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CONTENT

Emmanuel Ndhlovu	*Leveraging artificial intelligence to improve food system policy frameworks and strategies in Africa*	*6*
Rodica Burbulea, Lilia Șargu	*Measuring the organizational resilience of organizations in the Republic of Moldova through absorptive, adaptive and transformative capacities*	*26*
Igor Belostecinic, Lilia Chiriac	*Strategic branding as a driver of long-term equity*	*39*
Sergiu Mîrza, Lilia Chiriac, Feodosie Pitușcan	*Perception of ecological price acceptance: consumer attitude and price justification for ecological products in the Republic of Moldova*	*65*
Wei Pang, Ecaterina Covaci, Mariana Godoroja	*Sustainable digital trade and low-altitude economy: a new pathway for global wine market expansion in China*	*94*
Rachna Jain, Shikha Sharma	*Strategic integration of digital marketing practices and e-business performance in emerging markets*	*104*
Liliana Platon	*Efficiency of eco materials in contemporary interior design*	*117*
Nelly Țurcan, Rodica Cujba, Vitalie Minciuna	*Visibility and transformation of Moldovan scholarly output (2008–2024): a comparative bibliometric study*	*130*
Laura-Maria Giană	*Integrating the technique of detecting simulated behavior into the process of forensic investigation of corruption*	*157*
Lu Liu, Zhanglingyun Ning, Yiwen Jiang	*Research on the theoretical connotations, hot topics, and trends of social emotional resonance*	*168*
Ala Șișianu, Ala Pușcașu	*Facilitating a smooth transition from general english to technical english for students*	*185*
Tomy Michael	*Children's natural rights in the law on mother and child welfare according to Montesquieu*	*197*
Vitalie Jitariuc, Iulia Bria	*The essence, tasks and purpose of identification proceedings in criminal procedure*	*206*

CONTENT

Emmanuel Ndhlovu	*Utilizarea inteligenței artificiale pentru îmbunătățirea cadrelor de politici și a strategiilor sistemului alimentar din Africa*	*6*
Rodica Burbulea, Lilia Șargu	*Măsurarea rezilienței organizaționale a organizațiilor din Republica Moldova prin capacități absorbtive, adaptive și transformative*	*26*
Igor Belostecinic, Lilia Chiriac	*Brandingul strategic ca factor al echității pe termen lung*	*39*
Sergiu Mîrza, Lilia Chiriac, Feodosie Pitușcan	*Percepția acceptării prețului ecologic: atitudinea consumatorului și justificarea prețului pentru produsele ecologice în Republica Moldova*	*65*
Wei Pang, Ecaterina Covaci, Mariana Godoroja	*Comerț digital sustenabil și economia la altitudine mică: o nouă cale pentru expansiunea pieței globale a vinului în China*	*94*
Rachna Jain, Shikha Sharma	*Integrarea strategică a practicilor de marketing digital și a performanței ebusiness pe piețele emergente*	*104*
Liliana Platon	*Eficiența materialelor eco în designul interior contemporan*	*117*
Nelly Țurcan, Rodica Cujba, Vitalie Minciuna	*Vizibilitatea și transformarea producției academice din Republica Moldovenească (2008–2024): un studiu bibliometric comparative*	*130*
Laura-Maria Giană	*Integrarea tehnicii de detectare a comportamentului simulat în procesul de investigare criminalistică a corupției*	*157*
Lu Liu, Zhanglingyun Ning, Yiwen Jiang	*Cercetări asupra conotațiilor teoretice, subiectelor de actualitate și tendințelor rezonanței socio-emoționale*	*168*
Ala Şişianu, Ala Pușcașu	*Facilitarea unei tranziții line de la engleza generală la engleza tehnică pentru studenți*	*185*
Tomy Michael	*Drepturile naturale ale copiilor în legea privind bunăstarea mamei și copilului, conform Montesquieu*	*197*
Vitalie Jitariuc, Iulia Bria	*Esența, sarcinile și scopul prezentării spre recunoaștere în procesul penal*	*206*

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LEVERAGING ARTIFICIAL INTELLIGENCE TO IMPROVE FOOD SYSTEM POLICY FRAMEWORKS AND STRATEGIES IN AFRICA

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Abstract. Africa consistently faces policy challenges in all sectors, including its key sector, the food system. Existing challenges intertwine, making policy implementation challenging and necessitating improved regional cooperation and innovative solutions that transcend traditional approaches. This conceptual article examines how AI can be leveraged to enhance Africa's food system policy frameworks and strategies, identifies the challenges of leveraging AI to improve food system policies and strategies, and proposes pathways to strengthen the AI presence in food system adoption and policy-making. The article draws on existing literature as well as personal insights to explore how AI can enhance food systems policy-making in Africa. It reveals that AI holds transformative potential for improving food system policies in Africa by enhancing efficiency, productivity, and resilience across the entire agricultural value chain. By leveraging data-driven insights, AI can help policy-makers and farmers make more informed, timely, and localised decisions. However, poor digital infrastructure, high costs, data gaps, low digital literacy, lack of skilled AI experts, weak regulations, and governance issues, as well as cultural barriers, often combine to create a digital divide, where smallholders are left behind, hindering effective policy implementation and equitable benefits, despite AI's potential for efficiency and sustainability. Efforts should be directed at bridging the digital divide.

