key areas of concern and outlines specific actions that children believe should be taken to ensure that AI is developed and used in ways that are ethical, inclusive, and safe. The demands emphasize the importance of listening to children's voices and taking their experiences into account when creating policies related to AI. A strong focus is placed on child safety, particularly in relation to social media and the broader digital environment. Another major point is the need for transparency in AI development. This includes tracking and removing biased or discriminatory training data, ensuring companies are open about how their AI systems are built and used, and requiring that AI development follows clear ethical standards through appropriate legislation. Environmental concerns are also addressed, with a call for AI technologies to rely on clean, sustainable energy sources. Additionally, the text underlines the necessity of improving public education about AI so that people, especially children and their caregivers, can understand and use it safely and effectively. Finally, the demands include ensuring cybersecurity protections for AI systems and promoting equitable access so that all children, regardless of background, can benefit from the opportunities AI may offer. Overall, the text reflects a thoughtful and multi-dimensional perspective on the responsible use of AI from the viewpoint of younger generations.

5. Conclusions

Artificial intelligence and data-driven systems present powerful opportunities to improve child protection services by enhancing risk detection, supporting decision-making, and optimizing resource allocation. These technologies can strengthen the ability of social workers and institutions to identify and respond to cases of abuse, neglect, and exploitation more quickly and accurately, especially in resource-constrained environments. Tools such as the Allegheny Family Screening Tool and AI-powered mHealth platforms demonstrate how predictive analytics and real-time data can contribute meaningfully to child welfare.

However, while the potential is significant, the current implementation of AI in child protection remains limited and fraught with challenges. These include inconsistent data quality, lack of transparency in algorithmic decision-making, biases that disproportionately affect marginalized communities, and limited user trust in AI tools. Furthermore, ethical concerns about the balance between efficiency and child rights, particularly regarding privacy, family integrity, and non-discrimination, remain unresolved.

Comparative analysis of stakeholder concerns - policymakers, experts, and children - reveals differing priorities that must be integrated into the development of AI tools. Policymakers focus on inclusion and education; experts prioritize privacy, monitoring, and ethical governance; children emphasize understanding, mental development, and inclusion.

This diversity highlights the need for multi-stakeholder involvement, including children's participation, in designing child-centered AI systems.

Moreover, the demands of children voiced during the AI Children Summit call attention to crucial policy gaps and offer a normative framework for action. These include the need for ethical legislation, transparent data practices, guidance for safe AI use, and education about AI's role and risks. The emphasis on environmental sustainability, cybersecurity, and equitable access further enriches the discourse on AI and children's rights.

In conclusion, realizing the full benefits of AI in child protection requires high-quality, interoperable data systems; transparent, explainable, and accountable AI models; ethical guidelines that prioritize children's rights over managerial efficiency; active participation of children and caregivers in AI governance; collaborative policymaking that bridges technical innovation with social justice. Only through such a comprehensive, rights-based, and inclusive approach can AI become a trustworthy partner in protecting and empowering children in the digital age.

Acknowledgements: *The work was developed within the framework of Subprogram 030101 „Strengthening the resilience, competitiveness, and sustainability of the economy of the Republic of Moldova in the context of the accession process to the European Union”, institutional funding.*

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SECURING INFORMATION THROUGH DATA CLASSIFICATION

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Abstract: *This paper explores the structured classification of information as a foundational element of information security, particularly within military and government systems. Using theoretical analysis and comparative review of access control mechanisms, the study identifies key strategies for mitigating data exposure risks. It distinguishes between subjective, objective, and technical information and analyzes their relevance to secure communication environments. The paper also discusses the evolution of access control post-9/11 and categorizes preventive, detective, and corrective security measures. Recommendations are proposed for policy development and implementation to enhance systemic resilience in the digital age.*

Keywords: *Network attacks, cryptographic, security, encryption, Virtual Private Networks, communication network.*

UDC: 004.056:004.67

Classification JEL: O3.

1. Introduction

Our statements are supported by concerns regarding information protection and security, which date back thousands of years. At the risk of contradicting some previous periodizations, we can assert that the signals provided by different peoples over time lead us to the conclusion that the phenomenon of globalization in information protection and security systems began more than ten thousand years ago. Historical accounts - from Mesopotamian encryption methods to modern digital protocols - demonstrate the longstanding importance of securing sensitive data. Even the traditional system based on a central computer has become obsolete, as people across the world discuss the Internet, Intranet, Extranet, and the integration of personal computers (PDAs), various generations of mobile phones, and many other technologies. The modern dependence on cyberspace heightens the risk of disruption, necessitating robust classification systems.

2. Literature Review

Several sources address information classification and protection strategies. Arvin S. Quist (1993)[1] extensively explored classification systems. Anderson (2021)[2] and Miller (2002)[3] examined dependable system design and PC privacy respectively. Chen (2006)[4] discussed information sharing and security informatics. Andress (2002)[5] focused on integrating security policies with people and technology. Baker (1995)[6] and EU legal frameworks (EUR-Lex, 2025)[7] provide insights into national and institutional responses. However, a gap remains in integrating historical, typological, and strategic perspectives into a unified framework.

3. Methodology

This paper is structured as a conceptual analysis. It synthesizes previous literature and applies a typological approach to the classification of information. The analysis draws upon institutional practices, governmental strategies, and legislative frameworks, including

post-9/11 security shifts. No primary data collection is involved; the approach is qualitative, interpretive, and policy-oriented.

4. Results and Discussion

4.1. The beginnings of modern information classification

Regarding access to certain categories of information for the purpose of exercising control, the rules are clearer: an official may read documents from a specific category only if they have at least the authorization to access information from that category or a higher one. For example, an individual authorized to access "top secret" information can read confidential, secret, and top-secret information, whereas someone with access rights to secret information cannot access top-secret materials. The rule is that information can flow only upwards from confidential to secret and top secret while downward flow is only possible if an authorized person deliberately decides to reclassify it.

Additionally, rules for document storage have been established as follows: confidential documents are kept in locked cabinets in any government office, while documents in higher categories require specific types of safes, guarded doors, and control over copiers and other electronic equipment

Two fundamental strategies are practiced in national security:

1. Everything that is not prohibited is permitted.
2. Everything that is not permitted is prohibited.

In the United States, the first strategy governs access to government information. In many countries around the world, access to national information is controlled by state secrecy laws, following the second strategy. A loyal and dedicated employee does not discuss company affairs until they are certain that the matter can be made public. Two tactics are used to implement the fundamental strategy for protecting sensitive information:

- Discretionary access control;
- Legally regulated access control.

4.2. Information classification

When information was divided into two main categories classified and unclassified certain principles were considered. However, understanding these principles requires a preliminary approach to some key concepts. Governments start with a broader classification, dividing information into two main types:

- Subjective information;
- Objective information.

Previously, another classification was used: "operational" and "scientific" information. Some have even mentioned a third type of government-classified information "technical" information. However, in many sources, technical and scientific information are considered subsets of objective information.

Subjective Information

Subjective information has also been described as "true secrets," while other authors have referred to it as "operational" or "operational secrets." However, the most appropriate term is subjective information or subjective secrets. This type of information is unique to the government, as it determines how key national activities will be conducted. As long as the government controls and protects the information on which it bases its decisions, adversaries cannot independently uncover it.

For example, in the military domain, subjective information includes the plan for invading another country (the timing and location of the invasion). The adversary cannot

generate such information independently; they can only obtain it through espionage or unauthorized disclosure.

Characteristics of subjective information:

- *Small size* – The secret can often be expressed in just a few words, making it easy to steal and share.
- *Universal perceptibility* – No special training is needed to understand the secret; anyone can steal it.
- *Vulnerability to theft* – An adversary can steal it through espionage since it cannot be discovered independently.
- *Modifiable content* – The secret can be changed at the last moment; if a country learns that the enemy knows the timing and location of an invasion, these details can be altered.
- *Short lifespan* – Secrets quickly become obsolete; for example, once an invasion starts, the secret is no longer relevant, as the adversary has already learned it. Thus, secrets can only be protected for a limited period.

Objective Information

Objective information includes data that, even if discovered, developed, or controlled by the government, can already be known or independently discovered by another country. This category includes scientific information or scientific secrets. Such information cannot be absolutely controlled, as it is tied to the nature of things rather than secrecy. Scientists from different countries, working independently, may make identical discoveries. This type of information is also referred to as objective information or objective secrets.

Characteristics of Objective Information:

- *Complex and detailed* – Unlike a simple secret formula, scientific information often requires extensive reports for explanation, making it difficult to transmit easily.
- *Requires specialized knowledge* – It can only be understood by scientists or experts in the field.
- *Not arbitrarily controlled* – Others can discover the same information if they ask the right scientific questions.
- *Unchangeable* – It has an eternal character; a natural phenomenon has a single, definitive value.
- *Long-lasting secrecy* – While others may independently discover it, the process takes time, allowing the information to remain secret for an extended period.

Technical Information as an Objective Secret

A third type of information does not fit neatly into the subjective or objective categories technical information, which includes designs and technical implementations of new weapons. Unlike the scientific nature of theoretical research, technical information relates to practical applications and is classified as technical secrets or objective secrets.

While technical information shares characteristics with scientific information, there are key differences. Unlike scientific discoveries, which are natural phenomena, technical information refers to a method, process, technique, or equipment used to create a product. Essentially, technical information is applied science, used to exploit scientific discoveries.

However, in the field of information classification, scientific and technical information are often grouped together as a single type of objective information.

4.3. Access control in information systems

After September 11, 2001, the concept of access control within systems underwent a radical transformation, both in terms of enforcement methods and areas of application. Regarding methods, a major debate in the late 1990s focused on whether biometric identification systems should be introduced. At that time, biometrics was mainly associated with fingerprint collection for criminal investigations, and there was significant opposition, particularly from the banking sector. Other security tools were considered inconvenient or even dangerous and were therefore widely rejected. However, after the aforementioned date, attitudes changed dramatically, particularly concerning biometric identification, a trend that will be analyzed in detail later in this chapter.

The areas of application also expanded significantly, driven by system owners' and administrators' growing belief in the necessity of enhanced verification methods. As a result, stricter security measures were implemented in presidential, governmental, and public or private institutions, while airports significantly expanded their high-security zones.

Impact on Information Systems

Information systems also evolved significantly. A clear example is Microsoft's efforts in security enhancement, where almost every movement of personnel is monitored, relying on complete dependence on special access cards.

By the end of this chapter, readers should be able to:

- Acquire sufficient knowledge to determine and implement appropriate access control measures for a specific organization.
- Understand different access control models and how to combine them effectively.
- Gain expertise in identification and authentication methods necessary for organizational security.

4.5. Types of system access control

Security controls are implemented *to reduce risks and minimize potential losses* within a system. These controls fall into three primary categories:

Preventive Controls

- Purpose: Prevent security incidents from occurring.
Examples:
 - ✓ Administrative: Security policies, employee training, background checks.
 - ✓ Technical: Firewalls, encryption, multi-factor authentication (MFA).
 - ✓ Physical: Locked server rooms, security guards, biometric access.

Detective Controls

- Purpose: Identify and detect anomalies or security breaches.
Examples:
 - ✓ Administrative: Security audits, monitoring workplace activities.
 - ✓ Technical: Intrusion Detection Systems (IDS), log analysis, anomaly detection.
 - ✓ Physical: Security cameras, motion sensors, badge access logs.

Corrective Controls

- Purpose: Restore normal operations after an incident.
Examples:
 - ✓ Administrative: Incident response plans, policy updates.
 - ✓ Technical: Patching vulnerabilities, restoring data from backups.
 - ✓ Physical: Replacing compromised locks, reinforcing physical barriers.

Security Control Pairings

For comprehensive protection, different types of controls are often combined:

- Preventive/Administrative – Employee security training.
- Preventive/Technical – Firewalls and access control lists.
- Preventive/Physical – Biometric security at entry points.
- Detective/Administrative – Internal security audits.
- Detective/Technical – Intrusion detection systems (IDS).
- Detective/Physical – Surveillance cameras monitoring sensitive areas.

By integrating these security controls effectively, organizations can ensure system security throughout its entire lifecycle.



Figure 1. Types of system access control

Source: author's elaboration

Preventive/Administrative Control

This approach focuses on the administrative responsibilities that contribute to achieving access control objectives. These mechanisms include organizational policies and procedures, background checks before hiring, employment termination practices (both normal and abnormal conditions), vacation planning, labeling or marking of special materials, more stringent supervision, training courses for security awareness, behavioral awareness, and procedures for signing contracts to obtain access to the informational system and network.

Preventive/Technical Control

The preventive-technical pairing focuses on using technologies to reinforce access control policies. Technical control, also called logical control, can be implemented through operating systems, applications, or an additional hardware/software component. Preventive/technical controls include protocols, encryption, smart cards, biometrics (for authentication purposes), software packages for local or remote access control, passwords, menus, antivirus software, and more.

Preventive/Physical Control

Mostly intuitive in nature, preventive/physical control measures aim to restrict physical access to areas containing sensitive system information. These areas are defined by a so-called security perimeter, under access control. This category includes fences, badges, multiple doors (after passing through one door, it locks automatically, and the next door requires knowledge of an opening system, trapping the person between two doors, hence referred to as "trap doors"), magnetic card entry systems, biometric identification

systems, security services, guard dogs, environmental control systems (temperature, humidity, etc.), building and access route blueprints, and specially designated areas for storing information media.

Detective/Administrative Control

Some of the detective/administrative controls overlap with reventive/administrative controls because they can be exercised to prevent potential security policy violations or to detect those in progress. This category includes security procedures and policies, background checks, vacation planning, marking or labeling special materials, more stringent supervision, and training to raise security awareness. Additionally, detective/administrative controls include those aimed at personnel rotation at workplaces, shared responsibility for tasks, and reviewing records for auditing purposes.

Detective/Technical Control

Detective/technical control measures aim to highlight security policy violations using technical means. These measures refer to intrusion detection systems and automated security violation reports, generated based on information collected for audit purposes. The reports can highlight deviations from “normal” operation or detect known signatures of unauthorized access episodes. Due to their importance, the information used in auditing must be protected at the highest level possible within the system.

Detective/Physical Control

Generally, these controls require human intervention to assess what the sensors or cameras provide in order to determine if there is a real threat to the system. In this case, control is exercised through video cameras, thermal detectors, smoke detectors, and motion detectors.

6. Conclusions

The classification of data is fundamental for national and organizational security. This study has shown that differentiating between subjective, objective, and technical types of information allows institutions to apply nuanced protection mechanisms. The typological understanding of data lays the groundwork for robust access control strategies - particularly in environments where digital vulnerability intersects with national interest.

Preventing all cyber-attacks is an unrealistic goal; however, the implementation of layered controls - preventive, detective, and corrective - ensures continuity and resilience in information systems. The evolution of access control systems post-9/11 demonstrates the critical role of adaptive policies and biometric technologies in enhancing security protocols.

Furthermore, institutional coordination, especially between the public and private sectors, must become a cornerstone of cyber governance. By building institutional capacity, raising awareness, and enforcing compliance frameworks, states and organizations can reduce the systemic risks associated with digital infrastructure.

Future research and practice should prioritize real-time threat detection capabilities and legal harmonization at transnational levels. Investments in education, cybersecurity certification, and interoperable policy frameworks are necessary to ensure sustainable digital resilience in an increasingly interconnected world.

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OPTIMIZING ONCOLOGY DATA MANAGEMENT: THE ROLE OF A NATIONAL CANCER REGISTRY IN PUBLIC HEALTH

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Abstract: In the context of the growing cancer burden, both nationally and internationally, optimizing the management of oncological data is a strategic priority for public health in the Republic of Moldova. The National Cancer Registry plays a key role in collecting, standardizing, and analyzing epidemiological data on cancer patients. By centralizing this information, the registry enables the monitoring of trends in incidence and mortality, the evaluation of the effectiveness of therapeutic interventions, and the development of evidence-based prevention and treatment policies. A well-structured cancer registry supports public health decision-makers in making informed, evidence-based decisions. Furthermore, the integration of digital technologies and international standards into data collection ensures global comparability and facilitates participation in multicenter studies. In conclusion, a well-organized National Cancer Registry represents a fundamental pillar of modern cancer management and public health strengthening. It contributes to a coherent and effective approach to cancer control programs.

Keywords: Cancer Registry, public health, cancer control programs.

UDC: [004.67:616-006.6]:614.2

Classification JEL: I18, C80, H51

1. Introduction

Relevance and Importance of the Addressed Issue - an integrated and automated population-based cancer registry (information system) has the capacity to record all cancer cases within a defined population – most commonly a specific geographical area, such as a country or a significant region.

It places a strong emphasis on the use of epidemiological data, which are frequently employed in global studies assessing health outcomes and the cancer burden among populations, playing a critical role in shaping public health policies.

The registry is designed to identify the distribution of cancer cases by sex, race/ethnicity, age, and other demographic factors, as well as to determine the types of cancer most prevalent among various population groups. It also monitors cancer trends over time, supports the planning and evaluation of cancer control efforts, and helps prioritize the allocation of health resources.

Moreover, such registry advances research and supports clinical, epidemiological, and health services studies at the national level. The importance of this issue is further underscored by the current context, in which the growing volume of information demands several essential characteristics: data comparability, validity and accuracy of records, timeliness – frequently required by population-based cancer registries - as well as data completeness. All of these requirements can be met through a complex, well-organized information system, developed in strict accordance with customized (internal) needs while remaining aligned with international standards and requirements.

2. Literature Review

In recent decades, the exponential rise in cancer incidence has generated a growing need for high-quality epidemiological data to support public health decision-making. This necessity has fostered the emergence of *cancer informatics* - an interdisciplinary domain at the intersection of information science, computer science, oncology, and health systems research. The National Cancer Registrars Association (2023) defines it as the integration of all tools and processes required to optimize data acquisition, storage, processing, and utilization in oncology surveillance [1].

Global studies emphasize that early-onset cancer is becoming increasingly prevalent, especially among populations under 50 years old. Zhao et al. (2023) forecast a 31% increase in incidence and a 21% rise in mortality for early-onset cancers by 2030 [2]. Such projections underline the urgent need for real-time, standardized cancer registries that can track population-level dynamics and guide timely interventions.

Comprehensive, population-based cancer registries are recognized as essential instruments for monitoring incidence, prevalence, and survival rates. According to Merriman et al. (2021), registries not only support epidemiological surveillance but also enable cost-efficient screening strategies and outcome-based clinical benchmarking [3]. However, the effectiveness of these registries depends heavily on their *interoperability, completeness, and data standardization* - three elements often underdeveloped in low- and middle-income countries.

In Moldova, as in other developing health systems, oncological data often originates from multiple fragmented sources: imaging systems, laboratory platforms, handwritten records, and isolated clinical databases. Without structured integration, this diversity impairs the capacity to generate accurate, timely, and actionable insights. Wormeli et al. (2021) advocate for the adoption of centralized, digital registry models aligned with international standards to overcome such challenges [4].

Recent advances in natural language processing (NLP) and artificial intelligence also show promise in enhancing oncology data management. Savova et al. (2019) demonstrate how machine learning tools can mine electronic health records to produce structured cancer phenotypes, improving registry accuracy and enabling predictive analytics [5].

According to the *World Health Organization* (2023), Moldova still faces significant disparities in cancer surveillance infrastructure, particularly in rural areas. These challenges underscore the need for robust registry systems to ensure equitable health outcomes nationwide [6]. In parallel, platforms such as the *Global Cancer Observatory* from the International Agency for Research on Cancer (IARC) highlight the importance of harmonized cancer data collection to track global trends and enable policy-relevant cross-country comparisons [7].

In summary, the literature strongly supports the development of integrated, interoperable, and digitally enhanced cancer registries as a cornerstone of resilient oncology systems. Moldova's evolving National Cancer Registry is well-positioned within this global shift toward data-driven health governance and offers a valuable model for systems-level transformation.

3. Methodology

This study employs a descriptive research design with a practice-oriented approach, aiming to assess and optimize oncology data management within the National Cancer

Registry of the Republic of Moldova. The research was conducted over a four-year period (2016–2020) and involved both qualitative and quantitative components.

Data collection was based on a structured questionnaire adapted from the survey model recommended by the American Institute for Cancer Research (AICR). The tool was customized to reflect the local institutional context, targeting oncologists and healthcare professionals working at the IMSP Institute of Oncology and the Consultative Diagnostic Center.

The questionnaire included two main sections:

- *Section I:* socio-professional data (age, specialization, years of experience, department);
- *Section II:* items assessing practices, challenges, and perceptions related to oncological data reporting, interoperability, and registry integration.

Respondents were selected using purposive sampling to ensure relevant expertise. In total, 58 oncology specialists participated, covering various departments (surgery, radiotherapy, diagnostics, epidemiology).

The collected data were analyzed using descriptive statistics (frequency distributions, percentages) and thematic content analysis for open-ended responses. The study did not involve patient-level clinical data and was exempt from formal ethical review, as it focused on institutional practices and system-level evaluations.

This methodological design allows the findings to offer both practical recommendations and policy-relevant insights for enhancing cancer data infrastructure.

4. Results and Discussion

We have identified the following issues related to the optimization of data management within the National Cancer Registry (NCR) - although medical institutions involved in the diagnosis or treatment of cancer patients are legally required to report a minimum set of relevant data to the NCR, many of these institutions face challenges in meeting reporting deadlines and complying with standardized requirements.

As a result, the risk of errors increases significantly, and failure to adhere to standards may compromise the accuracy of oncological data. This can have serious consequences, hindering the ability of public health authorities to respond effectively, as the actual situation may differ substantially from the data reported to the NCR.

One of the key areas for optimization with the integration of the NCR Information System (NCR-IS) is the reduction of oncological data fragmentation, which currently exists across multiple platforms (including information systems such as SIA AMP, SIA AMS, etc.).

These systems are not interconnected, often contain unstructured free-text entries (lacking standardized classifiers), or, even more problematically, the information is recorded manually. Although this data is valuable, its current form hinders the ability to rapidly identify and implement real-time interventions.

The lack of integration and structured formatting makes it difficult and time-consuming to develop and apply effective public health policies. In the Republic of Moldova, since 2016, a National Cancer Registry Information System (NCR-IS) has been implemented.

It was developed from the ground up by a multidisciplinary team, including graduates of the Academy of Economic Studies of Moldova (ASEM) specialized in cybernetics and economic informatics, working in collaboration with oncologists from the IMSP Institute of Oncology. The system was designed to optimize the management of oncological data. It includes integration with existing information systems, the implementation of both national and international classification standards for data

standardization, and the generation of reports aligned with internationally comparable indicators. The oncological indicators generated by the NCR are illustrated in Figure 1.

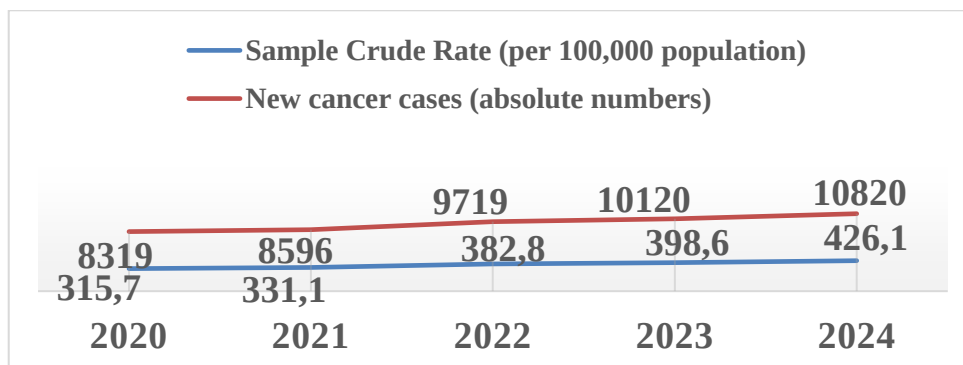


Figure 1. The dynamics of cancer incidence in the Republic of Moldova over the last 5 years

Source: National Cancer Registry

The National Cancer Registry Information System (SI RNC) ensures the accuracy of data management through the implementation of strict validation and verification protocols. Each entry undergoes rigorous control to eliminate errors and ensure interoperability between different data sources. The RNC uses advanced technologies, including machine learning tools, to detect anomalies and optimize workflows.

Significant progress has been made in reducing the challenges encountered in integrating data from multiple sources - such as inconsistencies in data formats and reporting gaps - through engineering solutions like the standardization of reporting formats and the development of user-friendly interfaces [5].

5. Conclusions

The findings of this study underscore the pivotal role of the National Cancer Registry in strengthening oncology data infrastructure and informing public health strategies in the Republic of Moldova. Through a practice-oriented approach, the research has identified both systemic gaps and recent technological advancements that contribute to optimizing cancer-related data management at the national level.

To optimize oncological data management, we have strengthened the use of information technologies within the National Cancer Registry, aiming for their full integration and focusing on the development of intuitive, accessible, and user-friendly interfaces for specialists.

In the long term, this approach not only contributes to cost reduction and ensures compliance with quality requirements and standards but also helps to reduce reliance on paper documentation, simplifying the medical documentation process and easing the administrative burden on physicians.

In public health policy, the National Cancer Registry ensures a continuous data validation process to eliminate errors and enhance the quality of processed and reported information. It also promotes interdisciplinary collaboration by involving experts in oncology, economics, informatics, engineering, and other fields to develop more advanced and efficient solutions that play a crucial role in reducing the cancer burden.

Finally, it is worth highlighting that the implementation of an integrated National Cancer Registry Information System underlines the importance of continuing efforts to improve the healthcare system in the field of oncology and adapt it to the specific needs of the medical community in the Republic of Moldova.

At the same time, the essential impact of the registry significantly contributes to strengthening the evidence base in cancer research, diagnosis, and treatment, as well as supporting the decision-making process in the development of public health policies.

Looking ahead, continued investment in digital infrastructure, workforce training, and international data alignment will be essential to ensure the sustainability and resilience of Moldova's cancer control system. The model presented can also serve as a reference for other countries seeking to modernize their cancer registries and enhance data-driven governance in public health.

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THE COVID CRISIS, CEO PAY BALANCE AND FIRM PERFORMANCE

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Abstract: This study examines how the COVID crisis affected CEO pay balance. CEO pay balance is defined as the total CEO compensation relative to the average employee's compensation and relative to the other officers' compensation. The paper focuses on the ten most valuable firms traded on NASDAQ. The previous literature has contradictory results. While some papers argue that CEOs get a pay cut in times of crisis, others argue that firms increase CEO pay to motivate the CEO to navigate the firm during these tough times. The current study also looks at the relationship between CEO pay balance and firm performance. For firm performance, the paper focuses on profitability. Does increasing the CEO's relative pay cause an increase in firm profitability? The paper contributes to both streams of research, namely, CEO pay in tough economic times, and whether increasing CEO pay contributes to the performance of a firm.

Keywords: COVID, CEO, Nasdaq, President, VP, pay ratio, profitability.

UDC: 005.334:[331.2:005.332.1]

Classification JEL: G01, G30, I15, I18, M12

1. Introduction

This study aims to look at two issues: First, it looks at the relationship between the COVID-19 crisis and CEO pay balance. CEO pay balance is CEO relative pay compared to the average employee of the firm or compared to the other officers of the firm. Did "CEO pay balance" increase after COVID started? Then, it looks at the relationship between CEO pay balance and firm performance. For firm performance, we use profitability measures. Does firm profitability increase when CEO pay balance increases?

The paper first looks at the trend in CEO pay balance. Over time, did the CEO pay balance increase or decrease? Then, it compares the pre-COVID period to the post-COVID period to see if there is any significant difference in CEO pay balance before and after COVID. We run nonparametric tests as well as regressions to achieve this objective. Finally, we test to see if there is any relationship between CEO pay balance and profitability. Again, we use regression analysis to see this relationship.

2. Results and Discussion

2.1 Literature Background

Several studies offer relevant context. Afzali et al. (2022) report that firms facing declining revenues and profits during COVID adopted cost-cutting measures that included salary reductions across all levels. Ahmad et al. (2023) find that CEOs at firms with stronger governance structures were more insulated from pay cuts, while Cambrea et al. (2023) show that CEOs who also served as board chairs were better able to preserve their compensation.

Previous research presents mixed and often inconclusive findings on the relationship between CEO pay and financial performance.

2.2 Methodological Approach

The study focuses on the ten most valuable firms listed on the Nasdaq, including the six largest publicly traded U.S. companies by market capitalization. The pre-crisis period is defined as 2017–2019, and the post-crisis period as 2020–2022. CEO pay balance is measured relative to the average employee, the company President, and both the top-earning and average-earning Vice Presidents.

The research employs trend analysis, non-parametric tests, and regression analysis to determine the effects of the COVID-19 crisis on CEO pay balance and to evaluate the relationship between CEO pay balance and firm profitability.

2.3 Key Results and Interpretation

The objective of this paper is to see the impact of the COVID-19 crisis on CEO Pay Balance and to examine the relationship between CEO Pay Balance and firm performance. The first part of the paper investigates the impact of the COVID-19 crisis on CEO pay balance, defined as the CEO's compensation relative to that of the average employee and other top executives. The study finds that the relationship between the COVID-19 crisis and CEO pay balance is not clear. If there is a link, it is weak.

The second part of the study involves the examination of the relationship between CEO compensation and firm performance. While some research supports the view that generous CEO compensation can motivate effective leadership in crisis contexts, other studies stress that adaptability, employee engagement, and organizational resilience may be more critical drivers of success.

The current paper shows that if there is any change in relative CEO pay, this change did not correspond to improved financial performance. Based on accounting-based profitability metrics, there is no support for the notion that higher CEO pay balance improves firm performance.

5. Conclusions

The current study finds very limited evidence of an increase in CEO Pay balance after COVID started. Also, the study did not find any significant relationship between CEO pay balance and firm performance. Future studies may extend the sample to see if these results hold for the larger market. Future studies may also focus on cash versus other types of compensation. Also, future studies may try to answer the following question: By motivating the top executives more than the average employee, were these firms able to improve their performance? In other words, was this a good decision by the firms? As suggested here, this stream of research can be expanded in several directions.

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TERRITORIAL RESILIENCE AND EXPORT IN ROMANIA AT COUNTY LEVEL

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Abstract: This article explores the relationship between territorial resilience and export performance at the county level in Romania, aiming to assess how external trade contributes to regional economic stability and adaptive capacity in times of crisis. Territorial resilience is analyzed through the GDP indicator as a key indicator that shows the economic robustness and development, while export performance is evaluated using export volume. The study uses quantitative methods, including correlation and regression analysis, in order to identify patterns and disparities across Romanian counties and the capital over the period 2011–2023. Findings suggest that counties with higher export intensity diversified trade structures and a stronger integration into international markets tend to exhibit stronger resilience to external shocks. Additionally, the research highlights the territorial inequalities, with the resilience being concentrated in a handful of economically advanced and export-oriented counties. These disparities raise important questions about balanced regional development and the long-term sustainability of resilience across all territories. In response, the paper offers a set of policy recommendations aimed at strengthening resilience in underperforming regions. These include the development of tailored export strategies, increased investment in physical and digital infrastructure, and the promotion of small and medium-sized enterprises' (SMEs) internationalization through targeted support programs. The study contributes to the broader discourse on resilience-building in peripheral economies facing systemic vulnerabilities.

Keywords: Territorial resilience, county disparities, quantitative analysis, GDP, exports, Romania.

UDC: 339.564(498)

Classification JEL: C12, R11, R58.

1. Introduction

In the context of economic changes and successive crises that have affected Europe in the last two decades, the concept of territorial resilience has gained particular importance in the scientific literature. Territorial resilience implies the capacity of a territory – be it national, regional or local – to resist, adapt and reinvent itself in the face of external or internal shocks, maintaining economic and social cohesion. In Romania, the persistent regional imbalances, together with the challenges generated by the economic transition, globalization and recent crises (the financial crisis of 2008-2010 and the health crisis of 2020), have highlighted the significant differences between counties in terms of the capacity for adaptation and economic recovery.

In this situation, the exports play a crucial role in the dynamics of territorial resilience. A region's capacity to integrate into international trade flows, attract foreign investment and sustain a diversified and competitive economic base can determine the speed and sustainability of the post-crisis recovery process. However, in Romania, the

analysis of the correlation between export performance and territorial resilience at county level remains insufficiently explored in the scientific literature.

This paper aims to investigate this relationship through a detailed quantitative analysis of export and Gross Domestic Product (GDP) indicator for the 41 counties of Romania and the municipality of Bucharest over the period 2011-2023. The study makes an important empirical contribution, using statistical methods such as regression analysis, and aims to provide an in-depth understanding of how exports can contribute to strengthening territorial resilience.

2. Literature Review

A critical analysis of existing literature, identifying gaps and positioning the current study within the academic discourse. Discuss theoretical frameworks, prior empirical studies, and relevant methodologies from past research. Ensure proper citation following the journal's referencing style

The concept of territorial resilience has become increasingly common in the scientific literature, being associated with the capacity of regions to cope with and adapt to economic and social shocks. In the context of the European Union, this concept is essential for understanding how regions can achieve economic and social convergence [1]. In Romania, recent research has highlighted the need to develop instruments to measure territorial resilience, adapted to national and regional specificities [2].

In literature, resilience is often conceptualized as a cyclical process, governed by structural and adaptive factors. Bănică and Petrişor highlight three essential forms of regional resilience: resistance at a lower level, recovery from a decline, and creative leap to a higher level [3]. This view emphasizes the dynamic nature of resilience, associated with a continuous development process, likely to be traced along specific evolutionary cycles.

In the Romanian context, the applicability of the concept of territorial resilience is highlighted in recent studies analyzing the impact of the COVID-19 pandemic on territorial disparities. Muntele, Bănică and Ursache highlight the manifestation of strong spatial differentiations between January 2020 and June 2022, highlighting the need for adapted public policies in order to strengthen territorial resilience [4].

Also, multidisciplinary approaches in the study of resilience, such as those presented in the work coordinated by Nijkamp et al., integrate economic, social, institutional and geopolitical dimensions [5], providing a comprehensive framework for the analysis of territorial resilience in the European Union and, implicitly, in Romania.

Exports are a key pillar in stimulating economic growth and reducing regional disparities [6]. In Romania, the export performance has been influenced by factors such as foreign direct investment (FDI), infrastructure, human capital and local policies supporting exporters. Zaman and Simion highlighted that, during the period 2001–2017, international trade had a significant impact on Romania's regional economic development, highlighting the efficiency of exports and imports by product and geographical orientation [7]. They applied a modern analytical toolkit to identify trends and processes generated by Romania's integration into the European Union.

Also, the comparative analysis of Romania's position in the region from the perspective of exports and foreign investments shows that, although in 2020 Romania had a higher share of imports used in the production of exports compared to the European Union average, regionally it has been placed in more favorable positions compared to neighboring countries over the last 10 years [8].

In the context of territorial resilience, exports represent an essential pillar of the ability of counties to adapt and recover from economic shocks, due to their openness and

orientation towards international markets. Regions with a strong and diversified export sector benefit not only from external capital flows, but also from increased opportunities for innovation, technology transfer and economic efficiency [9].

Exports allow firms to reduce their dependence on domestic demand, which can be severely affected during crises, and to access global demand, thus maintaining higher levels of production and employment. Geographical diversification of sales markets also helps to mitigate regional or sectoral risks, which gives counties increased resilience [10].

Furthermore, a strong export sector is often associated with higher productivity, investment in research and development (R&D) and a higher level of integration into global value chains, all of which are factors conducive to structural adaptability [11]. These counties are better prepared for post-crisis recovery, as they can capitalize on external trade relations and the rapid response capacity of exporting companies.

In the case of Romania, counties with high-performance logistics infrastructure, well-connected transport networks and export-oriented industrial clusters – such as Timiș, Argeș, Sibiu or Brașov – have shown superior economic resilience compared to those dependent mainly on domestic consumption [6]. The export performance directly influences regional development, and public policies must aim to strengthen the export capacity of regions, especially by supporting SMEs, improving infrastructure and attracting foreign direct investment.

The relationship between territorial resilience and export performance is complex and bidirectional. On the one hand, a resilient regional economy can support and diversify exports; on the other hand, a strong export base can contribute to increasing the region's economic resilience. Economic analyses highlight that regions with a specialization in exports of high value-added products and advanced technology tend to be more resilient to external economic shocks. In Romania, however, exports are dominated by products with a low technological level, which may limit the capacity for adaptation and territorial resilience [12].

In addition, European cohesion policies emphasize the importance of developing a competitive and export-oriented economy to strengthen territorial resilience. Thus, the European funds allocated to Romania in the period 2021-2027 aim to support smart and innovative economic transformation, with a focus on increasing the competitiveness of small and medium-sized enterprises and supporting research and innovation [13].

In conclusion, the interdependence between territorial resilience and export performance suggests the need for integrated policies that support both the diversification and sophistication of exports and the strengthening of regions' capacity to face economic challenges.

3. Methodology

The methodology used is quantitative and consists of analyzing a panel data set. The data used refer to the 41 counties of Romania, plus the municipality of Bucharest, for the period 2011-2023. The main source of data for GDP (the dependent variable expressed in millions of euros) is Eurostat, and for the value of exports (the independent variable measured in thousands of euros) is the National Institute of Statistics (NIS).

4. Results and Discussion

The model proposed in this research aims to estimate the influence of exports on the evolution of Gross Domestic Product (GDP) at county level. Starting from the premise that exports can represent an important engine of economic growth, we first conducted an OLS analysis (table 1). This method serves as a point of comparison and validation of the trends identified in the panel analysis. The estimated model has the following functional form:

$$\text{GDP}_t = c + a_1 \cdot \text{Exports}_t + \varepsilon_t \quad (1)$$

where:

a_1 - the independent variable coefficient;

ε_t - the residual value;

c - the regression equation constant;

t - 2011, ..., 2023

Table 1. The OLS model

Variable	Coefficient	Std. Error	t-statistic	Prob
Exports	0.041558	0.001016	40.90528	0.0000
C	242.5078	198.7762	1.220004	0.2230
R-squared	0.754650	Mean dependent var		4732.729
Adjusted R-squared	0.754199	S.D. dependent var		7810.394
S.E. of regression	3872.261	Akaike info criterion		19.36472
Sum squared resid	8.16E+09	Schwarz criterion		19.38048
F-statistic	1673.242	Hannan-Quinn criterion		19.37088
Prob(F-statistic)	0.000000	Durbin-Watson stat		0.129697

Source: own computations based on the Eurostat and NIS databases

For comparison, a regression model was also estimated on level (non-stationary) data, using the ordinary least squares (OLS) method, without controlling for fixed or random effects. The coefficient associated with exports was positive and significant ($a_1 = 0.0415$, $p < 0.001$), apparently indicating a robust relationship between exports and GDP.

However, the result should be interpreted with caution. The extremely low value of the Durbin-Watson statistic (0.129697) suggests the presence of autocorrelation in the model errors, which significantly reduces confidence in the validity of the statistical inferences. Moreover, the non-stationarity of the GDP and exports series raises the risk of a spurious relationship, making it possible that the detected dependence is just a consequence of the common trend in the two series.

Table 2. The Unit Root test

	Level	First difference
GDP		
Levin, Lin & Chu t	21.3404	-6.39019
Prob.	(1.0000)	(0.0000)
Im, Pesaran and Shin W-Stat	23.4331	-3.46183
Prob.	(1.0000)	(0.0003)
ADF-Fisher Chi-Square	0.17901	126.043
Prob.	(1.0000)	0.0021
PP-Fisher Chi-Square	0.19435	111.233
Prob.	(1.0000)	(0.0250)
Exports		
Levin, Lin & Chu t	-4.51851	
Prob.	(0.0000)	
Im, Pesaran and Shin W-Stat	-1.98683	
Prob.	(0.00235)	
ADF-Fisher Chi-Square	124.048	
Prob.	0.0030	
PP-Fisher Chi-Square	123.959	
Prob.	0.0030	

Source: own computations based on the Eurostat and NIS databases

Estimation of this OLS model in level, to demonstrate potential crude correlations between GDP and exports. However, due to the likely non-stationary nature of the variables, it is necessary to test and, if necessary, transform them before panel modeling.

It can be seen that all tests performed on GDP indicate the presence of a unit root, which suggests that the data series isn't stationary at the level but is stationary in the first difference. Exports are stationary at level (table 2).

The first-order differentiation of GDP was a necessary step in order to obtain a stationary series, thus preparing the data for the application of econometric techniques such as OLS regressions or other panel modeling methods. The test results confirm that the differentiated GDP does not contain unit roots, which means that we can continue the analysis on stationary data (table 3).

Table 3. The OLS model with differentiated GDP in I(1)

<i>Variable</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-statistic</i>	<i>Prob.</i>
Exports	0.004242	0.000186	22.75305	0.0000
C	-97.10979	37.21659	-2.609315	0.0093
R-squared	0.508197	Mean dependent var		369.8637
Adjusted R-squared	0.507216	S.D. dependent var		991.8870
S.E. of regression	696.2907	Akaike info criterion		15.93338
Sum squared resid	2.43E+08	Schwarz criterion		15.95016
F-statistic	517.7014	Hannan-Quinn criterion		15.93996
Prob(F-statistic)	0.000000	Durbin-Watson stat		0.978348

Source: own computations based on the Eurostat and NIS databases

The coefficient for EXPORTS is positive and statistically significant (p-value is 0.0000). This means that there is a direct relationship between exports and GDP growth at the level of the analyzed counties. In simple terms, for 1,000 euros of export growth, GDP is estimated to increase by 0.004242 million euros. The effect is significant and indicates a positive contribution of exports to the economies of the counties. The constant (C) represents a base value of GDP in the absence of exports. The negative value of the coefficient (-97.10979) suggests that, in the absence of exports, GDP would have a decreasing trend for a typical county in the sample, but this value does not have a very meaningful interpretation from an economic point of view, since the probability is still significant, indicating that county fixed effects or other variables could influence this coefficient.

The model explains about 51% of the variation in GDP based on exports, which is a fairly good result in the context of the regional economy. However, there remains a significant part of the variability of the GDP that is not explained by the model. This suggests that there are other relevant factors (e.g. infrastructure, investments, regional economic policies) that should be taken into account. The high F-statistic (517.7014) and p-value of 0.0000 suggest that the model is globally significant, meaning the variables included in the model explain a significant part of the behavior of GDP. The Durbin-Watson of 0.9783 indicates the possibility of positive autocorrelation in the residuals. This could mean that there are unspecified factors that influence GDP continuously over successive periods (e.g. effects of the financial crisis, regional economic policies or other external shocks).

In order to determine the most appropriate estimation model for the analysis of the impact of exports on GDP in the counties of Romania, the Hausman test will be applied. This test allows for the comparison of two types of models: the fixed-effects model and the random-effects model. The aim is to establish whether the unobserved individual variables affecting each county are correlated with the explanatory variables (exports), which would

justify the use of a fixed-effects model. The Hausman test is based on the null hypothesis that the random-effects model is more appropriate, since it assumes that the individual effects are not correlated with the explanatory variables. If the null hypothesis is rejected (the p-value is significant), this indicates that the fixed-effects model is more appropriate for our analysis, since capturing the unobserved individual variability in each county would improve the accuracy of the estimates.

Table 4. The Hausman test

Correlated Random Effects - Hausman Test			
Test cross-section random effects			
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f	Prob.
Cross-section random	117.791994	1	0.0000

Source: own computations based on the Eurostat and NIS databases

The result of the Hausman test (table 4) indicates a very small p-value (0.0000), which suggests the rejection of the null hypothesis that the random effects model would be appropriate. Clearly, the correlation of the random effects with the explanatory variables (Exports) is significant, which means that the fixed effects model is more suitable for the analysis (table 5).

Table 5. The fixed effects model

Variable	Coefficient	Std. Error	t-statistic	Prob.
Exports	0.009624	0.000439	21.93075	0.0000
C	-689.6227	53.97548	-12.77659	0.0000
R-squared	0.728538	Mean dependent var		369.8637
Adjusted R-squared	0.703752	S.D. dependent var		991.8870
S.E. of regression	539.8709	Akaike info criterion		15.50215
Sum squared resid	1.34E+08	Schwarz criterion		15.86295
F-statistic	29.39348	Hannan-Quinn criterion		15.64369
Prob(F-statistic)	0.000000	Durbin-Watson stat		1.704862

Source: own computations based on the Eurostat and NIS databases

The results obtained from the application of the fixed effects model show that almost 73% of the variation in GDP is explained by the model, which is a very good result. The coefficient for Exports in the fixed effects model is 0.009624, which means that, on average, an increase of exports by 1,000 euros is associated with an increase of 0.009624 million euros for the GDP at the county level. The effect is statistically significant (p-value < 0.0001). The constant c (-689.6227) is significant (p=0.0000), but in general, this value does not have a direct economic interpretation, since it represents the estimated GDP in the absence of exports and can also be influenced by variations between counties. The model is statistically significant (Prob(F-statistic)=0.0000, indicating that exports have a significant impact on GDP.

In order to observe the variations between counties of Romania, a cross-section analysis was applied for the fixed effects model obtained (figure 1).

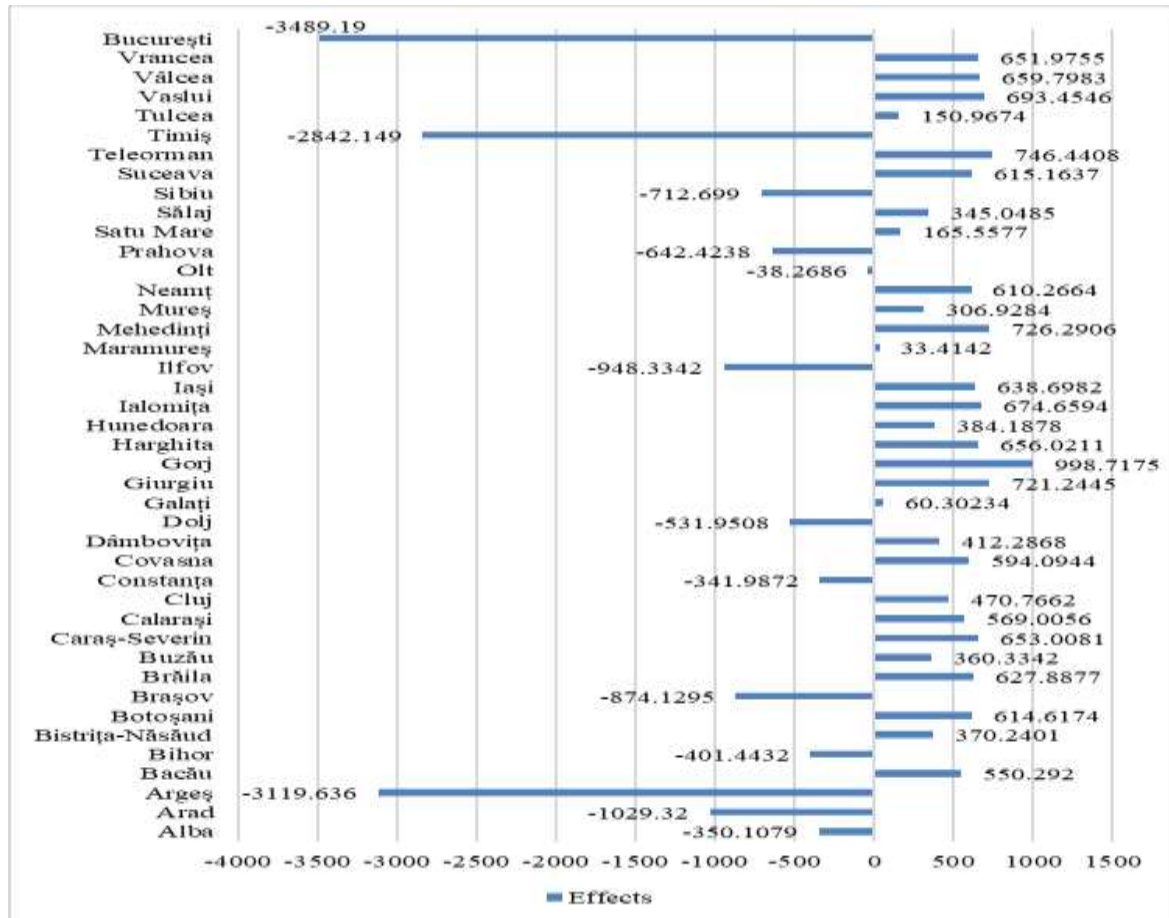


Figure 1. The heterogeneity of the counties of Romania

Source: own computations based on the Eurostat and NIS databases

The analysis of heterogeneity at the level of the 41 counties of Romania together with the municipality of Bucharest revealed the following:

- In Bacău County, an increase in exports is associated with a considerable increase in GDP. This could reflect a more open economy to trade, where exports have a significant impact on economic growth.
- In Bistriţa-Năsăud County, an increase in exports leads to a moderate increase in GDP. This could indicate a local economy benefiting from increased external demand for its products.
- Giurgiu has a high coefficient, which suggests that this county has a strong and positive reaction to export growth. This county probably benefits significantly from exports.
- Mehedinţi, with a high coefficient, suggests a strong link between export growth and GDP growth.
- Vaslui has a significant positive impact on GDP following the increase in exports, which suggests an increasing integration of the county into international trade.
- Arad, with a negative coefficient, indicates that an increase in exports could lead to a decrease in GDP in this county. This result may suggest that exports are not efficient enough or are not directly reflected in the county's GDP.
- Bucharest, with the highest negative coefficient, suggests an inverse relationship between exports and GDP, which is counterintuitive. Bucharest is generally the economic center of Romania and should benefit from exports.

However, this coefficient suggests that, during this period, the exports had a negative impact on GDP.

- Timiș has a negative coefficient, which suggests that, during this period, the increase in exports was associated with a decrease in GDP. Timiș is a county with a fairly diversified economy, but there may be economic complexity that makes exports not have positive effects on GDP.
- Sibiu has also a negative coefficient, suggesting an inverse relationship between exports and GDP. This result is interesting, considering that Sibiu is a county with a well-developed economy.
- Prahova, with a negative coefficient, suggests that exports did not have beneficial effects on GDP. This could be due to the economic structure of the county, which may depend more on domestic sectors than on foreign trade.

Based on the estimated effects of export performance on territorial resilience, Romanian counties were grouped into three categories. This classification enabled the development of a tailored policy matrix, offering targeted strategies to reinforce regional resilience. While some counties benefit from export-driven stability, others require diversification and risk mitigation, especially in highly industrialized regions such as Argeș, Timiș, and Bucharest (table 6).

Table 6. The tailored policy matrix for the counties in Romania and the Bucharest municipality

Category	Criterion	Counties	Possible economic characteristics	Policy recommendations
I. Counties where exports support resilience	Positive estimated effect (over +500)	Bacău, Bistrița-Năsăud, Botoșani, Brăila, Caraș-Severin, Călărași, Covasna, Dâmbovița, Giurgiu, Gorj, Harghita, Hunedoara, Ialomița, Iași, Mehedinți, Neamț, Suceava, Teleorman, Vaslui, Vâlcea, Vrancea	Regional economies where exports, perhaps from traditional sectors, agri-food or light manufacturing, contribute to stability and adaptability.	• Strengthening transport and logistics infrastructure • Support for the expansion of SMEs into foreign markets • Certification and quality programs for exports • Regional export support centers
II. Counties with moderate or mixed effects	Estimated effect between -500 and +500	Alba, Bihor, Bistrița-Năsăud, Cluj, Constanța, Dâmbovița, Galați, Maramureș, Mureș, Neamț, Olt, Satu Mare, Sălaj, Tulcea	Counties with a balanced, transitional or diversified economic structure, where exports do not have a clear negative impact on economic resilience.	• Creation of industrial clusters and technology transfer • Investment in education and vocational training • Support for innovation and exportable entrepreneurship
III. Counties with vulnerability to exports	Estimated negative effect (< -500)	Arad, Argeș, Brașov, București, Dolj, Ilfov, Prahova, Sibiu, Timiș	Counties with concentrated industry, specialized in exports sensitive to external shocks (auto, IT, equipment). Possible lack of diversification or dependence on few partners.	• Diversifying the structure of exports • Reducing dependence on a single sector • Developing alternative markets • Digitalization and operational resilience for exporting companies

Source: own processing based on the results obtained in Figure 1.

From the data obtained we can see that Argeș, Timiș, Sibiu, Brașov, Arad, Bihor, Cluj, Prahova, Dolj, Alba, Mureș, Galați, Satu Mare, Hunedoara, Bistrița-Năsăud, Sălaj, Ilfov are export based counties and Bucharest, Iași, Constanța, Suceava, Vaslui, Botoșani, Teleorman, Giurgiu, Călărași, Brăila, Vrancea, Bacău, Dâmbovița, Ialomița, Neamț, Vâlcea, Mehedinți,

Harghita, Covasna, Tulcea, Maramureş, Gorj, Olt are mostly services based counties as here they are oriented towards public services, administration, local services.

In order to place the results obtained in the European context, a brief comparison with trends observed in other EU Member States was also made. Recent studies [14], [15] indicate that regions with a diversified export structure and strong integration into international trade networks have shown higher levels of resilience to external shocks, such as the 2008 financial crisis or the COVID-19 pandemic. Similarly, the results from Romania show that counties with high export intensity and diverse trade portfolios have been better prepared to cope with economic disruptions. However, compared to the EU average, Romania shows a stronger concentration of resilience in a few developed counties, suggesting a higher degree of territorial imbalance. This finding highlights the need for tailored regional policies, similar to those applied in other Member States, that aim to expand the export capacity and economic infrastructure also in less developed regions, namely for the country analyzed for the less developed counties.

5. Conclusions

The analysis of the estimated coefficients for each county highlights a significant heterogeneity in terms of the impact of exports on regional GDP. The results obtained suggest that the effect of exports is not uniformly distributed territorially, but is deeply influenced by the local economic structure, the level of industrial specialization, infrastructure and the capacity to capitalize on regional comparative advantages.

On the one hand, counties such as Giurgiu, Mehedinţi, Vaslui and Bacău have recorded significant positive coefficients, indicating a strong correlation between exports and regional economic growth. This suggests that in these counties, exports act as a vector of economic growth, either by consolidating the industrial sector or by capitalizing on local resources with competitive potential on foreign markets. It is also worth noting the potential role of transport infrastructure (e.g. ports, railways, border crossings) in supporting this process.

On the other hand, counties such as Bucharest, Timiş, Arad or Sibiu present negative coefficients, indicating an inverse relationship between exports and regional GDP. This apparently paradoxical result may reflect either a strongly service-oriented economic structure (which is not always reflected in the data on goods exports) or a reduced capacity to convert exports into local value added. In the case of Bucharest, for example, the fact that this is the location of large companies which have as domain of activity in the services sector having a high number of employees may explain this discrepancy.

Thus, the results of the analysis confirm the existence of an asymmetric economic development model at the territorial level, in which export support policies must be calibrated according to the specifics of each county. Not all regions benefit equally from export growth, and the formulation of effective support measures must take into account the local economic context, the existing infrastructure, the degree of diversification of the economy and external trade connections.

This heterogeneity also raises relevant questions for public policies, related to the need for a differentiated approach in promoting exports and identifying the most efficient mechanisms through which exports can become a sustainable factor in regional GDP growth in all counties of the country.

Based on the results of the analysis of the influence of exports on GDP in the 42 counties of Romania, it is evident that export-led economic development does not have a uniform effect at the territorial level. This finding has multiple implications for the formulation and implementation of economic policies, both at the country and regional levels.

In counties where the coefficients are positive and significant (e.g. Vaslui, Mehedinţi, Giurgiu, Caraş-Severin), existing advantages can be consolidated through: investments in transport and logistics infrastructure to facilitate exports, implementation of economic policies that lead to the stimulation of small and medium-sized enterprises aimed at helping them integrate into international value chains and the promotion of smart specializations and sectors with export potential, in line with the Regional Development Strategies.

Whereas, in counties where the coefficients are negative (e.g. Bucharest, Timiş, Sibiu, Arad), a recalibration of policies is necessary, focused not only on increasing the volume of exports, but also on: maximizing the local added value generated by commercial activities, supporting sectors oriented towards high-value services, IT&C, research and development, creating mechanisms to retain economic capital in the territory (e.g. reinvestment of profits, tax incentives for locating new production facilities).

For many counties with untapped export potential, the limitations related to the road, railway and digital infrastructure represent a major obstacle, therefore it is necessary to accelerate the major infrastructure projects (expanding the motorways, creating multimodal hubs), modernizing customs points and logistics facilities and expanding high-speed internet access, especially in rural areas.

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INNOVATION PROCESS IN PUBLIC PROCUREMENT: CHALLENGES AND OPPORTUNITIES

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Abstract: *This paper examines the complex role of innovative public procurement (IPP) as both a strategic mechanism and a systemic instrument within the European Union, emphasizing its voluntary adoption by Member States while being closely monitored by public authorities. More than a mere procedural tool, IPP acts as a catalyst for sustainable economic transformation, enabling public entities to stimulate innovation while addressing social, financial, and environmental challenges. By directing demand toward innovative goods, services, and technologies that would otherwise struggle to enter the market, innovative procurement helps build a dynamic ecosystem for progress, innovation stimulation, and increased competitiveness. The study outlines the structural and functional dimensions of IPP, highlighting its ability to balance economic efficiency with positive and innovative impacts on national economies. Furthermore, the paper underscores IPP's contribution to developing institutional competencies and fostering an innovation-driven organizational culture in the public sector, aligned with good governance principles. The conclusions position innovative public procurement not only as a procurement strategy but as a public policy instrument with real potential to generate inclusive growth and systemic change in line with the evolving needs of a rapidly changing society.*

Keywords: Innovative public procurement, Public policy, Innovation, Governance, Sustainability.

UDC: 001.895:351.712

Classification JEL: H57, O31, O38, Q56.

1. Introduction

In recent decades, digital transformation has redefined the way individuals, businesses, and institutions interact with public and private services, making access easier and streamlining everyday processes. However, few realize that the foundations of these changes were laid long before the recent acceleration of digitalization. Today, a shared vision centered on competitiveness and sustainability is taking shape at the global level, supported by states, international organizations, and the private sector alike [1]. This convergence reflects a growing awareness that contemporary society is evolving within a globalized framework, marked by profound imbalances and uneven development. As such, today's challenges require solutions that go beyond purely economic logic, placing innovation and sustainability at the core of development strategies.

Within this new strategic landscape, innovation is no longer a luxury but a necessity cross-cutting mechanism that affects all levels of society: national, regional, and international. Whether it involves emerging technologies, new organizational methods, or

market transformations, all forms of innovation contribute to shaping a sustainable future [2]. Therefore, sustainability cannot be conceived without a continuous innovation process, capable of responding to global dynamics and the multiple pressures on resources, economies, and social cohesion.

At the heart of this transformation lies the public sector, which increasingly plays a dual role: both as a driver of innovation and as a beneficiary of its outcomes. Through mechanisms such as innovative public procurement governments [7],[8] could not only improve the efficiency and quality of public services but also to actively shape markets in a direction that promotes environmental responsibility and social progress. By directing public demand toward sustainable and forward-looking solutions, public authorities can stimulate innovation ecosystems, support small and medium enterprises, and foster collaboration between academia, industry, and civil society. In this context, innovation is no longer limited to technological advancement but becomes a broader cultural and institutional shift - one that redefines how public value is created and delivered in an increasingly complex and interdependent world.

2. Literature Review

In the context of a globally shifting economy, academic literature reveals a growing interest in integrating innovation and sustainability into public policies, particularly in the field of public procurement. The review of relevant literature has allowed for the analysis of core concepts, the synthesis of theoretical approaches, and the use of comparative methods to shape an original perspective on the topic.

Directive 2014/24/EU [3] offers a broad definition of innovation, referring to the introduction of a new or significantly improved product, service, or process - including production, construction, marketing, or organizational methods - aimed at addressing societal challenges and supporting the Europe 2020 strategy for smart, sustainable, and inclusive growth [1].

The Oslo Manual 2018, developed by the OECD, expands on this concept by defining innovation as the implementation of a new or significantly improved product or process, which differs from the establishment's previous offerings and has been made available to users or introduced into operations [2].

In their 2025 report, Volodymyr Tarnay and Karolis Granickas [9] analyze how public authorities and companies perceive the impact of EU procurement directives. While over 50% of public authorities believe these directives have improved green and social procurement, companies tend to be more skeptical. Nearly half argue that the directives have not sufficiently supported green (46%), social (50%), or innovative (54%) procurement.

Broader international perspectives reinforce the need for transformation. According to the Open Contracting Partnership's Strategy 2024–2030 [10], there is a goal to improve \$2 trillion in public procurement spending by 2030, aiming to create more equitable, prosperous, and sustainable communities. The emphasis is placed on digital and sustainable procurement as key levers to better serve people and protect the planet.

Scholarly contributions also stress that the success of innovative public procurement depends not only on legal frameworks but also on institutional capacity and strategic alignment. Countries such as Finland, the Netherlands, and South Korea have developed coherent national strategies for innovative procurement, driven by cross-sector collaboration and an openness to risk-taking [11] and [12].

Public procurement's potential as a driver for innovation has been widely recognized in recent studies, emphasizing the role of government demand in shaping markets and fostering new technologies. According to Edler and Georghiou [14], public procurement can act as a "lead market" that encourages suppliers to develop innovative solutions that might otherwise remain uncommercialized due to high risk or cost. This perspective is reinforced by Uyarra et al. [13], who highlight the importance of policy coherence and strategic alignment between procurement practices and innovation goals to maximize the impact on national innovation systems. The strategic use of procurement not only accelerates innovation diffusion but also contributes to broader socio-economic objectives, including job creation and environmental sustainability [11, 12, 13].

Moreover, recent research draws attention to the barriers and enablers of innovative public procurement implementation. Walker and Brammer [15] identify organizational inertia, risk aversion, and lack of expertise as critical challenges hindering the adoption of innovative procurement practices. Conversely, building institutional capacities, fostering cross-sector collaboration, and developing clear policy frameworks are cited as key enablers that empower public authorities to pursue innovative solutions effectively [16]. Furthermore, digitalization emerges as a transformative force in modern public procurement, enhancing transparency, efficiency, and stakeholder engagement [17]. Integrating sustainability criteria alongside innovation in procurement decisions has also been shown to generate positive externalities that align with global agendas such as the UN Sustainable Development Goals [4, 14, 15, 16].

In summary, the literature demonstrates that innovation and sustainable development are not merely complementary concepts, but strategic foundations of a new public governance paradigm. Public procurement can become a true catalyst for systemic transformation - provided it is implemented through coherent policies, supported by institutional commitment, and embraced by economic actors.

3. Methodology

1. This research adopts a qualitative, exploratory approach grounded in the critical analysis of academic literature, normative frameworks, and international strategic documents. The methodological foundation lies in a multidisciplinary perspective, combining public management, innovation studies, and policy analysis to explore the role of innovative public procurement (IPP) in promoting sustainable development.
2. The study integrates several classical research methods. A descriptive monographic method, in line with the guidelines of the Oslo Manual (OECD/Eurostat, 2018), was employed to examine conceptual developments and theoretical frameworks relevant to innovation in public procurement. To reinforce the analytical dimension, a comparative analysis was conducted, juxtaposing practices and policy approaches adopted by various EU Member States with those of the Republic of Moldova. This allowed for the identification of key similarities, structural gaps, and context-specific opportunities.
3. Furthermore, the research drew on a systematic review of European Union directives, particularly Directive 2014/24/EU, as well as official reports and policy documents issued by the European Commission, the OECD, and the Open Contracting Partnership. These sources provided empirical grounding for the

theoretical assertions and helped trace the evolution of public procurement from a procedural function to a strategic policy tool.

4. Through the triangulation of data from literature, regulatory documents, and institutional reports, the study tests the central hypothesis that public procurement - when aligned with innovation policy - can serve as a catalyst for structural transformation and inclusive growth in emerging economies, such as the Republic of Moldova. The methodological approach emphasizes the contextual adaptability of European models and the potential for transposing good practices in line with national innovation capacities and governance structures.

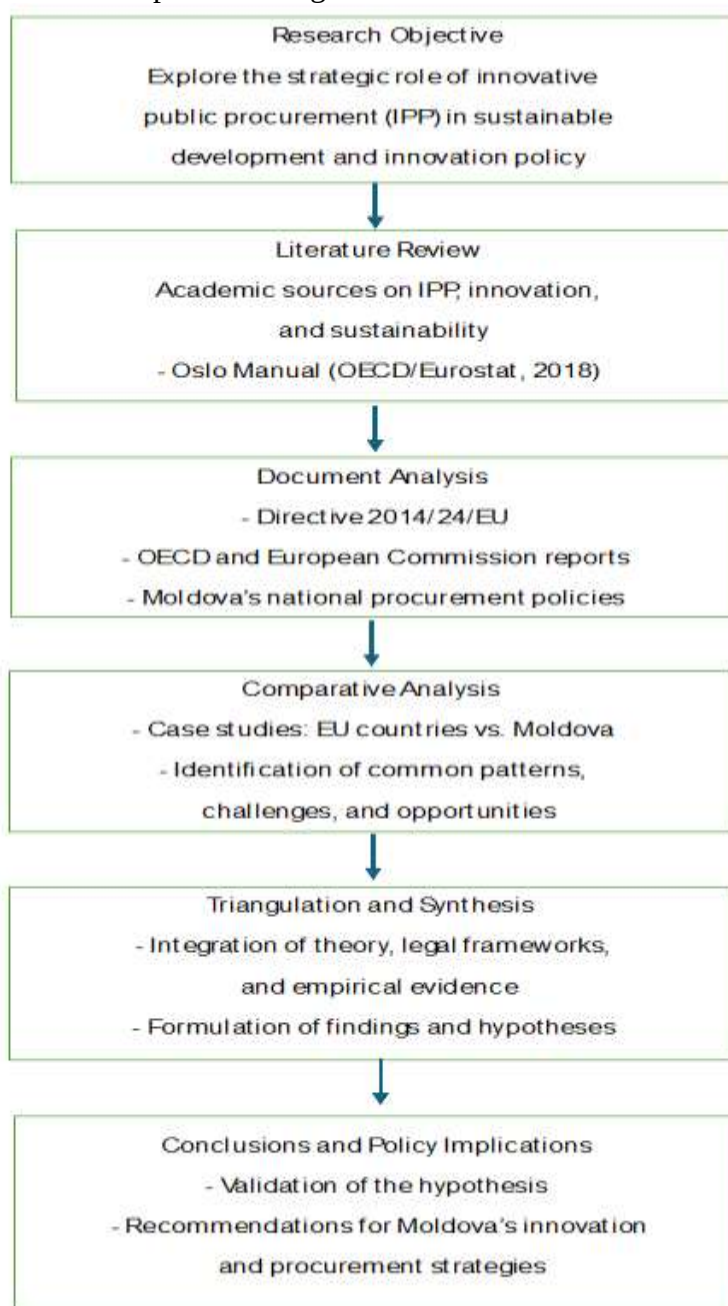


Figure 1. Methodological framework (visual logic scheme)

Source: Own processing

This model illustrates the logical flow of the research. It starts from the formulation of the core objective and proceeds through a structured review of theoretical literature, legal analysis, and cross-country comparison. The synthesis step integrates all sources and validates the research hypothesis: that IPP can serve as an effective policy lever for sustainable development in Moldova, especially when adapted to local institutional contexts.

4. Results and Discussion

The integration of innovation into public procurement mechanisms offers public authorities not only access to novel solutions but also the opportunity to enhance service efficiency while reducing costs. This strategic alignment transforms innovation into a pivotal element for building more sustainable, resilient, and competitive societies. When private enterprises aim to innovate in alignment with sustainable development objectives, they must orchestrate a synergy between process innovation, product improvement, organizational adaptation, and market transformation, each calibrated to the practical opportunities and constraints of their operational context.

In an era increasingly oriented toward the dematerialization of the economy [19], large corporations have adopted service-oriented strategies by embedding services into their products. This hybrid offering enhances perceived value while also contributing to waste reduction, a crucial objective in sustainability transitions. These service-based models not only foster customer loyalty but also allow firms to differentiate themselves through personalization and innovation, distancing themselves from price-based competition. Such models require highly specialized skills, reducing standardization and increasing competitive advantage. From a sustainability standpoint, this strategy strengthens the environmental argument while deepening consumer engagement through marketing innovations, such as transparent communication campaigns and stakeholder-driven feedback loops. Companies also engage in shaping environmental regulations through active participation in setting standards or sectoral agreements - a practice that can be interpreted both as environmental proactivity and as a form of lobbying that may limit regulatory ambition.

In contrast, small and medium-sized enterprises (SMEs) operating in niche innovation-driven markets often align their business models directly with sustainable development goals. Despite lacking the political influence of larger corporations, these firms remain highly proactive. Their agility enables them to focus on research and development (R&D), fostering a workplace culture rooted in innovation and employee empowerment. These firms acknowledge their limited global footprint but capitalize on specialized knowledge to remain competitive in defined market segments. Their innovation strategies are less reliant on scale and more on depth, adaptability, and the cultivation of human capital.

Other businesses, however, perceive environmental challenges as externalities rather than integral to their strategic outlook. For them, sustainability is more a regulatory compliance issue than a catalyst for transformation. The varying commitment of these three business typologies - large, service-integrated corporations; innovation-focused SMEs; and sustainability-indifferent firms - should be considered when designing and implementing national innovation and procurement policies.

The impacts of innovation on sustainable development can range from beneficial to adverse, depending on how the innovation is conceived, deployed, and scaled. According to criteria established in prior studies [20], innovation outcomes can be categorized along three dimensions:

Functional purpose: including innovations aimed at prevention, end-of-pipe solutions, remediation, monitoring, substitution, and resource efficiency.

Technological integration: distinguishing between complementary technologies - add-ons that reduce environmental harm without altering the core process - and integrated technologies that embed sustainability into the design and production stages.

Degree of novelty: differentiating between incremental innovations, which involve gradual improvements, and radical innovations that disrupt entire sectors or spawn new industries (e.g., lasers, radar, fiber optics, computing).

From a regulatory perspective, Directive 2014/24/EU, Article 2(22) defines innovation as the development of significantly enhanced or entirely new products, services, or processes, including changes in marketing or business practices, that contribute to societal problem-solving or support inclusive and green growth strategies [10]. The OECD (2018) similarly characterizes innovation as the implementation of new or significantly improved offerings, either through products or processes, that differ markedly from previous iterations [13].

In this context, innovative public procurement (IPP) emerges as a mechanism through which public authorities acquire solutions that are either novel or significantly improved, thereby raising standards of performance, quality, sustainability, and impact [21]. Importantly, IPP often targets output and performance indicators - such as quality, effectiveness, and operational capacity - rather than prescriptive technical specifications.

Procurement for innovation typically occurs when the public sector leverages its demand power to acquire solutions that are not yet commercially mainstream [18]. The first step in this process is aggregated demand formation, where public entities (either individually or collectively) announce their innovation needs and signal purchasing intentions. By articulating performance expectations and projected timelines, procurers can stimulate private sector investment in solution development. This preparatory phase may also include solution validation, wherein suppliers' prototypes are assessed for feasibility prior to procurement.

IPP complements pre-commercial procurement (PCP), which supports the R&D phase of innovation. While PCP covers prototype development and testing, IPP enables the deployment and scaling of market-ready innovations, including those arising from non-technological innovation such as organizational redesign or service model transformation.

When public procurement fosters innovation at scale, it yields a series of interconnected benefits [9]:

- Enhanced public services through high-quality, cost-efficient solutions.
- Creation and expansion of niche markets for innovative products and services.
- Increased competitiveness for innovative firms, enabling them to reach economies of scale.
- Stimulation of long-term partnerships, cross-border collaborations, and sustainable supplier relationships.

The innovative dimension of public procurement lies not only in the nature of the goods or services procured but also in the strategic design of the procurement process itself. This includes the use of forward-looking award criteria, the promotion of supplier collaboration, integration of digital platforms like SEAP (Electronic System for Public Procurement) and ESPD (European Single Procurement Document), and joint procurement at regional or national levels.

Innovative public procurement allows public authorities to access advanced, tailor-made solutions that respond effectively to specific needs, supporting the delivery of high-quality public services in a cost-efficient manner. In a context shaped by significant challenges - such as demographic ageing, climate change, energy crises, and the need for responsible resource management - local and national administrations are increasingly required to adopt strategic instruments that generate long-term public value.

Directing investment towards innovation-oriented procurement policies has the potential to boost the European economy's competitiveness while accelerating the transition to a more sustainable and resilient economic model [4]. A well-structured strategic framework, supported by coherent policies and an institutional culture that fosters innovation, can transform public procurement from a routine administrative process into a powerful driver of technological and societal progress.

A key advantage of innovative procurement lies in its flexibility - it can be applied in any EU Member State, across any public authority, regardless of the sector. However, the success of these initiatives relies heavily on a deep understanding of beneficiaries' needs, the market's maturity level, and the institutional capacity to manage complex procedures. While the steps and tools may vary, several universal principles ensure implementation effectiveness: strategic planning, continuous market engagement, clear risk assessment, and a collaborative public-private approach.

Moreover, by cultivating an environment conducive to innovation and taking a proactive role in stimulating demand for new solutions, public authorities can shape markets in a sustainable direction and guide investment toward critical future-facing sectors. This dual impact - modernizing public services and strengthening innovation ecosystems at both national and EU levels - illustrates the strategic importance of public procurement as a lever for transformative and inclusive



Figure 2. Implementing innovation procurement (case study)

Source: [13]

Human capital stands at the core of competitiveness in the global economy, acting as the primary catalyst for innovation and sustainable growth. However, Europe currently lags in transitioning toward a truly knowledge-driven economic model. Bridging this gap demands a collective, strategic response. National governments must fully commit to the financial allocations already pledged - ideally with strong support and collaboration from

the private sector - and pursue comprehensive reforms across all levels of education, including vocational and lifelong training systems.

On a broader scale, the European Union needs to enhance its involvement by optimizing existing budgetary tools and leveraging institutions such as the European Investment Bank and the European Investment Fund more effectively. Additionally, to ensure long-term sustainability and innovation financing, the EU should explore alternative revenue mechanisms - such as introducing environmental levies or a carbon tax - as potential instruments to support this transformation.



Figure 3. Implementing innovation procurement (case study)

Source: [13]

Innovative public procurement is a license to ensure a sustainable socio-economic development both at the local/national level and at the global level.

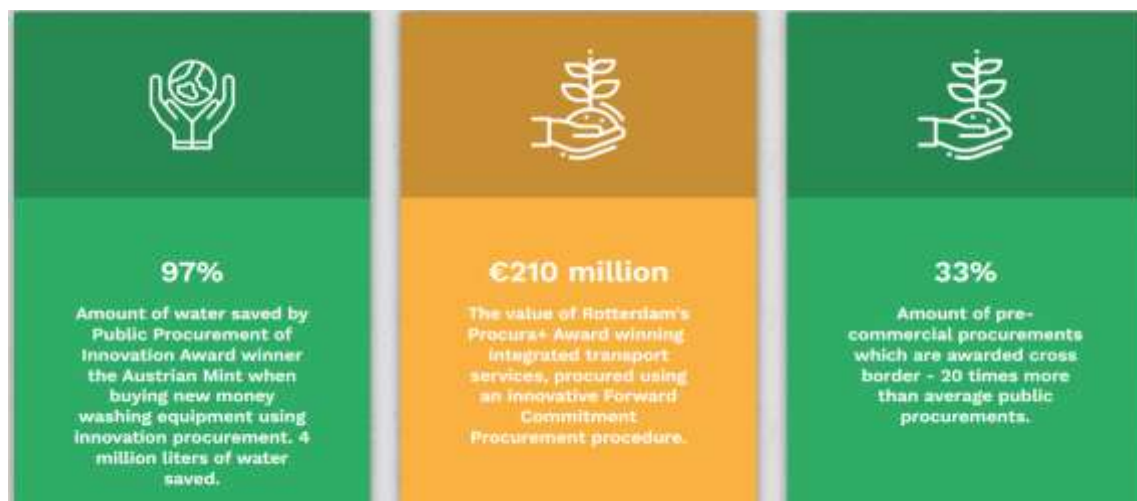


Figure 4. Implementing innovation procurement (case study)

Source:[13]

Driving Innovation through Professionalism and Digital Transformation in Public Procurement and Sustainable Finance

Delivering tangible value through innovative public procurement hinges on the professionalism and competence of those involved. A high level of motivation, combined with specialized expertise, is essential to navigate the complexities of modern procurement

processes. Civil servants tasked with managing innovation-based procurement must demonstrate proficiency across several domains, including:

- effective stakeholder engagement and cross-sectoral collaboration,
- deep understanding of targeted products and services,
- sound knowledge of applicable legal and regulatory frameworks,
- strategic risk assessment capabilities,
- negotiation techniques, and
- contract lifecycle management [20].

As the global financial ecosystem continues to evolve, the emergence of digital technologies is playing a transformative role in reshaping not only how services are delivered but also how capital is mobilized for sustainable development. Within this context, sustainable finance emerges as a strategic pillar, aligning investment decisions with long-term environmental, social, and governance (ESG) goals [4].

Sustainable finance seeks to direct capital toward projects and initiatives that actively address climate change, foster renewable energy, and promote social inclusion. Innovative instruments such as green bonds, sustainability-linked loans, and social impact funds are being enhanced by digital tools, which improve their operational efficiency and market penetration (OECD, 2020). These financial mechanisms are key enablers of environmental sustainability and social equity.

The Role of Digitalization in Advancing Sustainable Finance

The advent of digital solutions has dramatically expanded the capabilities of sustainable finance. Technologies such as blockchain, artificial intelligence (AI), and big data analytics are now central to the design and monitoring of ESG-aligned investments. Blockchain technology, for example, enhances transparency and traceability in financial transactions, ensuring that capital flows align with declared sustainability goals. AI, on the other hand, enables real-time environmental risk analysis and social impact evaluation, empowering investors to make evidence-based decisions [12].

These technologies collectively contribute to building a more resilient, inclusive, and accountable financial system. As a result, digital innovation is not just a tool, but a strategic driver for achieving sustainable development objectives in both public and private sectors.

Public Procurement Reform in the Republic of Moldova: Strategic Imperatives and Institutional Support

In pursuit of greater transparency, efficiency, and public value, the Government of the Republic of Moldova has undertaken comprehensive efforts to reform its public procurement system. Aligned with its commitments under the EU Association Agreement and the WTO Government Procurement Agreement, the Ministry of Finance requested technical assistance from the World Bank to assess the current system and propose reform priorities [29].

This assessment identified several key challenges and areas requiring targeted intervention, including:

- harmonization and modernization of the legal and institutional frameworks,
- professionalization of the procurement workforce,
- enhanced procurement planning and needs analysis,
- transparency and consistency in bid evaluation and contract awarding, and
- robust contract execution and performance monitoring mechanisms.

Given that public procurement accounts for a substantial share of national expenditure, its reform has far-reaching implications. Besides improving service delivery and infrastructure development, a well-regulated procurement system can foster

innovation, reduce corruption, and serve as a catalyst for local economic growth, particularly by supporting small and medium-sized enterprises (SMEs).

The Republic of Moldova has already made strides in this direction by deploying a national e-procurement platform and introducing a digital procurement guide to facilitate the end-to-end procurement process. However, to realize the full potential of these reforms, innovation must become a central strategic objective—not merely a procedural improvement. Embracing innovative procurement practices will be vital for delivering public services that are not only cost-effective and efficient but also sustainable and future ready.

From a data perspective, the situation is as follows:

1. Cost Efficiency and Savings through Digital Public Procurement

Since 2018, Moldova's MTender e-procurement platform has generated budgetary savings estimated at approximately €25 million by streamlining processes across over 2,500 institutions and awarding more than 26,000 contracts [23]. In comparison, Lithuania's centralized procurement reforms have rapidly increased the share of procurement through central entities from 10% in 2020 to 34.6% in the first half of 2023, while public procurement spending remains below the OECD average (9.4% of GDP vs. 12.9%) [22]. These figures confirm that digitalization and strategic centralization can produce significant fiscal efficiency and enhanced transparency in emerging administrations.

2. Market Transparency and Anti-Corruption Outcomes

The MTender electronic tool has significantly improved transparency: over 70% of stakeholders reported increased access to information and a notable reduction in corruption risks through publishing more than 14,000 calls for tender and awarding over 6,200 contracts in a controlled environment [5], [23]. A relevant regional example is Ukraine's Prozorro system, which reduced procurement costs by about 10%, resulting in estimated daily savings of US \$2.7 million [23]. These cases demonstrate how transparent and digitized platforms serve as effective instruments for building public trust and fostering a healthier competitive market.

3. Strategic Innovation and Sustainability Targets

In the European Union, public procurement accounts for approximately 14% of GDP and serves as a strategic lever for stimulating demand for innovative and sustainable solutions [24]. Lithuania, for instance, aims to achieve 100% green procurement and 20% innovation procurement by 2030, supporting the country's ecological and digital transition [22]. In Moldova, EU-supported programs like EU4Environment [28] target at least 15% of public procurement to include sustainability criteria by 2026, with technical specifications applied across various product categories [25]. These initiatives illustrate how public procurement can become a driver of innovation and sustainability when implemented strategically.

Policy Implications

The evidence from Moldova's experience, alongside best practices from Lithuania and Ukraine [26], highlights several strategic recommendations for enhancing public procurement as a driver of innovation and sustainability. First, continued investment in digital procurement platforms like MTender [27] is crucial to improve transparency, reduce corruption, and increase operational efficiency. Ensuring interoperability and user-friendliness will further increase adoption rates among public institutions and suppliers.

Second, fostering aggregation mechanisms such as centralized procurement units can strengthen the purchasing power of public buyers, encouraging suppliers to innovate and scale production of green and digital solutions. Policymakers should establish clear

mandates and incentives for procurers to prioritize sustainable and innovative criteria in tender processes, aligned with national and EU-level environmental and economic goals.

Third, capacity-building efforts for procurement officers must be expanded, emphasizing training on the latest regulations, innovation procurement strategies, and sustainable purchasing frameworks. Encouraging collaboration between public entities, private sector innovators, and research institutions will catalyze knowledge exchange and co-creation of tailor-made solutions.

Finally, monitoring and evaluation systems should be enhanced to track procurement outcomes, including the impact on market competition, sustainability indicators, and fiscal savings. Data-driven policymaking will enable continuous refinement of procurement strategies, ensuring alignment with long-term development priorities.

Public procurement represents a powerful lever for fostering innovation, sustainability, and economic modernization, especially in emerging economies such as Moldova. The adoption of digital procurement systems combined with strategic policy frameworks supports not only cost efficiency but also environmental stewardship and social inclusion. Comparative analysis with EU member states underscores the benefits of coordinated approaches that integrate demand aggregation, transparency, and capacity development.

Innovative public procurement, when effectively implemented, drives the adoption of new technologies and business models, thus promoting competitiveness and resilience. Moreover, aligning procurement practices with broader sustainability agendas amplifies positive societal impacts, contributing to the fulfillment of international commitments such as the European Green Deal and the UN Sustainable Development Goals.

Going forward, policy efforts must focus on scaling best practices, fostering multi-stakeholder collaboration, and embedding innovation as a core criterion in public purchasing decisions. Such a paradigm shift will enable governments to harness the full potential of public procurement as a catalyst for inclusive and sustainable growth.

5. Conclusions, Limitations, and Future Research Directions

In modern economies, a clear link exists between sustainability and innovation, although defining and measuring this relationship remains a complex challenge. Innovation serves as a vital mechanism through which companies can embed sustainable practices within their core operations. Conversely, sustainability acts as a catalyst that drives innovation, thereby creating a continuous cycle of mutual advancement. Nonetheless, organizations often encounter tensions and contradictions when attempting to implement innovation and sustainability strategies simultaneously. Effectively managing these paradoxes, particularly by fostering innovation-driven enterprises, benefits not only in terms of creativity but also for the broader societal well-being.

The development and deployment of the public procurement system in the Republic of Moldova have been shaped by an innovative mindset and close collaboration with international partners, overcoming numerous challenges along the way. The concerted efforts of the private sector, alongside a progressive segment of the public administration, have resulted in the establishment of a state-managed platform interconnected with multiple satellite platforms. This structure ensures transparency across all procurement activities while providing participants with choice, thereby enhancing competition and improving user convenience.

Looking ahead, the system faces ongoing challenges related to aligning with European standards. While the outlook remains positive, the future success of the platform

largely depends on political will and sustained commitment to the continuous digitization of public services.

To fully grasp the positive impact of innovation on sustainable growth, several key factors should be emphasized:

- The technological dimension of innovation, including digital and ecological technologies, rapid advancement could drive the transition to a more sustainable society.
- The promotion and support of sustainable development in synergy with technological innovation;
- The adoption and integration of emerging sustainable alternatives, either as replacements for or complements to conventional models;
- The encouragement by governments and corporations of innovation dissemination and geographic expansion, through various approaches to embedding sustainability into innovation processes.

Regarding the advancement of innovative public procurement in the Republic of Moldova, the following recommendations are proposed:

- Conducting pilot tenders focused on selected categories of innovative products;
- Updating procurement guidelines to reflect current best practices;
- Organizing training sessions for suppliers on sustainability compliance and certification, alongside sharing best practices for EU directive implementation;
- Developing a robust monitoring and evaluation framework to oversee contracts stemming from innovative public procurement;
- Creating an operational manual dedicated to innovative public procurement;
- Expanding the Public Procurement Agency's website to explicitly incorporate the innovative procurement dimension.

Implementing these measures will strengthen the strategic role of public procurement as a key instrument for fostering innovation and promoting sustainable development over the long term.

Limitations and Future Research Directions

Despite the comprehensive analysis provided, this study faces several limitations. Firstly, the reliance on secondary data and document analysis means that some contextual nuances, especially those specific to local practices and informal processes, may not have been fully captured. Additionally, the rapidly evolving nature of public procurement policies and innovation ecosystems means that findings may become outdated as new legislative changes and technological advancements emerge.

Another limitation relates to the focus on the Republic of Moldova and comparative analysis with European states, which may limit the generalizability of the conclusions to other geopolitical contexts with different administrative frameworks or economic conditions.

Future research should address these gaps by incorporating primary data collection methods, such as interviews with key stakeholders involved in innovative public procurement, including policymakers, suppliers, and end-users. Longitudinal studies would be valuable to track the evolution and impacts of innovative procurement practices over time.

Moreover, exploring the role of digital transformation and emerging technologies like artificial intelligence and blockchain in enhancing transparency, efficiency, and sustainability in public procurement presents promising avenues for further inquiry.

Finally, comparative cross-country studies involving a wider range of economies, developed, emerging, and developing—could provide deeper insights into best practices,

challenges, and contextual factors that influence the success of innovation-driven procurement policies globally.

In conclusion, innovative public procurement constitutes a vital mechanism for fostering sustainable development and enhancing economic competitiveness, particularly in transitional economies such as the Republic of Moldova. The strategic integration of innovation and sustainability principles within public procurement policies enables public authorities to act as catalysts for market innovation, technological progress, and social value creation. Despite persistent challenges related to governance, capacity constraints, and the pace of digital transformation, the empirical evidence underscores the significant potential of innovative procurement to drive systemic change. Moving forward, it is imperative to strengthen institutional frameworks, foster multi-stakeholder collaboration, and prioritize the continuous evolution of procurement practices. Such efforts will be essential in ensuring that public procurement not only meets immediate operational objectives but also aligns with broader policy agendas aimed at building resilient, inclusive, and sustainable societies.

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APPEALS IN PUBLIC PROCUREMENT PROCEDURES, IN THE CONTEXT OF SUSTAINABILITY AND ECONOMIC RESILIENCE

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Abstract: Appeals, in public procurement procedures, are an essential mechanism to ensure transparency and respect for competition principles. The aim of the research is to analyze the influence of appeals on the efficiency of procurement processes, economic sustainability and resilience of projects financed from public funds. The methodology applied in this study includes a comparative and qualitative analysis of the procedural framework and practices in two European countries: France and Estonia. The study examines the impact of appeals on implementation deadlines, additional costs and the quality of decision-making by contracting authorities. The results show that, while appeals may cause delays, they contribute to correcting procedural deficiencies and strengthening institutional accountability. For example, in France, the existence of specialized administrative courts supports efficient dispute resolution, and in Estonia, extensive digitization supports transparency and the application of environmental criteria in procurement. The research findings argue that the existence of a clear and effective appeal mechanism is a key determinant in aligning public procurement processes with the principles of sustainability and economic resilience.

Keywords: Public procurement procedures, public procurement appeals, principles governing the appeals resolution stage, examination and resolution of appeals, transparency, objectivity, fair competition, sustainability, economic resilience.

UDC: 351.712

JEL classification: H57, F52, K22.

1. Introduction

In public procurement, appeals are an essential mechanism for ensuring transparency, fairness and fair competition in the allocation of public funds. However, in practice, their frequency and duration can lead to significant delays of public projects, affecting strategic investments, including those financed by external funds. In a context where sustainability and economic resilience are political and administrative priorities, the question arises as to how appeals influence the conduct of public procurement procedures and to what extent do they affect the objectives of sustainability and economic resilience?

In public procurement, contracting authorities are obliged to follow strict procedures to select suppliers or service providers, but situations may arise in which economic operators consider that the decisions taken did not comply with legal principles or did not ensure fair treatment. Thus, in this study, we set out to achieve a general objective, namely to identify the need to analyze the impact of appeals on the efficiency and sustainability of public procurement procedures in the context of sustainable development and strengthening economic resilience. As specific objectives, we can mention the identification of the main causes and types of appeals in public procurement procedures; the assessment of the duration and frequency of appeals and their impact on the performance of public procurement contracts; the determination of the perception of

contracting authorities on the role and effects of appeals; and the balancing of the right to appeal with the need for rapid implementation of sustainable public projects.

Therefore, in public procurement procedures, appeals can significantly influence the pace and efficiency of public investments, and their proper management is essential to ensure economic sustainability and resilience, especially in the current context of multiple crises (health, climate, geopolitical, etc.).

In the context of a unitary European regulatory framework, the review procedure allows any economic operator to bring a case before a specialized authority or the courts if it considers that its rights have been infringed during a public procurement procedure. This right of review has a dual role: it provides a means of redress for operators who have been harmed and, at the same time, it contributes to improving the public procurement system by preventing and correcting errors and abuses.

Each country's public procurement law imposes clear rules on the conduct of the appeal procedure, the time limits and the conditions under which appeals can be lodged, in order to protect both the rights of economic operators and the public interest in conducting procurement in an efficient and responsible way.

2. Methodology

Over time, appeals have become a critical component of the public procurement process, ensuring compliance with the principles of transparency, non-discrimination and efficient use of public funds. At European Union level, Member States have developed mechanisms adapted to European legislation, but also to national specificities, to allow economic operators to appeal decisions considered incorrect.

Among the most important research methods that have added value to the study carried out in this article are: documentary analysis, comparative analysis, synthesis, the method of induction and deduction, etc. Equally important is the application of SWOT analysis, thanks to which we have assessed the strengths, weaknesses, opportunities and threats in the management of appeals in public procurement in the context of the objectives of sustainability and economic resilience, with the aim of identifying the most important aspects to be improved in the management of appeals and developing recommendations for improving the process. These methods have allowed us to obtain effective results that will contribute to a deeper understanding of the impact of appeals on public procurement and economic sustainability.

Thus, the appeal procedure in public procurement is a pillar of the integrity of the procurement system and of the protection of economic operators, contributing to the consolidation of a healthy competitive environment and to the sound management of public resources.

3. Results and Discussion

Public procurement procedures are complex and generate multiple legal problems for both the contracting authorities and the economic operators involved. Often, these legal disputes are resolved by the National Agency for the Settlement of Disputes (ANSC).

According to the provisions of Article 80 of Law no. 131 [1, art. 80], ANSC is an autonomous public authority, independent from other public authorities, individuals and legal entities, which examines the appeals filed in public procurement procedures. ANSC is a legal person under public law, financed from the state budget, within the limits of the budgetary allocations approved by the annual budget law. ANSC has organizational, functional,

operational and financial independence. Its budget is drawn up, approved and administered in accordance with the principles, rules and procedures laid down by Law No. 181[2].

The Agency presents an annual performance report, including data and analysis on appeals cases, to the Parliament in plenary session by March 15 each year [1].

It is relevant to mention, in this context, the role of the principles that govern the stage of settling appeals. Therefore, in the performance of its main activity, the settlement of appeals lodged by economic operators in the procedures for the award of public procurement contracts, ANSC ensures the consistent application of the legislation in force, in accordance with the principles of law expressly regulated by the decisions adopted in the exercise of its powers:

- *Celerity*, i.e. the resolution by the ANSC of all appeals submitted by interested economic operators on public procurement procedures, within a reasonable and predictable timeframe.
- *Legality* - in the appeals process. This principle implies that, both in the organization of the appeals settlement and in the settlement procedure, the ANSC and all those concerned must strictly comply with the international agreements to which the Republic of Moldova is a party, the fundamental law and other subordinate normative acts.
- *Contradictory* - the parties to the proceedings have an obligation to set out the facts to which their claims and defenses relate fairly and completely, without misrepresenting or omitting facts known to them. The parties are under an obligation to set out their own views in relation to the opposing party's assertions of factual circumstances relevant to the case. ANSC will organize open hearings with the participation of the parties concerned for the examination of objections, i.e. it will base its Decision only on factual and legal grounds, explanations or evidence which have been submitted in advance for adversarial debate.
- *Right of defense* - the parties have the right, throughout the proceedings, to be represented or, where appropriate, assisted according to the law.

The subject of the appeal procedure may be any person who meets 2 cumulative conditions: who has or has had an interest in obtaining a public procurement contract; who considers that, in the context of public procurement procedures, an act of the contracting authority has infringed a right recognized by law, as a result of which he has suffered or may suffer prejudice. Only the cumulative fulfilment of these two conditions confers legal standing on the challenger.

The aggrieved economic operator may refer the matter to the ANSC in order to annul the act and/or to recognize the alleged right or legitimate interest by filing a appeal. Thus, the following terms shall be respected when filing the contestation: 5 days, if the estimated value of the public procurement contract for goods/services is less than 2,300,000 lei and less than 90,000,000 lei in case of works procurement; 10 days if the estimated value of the public procurement contract for goods/services is greater than or equal to 2,300,000 lei and greater than or equal to 90,000,000 lei in case of works procurement. [3]

The appeal shall be submitted in written form, in the state language, signed and, where appropriate, stamped and shall contain:

- a) the name, domicile or residence of the contestant or, for legal entities, the full name of the economic operator, the name and surname of its representative, a copy of the document confirming the powers of attorney, the legal address and contact details;

- b) the name of the contracting authority, its legal address and contact details;
- c) the subject of the public procurement contract and the tender procedure applied;
- d) the essence and basis of the challenge, indicating the rights and legitimate interests of the challenger, infringed in the public procurement procedure;
- e) the nomenclature of documents attached to the contestation.

The appellant shall also attach to the appeal a copy of the contested act, if it has been issued, as well as copies of the documents referred to above, if available. [4]

In most European countries, the function of reviewing and settling appeals in the field of public procurement is entrusted to judicial bodies (administrative or civil). In some countries, the review function (in the first instance) is entrusted to an independent institution specialized in the settlement of public procurement disputes, such as: Estonia (Public Procurement Complaints Commission) [5, p. 55].

In Estonia, the public procurement challenge procedure is regulated by the Public Procurement Act and other specific regulations. Appeals are an essential mechanism for protecting the interests of economic operators and ensuring transparency and fairness in the public procurement process.

Before analyzing some steps on the proper conduct of the examination of appeals in public procurement, we would like to mention that the efficient use of public money requires following a balanced, well-determined route, from highlighting the best procurement procedures to effective control. National economic security is also described by the phenomenon of the public procurement contract, which will take into account the rigors imposed by the legislator, respecting the fundamental principles and capitalizing on concepts such as good management of public money, green procurement, wise procurement, managerial quality control, by involving with the responsibility of all participating actors. [6, p. 197].

Filing the appeal. Economic operators who consider that they have been unfairly treated in a public procurement procedure can lodge a challenge. Appeals may relate to any stage of the procurement procedure, including: violation of the conditions for participation; violation of the principles of transparency, equal treatment and non-discrimination; contract award decisions.

The deadline for lodging an appeal is specifically regulated and varies depending on the nature of the contested act. Typically, the time limit for lodging an appeal is 10 working days from the date on which the participant became aware of the contested act or decision. It may be shorter depending on the specifics of the procedure.

Competent authority for settling appeals

In Estonia, public procurement disputes are handled by the Public Procurement Office or, in some cases, by the courts.

The Office for Public Procurement is the administrative authority responsible for examining and settling appeals. It can take measures such as: annul or modify administrative acts of the contracting authority; suspend the public procurement procedure. If a party disagrees with the decision of the Public Procurement Office, it can appeal to the courts, which will examine the legality of the decision.

Settlement of the appeal. The Public Procurement Office must settle the appeal within a reasonable time. Usually, the time limit for settling a challenge is 15 working days, but may be extended in certain circumstances, depending on the complexity of the case. After considering the appeal, the Office may decide:

- Rejects the appeal: If it considers that there are no legal grounds to amend or annul the contracting authority's decision.
- Accept the appeal. If infringements of the law or fundamental principles of public procurement are found, the Office may order measures such as: suspension of the public procurement procedure; review of the contracting authority's decision; annulment of a stage of the procurement procedure; annulment of the entire procurement procedure in serious cases of infringement of the regulations.

Appeals. If a party is not satisfied with the decision of the Public Procurement Office, it can ask the courts to review the decision. The courts competent to hear appeals in the field of public procurement are usually administrative courts.

Administrative appeals are quicker than court proceedings, but if the courts are seized, they can examine the legal and procedural aspects of the case in more detail. Estonian administrative courts may also temporarily suspend the procurement procedure pending a final decision.

Interim measures. If the public procurement procedure is found to be flawed or if a participant's rights are infringed, the Public Procurement Office may order interim measures. For example, it may suspend the procurement procedure until the final decision on the complaint.

Effects of the appeal on the procurement procedure. In Estonia, the submission of a appeal may have a suspensive effect on the public procurement procedure. This means that, in certain circumstances, the contracting authority may not conclude the procurement contract or complete the stages of the procedure until the appeal has been resolved. However, the contracting authority may require the procedure to continue if there are justified reasons.

Penalties for non-compliance with decisions. If the contracting authority does not comply with a decision of the Public Procurement Office or a court decision on public procurement, it may be sanctioned. Penalties may include financial penalties or even invalidation of the procurement contract, depending on the seriousness of the infringement.

Therefore, appeals in the public procurement process in Estonia are an important component in ensuring the transparency and fairness of procurement procedures. They allow economic operators to defend their rights and interests when they consider that they have been victims of illegal or unfair practices in the procurement process. They are dealt with by the Public Procurement Office and, in case of dissatisfaction, they can appeal to the administrative courts. [7]

In France, the appeal procedure in public procurement is governed by the Public Procurement Code and other specific legislation. Appeals are essential to ensure transparency, competition and respect for fundamental principles in the public procurement process. The French system provides several mechanisms through which participants in a procurement procedure can challenge a decision or action of the contracting authority. [8]

Filing the appeal. Economic operators who consider that they have been unfairly treated in a public procurement procedure may lodge a complaint with the contracting authority or, subsequently, with the competent court.

Types of appeals: administrative appeals: These are lodged against administrative decisions of the contracting authority, such as the selection of tenders or the award of a procurement contract. *Judicial appeals:* If administrative challenges are not resolved

favorably, or if there is a violation of the rights of the participants, they can appeal to the administrative courts to challenge the contracting authority's decisions.

Submission deadline. In France, appeals must be filed within 30 days of the date of publication of a decision that may affect a participant's rights (e.g. publication of the results of the procurement procedure or notification of a winning bid).

Settling appeals. Appeals are usually resolved in two stages:

a) *Administrative appeal.* First of all, participants in a public procurement procedure may lodge an administrative challenge with the contracting authority. This may be a local or central authority, depending on the nature of the procurement. The contracting authority is obliged to reply within 15 days of the submission of the challenge, but in practice this period may vary. Depending on the circumstances, the contracting authority may reject the challenge if it considers that the procedure was fair; suspend the procurement procedure if it identifies infringements that could affect the conduct of the procedure; or modify the decision or procedure if the challenge is justified.

b) *Judicial appeal.* If the administrative appeal is not satisfactory or if the economic operator considers that his rights have been infringed, he may appeal to the administrative courts. The administrative courts are the courts competent to hear appeals in the field of public procurement. The administrative tribunal is the competent judicial authority which examines the legality of the procurement procedure and may order remedies. An important role here is played by the Administrative Court of Appeal (Cour Administrative d'Appel), which can examine appeals against decisions of the administrative tribunals. [8]

The administrative courts may suspend the procurement procedure, amend the contracting authority's decisions or annul the entire procurement procedure if substantial breaches of the law are found.

Provisional measures. One of the important features of the appeal procedure in France is the possibility to apply interim measures to protect the rights of participants. For example, the administrative courts may order: the suspension of the procurement procedure to prevent the conclusion of the procurement contract pending the outcome of the challenge; a prohibition on signing the contract until the appeal is resolved. These measures are essential to ensure that the rights of economic operators are not irrevocably affected during the procurement procedure.

If we are to analyze *the remedies*, we can mention that, in France, decisions taken by the administrative courts can be challenged by an appeal to the Administrative Court of Appeal. However, the appeal is only admissible on a legal ground (e.g. errors of interpretation of the law or procedure). In certain cases, the Court of Cassation can be seised to review the decisions of the Administrative Courts of Appeal, but this is a procedure of last resort, limited to important legal issues.

Effects of appeals on the procurement procedure. Filing a appeal in France can affect the procurement procedure to a significant extent. Typically, filing a appeal: suspends the procurement procedure, i.e. the contracting authority cannot sign the contract or move forward with the final stage of the procedure until the appeal is resolved. Or it can overturn previous decisions of the contracting authority, for example, if the court or competent authority considers that fundamental principles of public procurement (e.g. transparency, non-discrimination) have been infringed.

In general, appeals are settled quickly and interim measures are often put in place to minimize potential damage.

Penalties for violating procurement procedures. If the contracting authority does not comply with the decisions of the court or the competent administrative authorities, there may be sanctions, including financial penalties or invalidation of the contract awarded. In addition, the authorities may be obliged to pay damages to economic operators who have suffered harm due to an incorrect procurement procedure.

Relevant issues in appeal procedures. Appeals are essential in ensuring a fair and transparent public procurement process, and in France, the protection mechanisms are well regulated and effective. Some of the key issues that may be subject to appeals include [8]: violation of the principles of transparency and non-discrimination; unjustified modification of the participation requirements; selection of a winning bid in a way that does not comply with the criteria set out in the procurement documentation.

In France, appeals in public procurement procedures are governed by a detailed legal framework which guarantees the protection of the rights of participants and ensures the transparency and fairness of the procedures. Such appeals can be settled administratively or judicially, and protective mechanisms such as interim measures are essential to prevent irreparable harm.

At the current stage, the circular economy formation mechanism, in the Republic of Moldova, includes a complex series of procedures, tools, processes that have a particular relevance to the transition from the linear economy to the circular economy. The spectrum of the rights of individuals to participate in the public procurement process, in the European Union states, can be seen as guaranteed and necessary to be implemented, thanks both to the substantial, beneficial changes provided for in the European directives, as well as to the existing good practices in the field concerned [9, pp. 108].

In their study on sustainable public procurement, the Lithuanian researchers consider that "...taking into account the best foreign practice it is also recommended to consider taking specific measures both in encouraging contracting authorities to apply the social requirements in public procurement and developing socially-oriented business competencies to participate in such proceedings. Social public procurement (as well as in general public procurement) is a field of research which requires interdisciplinary approach. Designing future research implications in this field it is recommended to pay attention towards separate aspects of the problem as the need of application of certain stimulation measures (both managerial and legal), requirements for social enterprises and its implementation as well as in managerial level analyzing in general demand and supply issues in this section of market". [10, pp. 313].

In order to better understand how different European countries deal with appeals in public procurement procedures and their impact on the implementation of sustainable projects, a brief comparative analysis of some of the above issues (between Moldova, France and Estonia) was carried out. These three countries offer distinct perspectives: Moldova, with a well-functioning but often cumbersome system vulnerable to unjustified appeals; France, with a well-structured but more rigid administrative framework; Estonia, recognized for its advanced digitalization of public administration and efficient decision-making processes.

The analysis focuses on key elements such as the institutional framework, the length of time it takes to resolve appeals, the degree of digitization, preventive mechanisms and how projects impacting on sustainability and economic resilience are affected. The results are summarized in the table below (See Table 1.).

The results of the comparative analysis highlight the fact that the efficiency of the appeals process does not depend exclusively on legal regulations, but mainly on the *degree*

of digitization, the preventive mechanisms put in place and the prioritization of strategic projects. The Estonian model provides a best practice example of speed, transparency and adaptability, while the French system illustrates the importance of institutional rigor. Moldova has an accessible framework, but a reform geared towards digitization and efficient filtering of challenges is needed to better support public projects with an impact on sustainability and economic resilience.

Table 1. Appeals in public procurement - Moldova vs. France vs. Estonia

Criteria	Moldova	France	Estonia
Competent body for resolution	ANSC (National Agency for the Settlement of Appeals); then administrative courts	Tribunal Administratif (administrative courts)	Public Procurement Review Committee; administrative courts where appropriate
Average settlement time	(Approximately 20 days at ANSC); the appeal in court can take months.	Variable, (about 30-60 days); relatively fast procedures for emergencies.	Fast: (about 10-15 days to committee), with a focus on digitization.
Costs for the challenger	Relatively low (modest fee), affordable for most economic operators.	Higher than in Moldova; depends on the value of the contract.	Very low; encourages contestation only if justified.
Digitization	Electronic system (SEAP) still being modernized.	Administrative portals for submitting documents, but the procedure is not fully digitized.	Fully digitized system; procedures move quickly online.
Appeal prevention measures	Limited; lack of effective prior dialog mechanisms.	Competitive dialog and clarifications are encouraged.	Prior mediation recommended in certain cases.
Impact on sustainable projects	Procedures can be seriously delayed by appeals, including for green projects.	Strategic projects can be accelerated through controlled derogations.	Appeals are handled quickly, avoiding bottlenecks in green projects.
Regulations on ecological criteria	Although legally allowed, they are rarely used (green procurement <5%).	Frequently included; French legislation encourages sustainable procurement.	Very well integrated; Estonia has an actively implemented green procurement strategy.

Source: Author (based on researched data)

We reiterate that according to the National Program for the Development of the Public Procurement System for 2023-2026, Chapter IV, point 60 [11], public procurement is a necessary tool for achieving smart, sustainable and inclusive growth. This tool could have an impact on economic growth, employment growth and cross-border trade. And the harmonization of public procurement legislation with the EU acquis, in particular the clear designation of the authorities/entities that apply the regulatory provisions and the means of appeal for each mode of contract award is expected to be achieved by 2026.

4. Conclusions

1. Appeals are a fundamental mechanism for ensuring transparency and fairness in the public procurement process. However, their excessive or abusive use can have a negative impact on the efficient implementation of public projects, especially those with strategic relevance for the green and digital transition.
2. In the Republic of Moldova, the procedural framework for resolving appeals is generally accessible and well regulated. However, shortcomings persist related to the length of the process, the absence of full digitization and the lack of effective

- mechanisms to filter unfounded appeals, which leads to significant delays in contract execution.
3. Projects focusing on sustainability and economic resilience are particularly at risk of procedural bottlenecks, as they involve strict deadlines, limited funding (including EU funds) and environmental criteria that can be easily challenged, often through ignorance or bad faith.
 4. The comparative analysis with France and Estonia shows that extensive digitization (Estonia) and the existence of specialized and hierarchical administrative courts (France) contribute significantly to the efficiency of the appeals process.
 5. The lack of preventive measures, such as pre-contest clarification mechanisms or preliminary filters, favors an increase in the number of contestations and negatively affects the authorities' capacity to quickly implement projects with high socio-economic impact.
 6. A sustainable and efficient public procurement system requires the integration of modern, digital and selective solutions for the management of appeals, capable of simultaneously protecting the legitimate rights of economic operators and the public interest associated with strategic investments.
 7. And last but not least, increasing institutional capacity in the field of public procurement requires continuous investment in the training of actors involved in the resolution of appeals, so that they can consistently and effectively apply the principles of legality, transparency and sustainability.

Therefore, the implementation of structural reforms in the appeals system, inspired by European best practices, is indispensable for strengthening the institutional capacity to implement sustainable, efficient public projects aligned with the objectives of sustainability and economic resilience.

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LEGAL CHARACTERISTICS OF SOME ELECTORAL CRIMES

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Abstract: *This paper analyzes the legal framework applicable to electoral crimes in the Republic of Moldova, with a focus on offenses such as obstructing the electoral process, voter corruption, and falsification of voting results. Using a qualitative doctrinal methodology, the study interprets national legislation—especially Articles 181 and 182 of the Criminal Code - and compares these provisions with international standards and democratic principles. The research identifies gaps in the current legal definitions, inconsistencies in the application of criminal norms, and the need to integrate jurisprudential practice and international recommendations more effectively. The conclusions point to the necessity of refining the legal framework and enhancing institutional capacities in order to safeguard electoral integrity and democratic values.*

Keywords: *Legal framework, electoral cycle, normative violations, perpetrator, criminal liability, sanction.*

UDC: 342.841

Classification JEL: K10, K14, D72.

1. Introduction

Article 181 of the Criminal Code of the Republic of Moldova (CP RM) provides for criminal liability for preventing by any means the free exercise of electoral rights or for preventing the activity of electoral bodies: committed by blocking or attacking polling stations by any means and in any form; committed by stealing ballot boxes or electoral documents; committed with endangering the life of a person; accompanied by serious injury to bodily integrity or health; resulting in other serious consequences. In the case of the offense provided for in Article 181 of the CP RM (as well as the offenses provided for in Articles 181 and 182 of the CP RM), the generic legal object is formed by social relations regarding the realization of the constitutional rights of citizens. The special legal object of the offense of preventing the free exercise of electoral rights or the activity of electoral bodies is a complex legal object. Thus, the main legal object is the social relations regarding the realization, in accordance with art.38 of the Constitution of the Republic of Moldova, of the right to vote and the right to be elected. The secondary legal object has an alternative character, depending on the concrete modality of the offense, specified in letters a)-e) of art.181 of the Criminal Code of the Republic of Moldova, and may consist of social relations regarding: public security or the realization, in accordance with art.27 of the Constitution of the Republic of Moldova, of the right to free movement; possession of ballot boxes or electoral documents; the mental freedom of the person; the health of the person; or other social values. The material object of the offense provided for in art. 181 of the Criminal Code of the Republic of Moldova consists, as the case may be, of: the premises of the polling station; ballot boxes; electoral documents; the body of the person. The victim (passive subject of) the offense in question is the person who belongs to the following two categories: voters or members of electoral bodies. This list is exhaustive. Any other persons cannot be considered as victims of the crime specified in art.181 of the Criminal Code of the Republic of Moldova. Most often, the objective side of the crime provided for in art.181 of the Criminal Code of the Republic of Moldova consists of the harmful act consisting of:

- 1) the main action or inaction;
- 2) the adjacent action or inaction.

2. Methodology

This paper applies a qualitative research methodology focused on doctrinal and legal-normative analysis. The study involves a comprehensive examination of the Criminal Code of the Republic of Moldova, in particular Article 181 and 182, the Electoral Code (2022, updated 2024), and other relevant electoral legislation. Doctrinal sources, including academic studies by local and international legal scholars, are also integrated to support legal interpretations.

In addition, the study uses the comparative legal method to contrast the national legal provisions and practices with international standards and recommendations, including those issued by the Organization for Security and Cooperation in Europe (OSCE) and principles outlined in the Universal Declaration of Human Rights. The analytical method supports the extraction of conceptual legal distinctions between various forms of electoral crimes.

This methodology ensures a multidisciplinary legal perspective and aims to identify both theoretical and practical shortcomings in the current legal framework governing electoral integrity in the Republic of Moldova.

3. Results and Discussion

An important aspect of philosophical thinking in this sense is highlighted by Mihai Eminescu, who in his journalism shows that: In vain would anyone try to prove that the state is a result of convention and of contriving through theories; it is and remains a product of nature, an organ of society and, just as man is not free to change his heart or brain or lungs at will, so neither can society, in a given state of economic and cultural affairs, change the form and functions of the state at will, it cannot play with impunity at the hands of parliament and government [1].

The main action or inaction is expressed in preventing by any means the free exercise of the electoral right or preventing the activity of electoral bodies. Preventing the free exercise of the electoral right is materialized in: unjustified failure to hand over the ballot to the voter registered in the electoral list; destroying, soiling, damaging electoral lists, displayed programs and platforms, or any other posters (appeals, statements, photographs and other materials used by electoral competitors for the purpose of electoral agitation) or electoral agitation announcements; preventing the observer from accessing the polling station premises; unfounded limitation of the participation of electoral competitors in meetings with voters, etc. In turn, preventing the activity of electoral bodies is materialized in the failure of official persons to provide the data and materials necessary to electoral bodies or in the failure to comply with their decisions; in refusing to fulfill the instructions of the president of the electoral bureau of the polling station regarding ensuring order in the premises of the polling station and on the related territory, etc. In order to incur criminal liability under art.181 of the Criminal Code of the Republic of Moldova, the main action or inaction must be accompanied by the adjacent action or inaction. The adjacent action or inaction is presented in any of the ways specified in letters a)-d) of art.181 of the Criminal Code of the Republic of Moldova. Referring to the ways of the adjacent action or inaction, we mention that, within the meaning of letter a) of art.181 of the Criminal Code of the Republic of Moldova, „blocking the premises of the polling stations” means isolating the respective premises, by preventing the movement of persons leaving or entering the respective premises [2].

Within the meaning of letter a) of Article 181 of the Criminal Code of the Republic of Moldova, „attacking polling stations” means an aggressive action that surprises the victims

who are inside the polling stations, an action that is accompanied by violence or the threat of violence.

Within the meaning of letter b) of art.181 of the Criminal Code of the Republic of Moldova, „stealing ballot boxes or electoral documents” means the illegal (and gratuitous) taking of ballot boxes or electoral documents from the possession of another person, an act that caused actual patrimonial damage to this person, committed for greedy purposes [3].

In letter c) of Article 181 of the Criminal Code of the Republic of Moldova, „endangering the life of a person” cannot be considered attempted murder, only the threat of murder can be considered in the absence of more acceptable alternatives.

Also, in letter d) of art.181 of the Criminal Code of the Republic of Moldova, intentional serious harm to bodily integrity or health is not taken into account. Consequently, it can only be a matter of serious harm to bodily integrity or health caused by imprudence.

Article 181, letter e) of the Criminal Code of the Republic of Moldova provides for liability for obstructing by any means the free exercise of electoral rights or for obstructing the activity of electoral bodies, resulting in other serious consequences.

By other serious consequences” we mean: the death of the person (due to imprudence); declaring the elections invalid; annulling the elections; destabilizing the socio-political situation in the country, etc. We consider that in order to complete the objective side, it is necessary to also establish the time of the commission of the crime: the time of the electoral period, that is, the period of time between the day the election date is made public and the day the final election results are confirmed by the competent bodies.

The electoral period includes the electoral campaign, i.e. the period of activity that is carried out with the aim of determining voters to cast their votes for the election of one or another electoral competitor and that begins, for each electoral competitor, on the date of his/her registration by the Central Electoral Commission of the Republic of Moldova or by the constituency electoral council and ends on the date of the exclusion of the electoral competitor from the elections or on voting day.

The offense provided for in art.181 of the Criminal Code of the Republic of Moldova is considered to have been committed from the moment of: blocking or attacking the premises of the polling stations (lit. a)); the emergence of a real danger of carrying out the threat of murder (lit. c)); the perpetrator obtaining the real possibility of using or disposing of the ballot boxes or electoral documents at his own discretion (lit. b)); the occurrence of serious bodily injury or health injury (lit. d)); the occurrence of other serious consequences (lit. e)).

The subjective side of the crime of preventing the free exercise of electoral rights or the activity of electoral bodies is characterized by intention, which is, as the case may be, direct or indirect. The motives for the crime may be: the desire to promote an electoral competitor other than the victim; social, national, racial or religious hatred; secessionist motives, etc.

The subject (active subject) of the crime under consideration is the responsible natural person who, at the time of the commission of the crime, has reached the age of 16. It is not essential that the subject of the crime has a special quality.

Voter corruption. Paragraph (1) of Article 181¹ of the Criminal Code of the Republic of Moldova establishes liability for the crime of voter corruption, i.e. for offering or giving money, goods, services or other benefits in order to induce a voter to exercise his electoral rights in a certain way in parliamentary, local elections or in a referendum. According to paragraph (2) of Article 181¹ of the Criminal Code of the Republic of Moldova, the category of goods provided for in paragraph (1) also includes alcoholic beverages, tobacco products and food products. Finally, according to paragraph (3) of article 181¹ of the Criminal Code of the

Republic of Moldova, the category of goods provided for in paragraph (1) does not include electoral campaign materials and objects, paid for from the electoral fund, that bear the name and surname of the candidate, respectively the name of the political party, signs or symbols of electoral competitors, such as: posters, leaflets, postcards, calendars, notebooks, illustrated books, pens, lighters, matchboxes, badges, badges, CDs, DVDs, USB storage media, pennants, flags, books, bags, T-shirts, caps, scarves, headscarves, the value of which for one unit does not exceed two conventional units.

The special legal object of the crime of corruption of voters is the social relations regarding the realization, in accordance with art.38 of the Constitution of the Republic of Moldova, of the right to vote and the right to be elected, in terms of the freedom of voters to form an opinion without influences of the nature of offering or giving money, goods, services or other benefits for the purpose of determining the voter to exercise his electoral rights in a certain way in the framework of parliamentary, local elections or in the framework of the referendum.

In the provision of paragraph (1) of article 181¹ of the Criminal Code of the Republic of Moldova, the material or immaterial object of the crime of corruption of voters is designated by the phrase „money, goods, services or other benefits”. From the analysis of paragraph (3) of article 181¹ of the Criminal Code of the Republic of Moldova, it follows that the material or immaterial object of the crime of corruption of voters is not those goods that cumulatively meet the following conditions:

- 1) represent materials or objects of electoral agitation;
- 2) bear the name and surname of the candidate, respectively the name of the political party, signs or symbols of the electoral competitors;
- 3) are embodied in: posters; leaflets; postcards; calendars; notebooks; illustrated books; pens; lighters; matchboxes; badges; badges; CDs; DVDs; USB storage media; pennants; flags; books; bags; T-shirts; caps; scarves; scarves;
- 4) are paid from the electoral fund;
- 5) their value per unit does not exceed two conventional units.

If at least one of the five conditions listed above is missing, the respective goods will constitute the material or immaterial object of the offense specified in art.181¹ of the Criminal Code of the Republic of Moldova.

In the case of parliamentary or local elections, the victim (passive subject) of the offense provided for in art.181¹ of the Criminal Code of the Republic of Moldova is the electoral competitor within the meaning of art.1 of the Electoral Code of the Law of the Republic of Moldova, who, through the corruption of voters, has had his right to be represented in an elective authority violated, by reducing the votes cast. At the same time, in the case of a referendum, the victim of the analyzed offense is the initiator of the referendum within the meaning of art.144 and 180 of the Electoral Code of the Law of the Republic of Moldova, who, through the corruption of voters, has had his right to resolve the issue subject to the referendum violated, by reducing the votes cast [4].

The objective side of the crime specified in art.181¹ of the Criminal Code of the Republic of Moldova consists of the harmful act expressed in the action of offering or giving money, goods, services or other benefits. It can be seen that the two alternative normative modalities of the harmful action examined are:

- 1) offering money, goods, services or other benefits;
- 2) giving money, goods, services or other benefits. The first of the modalities named above – offering – is expressed in the presentation, display, appearance, in relation to the voter, of money, goods, services or other benefits.

As for the second of the normative modalities of the prejudicial action specified in the provision of art.181¹ of the Criminal Code of the Republic of Moldova, giving constitutes the actual handing over, remittance, or delivery of money, goods, services, or other benefits by the perpetrator to the voter. The offering or giving of money, goods, services, or other benefits can be done personally or through an intermediary. In the latter case, the intermediary acts on behalf of the perpetrator and with the intention of helping him, having the quality of an accomplice in the crime of voter corruption. In another context, it is not excluded that the commission of the crime of voter corruption is accompanied by the application of vote control methods. In this way, the perpetrator tries to ensure the efficiency of offering or giving money, goods, services, or other benefits to the voter. However, in the absence of vote control, voter corruption „risks” being useless, because voters can no longer be persuaded to vote as they promised. The doctrine mentions the following methods of vote control:

- 1) **photo**, which involves entering the voting booths with cameras or mobile phones with cameras to photograph the vote. Such a method is used by those who want to follow the vote of voters who have been promised certain benefits;
- 2) **ballot box**. It is used when those who buy votes use a ballot fraudulently removed from the polling station and a counterfeit ballot stamp. The „bought” voter enters the polling station with a ballot already stamped outside the station hidden in his pocket and takes the ballot handed out at the polling station. In the voting booth, the voter no longer applies a stamp, but only takes the stamped ballot out of his pocket, which he will insert into the ballot box, and puts the blank ballot in his pocket, with which he leaves the polling station. This ballot is used further, to continue the ballot box;
- 3) **the blue shirt**, which implies that a person, recognized by an element of clothing, is hired to accompany the voter to the voting booth in order to supervise him during the exercise of the vote;
- 4) **the mobile ballot box**. It is applied when the mobile ballot box, which is used with the approval of the precinct president, is used excessively, as a result of repeated written requests. When voting with the mobile ballot box, the secrecy of the vote is not as well ensured [5].

If the crime of voter corruption is accompanied by the application of vote control methods, it is not excluded that this crime may be concurrent with the crime specified in paragraph (1) of Article 182 of the Criminal Code of the Republic of Moldova (for example, when vote control involves voting using a fake ballot). The crime provided for in Article 181¹ of the Criminal Code of the Republic of Moldova is considered to be committed from the moment of offering or giving in full the money, goods, services or other benefits.

The subjective side of the analyzed crime is characterized by direct intent.

The motives of the crime in question are most often expressed in: the perpetrator's desire to be elected to a certain position (namely, that of deputy, councilor in the local council or mayor) as a result of parliamentary or local elections; the desire for other persons (other than the perpetrator) to be elected to certain positions (namely, that of deputy, councilor in the local council or mayor) as a result of parliamentary or local elections; the perpetrator's desire to obtain certain material or non-material advantages as a result of submitting an issue to a referendum, etc.

The purpose of the crime of corruption of voters is a special purpose. It is intended to determine the voter to exercise his electoral rights in a certain way in the parliamentary, local elections or in the referendum. In the presence of any other purpose, the act cannot be qualified under art.181¹ of the Criminal Code of the Republic of Moldova.

Subject (active) of the offense provided for in art.181¹ of the Criminal Code of the Republic of Moldova is a responsible natural person who at the time of committing the offense has reached the age of 16. Also, the subject of this offense may be a legal entity (except for a public authority). No special capacity is required to be a subject of the offense provided for in art.181¹ of the Criminal Code of the Republic of Moldova. Practically, any person who meets the general conditions of the subject of the offense, and who, in one way or another, is directly or indirectly involved in the electoral campaign or in the conduct of a referendum, may be the subject of the offense under consideration.

Falsification of voting results. In Article 182 of the Criminal Code of the Republic of Moldova, the legislator provides for liability not for a single offense, but for one that can be committed in two ways. The two paragraphs of Article 182 of the Criminal Code of the Republic of Moldova include two standard variants of offenses that are united by the same marginal name of falsification of voting results. Thus, in paragraph (1) of Article 182 of the Criminal Code of the Republic of Moldova, liability is established for the offense of voting by a person: without having this right, either twice or more times, or by inserting more ballot papers into the ballot box than he is entitled to, or by using a false identity document or a false ballot paper. In turn, in paragraph (2) of Article 182 of the Criminal Code of the Republic of Moldova, liability is provided for the offense of falsification, by any means, of voting results.

The special legal object of the offense provided for in paragraph (1) of article 182 of the Criminal Code of the Republic of Moldova is formed by social relations regarding the realization, in accordance with article 38 of the Constitution, of the right to vote and the right to be elected, in terms of equality in electoral law.

The material object of the offense in question is represented, as the case may be: the ballot paper inserted without right into the ballot box; the fake ballot paper; the fake identity document.

The objective side of the offense specified in paragraph (1) of article 182 of the Criminal Code of the Republic of Moldova consists of the prejudicial act expressed in the action. This action has the following four alternative modalities:

- 1) voting without the right, i.e. voting by someone who does not have the right to vote (in accordance with Articles 11, 13 and 123 of the Electoral Code of the Republic of Moldova, adopted by the Parliament of the Republic of Moldova on 21.11.1997): is not a citizen of the Republic of Moldova; has not reached the age of 18, including on election day; is recognized, by a final court decision, as incompetent (in the sense that this does not exclude his responsibility within the meaning of Article 22 of the Criminal Code of the Republic of Moldova); has been deprived of the right to vote by a final court decision; is a military man who is fulfilling his military service within the term (in the case of local elections); does not reside in the respective administrative-territorial unit (in the case of the election of the local council or mayor);
- 2) voting twice or more, i.e. violating the rule according to which, in any election, each voter has the right to only one vote (rule established by art. 4 of the Electoral Code of the Law of the Republic of Moldova and by paragraph (3) art. 8 of the Law of the Republic of Moldova on the procedure for electing the President of the Republic of Moldova, adopted by the Parliament of the Republic of Moldova on 22.09.2000);
- 3) voting by inserting more ballot papers into the ballot box than the voter has the right to. In any election, each vote has equal legal force. Therefore, it is not allowed for the voter to insert more ballot papers into the ballot box than he has the right to. This

right does not always imply the insertion of a single ballot paper. However, in the case of simultaneous holding of several types of elections, there may be more ballot papers;

- 4) voting by using a false identity document or a false ballot paper The falsity of the identity document or ballot paper implies the lack of authenticity in terms of the preparation of the respective documents by subjects not authorized by law or in terms of the alteration of authenticity as a result of the introduction of false elements of form or content into the authentic identity document or ballot paper. The offense specified in paragraph (1) of article 182 of the Criminal Code of the Republic of Moldova is considered consummated from the moment the perpetrator votes without having this right, either twice or more times, or by inserting more ballot papers into the ballot box than he is entitled to, or by using a false identity document or a false ballot paper [6].

The subjective side of the examined crime is characterized by direct intent.

The motives of the crime may be the following: the desire to promote a certain electoral competitor; material interest (when the crime is committed in exchange for material remuneration), etc.

The subject (active subject) of the crime is the responsible natural person who, at the time of committing the crime, has reached the age of 16. In addition, the subject of the crime must have the special quality of a person who performs the vote. Such a person does not always have the legal quality of a voter. In other words, the special legal object of the crime provided for in paragraph (2) of article 182 of the Criminal Code of the Republic of Moldova is formed by social relations regarding the realization, in accordance with article 38 of the Constitution of the Republic of Moldova, of the right to vote and the right to be elected, in terms of the authenticity of the voting results.

The immaterial object of the crime in question is the voting results.

The objective side of the crime provided for in paragraph (2) of Article 182 of the Criminal Code of the Republic of Moldova includes the prejudicial act consisting in the action of falsifying, by any means, the voting results. The phrase „by any means” indicates the variety of factual modalities by which the action of falsifying the voting results can be manifested. These modalities are the following: signing the minutes of totaling the voting results before these results are established; knowingly completing the minutes of totaling the voting results incorrectly (which do not correspond to the real voting results); introducing unfounded changes into the minutes of totaling the voting results after its completion, etc. Since the voting results represent documentary information, falsifying the voting results involves influencing the document by the following methods:

- 1) scraping, i.e. mechanical removal of some details of the document, in order to modify its initial content;
- 2) treating the document with chemicals, i.e. removing the text of the document by discoloring the dye of the text line using chemical reagents;
- 3) removing by washing, i.e. removing the text from the surface of the document using solvents;
- 4) inserting, i.e. inserting by gluing parts of the text, gluing another photo in place of the one removed from the document, etc. The offense provided for in paragraph (2) of Article 182 of the Criminal Code of the Republic of Moldova is considered to have been committed from the moment of falsifying the voting results. The extent of the falsification does not influence the qualification of the act according to paragraph (2) of Article 182 of the Criminal Code of the

Republic of Moldova, but it may be taken into account when individualizing the punishment [7].

The subjective side of the crime in question is characterized by direct intent. The motives of the analyzed crime are: revenge; the desire to promote a certain electoral competitor; careerism, etc.

The subject (active subject of) the crime specified in paragraph (2) of article 182 of the Criminal Code of the Republic of Moldova is a responsible natural person who, at the time of committing the crime, has reached the age of 16. In addition, the subject of the crime must have the special status of a member of the electoral body, i.e. a member of the Central Electoral Commission, of the constituency electoral council or of the electoral bureau of the polling station.

4. Conclusions

As a result of the investigation of these electoral offenses provided for in art.181, 181¹ and 182 of the Criminal Code of the Republic of Moldova, we consider it necessary to formulate the following conclusions:

- 1) art.181, 181¹ and 182 of the Criminal Code of the Republic of Moldova have similarities with art.385-387 and par.(1) art.391 of the Criminal Code of Romania of 17.07.2009;
- 2) the purpose of art.181, 181¹ and 182 of the Criminal Code of the Republic of Moldova is to defend – par excellence or mainly – social relations regarding the realization, in accordance with art.38 of the Constitution of the Republic of Moldova, of the right to vote and the right to be elected;
- 3) the offense provided for in art.181 of the Criminal Code of the Republic of Moldova can be committed by action or inaction. In contrast, the offenses provided for in art.181¹ and 182 of the Criminal Code of the Republic of Moldova can be committed only by action;
- 4) the offenses provided for in art.181, 181¹ and 182 of the Criminal Code of the Republic of Moldova are committed with intent, which is, as the case may be, direct or indirect;
- 5) no special quality is required in the case of the subjects of the offenses provided for in art.181 and 181¹ of the Criminal Code of the Republic of Moldova. On the contrary, the subjects of the two offenses provided for in art.182 of the Criminal Code of the Republic of Moldova are special subjects.

Electoral crimes pose a constant threat to the democratic process in the Republic of Moldova, affecting the integrity of elections and undermining citizens' trust in democratic institutions. Analyzing the existing legislation and institutional practices in combating these crimes, the following conclusions and recommendations can be drawn:

1. Moldovan legislation should provide clear and concise definitions for the various electoral crimes, so that there is a solid legal framework for their investigation and sanctioning;
2. Judicial authorities and law enforcement bodies should benefit from adequate resources and specialized training to effectively investigate and sanction electoral crimes. Improving cooperation between the different institutions involved in the electoral process is essential for a coordinated approach to these problems;
3. Rigorous and independent supervision of the electoral process is necessary, with the active participation of domestic and international observers. Transparent and detailed reporting of incidents of electoral fraud and other irregularities is crucial for ensuring accountability and implementing appropriate reforms;

4. Electoral education and raising citizens' awareness of the importance of the integrity of the electoral process can help reduce vulnerability to fraudulent practices and strengthen democratic participation;
5. It is essential that institutions responsible for monitoring and managing the electoral process operate independently and are protected from political or partisan influence.

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INNOVATIVE ENTREPRENEURSHIP AS A DRIVER OF SUSTAINABLE BUSINESS DEVELOPMENT IN THE REPUBLIC OF MOLDOVA

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Abstract. *The growing importance of innovative entrepreneurship as a driver of sustainable business development has become an important focus in transition economies, including the Republic of Moldova. This study explores the current state of innovative enterprises in Moldova, showing their role in economic growth while addressing environmental and social challenges. The research aims to assess the factors influencing the development of innovative entrepreneurship and identify the main barriers that hinder its progress. To achieve this, a combination of qualitative and quantitative research methods was used, including the analysis of statistical data on innovative enterprises, a review of relevant literature, and case studies of businesses implementing sustainable innovations. The findings reveal that, despite the growing interest in innovation, Moldova's entrepreneurial ecosystem faces challenges such as regulatory barriers, limited access to funding, insufficient technological infrastructure, and a weak innovation culture. However, the study also identifies opportunities for fostering sustainable entrepreneurship, emphasizing the need for policy support, financial incentives, and increased collaboration between the government, businesses, and research institutions. Strengthening the innovation ecosystem can contribute to greater competitiveness, economic resilience, but also long-term sustainability. The results underline the necessity of strategic interventions to support the growth of innovative enterprises and create a favorable environment for sustainable business development in Moldova.*

Keywords: *Innovative entrepreneurship, sustainable business development, economic growth, policy support, financial accessibility, entrepreneurial ecosystem, technology.*

UDC: 001.895:334.72(478)

Classification JEL: L26, M13, O31.

1. Introduction

The importance of studying innovative entrepreneurship as a driver of sustainable business development has grown significantly in recent years, especially in transition economies like the Republic of Moldova. In a world characterized by rapid technological advancements and changing market dynamics, the ability to innovate is vital for businesses seeking to remain competitive and contribute in a positive way to society. Sustainable entrepreneurship, which focuses on economic growth while minimizing environmental impact and fostering social responsibility, may become a key solution to these challenges.

In Moldova, the potential for innovative entrepreneurship to stimulate economic development and address sustainability challenges is especially pressing. With an evolving market structure, the country faces numerous challenges in organizing a business environment that can conduct to innovation. These include limited access to regulatory barriers, financial resources but also the lack of infrastructure to support new business ventures. However, there is also untapped potential for innovation-driven growth that could not only boost Moldova's economy but also contribute to achieving broader sustainability goals in the region.

2. Literature review

The concept of innovative entrepreneurship has been extensively studied in the field of economics, particularly due to its important role in driving economic growth, competitiveness, and sustainability. Innovation, as proposed by Schumpeter (1934), is central to the entrepreneurial process, where entrepreneurs are seen as agents of creative destruction—introducing new products, services, and business models that replace outdated ones [1]. Schumpeter's theory has been expanded upon in modern studies, emphasizing that innovation is not only about technological breakthroughs but also about new business models and organizational processes that respond to market demands and societal challenges (Drucker, 1985).

Sustainable entrepreneurship, which integrates innovation with environmental and social responsibility, is a more recent development. According to Hall et al. (2010), sustainable entrepreneurship is about creating value that not only benefits the business but also contributes to society and the environment. In this context, sustainable entrepreneurs develop products, services, or business models that reduce negative environmental impacts while promoting long-term social and economic benefits. This approach aligns with the Triple Bottom Line (Elkington, 1997), which calls for businesses to focus not just on profits but also on people and the planet.

3. Methodology

The research involves a review of relevant literature to establish the theoretical foundations of innovative entrepreneurship and sustainability. Additionally, data analysis follows a thematic approach, identifying main patterns and trends within the responses to identify the factors that drive or hinder sustainable innovation in the Moldovan context. This methodology allows for a comprehensive understanding of both the theoretical concepts and real-world applications of innovative entrepreneurship.

4. Results and Discussion

While analyzing statistical data on innovative enterprises in the Republic of Moldova, we noticed that this is a relatively new field, as official statistics are only available starting from 2015. This indicates that innovation has only recently gained significant attention.

Table 1. provides an overview of the distribution of enterprises in the Republic of Moldova based on their types of innovations for the years 2021-2022 and 2019-2020. It shows a slight decrease in the proportion of innovative enterprises, which dropped from 12.6% in 2019-2020 to 11.4% in 2021-2022. Among these innovative enterprises, those that implemented multiple types of innovations (product, process, organizational methods, and marketing) accounted for 5.0% in 2021-2022, a decline from 6.3% in the previous period.

The percentage of enterprises innovating in products and/or processes also decreased from 2.1% to 1.7%, with product-only innovation dropping from 0.9% to 0.5%. In contrast, the share of enterprises innovating only in processes increased slightly from 0.7% to 0.9%.

Regarding organizational methods and marketing, the proportion of enterprises innovating in these areas rose marginally from 4.2% to 4.6%. Within this category, the number of enterprises innovating solely in organizational methods rose from 0.9% to 1.1%, and those focused on marketing methods remained stable at 1.6%. Moreover, the share of businesses innovating in both organizational methods and marketing slightly increased from 1.7% to 1.8%.

Meanwhile, the percentage of non-innovative enterprises saw a slight increase, rising from 87.4% to 88.6%.

Table 1. The number of enterprises by types of innovations, 2019-2022, Republic of Moldova

Indicators	Weight in the total number of enterprises (%)	
	2021-2022	2019-2020
Total enterprises	100.0	100.0
Innovative enterprises - total, of which:	11.4	12.6
Enterprises that have achieved multiple types of innovations (product, process, organizational methods, and marketing)	5.0	6.3
Enterprises innovative in products and/or processes	1.7	2.1
Of which:	0.0	0.0
Enterprises innovative only in products	0.5	0.9
Enterprises innovative only in processes	0.9	0.7
Enterprises innovative products and processes	0.3	0.5
Enterprises innovative in organizational methods and/or marketing	4.6	4.2
of which:	0.0	0.0
Enterprises innovative only in organizational methods	1.1	0.9
Enterprises innovative only in marketing methods	1.7	1.6
Enterprises innovative in organizational methods and marketing methods	1.8	1.7
Non-innovative enterprises	88.6	87.4

Source: National Bureau of Statistics, https://statistica.gov.md/ro/rezultatele-activitatii-de-inovare-a-intreprinderilor-in-republica-moldova-in-an-9794_60858.html

These changes may be attributed to several factors. The decrease in overall innovation could reflect economic challenges faced by Moldovan enterprises, such as limited access to funding or lack of incentives for research and development. The global economic context, including the impact of the COVID-19 pandemic, might have led to reduced investments in innovation as businesses focused on survival and short-term recovery. Additionally, the shift toward innovations in organizational methods and marketing could indicate a growing recognition of the importance of non-technical innovations for enhancing business operations and competitiveness in challenging times. The rise in non-innovative enterprises may also suggest that some businesses are struggling to adapt to changing market conditions or lack the resources to implement significant innovations. Overall, the data highlights the impact of both external economic pressures and internal business challenges on innovation activities in Moldova.

Table 2 presents the structure of innovative enterprises in the Republic of Moldova, categorized by economic activity for the years 2021-2022 and 2019-2020. It highlights the share of innovative enterprises across industry and services sectors, revealing some shifts in the distribution of innovation activities over the two periods.

In 2021-2022, the industrial sector accounted for 50.0% of innovative enterprises, which is a slight increase from 48.9% in 2019-2020. This indicates a stable role for industry in innovation, with manufacturing being the primary contributor. The manufacturing industry rose from 44.6% in 2019-2020 to 46.2% in 2021-2022, suggesting that manufacturing enterprises are still the driving force behind innovation in the industrial sector. However, the extractive industry saw a significant decrease, from 0.7% to 0.2%, which could be attributed to declining investments in resource extraction and the growing importance of more sustainable industries. The production and supply of electricity, thermal energy, gas, hot water, and air conditioning remained stable at 1.9% in 2021-2022, while water distribution,

sanitation, waste management, and decontamination activities increased slightly from 1.3% to 1.7%, reflecting the growing importance of environmental and infrastructure innovations in the country.

Table 2. Innovative enterprises by economic activities, in 2019-2022, Republic of Moldova

	Structure of innovative enterprises, %	
	2021 -2022	2019 -2020
Total	100.0	100.0
Industry – total	50.0	48.9
Extractive industry	0.2	0.7
Manufacturing industry	46.2	44.6
Production and supply of electricity and thermal energy, gas, hot water, and air conditioning	1.9	2.2
Water distribution; sanitation, waste management, decontamination activities	1.7	1.3
Services – total	50.0	51.1
Wholesale trade	20.2	22.3
Transport and storage	8.8	7.1
Information and communications	11.4	14.1
Financial and insurance activities	5.0	4.2
Professional, scientific, and technical activities	4.5	3.3

Source: National Bureau of Statistics, https://statistica.gov.md/ro/rezultatele-activitatii-de-inovare-a-intreprinderilor-in-republica-moldova-in-an-9794_60858.html

The services sector accounted for 50.0% of innovative enterprises in 2021-2022, a slight decrease from 51.1% in the previous period. Within this sector, wholesale trade innovation declined from 22.3% in 2019-2020 to 20.2% in 2021-2022, possibly due to the challenges faced by businesses in international trade during the pandemic and other economic disruptions. The transport and storage sector saw a notable increase from 7.1% to 8.8%, potentially driven by the growth in logistics and supply chain innovations due to changes in consumer behavior and the rise in e-commerce. The information and communications sector also experienced a decline from 14.1% to 11.4%, which may be attributed to market saturation and a slowdown in the rapid digital transformation experienced in earlier years. Financial and insurance activities saw a slight increase from 4.2% to 5.0%, reflecting innovations related to fintech and digital finance services. Professional, scientific, and technical activities saw a modest rise from 3.3% to 4.5%, suggesting that businesses in this area are becoming more innovative, likely driven by the increasing demand for advanced expertise and solutions.

Figure 1 presents the distribution of innovative enterprises in the Republic of Moldova based on the size of the enterprise, categorized by the number of employees. There are a total of 420 innovative enterprises, with their distribution varying significantly across different size classes.

The largest share, 58.6%, of innovative enterprises falls within the size category of 10-49 employees. This suggests that small and medium-sized enterprises (SMEs) play a crucial role in fostering innovation in Moldova. Smaller businesses often have greater flexibility, which allows them to adapt quickly to market changes and experiment with new ideas. They can implement innovative solutions more rapidly compared to larger firms, as they are not bound by the same bureaucratic hurdles. Additionally, SMEs tend to focus on

specific niches, which allows them to innovate in ways that cater directly to these specialized markets. However, their limited resources may restrict them from pursuing large-scale or capital-intensive innovations, which might explain why this size category has the highest proportion of innovative enterprises.

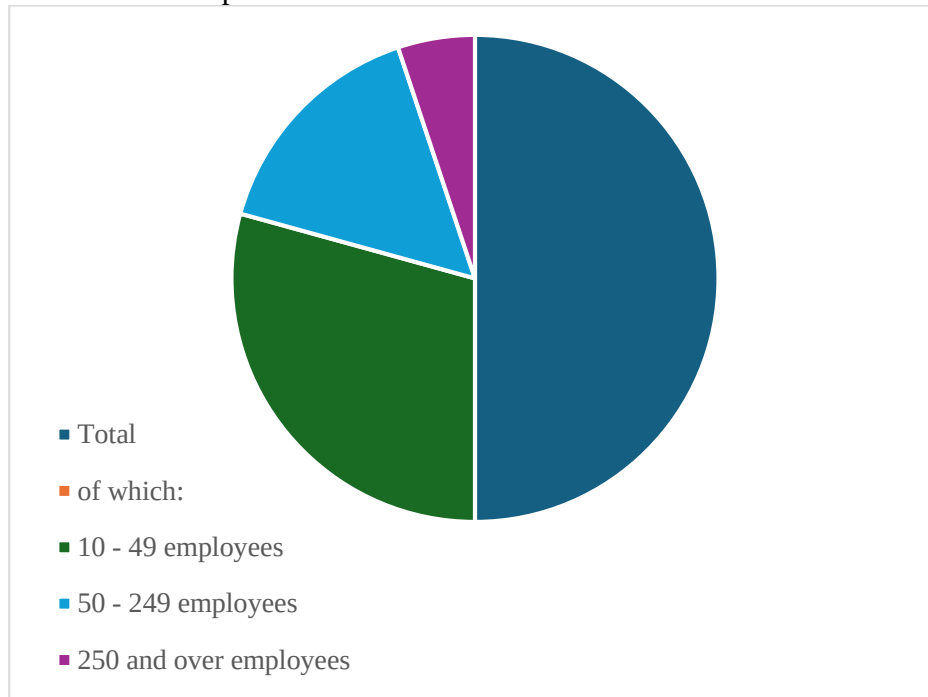


Figure 1. Innovative enterprises, units, 2022, Republic of Moldova

Source: National Bureau of Statistics, https://statistica.gov.md/ro/rezultatele-activitatii-de-inovare-a-intreprinderilor-in-republica-moldova-in-an-9794_60858.html

Enterprises with 50-249 employees account for 31.2% of innovative enterprises. Medium-sized businesses typically have more resources than smaller firms, enabling them to invest in research and development (R&D) and adopt new technologies. They are more likely to engage in innovation, as they have the capacity to scale new ideas while still maintaining the agility needed to implement changes effectively. However, these businesses may still face challenges in competing with larger corporations, which could be why their share of innovative enterprises is slightly lower than that of smaller businesses.

Finally, enterprises with 250 or more employees represent 10.2% of innovative enterprises. Large businesses generally have more established processes and focus on operational efficiency and profitability. As a result, they may not prioritize innovation in the same way that smaller or medium-sized businesses do. The complex organizational structures of large firms can slow down decision-making processes, which may hinder their ability to implement innovative ideas quickly. Nevertheless, when large enterprises do innovate, they tend to do so on a larger scale, often with significant investments in advanced technologies or new product development. The smaller share of innovative enterprises in this category may reflect the fact that large firms often focus more on incremental innovations rather than disruptive ones, which can result in fewer high-impact innovations.

Overall, the distribution of innovative enterprises by size in Moldova suggests that small and medium-sized businesses are more likely to engage in innovation due to their flexibility, market focus, and risk tolerance. In contrast, large enterprises, despite their resources, may innovate more incrementally and face challenges in maintaining the same level of agility in the innovation process.

One of the most relevant indicators that could help us in our research of innovative entrepreneurship as a driver of sustainable business development in the Republic of Moldova is the The Global Innovation Index (GII). In the 2024 GII rankings, the Republic of Moldova was placed 68th out of 133 countries, reflecting a decline of eight positions compared to 2023, when it ranked 60th (World Intellectual Property Organization, Global Innovation Index 2024). The GII serves as a key mark for assessing a country's innovation performance, evaluating approximately 80 indicators across various categories, including human capital and research. In 2024, Moldova ranked 80th in the Innovation Input Sub-Index (compared to 81st in 2023) and 57th in the Innovation Output Sub-Index (down from 50th in 2023). A more significant drop was recorded in Infrastructure, where Moldova fell to 89th place from 75th in the previous year. In Human capital and research, the country ranked 68th, slightly below its 67th position in 2023.

A similar downward trend is observed in Creative outputs, where Moldova placed 51st, down from 42nd in 2023. The Knowledge and technology outputs category also saw a decline, with Moldova ranking 64th (compared to 60th the previous year). Furthermore, the country placed 105th in Business sophistication and 90th in Institutions, marking a deterioration from its 96th position in 2023. However, a notable improvement was registered in Market sophistication, where Moldova moved up to 63rd from 76th, suggesting a positive trajectory in this area.

Historically, Moldova's highest position in the Global Innovation Index was 39th in 2011, reflecting its earlier efforts in fostering innovation. In the 2024 edition of the GII, Switzerland maintained its position as the world's most innovative country - a title it has held since 2011 - followed by Sweden, the United States and Singapore. Among Moldova's neighbors, Romania ranked 48th, while Ukraine secured the 60th position.

Another important influencing factor on innovation is, of course, the government expenditure for research and development. These are the kinds of public investments that prepare the soil for the future innovation and their implementation in the real economy sector. In 2022, expenditures on research and development activities amounted to 630.2 million lei, representing 0.23% of the Gross Domestic Product. Compared to 2021, research and development expenditures in 2022 increased by 69.7 million lei (or 12.4%), with public institutions seeing an increase of 74.6 million lei (or 16.4%). Out of the total expenditures on research and development activities in 2022, 84.1% were accounted for by public institutions, compared to 81.2% in 2021 (registering an increase of 2.9 percentage points) (National Bureau of Statistics, 2023).

Researching the data about European Union countries' public expenditure on research and development (R&D), we notice that the R&D intensity remained constant in 2023 at 0.7% which is three times bigger compared with the Republic of Moldova (EUROSTAT, 2023).

Taking in consideration all above, we conclude that the main actors that determine the state of innovation which influence at its turn the innovative entrepreneurship in the Republic of Moldova are diverse and interdependent, included in the Figure 2.

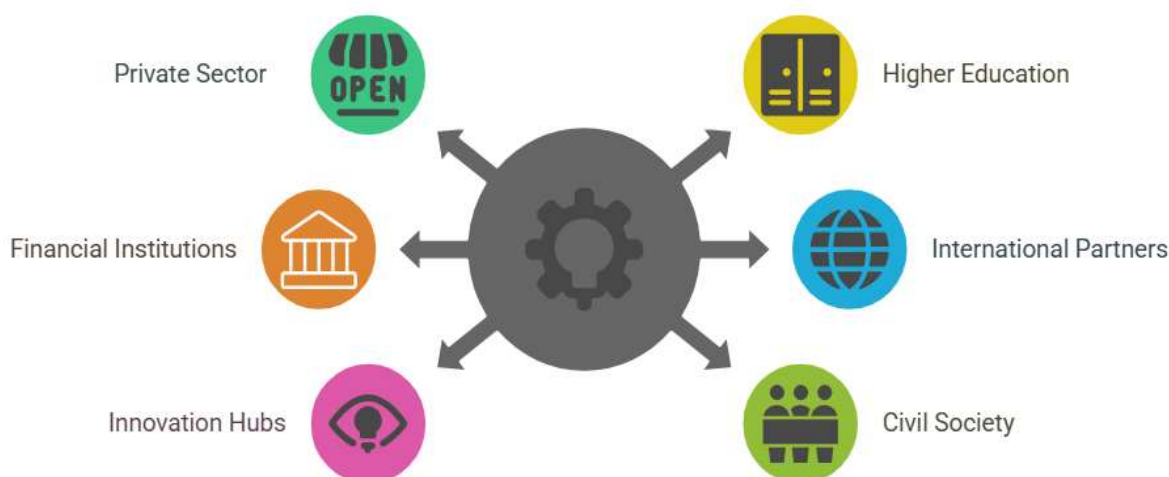


Figure 2. Innovation ecosystem in Republic of Moldova

Source: author's elaboration

The Moldovan government plays a significant role in creating the regulatory framework and policies that foster or hinder innovation. This includes setting up national strategies for research and development, providing funding for R&D, and implementing policies that support innovation in various sectors. Institutions such as the Academy of Sciences of Moldova and Ministry of Education, Culture and Research are key players in advancing scientific research, technological development, and innovation. Furthermore, government incentives for businesses that engage in innovation are critical.

The private sector, particularly small and medium-sized enterprises (SMEs), is a major driver of innovation in Moldova. These businesses contribute to the economy by developing new products, services, and processes. However, the level of innovation in the private sector is often dependent on the financial and technological resources available, as well as the willingness of companies to invest in R&D. Businesses in sectors like IT, agriculture, and manufacturing have shown growing interest in innovation, especially with the support of EU programs and international partnerships.

Universities and research centers play a determinant role in shaping the innovation landscape in Moldova. However, the connection between academia and industry still needs improvement to facilitate more applied research and technology transfer.

Access to finance is a major barrier to innovation in Moldova. Banks, venture capital funds, and other financial institutions influence the availability of funding for startups and innovative projects. Moldova has made progress with the establishment of initiatives like Innovative Moldova, which offers funding for innovative enterprises. Despite that, the investment climate still faces challenges, such as limited access to risk capital and low levels of investment in high-tech sectors.

Moldova's integration into European and international networks has helped the country gain access to innovation-focused programs, such as those offered by the European Union, Horizon Europe, and Erasmus+. These programs provide funding, training, and collaboration opportunities, enabling Moldovan businesses and researchers to collaborate on innovative projects and gain access to advanced technologies.

Innovation hubs, business incubators, and technology transfer offices play a role in fostering innovation in Moldova. Institutions like the Moldovan Innovation and Technology Transfer Agency (MITTA) and various tech parks have been established to support the commercialization of research and help startups scale their innovative ideas.

Civil society, NGOs, and the media also contribute to innovation by raising awareness, organizing events, and providing platforms for dialogue on innovation and entrepreneurship. They play an important role in advocating for policies that support innovation and educating the public on the importance of research.

Despite the positive roles these actors play, the innovation ecosystem in Moldova still faces several challenges, represented in the Figure 3.



Figure 3. Innovation entrepreneurship barriers in Republic of Moldova

Source: author's elaboration

- Both public and private sectors in Moldova allocate minimal resources to research and development, hindering innovation. Small businesses struggle to invest due to limited financial resources and a lack of venture capital.
- There is insufficient collaboration between academia, industry, and government. Research often remains disconnected from real-world applications, limiting commercialization and innovation.
- A lack of awareness and weak enforcement of intellectual property rights discourage innovation and reduce the incentive to invest in new ideas.
- Moldovan businesses are risk-averse, focusing on short-term profits. Limited access to funding, especially for startups, further slows innovation.
- Many talented professionals leave Moldova for better opportunities abroad, which limits the country's innovation capacity.
- Moldova's innovation hubs and technological infrastructure are underdeveloped, hindering the commercialization of new ideas and technological advancement.
- Complex regulations, excessive bureaucracy, and a lack of tax incentives create obstacles for innovation and slow down the commercialization of new products.
- Low public understanding of the importance of innovation limits demand and support for innovative products and services.

5. Conclusions

Innovative entrepreneurship plays a very important role in building sustainable businesses, especially in transition economies like Moldova. By adopting new ideas and technologies, businesses can grow while also contributing to environmental and social well-being.

However, entrepreneurs in Moldova face significant challenges, such as complicated regulations, limited financial support, and restricted access to modern technologies. Despite these difficulties, there are companies that have successfully integrated sustainable innovations, proving that progress is possible with the right approach.

To encourage more businesses to follow this path, stronger collaboration is needed between the government, educational institutions, and the private sector. More supportive policies, better funding opportunities, and investment in research and development could help create an environment where innovation thrives.

Although Moldova's entrepreneurial ecosystem has its struggles, there are also great opportunities for growth. By promoting innovation and sustainability, businesses can become more competitive, generate jobs, and contribute to a stronger economy.

Supporting innovative entrepreneurship is essential for long-term economic stability. Overcoming existing obstacles and making the most of new opportunities will help Moldova move toward a more dynamic and sustainable future.

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ENHANCING THE ECONOMIC SUSTAINABILITY OF COMMERCIAL BANKS THROUGH HUMAN RESOURCES MANAGEMENT

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Abstract: *In an era of significant change for the financial sector, this article analyses the imperative and central role of Human Resource Management (HRM) in building and driving sustainable long-lasting performance in commercial banks. It proves that HRM has tremendously evolved from an administrative support function into a core strategic partner, critical for embedding sustainability across economic, social, and environmental goals of the company. Thus, through a comparative analysis of HRM practices in diverse banking contexts as well as in different geographic regions, this research investigates how talent and culture are leveraged to achieve the relevant company integrated objectives. The findings reveal that an aligned and balanced combination of strategic harmonization, deep employee engagement, servant leadership, and future-focused workforce and talent management is fundamental for banks to build resilience and achieve lasting sustainable success.*

Keywords: *Human Resource Management (HRM), Sustainable Performance, Commercial Banks, Comparative Analysis, ESG (Environmental, Social, Governance), Strategic Alignment*

UDC: 005.96:336.711

Classification JEL: M12, G21, M54

1. Introduction

Commercial banks today are facing and dealing with several major changes at once. All the stakeholders, including company customers and investors, have much higher expectations for the products the banks are offering, the customer experience the company insure, the impact of the bank on the social dimension of the country and the environmental performance. Technology is advancing at a rapid pace all over the world, pushing banks to become more digital and ensure the best experience to their employees and customers. Additionally, the rules and regulations they must follow are becoming more complex. This changing environment means that banks must reconsider their strategy and goals. Instead of only focusing on financial numbers, they need to move towards a more complete and sustainable way of operating.

This means that for banks to succeed in the long run, they must focus on "sustainable performance." This is a complex and holistic approach that ensures an equilibrium between the financial performance of the organization, the social impact in the society and the contribution to the environmental aspects. These factors are known worldwide as the "Triple Bottom Line" (TBL) or "Environmental, Social, and Governance" (ESG) factors (Taticchi & Demartini, 2020). Thus, the mentioned factors has been take as a foundation by many companies in building their long-terms sustainable strategy, with the clear purpose to remain relevant and long-term competitive. It's not just about adding a few "green" or social initiatives for a specific period; it's about fundamentally building and embedding sustainability into their everyday business (Aguinis & Glavas, 2012).

Considering the big industry shifts, the role of Human Resource Management (HRM) is also undergoing a huge transformation. Traditionally seen as an administrative

department, HRM is now being recognized as a key strategic partner. It is critical to embed the sustainability long-lasting principles into the core processes of a commercial bank. Ultimately, a bank can't meet its sustainability goals without the right people at the right positions, a supportive and positive culture, and employees who act on sustainability principles. HRM is the foundation that makes this transformation happen.

While there's plenty of research showing the link between HR and general company success (Huselid, 1995; Khalumba, 2009), we have a less clear picture of how different HR setups and processes specifically help commercial banks become more holistically sustainable. Much of the existing research is fragmented; it might look at one HR practice at a time or focus on a single sustainability outcome. What's missing is a comprehensive, comparative analysis that considers the unique challenges of the banking sector.

The reasons *why* a bank adopts sustainable HR practices make a big difference.

- A bank that is simply reacting to **outside pressure** - like regulations or what competitors are doing - might adopt these practices superficially. This could mean focusing on easy-to-track numbers or making symbolic changes that look good but don't change how the bank really works.
- In contrast, a bank driven by a **genuine belief** in the value of sustainability will embed these principles deeply into its culture and HR systems. This approach leads to more authentic and powerful contributions to its sustainable performance.

The move toward sustainable banking creates a unique hiring challenge: the "sustainability talent imperative." Banks don't just need good employees; they need specialists who possess a complex mix and set of skills. This includes financial expertise, tech and data skills related to Environmental, Social, and Governance (ESG) factors, a solid foundation of sustainability principles, and a strong ethical compass. How well banks adapt their HR systems to find and support this specific type of talent will be a key factor in their long-term success.

This article argues that for commercial banks to achieve lasting and comprehensive sustainable performance, a strategically aligned and integrated HR system is non-negotiable. By comparing different HRM strategies from existing academic literature, this study will clarify how they impact all dimensions of sustainability. The goal is to understand how all of HR's functions work together to create sustainable value in banking, instead of just looking at one process at a time.

The article is structured to build this case, first by exploring HR's evolving strategic role, and second, by providing a comparative analysis of specific HR practices.

2. The Changing Strategic Role of HR in Bank Sustainability

Human Resource Management (HRM) in the banking world, similar as in other industries, has gone through a major transformation. In the past, HR departments were often limited to administrative responsibilities like managing payroll, handling benefits, and ensuring basic legal labor compliance. Today, HR function has evolved into a critical strategic partner that has a significant contribution and impact in establishing and achieving the bank's key performance indicators. This transformation of HR role is truly is mostly important when considering to support banks to become genuine long-lasting sustainable.

HR's strategic importance comes from its potential to create a long-term competitive advantage for the bank (Barney, 1986). In an industry where products and services can often be easily copied, there are several factors as quality, commitment, and skills of a bank's employees that provide a unique, original difference that is difficult for competitors to replicate. By effectively attracting, developing, and motivating top talent -

while building up and ensuring a positive and inclusive culture - HR directly add their value to the bank's long-term success and resilience (Huselid, 1995; Khalumba, 2009).

HR's contribution to a bank's sustainability is very extensive, impacting all key areas of performance, often understood through frameworks like the Triple Bottom Line (TBL) (Taticchi & Demartini, 2020) and ESG criteria.

- **Financial Performance:** Good HR practices lead to better financial results. Effective talent management ensures the bank has the right people to drive innovation and improve productivity. Engaged and well-trained employees provide better customer service, leading to happier, more loyal customers, which in turn boosts revenue and profit (Huselid, 1995; Khalumba, 2009).
- **Social Performance:** HR is at the heart of the "people" side of sustainability. This includes creating programs for employee well-being, ensuring fair labor practices, championing diversity and inclusion (DEIB), promoting ethical behavior, managing employee relations constructively (Khalumba, 2009), and encouraging employee involvement in community and corporate social responsibility (CSR) activities (Babu, 2016; Aguinis & Glavas, 2012). These efforts improve employees' quality of life and strengthen the bank's public reputation and trust (Babu, 2016).
- **Environmental Performance:** Through "Green HRM," HR departments can foster eco-friendly attitudes and behaviors. This can involve adding environmental criteria to the hiring process, providing training on sustainability, and designing reward systems that recognize green contributions from employees.
- **Governance Performance:** HR helps build a foundation of strong corporate governance. It does this by shaping ethical leadership, ensuring compliance with labor laws and codes of conduct, and fostering a culture of transparency and accountability.

When sustainability is deliberately built into every part of HR, it creates what is known as **Sustainable HRM (SHRM)**. This is a strategic approach where the goal is to ensure the long-term health and success of employees, the organization, the wider community, and the natural environment.

A core principle of Sustainable HR is that it focuses on regenerating and developing people. Instead of just using up employees' skills and energy, the goal is to invest in them and build them up, ensuring their well-being and vitality for the future.

3. A Comparative Look at HR Practices for Sustainable Banking

Using a comparative analysis to study Human Resource Management (HRM) is a well-proven method. This approach helps identify similarities, differences, and key situational factors that determine how effective HR strategies are in various settings (Grosvold, 2009). In turn, this provides a stronger foundation for developing theories (Eisenhardt & Graebner, 2007), improving conceptual models, and identifying the best practices for specific industries like commercial banking (RG Author4, RG Author5, 2024). This section compares different HRM practices, using findings from the available literature, to clarify how they each contribute differently to sustainable performance in banks.

A. Strategic Talent Management for Long-Term Resilience and Innovation

A core idea coming out from the research is that for banks to achieve real sustainability, they need employees with more than just traditional banking skills. This new

talent pool must also have a solid understanding of sustainability (sustainability literacy), strong ethical principles, and the ability to innovate when facing Environmental, Social, and Governance (ESG) challenges (Zahra & George, 2002).

Comparing Approaches to Talent Acquisition:

- **Hiring Focus:** A key difference among banks is the main goal of their hiring process. Some banks are intentionally adding "green" criteria or sustainability-focused values into their hiring strategies, actively looking for candidates who show environmental awareness. For example, some Nepalese commercial banks are using green recruitment to build an eco-conscious workforce. In contrast, other banks may still use traditional models that focus on technical skills without specifically looking for sustainability traits. The need to redesign hiring processes to meet future demands, including sustainability, has been noted in contexts like Iranian banks. Furthermore, sustainable hiring involves recruiting a diverse range of candidates to ensure the workforce reflects society, which aligns with social goals of inclusion and fairness.
- **The "Build vs. Buy" Dilemma for Sustainability Talent:** Banks often face a strategic dilemma regarding how to source specialized sustainability talent, especially given the noted scarcity of personnel proficient in areas like data analysis for ESG metrics or digital technologies relevant to sustainable finance. The choice is essentially between "buying" this talent through external recruitment or "building" it via internal development programs (Zahra & George, 2002). "Buying" talent can offer a quicker solution to fill immediate skill gaps but may come at a higher cost and potentially pose challenges related to cultural integration. "Building" talent through targeted training and development takes longer but can foster greater loyalty, ensure a better fit with the bank's unique sustainability culture, and create a more sustainable internal talent pipeline. The optimal strategy likely involves a nuanced, hybrid approach, balancing external hires for specialized roles with robust internal development programs. Factors influencing this strategic choice include the urgency of the talent need, the maturity of the external market for sustainability professionals, cost considerations, and the bank's long-term vision for embedding sustainability competencies within its workforce. Banks operating in rapidly transforming environments or those initiating significant sustainability drives might initially lean towards "buying" critical talent, while those with a more established, long-term commitment to sustainability will likely invest heavily in "building" capabilities from within.

Comparing Approaches to Talent Development:

- **Focus of Development Programs:** Considering the different bank experiences there can be spotted different approaches to developing their employees. Some of the companies offer standard skills training, others are now providing targeted "green training" to give employees the specific knowledge needed to understand the concept and contribute to environmental goals. Leadership development programs are also being updated to ensure the preparation of leaders who can effectively guide and lead the bank's sustainability agenda (Paudel, 2020). A common focus in the research is the importance of continuous learning for building an adaptable and resilient workforce. In Nepalese commercial banks, for example, effective training

combined with strong managerial support is a key factor in increasing employee engagement, which is critical for driving sustainability initiatives.

- **Strategies for Retention:** Beyond hiring and training of employees, it is crucial to retain employees who are already skilled in sustainability. To encourage long-term commitment, banks are using different strategies which consider offering clear career paths that feature sustainability roles, promoting a healthy work-life balance (Guest, 2017), and ensuring the bank's sustainability values alignment with the personal values of its employees (Barney, 1986).

B. Navigating Contemporary HRM Challenges in the Pursuit of Sustainable Banking

The contemporary banking landscape presents HRM professionals with a multitude of challenges, driven largely by rapid technological advancements, evolving regulatory environments, and increasing expectations for environmental and social governance. In order to successfully navigate these challenges it is required to have adaptive strategies that proactively align HR practices with company sustainability objectives.

One important challenge is the rapid speed of digital transformation. Banks all over the world are making extensive technological upgrades and automation, fundamentally reshaping job roles, skill requirements, and workplace dynamics. HR departments must manage the complexities coming up from this transformation, such as reskilling and upskilling employees to handle advanced digital tools, analytics, and cybersecurity protocols. Effective HRM strategies involve comprehensive training and development programs that combine technical knowledge with critical sustainability skills, strengthening a workforce agile enough to succeed in digital and sustainable environments.

Moreover, aligning performance management systems with long-term sustainability goals remains a complex task. Traditional performance metrics focusing on short-term financial gains often conflict with sustainability objectives, which require a longer-term perspective. To address this, forward-looking banks implement balanced performance measurement frameworks, such as the Sustainability Balanced Scorecard, which integrate financial indicators with social, environmental, and governance metrics. This alignment ensures that employee behaviors and incentives consistently support sustainable value creation.

Another key challenge is maintaining employee engagement and well-being amidst ongoing changes and increased performance pressures. Banks must foster inclusive workplace cultures, prioritize mental health and overall well-being, and implement policies promoting diversity, equity, and inclusion (DEI). Sustainable HRM initiatives emphasize flexible working arrangements, comprehensive wellness programs, and robust diversity policies, which together enhance employee satisfaction, loyalty, and productivity, directly contributing to organizational resilience and sustainable performance.

Additionally, a significant challenge specific to regions like Moldova is workforce shortage coupled with low employee productivity. Banks face difficulties in attracting and retaining qualified talent due to demographic trends and migration patterns. This shortage places additional pressure on existing staff, negatively affecting overall productivity and organizational efficiency. HR departments must therefore develop innovative talent acquisition strategies, implement targeted retention programs, and foster environments that enhance productivity through continuous employee development and motivational incentives.

Lastly, regulatory compliance continues to present an ongoing and demanding challenge. Banks operate within stringent regulatory contexts, where continuously evolving ESG-related guidelines significantly influence HR policies and practices. Effective HR teams

must diligently monitor and proactively integrate these regulatory changes into their strategic frameworks, thus ensuring both compliance and organizational credibility.

4. Case Studies of HRM Excellence in Sustainable Banking

To transcend theoretical frameworks and practical applications, this chapter presents a series of compelling case studies showcasing commercial banks that have successfully integrated innovative and effective Human Resource Management (HRM) practices to significantly enhance their economic sustainability. These diverse examples, drawn from various geographical regions and banking models, illuminate the specific HRM strategies employed and the tangible positive outcomes observed in terms of financial performance, employee engagement, and overall organizational resilience. By analyzing the key success factors and extracting valuable lessons learned from these real-world implementations, this chapter aims to provide actionable insights for other banks aspiring to leverage their human capital for enhanced economic sustainability.

Case Study 1: Canara Bank – Strategic Talent Management for Long-Term Growth

Canara Bank provides a clear example of how strategic talent management process serves as a foundation for company long-term growth (Harvard Business Publishing Education, 2016). The bank has adopted a different approach in the sourcing with needed competencies. Thus, instead of reacting to hiring needs as they pop up, the bank get prepared for the future by conducting regular workforce studies. These studies allow the company to proactively identify future talent needs by analyzing additional context factors like bank branch expansion, business growth ambitions and employees' retirement forecasts.

This forward-thinking approach has brought the results in the highly efficient and proactive hiring process, ensuring a consistent pool and reserve of qualified candidates. This improves several HR KPIs, mainly reduces both hiring times and recruitment costs. A key part of their strategy is a strong focus on internal development of existing employees. Thus, Canara Bank frequently fills new leadership roles, especially in branch and retail banking, by promoting its own grown employees. This practice saves money as well as it also significantly boosts employee engagement and retention by showing a clear path for their career advancement.

In the end, the success of Canara Bank's revised talent management process proves the impactful benefits of aligning HR practices with long-term business goals, ensuring a major contribution to the bank's sustained economic growth and operational efficiency.

Case Study 2: Capital One – A Model for Future-Proofing the Workforce

Capital One offers a clear model for how financial institutions, specifically banks, can strategically invest in their human capital to drive performance. The bank recognized that rapid technological shifts brings the need for a proactive approach to talent development and made significant investments in a continuous learning framework (Capital One, 2023).

Specifically, the bank's strategy in improvement of the process included two key components: partnering with best-in-class educational providers and creating outstanding internal development programs. Its "Tech College" initiative is known as a flagship program designed to cover the critical skill gaps in areas like data analytics and cybersecurity. These operated changes in the development process of the company ensures that employees are equipped with relevant, competitive skills, enabling a culture of adaptability to constant changes and innovation in the area.

From a performance perspective, the outcomes of this strategy are clear. So, Capital One's focus on upskilling its workforce has been a key factor which enabled its digital transformation agenda. The initiative is also supported with improving operational efficiency and boosting innovation, which also enhances productivity and supports the company's long-term financial sustainable performance (Capital One Annual Report, 2023). This case illustrates how employees' development process, when treated as a strategic investment, can ensure a significant return.

Case Study 3: First Bank – Driving Performance Through Sustainable Employee Engagement

Another successful case is of the First Bank, which has made sustainable employee engagement a central part of its Human Resource Management strategy. To address the challenges of its large group of companies, situated in different geographic areas, the bank implemented the Bucketlist Rewards platform. This tool was specifically designed to empower employees to recognize their peers, reinforce the bank's core values in daily work, and build strong and meaningful connections across different departments (Bucketlist Rewards, 2023).

The results of this initiative have been impressive, which lead to a significant improvement in morale and motivation of the company employees, with reported employee engagement rates going upper then 90%. By creating a systematic way to recognize contributions and foster a unified organizational culture, First Bank has successfully improved both productivity and employee retention. These changes directly supports the bank goals for sustainable organizational performance and strengthens its long-term competitive advantage (First Bank Sustainability Report, 2023).

Case Study 4: Bank of America – Strategic Commitment to Sustainable Performance

Bank of America's corporate strategy demonstrates an embedded commitment to ESG initiatives, which logically extends to its operational practices and performance culture (Bank of America, 2024). While the bank has not publicly outlined the specific integration of ESG metrics into its employee performance management system, from the analysis of the complex actions of the bank provides strong indicators of the alignment between them.

This strategic alignment can be evidenced by two key pillars:

1. **Comprehensive Reporting:** The bank's detailed annual sustainability reports publicly express its commitments and progress.
2. **Robust Training:** Significant investment in training, especially in the area of compliance, ensures the company employees understand its operational and ethical responsibilities.

These initiatives cultivate a culture where performance is indirectly but powerfully guided by the bank's public sustainability commitments. Thus, Bank of America illustrates how a strong, top-down strategic focus can shape performance expectations throughout a large financial institution, driving contributions to both long-term economic and environmental sustainability.

Case Study 5: maib Bank – Strategic HRM Integration for Enhanced Sustainable Financial Performance

Maib, the largest commercial bank in Moldova, underwent a comprehensive transformation of its Human Resource Management (HRM) practices aimed at achieving sustainable performance and enhanced competitiveness. Recognizing the importance of aligning human capital strategies with long-term strategic goals, maib introduced robust

initiatives centered around leadership development, succession planning, and organizational culture transformation. Leadership development programs at maib emphasized strategic thinking, ethical governance, and customer-centric behaviors. Initiatives such as leadership academies, internal mentorship programs, and executive coaching sessions were implemented to build strong, adaptive leaders capable of navigating complex financial and regulatory environments. Succession planning was formalized through clear talent pipelines, ensuring continuity and institutional memory. In addition, maib heavily invested in employee training and upskilling, particularly in digital banking capabilities, cybersecurity awareness, and compliance management. Comprehensive training curricula were established, incorporating both technical and soft skills development. The bank introduced innovative digital learning platforms accessible to all employees, significantly enhancing engagement and knowledge retention. maib also prioritized creating an inclusive and diverse organizational culture.

The bank undertook a structured approach to diversity, equity, and inclusion (DEI), implementing transparent recruitment processes that encouraged diverse candidate pools and equal career advancement opportunities. Additionally, maib initiated community engagement projects aimed at financial literacy and local development, reinforcing its corporate social responsibility (CSR) commitments and enhancing employee pride and engagement. Strategically, HRM at maib integrated sustainability metrics directly into employee performance evaluations and compensation structures. Employees were incentivized to meet not only financial targets but also ESG-related goals, such as environmental initiatives, ethical practices, and community involvement. This alignment of incentives reinforced sustainable behaviors and outcomes throughout the organization. Consequently, maib's HRM transformation resulted in measurable financial improvements. Notably, maib recorded significant increase in profitability, improved return on equity (ROE), and stronger market positioning. Non-financial indicators, such as employee satisfaction surveys and external employer brand ratings, also showed consistent positive trends. These outcomes underline the effectiveness of integrated and strategic HRM practices in fostering long-term, sustainable organizational success.

The case studies presented offer several key insights into how commercial banks can effectively leverage HRM to enhance their economic sustainability. A common thread across these examples is the importance of aligning HRM strategies with the bank's overarching business objectives and long-term vision. Proactive talent management, as demonstrated by Canara Bank, ensures a consistent supply of skilled professionals who are equipped to drive future growth. Investing in continuous learning and development, as exemplified by Capital One, fosters a culture of innovation and adaptability, enabling banks to remain competitive in a rapidly evolving industry (Zahra & George, 2002). Cultivating a strong and engaged organizational culture, as seen in the case of First Bank, leads to a more motivated and productive workforce, ultimately contributing to the bank's success (Barney, 1986). While a direct case study of performance management fully aligned with sustainability objectives was not explicitly detailed, the broader sustainability commitments of institutions like Bank of America underscore the growing importance of integrating ESG considerations into all aspects of banking operations. The overarching lesson is that a strategic and holistic approach to HRM, which prioritizes talent acquisition and retention, invests in employee development, fosters a positive culture, and aligns employee performance with organizational goals, is fundamental to achieving and maintaining economic sustainability in the commercial banking sector.

5. Conclusions

Our research, which compared different Human Resource Management (HRM) approaches in banking, confirms that HR now plays a crucial strategic role in driving sustainable performance. A review of the literature shows that HR is no longer just an administrative department but an essential partner for banks facing today's challenges, including high stakeholder expectations, rapid technological change, and complex regulations.

We prove that a bank cannot achieve true sustainability - a balance of financial, social, and environmental health - without the strategic management of its human capital. All aspects of HR, from hiring and training to promoting well-being and ethical leadership, play an interconnected role. Our comparison highlights that these practices are most effective when they are aligned with the bank's specific strategy and work together as a unique system, not just as separate projects.

A critical insight from this analysis is the need to move beyond a one-time change approach. Instead of adopting one-off "HR practices for sustainability," banks must focus on designing and embedding complete "sustainable HRM systems." These systems work best when they are internally aligned and externally tuned to expectations of the customers and shareholders. This holistic view is essential for creating real and long-lasting change.

The way to sustainable banking is a continuous journey of learning and improvement, not a final destination. This means that HR departments themselves must be flexible, forward-thinking, and able to continuously evolve. HR professionals will need what we call "sustainability dexterity" - a sharp mix of strategic skill, ethical judgment, and technical knowledge of ESG matters - to lead this change.

In summary, strategic HR is at the very foundation of sustainable banking. Commercial banks that understand this deep connection and invest in building integrated and adaptive HR systems will be in a stronger and advantageous position. They will not only manage risk and build their reputation but also unlock new value, ensure their long-term resilience, and make a meaningful contribution to a more sustainable world. This requires ongoing commitment from researchers, bank leaders, and HR practitioners alike.

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LOW AND NEGATIVE ELECTRICITY PRICES: A THREAT OR INCENTIVE FOR RES INVESTMENTS

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Abstract: *The global energy landscape has been significantly shaped by rising energy prices and the increasing demand for energy resources, driven by factors such as global warming. In this context, the role of renewable energy sources (RES) has become crucial in shaping the future of the energy sector. This paper explores the impact of low and negative electricity prices on the investment climate in renewable energy, focusing on both global trends and the specific case of Moldova. It analyzes the factors contributing to the overproduction of electricity from RES, such as high shares of variable generation, limited energy storage capacity, insufficient grid flexibility, and rigid tariff systems. The study examines the experience of European countries with record periods of negative electricity prices and discusses the risks and potential solutions for Moldova, a country undergoing rapid growth in its renewable energy capacities. The paper highlights the need for investments in energy storage technologies, flexible consumption mechanisms, and balancing systems, alongside the development of interconnection infrastructure to export surplus renewable energy. It concludes that while Moldova's risk of electricity overproduction remains relatively low, proactive measures and investments in energy infrastructure are essential to mitigate future challenges associated with negative electricity prices and to optimize the use of renewable energy sources.*

Keywords: *Renewable energy, negative electricity prices, Moldova, energy storage, investment, grid flexibility, solar energy, wind energy.*

UDC: 330.322:620.91(478)

Classification JEL: Q42, Q43, Q47, Q48.

1. Introduction

In recent years, both globally and regionally, including in the Republic of Moldova, an energy crisis has been unfolding, driven by rising energy prices and the risks associated with insufficient energy supply to the country. The energy sector functions as a vital artery for the economy and industrial development. However, electricity and heat are often produced using outdated technologies and, for various reasons, operated under suboptimal efficiency conditions.

The development of the energy sector plays a critical role in stimulating economic growth. At the same time, economic growth itself is a key driver of increasing demand for energy resources. Investments in the energy sector have the potential to significantly accelerate the development of various branches of the national economy and contribute to GDP growth.

Currently, global investment is increasingly focused on green energy. Investments in renewable energy sources (RES) are becoming a primary driver for the transformation and modernization of the energy sector. According to forecasts, global electricity consumption is expected to reach 29.1 thousand TWh by the end of 2024, marking a 4.2% year-on-year increase. This would represent the highest growth rate since 2007, excluding the post-crisis and post-pandemic rebounds of over 6% observed in 2010 and 2021.

In 2025, the growth rate is expected to remain nearly unchanged, with electricity consumption projected to increase by 4.1%, reaching 30.3 thousand TWh. For comparison, in 2023, consumption grew by 2.5%, amounting to 27.9 thousand TWh.

One of the key drivers behind the accelerating growth in electricity demand, according to the report's authors, is global warming. "Heatwaves stressed power systems around the world in 2024. With global temperatures reaching record highs, demand for electricity used in cooling surged sharply, placing significant pressure on energy systems," the report states.

Renewable energy generation is expected to grow by 11.8% in 2024 and 12% in 2025, reaching 10 thousand TWh and 11.2 thousand TWh, respectively, according to the International Energy Agency (IEA). Thus, the growth rate will more than double compared to 2023, when it stood at 5% (up to 9 thousand TWh).

In 2023, the share of renewables in global electricity supply rose to 30%, and it is expected to increase to 35% by 2025. Solar energy alone will account for around 50% of the global increase in electricity demand, and together with wind energy, will cover nearly 75% of that growth.[1]

Currently, approximately \$2 trillion globally is expected to be allocated to clean technologies, including renewable energy sources, electric vehicles, nuclear energy, grid infrastructure, energy storage, low-emission fuels, efficiency improvements, and heat pumps. The remaining \$1 trillion is projected to be spent on fossil fuels such as gas, oil, and coal.[2]

According to the IEA, global electricity demand is set to grow by approximately 4% in 2024, compared to 2.5% in 2023. This would represent the highest annual growth rate since 2007 (excluding the recovery periods following the global financial crisis and the COVID-19 pandemic). The report also notes that significant growth in electricity consumption will continue into 2025, again reaching about 4%.[3]

As a result of the substantial increase in investments in renewables and the growing number of commissioned RES capacities, the world is increasingly witnessing electricity oversupply, which leads to low or even negative electricity prices. Naturally, the irreversibility of long-term investments in energy infrastructure slows down the pace of such changes. However, the flow of commercially viable innovations and investments in new technologies has become clearly evident.

The strongest output in power generation from solar parks in Germany since September pushed prices in several countries into negative territory.

Intraday power in Germany traded as low as €-17.73 per megawatt-hour for the period from 1 p.m. to 2 p.m., according to data from Epex Spot SE. Prices in the Netherlands and Belgium also dropped below zero.

Negative prices are becoming more frequent across Europe as renewable power floods the grid and supply outstrips demand. While that's good for some consumers in mainly northern Europe, they are a worry for investors in solar and wind because sub-zero prices cripple returns.[4]

2. Literature Review

The transition to renewable energy sources (RES) is a key focus of global energy policy. While many countries have integrated RES into their energy mix, challenges remain - particularly regarding economic sustainability. Fluctuating electricity prices, including negative price events caused by oversupply and low demand, create uncertainty for investors and threaten the financial viability of RES projects. This literature review explores how low and negative prices impact RES investments, with an emphasis on global patterns and Moldova's experience.

Key Concepts and Theoretical Background

Electricity prices play a critical role in shaping the investment climate. As Stern (2016) notes, price fluctuations can either stimulate or hinder investment, depending on expected trends and market stability. Couture and Gagnon (2010) highlight that persistently low prices, while favorable to consumers, reduce profitability and weaken incentives to invest in renewable energy.

Negative electricity prices typically emerge during periods of surplus generation, especially from intermittent sources like solar and wind—combined with low demand. Bunn and Bunn (2019) argue that such market imbalances distort price signals and threaten the economic sustainability of RES investments.

Global Trends in Price Volatility

Low and negative electricity prices have become increasingly common, especially in European markets. IEA (2024) reports that countries with high RES penetration, such as Germany and Denmark, regularly experience negative prices during peak production periods. Bloomberg (2025) finds that these occurrences are rising and may destabilize market structures.

Arenas and Martínez (2020) emphasize that traditional pricing mechanisms are poorly equipped to manage high RES penetration, and innovative policy tools are needed to maintain investor confidence, especially for capital-intensive RES projects.

Impact on RES Investment

Negative prices reduce revenue streams for RES projects, particularly those dependent on selling electricity into the market. Zhou et al. (2021) found that such conditions in the EU led to notable financial losses for wind and solar projects, discouraging further investment. Stern (2016) adds that investment risk increases in markets where prices are volatile or unpredictable, deterring private sector engagement.

The Moldovan Context

Moldova has expanded RES, especially in solar, supported by green certificates and the 2016 Renewable Energy Law. AGORA (2025) reports steady growth in solar capacity, and Energocom (2024) confirms ongoing integration efforts. However, Moldova's dependence on imports and limited local generation make the energy market sensitive to regional price swings. The impact of such fluctuations on RES investment in Moldova remains insufficiently studied.

Research Gap

Existing literature largely overlooks how price volatility affects RES development in small and emerging markets like Moldova. This study aims to fill that gap by analyzing how negative price events influence investment risks and returns in Moldova's renewable energy sector.

3. Methodology

In recent years, due to the risk of electricity shortages, as well as the complete cessation of supplies and the subsequent rise in energy resource prices, there has been an urgent need to increase electricity production in Moldova, primarily from renewable energy sources. However, the rapid introduction of new capacities has led to the risk of electricity production exceeding consumption. An example of this can be seen in many European countries. For this study, we will examine the introduction of renewable energy capacities worldwide and in one European country. We will also consider periods in European countries when electricity prices were negative, analyze the situation in Moldova

concerning the installed renewable energy capacities, analyze peak electricity consumption and production in Moldova throughout the year, as well as during the maximum production periods during the day, and identify the risks and potential solutions.

4. Results and Discussion

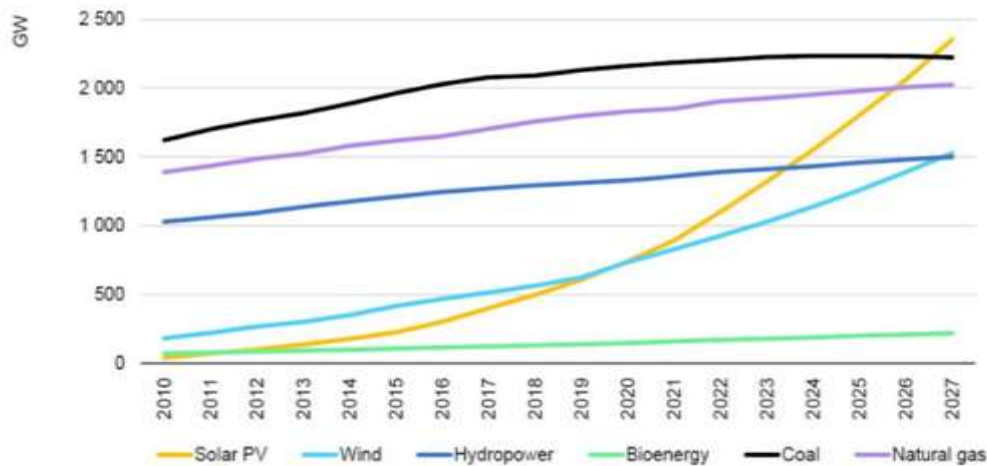


Figure 1. Cumulative power capacity by technology, 2010-2027

Source: www.renen.ru

The growth of renewable energy capacities will accelerate, according to the agency. This primarily concerns solar and wind generation. Currently, it is expected that global renewable energy capacities will increase by 2400 gigawatts (GW) from 2022 to 2027, which roughly corresponds to the current capacity of China's power sector, the agency notes. The report states that renewable energy sources will account for more than 90% of the global growth in electricity production over the next five years, and by the beginning of 2025, they will surpass coal-fired generation, becoming the largest electricity producer on Earth. The share of renewable energy in generation will increase by ten percent, reaching 38%.[5]

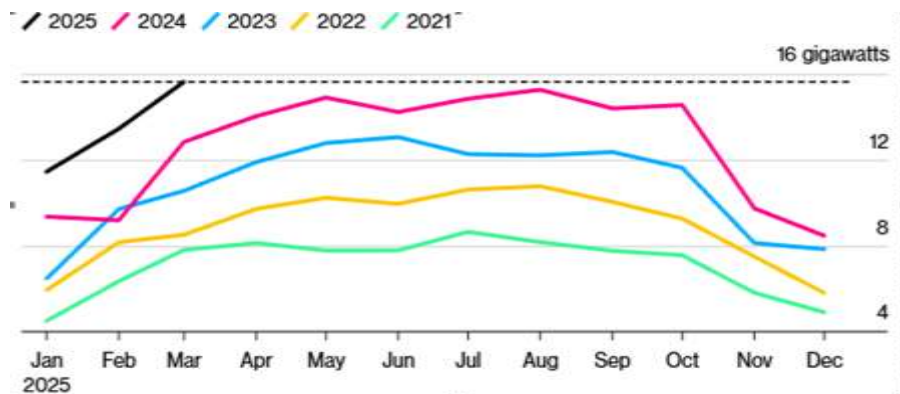


Figure 2. Highest solar generation in each month in France

Source: www.bloomberg.com

As we can see, electricity generation from solar panels in France has been growing every year, and the beginning of 2025 has also shown a significant increase. This indicates a continuing trend in the growth of solar energy output.[7]

Ultimately, the increase in renewable energy capacity leads to more frequent imbalances between electricity production and consumption. The main reasons for this are as follows:

High share of variable generation

Renewable energy sources such as solar and wind depend on weather conditions and cannot flexibly respond to changes in demand. On sunny or windy days, when generation exceeds consumption, a surplus of electricity occurs, with no immediate way to utilize it.

Limited energy storage capacity

Although storage technologies (such as battery systems and pumped hydro storage) are advancing, they currently lack the capacity to fully balance sudden fluctuations in generation and consumption. As a result, surplus energy must either be exported (if possible) or electricity prices are reduced to zero - or even negative values - to stimulate demand.

Insufficient grid flexibility

Traditional power plants (thermal, nuclear, hydro) cannot quickly adapt to the variability of renewable generation. For example, coal and nuclear plants typically operate in baseload mode and are unable to rapidly reduce output when excess energy is generated.

Rigid tariff models and subsidies

In many countries, renewable energy sources have priority access to the grid, and grid operators are obligated to purchase their electricity. This leads to a situation where, during times of excess supply, prices must be reduced to prevent grid overload.

Export limitations

If a country cannot quickly export its surplus electricity (e.g., due to congested interconnectors), an oversupply arises on the domestic market, which can trigger negative prices.

Let us now examine the experience of several European countries in terms of record durations of negative electricity prices.

Table 1. Hours with negative prices in Europe

Year	UK	France	Germany	Spain
2020	0	102	298	0
2021	7	64	139	0
2022	26	12	83	0
2023	106	144	292	0
2024	179	356	468	247

Source: <http://www.komersant.info>

Last year, European power markets experienced record periods of negative electricity prices as the rapid expansion of wind and solar capacity boosted generation. In Germany, there was a 60% increase compared to the previous year, reaching 468 hours, according to data from Epex Spot. In France, the number of hours with negative prices more than doubled to 356.

On the sunniest or windiest days, electricity can flood the grid, causing prices to drop below zero and leading to situations where consumers are paid to use electricity. However, due to how subsidies for renewable generators are structured, some producers are incentivized to continue generating even when prices fall below zero, further distorting the market. Experts are urging governments to adjust these mechanisms and help reduce the occurrence of negative prices. [6]

Let's look at the situation in Moldova. In recent years, investments in renewable energy sources have been actively developing in Moldova. Especially in the installation of solar panels and wind generators.

	Producer					TOTAL
	Law 160- XVI/2007	Law 10/2016/fixed tariff	Free market	Net Accounting	Net invoicing	
Solar panels	0,59	132,62	134,00	115,31	32,71	415,23
Wind power plants	27,23		151,65			178,88
Biogas	5,17	1,84				7,01
Hydropower	0,25		16,50			16,75
Total	33,24	134,46	302,15	115,31	32,71	617,87

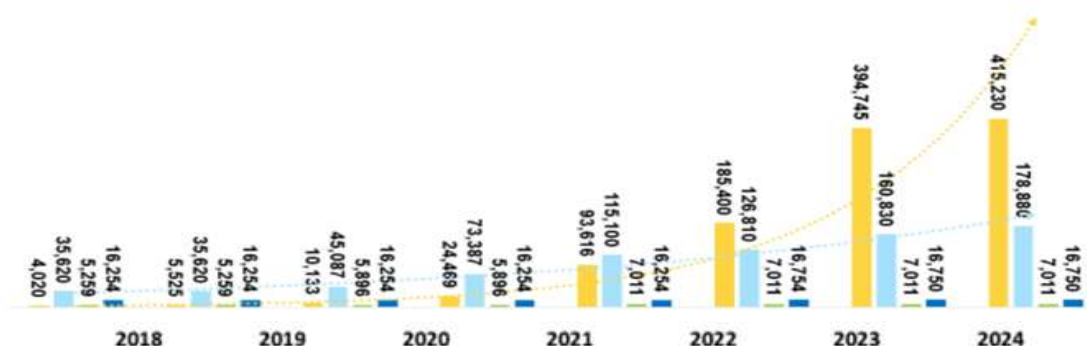
Figure 3. Existing RES electricity production capacities at the end of January 2025, MW

Source: www.cned.gov.md

The installed capacity of renewable energy sources (RES) reached 617.87 MW at the beginning of 2025, representing a 1.8-fold increase compared to 2024.[8] This trend continued throughout 2024, and according to data from the state-owned company Energocom, nearly twice as much green electricity was generated each month compared to 2023.

Let us now examine the annual commissioning of RES capacities.

photovoltaic installations ■ wind installations ■ biogas installations ■ hydro installations ■



Jan 2025

Figure 4. Evolution of installed RES capacities in the period 2018 – January 2025, MW

Source: www.cned.gov.md

As we can see, compared to 2018, by the beginning of 2025 the amount of installed RES capacity has increased several times.[8] During 2025, two large photovoltaic power plants are scheduled to be built: one in Negureni (Teleneşti district) with an installed capacity of 40 MW, and another in Rădeni (Străşeni district) with a capacity of 50 MW. This means that the total installed RES capacity will exceed 700 MW, while total electricity consumption in our country during spring and autumn does not exceed this amount.[9]

Let us consider the ratio of the maximum peak electricity consumption in Moldova and the capacity of renewable energy power plants commissioned in relation to peak production during the day. When examining the data from the table over the course of the year, it can be observed that the installed capacity of renewable energy sources (RES) at the beginning of 2025 reaches its maximum value relative to the peak energy consumption each month during the spring and autumn months, reaching up to 88%. With further

increases in the commissioning of new capacities, this figure may exceed the 100% threshold. Since we know that the installed power plants only generate a portion of their installed capacity throughout the year, we determined that the maximum value relative to peak demand reaches up to 20% in the autumn.

Table 2. Maximum electricity consumption, power and peak production in Moldova at the beginning of 2025

Indicator	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Maximum peak consumption of MW per unit of time per year	948	948	750	700	700	900	900	900	900	900	900	948
Solar panel power, MW	412.53	412.53	412.53	412.53	412.53	412.53	412.53	412.53	412.53	412.53	412.53	412.53
Wind energy power, MW	23.76	23.76	23.76	23.76	23.76	23.76	23.76	23.76	23.76	23.76	23.76	23.76
Other RES, MW	181.36	181.36	181.36	181.36	181.36	181.36	181.36	181.36	181.36	181.36	181.36	181.36
Total RES capacity, MW	617.67	617.67	617.67	617.67	617.67	617.67	617.67	617.67	617.67	617.67	617.67	617.67
Ratio of RES power to peak values, %	65%	65%	82%	88%	88%	69%	69%	69%	69%	69%	69%	65%
Average power used by wind turbines, MW	41	55	55	41	41	41	41	41	41	41	55	55
Average power used by solar panels, MW	21	21	54	62	62	100	100	100	62	62	21	21
Total average power, MW	110	121	228	228	228	280	280	280	228	228	117	117
Ratio of average power to peak values, %	11%	13%	30%	33%	33%	31%	31%	31%	25%	25%	13%	12%
Electricity production by wind power plants, MW	41 196	55 193	55 193	41 196	41 196	41 196	41 196	41 196	41 196	41 196	55 193	55 193
Electricity production by solar power plants, MW	15 447	15 447	39 734	45 607	45 607	73 552	73 552	73 552	45 607	45 607	15 447	15 447
The maximum power of solar and wind power plants in 9:00 to 15:00, MW	109	111	222	238	238	300	300	300	238	238	111	111
Ratio of RES peak production to peak demand 9:00 to 15:00	12%	12%	30%	34%	34%	36%	36%	36%	32%	32%	12%	12%

Source: compiled by the author based on data from <https://cned.gov.md>, logos-pres.md, [Energocom.md](https://energocom.md), [MyBusiness.md](https://mybusiness.md), ener-gy.com.ua, www.llnl.gov, solar.md, e-solarpower.ru

The period during the day when solar and wind power plants together generate the maximum output is from 9 AM to 3 PM. As a result, we determined that the maximum generation relative to peak demand reaches 36% in the summer period, which indicates that moments when the generation of electricity from RES exceeds the maximum demand are rare. Therefore, the risks associated with low or negative prices remain insignificant. In 2024, Energocom purchased 4.5 million MWh of electricity, and according to the calculation data from the table, the electricity generated from RES at these capacities will account for 22.9% of the purchased electricity. [8,9,13,23,25,26]

In 2030, the government set a target to achieve 30% of electricity generation from RES. [10]. Accordingly, based on the growth model from 2024, the table of capacities will look as follows.

	Producer					TOTAL
	Law 160- XVI/2007	Law 10/2016/fixed tariff	Free market	Net Accounting	Net invoicing	
Solar panels	0,59	182,27	224,26	115,31	58,43	580,87
Wind power plants	27,23		199			226,41
Biogas	5,17	1,84				7,01
Hydropower	0,25		16,5			16,75
Total	33,24	184,11	439,94	115,31	58,43	834,04

Figure 5. Capacities to be installed for electricity production from RES in MW as of 01.01.2030

Source: compiled by the author based on data from <https://cned.gov.md>

To achieve 30% electricity generation from RES relative to the consumption volume of 4.5 million MWh for the current year, it is necessary to increase the capacity to 834.04 MW, which is 34.5% higher than at the beginning of 2025.[8]

Based on this data, we will obtain a new table showing the relationship between maximum peak electricity consumption and the installed capacity of RES power plants in relation to peak generation throughout the day.

Table 3. Maximum electricity consumption, power and peak production in Moldova in 2030

Indicator	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum peak consumption of MW per unit of time per year	948	948	750	700	700	900	900	900	700	700	750	948
Solar panel power, MW	582.5 2	582. 52	582. 52	582. 52	582.5 2	582.5 2	582.5 2	582.5 2	582.5 2	582.5 2	582. 52	582. 52
Wind energy power, MW	23.76	23.7 6	23.7 6	23.7 6	23.76	23.76	23.76	23.76	23.76	23.76	23.7 6	23.7 6
Other RES, MW	331.0 3	331. 03	331. 03	331. 03	331.0 3	331.0 3	331.0 3	331.0 3	331.0 3	331.0 3	331. 03	331. 03
Total RES capacity, MW	937.3 1	937. 31	937. 31	937. 31	937.3 1	937.3 1	937.3 1	937.3 1	937.3 1	937.3 1	937. 31	937. 31
Ratio of RES power to peak values, %	88%	88%	111 %	134 %	134%	104%	104%	104%	134%	134%	125 %	99%
Average power used by wind turbines, MW	70	70	70	52	52	52	52	52	52	52	70	70
Average power used by solar panels, MW	29	29	87	139	139	193	193	193	139	139	29	29
Total average power, MW	132	132	235	266	266	320	320	320	266	266	152	152
Ratio of average power to peak values, %	13%	13%	31%	38%	38%	36%	36%	36%	38%	38%	20%	16%
Electricity production by wind power plants, MW	52 142	52 142	52 142	38 912	38 912	38 912	38 912	38 912	38 912	38 912	52 142	52 142
Electricity production by solar power plants, MW	21 698	21 698	65 181	93 627	93 627	130 876	130 876	130 876	93 627	93 627	21 698	21 698
The maximum power of solar and wind power plants in 9:00 to 15:00, MW	168	168	305	315	315	443	443	443	315	315	168	168
Ratio of RES peak production to peak demand at 9:00 to 15:00	16%	16%	41%	45%	45%	49%	49%	49%	45%	45%	30%	18%

Source: compiled by the author based on data from <https://cned.gov.md>, logos-pres.md, [Energocom.md](https://energocom.md), [MyBusiness.md](https://mybusiness.md), ener-gy.com.ua, www.lnl.gov, solar.md, e-solarpower.ru, agora.md

According to the table, generation capacities reach up to **119% of peak demand** during the autumn and spring periods, which indicates a **risk of electricity overproduction** if all renewable energy sources (RES) operate at their maximum capacity simultaneously. However, such occurrences remain rare at this stage.

If we consider the **average monthly electricity generation from RES**, the **maximum ratio of generation to peak demand** is observed in **October and the summer months**, reaching up to **25%**.

The **maximum daily generation** from RES in relation to peak demand reaches **49% during the summer period**, indicating that during certain times of the day - when there is both good solar irradiance and strong wind - the amount of electricity generated from renewables may exceed Moldova's current consumption. However, such instances remain relatively infrequent. [8, 9, 10, 13, 23, 25, 26]

Table 4. Key Mitigation Measures for RES Overproduction and Low/Negative Electricity Prices

Mitigation Measure	Description	Effect on Market
Electricity storage systems	Store excess energy in batteries or pumped hydro storage	Reduces curtailment and helps balance supply and demand
Demand response programs	Incentivize consumers to shift usage to periods of high RES output	Increases demand when supply is high, stabilizing prices
Grid interconnections	Export/import electricity across borders or regions	Enhances flexibility, reduces local overproduction
Flexible backup generation	Use gas or hydro plants that can quickly ramp up/down	Ensures grid stability without displacing RES
Dynamic pricing mechanisms	Real-time or time-of-use tariffs that reflect electricity market conditions	Aligns consumer behavior with RES generation patterns
Curtailment with compensation	Controlled reduction of RES output, compensated financially	Prevents extreme price drops, protects investor returns
Green hydrogen production	Use excess electricity to produce hydrogen as an energy carrier	Converts surplus into storable, tradable energy resource

Source: Compiled by the author based on multiple academic and policy reports (IEA, 2023; Agora Energiewende, 2022; European Commission, 2023).

5. Conclusions

Low and negative prices reduce the revenues of renewable energy producers and producers in a market where there are no fixed contracts or support mechanisms like Feed-in Tariffs (FiT) or Contracts for Difference (CfD).

Long-term investors may fear income instability, which makes projects less attractive for financing. If low prices become common, this can reduce interest in building new renewable energy capacities as the expected return on investment decreases.

This is especially true for markets without sufficient flexibility or energy storage support mechanisms. Renewable energy producers may face situations where generation must be curtailed to avoid losses. This reduces the effective use of installed capacity and can affect the profitability of the investment.

In Europe, these moments have arrived much earlier due to the high share of renewable energy sources in electricity generation.

In Moldova, the risk of overproduction exists and will increase in the future, but it is still significantly lower than in Europe. However, it is worth preparing for this in advance. To do this, investments in energy storage devices (batteries, pumped storage

stations) or flexible consumption mechanisms (demand response) are needed, which increases the total costs of projects.

Investors may increasingly invest in battery energy storage systems (BESS) and Power-to-X technologies (e.g., hydrogen production). This encourages the development of new business models, such as selling electricity during peak demand periods. Investments in balancing systems are needed, which requires additional resources. With the development of interconnection infrastructure, it will be possible to export cheap renewable energy to regions with higher demand, contributing to the growth of investments in new projects. New instruments are emerging to optimize the use of renewable energy sources, including flexible tariff systems and Contracts for Difference. In some countries, the practice of paying for consumption flexibility is being developed, which increases the economic efficiency of renewable energy sources.

Therefore, it is worth preparing and conducting all surveys, checks, and additional investments today to be ready for the consequences of excessive electricity supply and the emergence of negative prices in the future.

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The Proceedings is the result of the **International Scientific and Practical Conference "Sustainability and Economic Resilience in the Context of Global Systemic Transformations"**, organized on March 27-28, 2023 at the Academy of Economic Studies of Moldova and simultaneously online via the Zoom platform.

Conference organizer:

- Department "Economic Theory and Policy", Academy of Economic Studies of Moldova
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Approved for publication: 20.06.2025

Author sheets 29.60. Editorial sheets 29.70. Printing sheets 49.50.

Order no. 29.

Editorial and Publishing Service of the Academy of Economic Studies of Moldova
Chişinău, MD-2005, 59 Bănulescu-Bodoni Street, Phone: +373 22 402 910

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