Keywords: *Artificial Intelligence, food systems, policies, policy-making, production.*

Rezumat. Africa se confruntă în mod constant cu provocări politice în toate sectoarele, inclusiv în sectorul său cheie, sistemul alimentar. Provocările existente se intersectează, ceea ce face ca implementarea politicilor să fie dificilă și necesită o cooperare regională îmbunătățită și soluții inovatoare care să depășească abordările tradiționale. Acest articol conceptual examinează modul în care IA poate fi valorificată pentru a îmbunătăți cadrele de politici și strategiile sistemului alimentar din Africa, identifică provocările legate de valorificarea IA pentru îmbunătățirea politicilor și strategiilor sistemului alimentar și propune căi pentru consolidarea prezenței IA în adoptarea și elaborarea politicilor sistemului alimentar. Articolul se bazează pe literatura existentă, precum și pe perspective personale, pentru a explora modul în care IA poate îmbunătăți elaborarea politicilor sistemelor alimentare din Africa. Acesta dezvăluie că IA are un potențial transformator pentru îmbunătățirea politicilor sistemului alimentar din Africa prin creșterea eficienței, productivității și rezilienței pe întregul lanț valoric agricol. Prin valorificarea informațiilor bazate pe date, IA poate ajuta factorii de decizie și fermierii să ia decizii mai informate, mai

prompte și mai localizate. Cu toate acestea, infrastructura digitală deficitară, costurile ridicate, lacunele în date, nivelul scăzut de alfabetizare digitală, lipsa experților calificați în domeniul inteligenței artificiale, reglementările slabe și problemele de guvernanță, precum și barierele culturale, se combină adesea pentru a crea un decalaj digital, în care micii fermieri sunt lăsați în urmă, împiedicând implementarea eficientă a politicilor și beneficiile echitabile, în ciuda potențialului IA pentru eficiență și sustenabilitate. Eforturile ar trebui să fie îndreptate spre reducerea decalajului digital.

Cuvinte cheie: *Inteligență artificială, sisteme alimentare, politici, elaborare de politici, producție.*

1. Introduction

Artificial Intelligence (AI) is revolutionising society. Its power lies in its capacity to exhibit human cognitive abilities, such as learning, reasoning, and problem-solving, enabling machines to perform complex tasks with extraordinary speed and precision across nearly every industry. AI excels at automating high-volume, repetitive tasks, both digital (such as data entry and email summarisation) and physical (including manufacturing assembly lines and warehouse logistics), thereby freeing humans for more creative and strategic work [1, 2]. AI systems can also process and analyse massive datasets far beyond human capacity, uncovering hidden patterns and generating actionable insights in seconds. This capability is fundamental to improved decision-making and innovation. By providing data-driven insights and predictions, AI enables faster, more reliable, and less biased decision-making in critical fields such as finance and healthcare. Through machine learning (ML) and deep learning (DL), AI models can adapt and improve their performance over time as they are exposed to new data and experiences, becoming more accurate without overt reprogramming. Generative AI, a recent breakthrough, can also create original text, images, code, and music, revolutionising industries like marketing, entertainment, and software development. In addition, AI enables machines to understand and interact using human language (virtual assistants and chatbots) and interpret visual information (facial recognition and autonomous vehicles).

The transformative potential of AI runs across fields and sectors. In the healthcare sector, AI aids in early disease diagnosis (by analysing medical images), accelerates drug discovery, helps personalise treatment plans, and enables remote patient monitoring [3]. In transportation, AI plays a central role in self-driving cars, optimising traffic management, and enhancing navigation apps by processing real-time data to improve safety and efficiency [4]. For the finance sector, AI-powered systems can also detect fraud, perform rapid and accurate credit scoring, manage investments through 'robo-advisers,' and provide personalised banking services [5]. In science and research, AI helps solve complex scientific challenges, from predicting protein structures to modelling climate change effects, by speeding up research and development [1]. In addition, AI-driven chatbots and virtual assistants can also provide instant, around-the-clock support, handling queries and personalising customer experiences [6]. Ultimately, AI is a tool that can augment human capabilities and solve some of the world's most challenging problems. Harnessing this power responsibly, with clear ethical guidelines and a focus on human-centred systems, will be key to ensuring it benefits society as a whole. AI also holds much potential to contribute significantly to policy formulation and implementation. There are currently limited studies that explore the use of AI in this regard. However, this breakthrough will be critical for global regions, such as Africa, which face policy implementation challenges due to poor governance, corruption, weak institutions, infrastructure deficits, and economic dependence on resources, as well as

widespread poverty and inequality [7, 8]. African governments are in the early stages of experimentation, but they are facing challenges in adopting widespread use. This article closes this gap by exploring how AI can be used to improve food system policies in Africa. A food system is defined as the entire network of activities and elements involved in food production, processing, distributing, selling, preparing, and disposing, encompassing all activities, from farm to fork (and beyond) and considering its economic, health, social, and environmental impacts [9, 10]. It comprises farmers, processors, retailers, consumers, policies, and the environment, all working together to deliver food, while also facing challenges such as waste, climate change, and ensuring nutrition for all.

African countries have not fully utilised AI in several sectors, including leveraging the technology to address policy issues, despite AI's potential for data analysis, scenario simulation, and real-time monitoring to enhance policy effectiveness. This conceptual article (i) examines how AI can be leveraged to improve Africa's food system policy frameworks and strategies, (ii) identifies challenges of leveraging AI to improve food system policies and strategies, and (iii) proposes pathways to strengthening AI presence in food system adoption and policy-making. The importance of leveraging AI to enhance food system policy is significant, as it provides powerful tools to address the complex, interconnected challenges facing the global food system, including climate change, food security, and sustainability. AI-driven food system policies are crucial for boosting efficiency, sustainability, and security by optimising production, reducing waste, improving supply chains, and enabling better resource management through predictive analytics, precision agriculture, and traceability, helping address challenges like climate change and population growth, while needing careful policy to manage data gaps, equity, and infrastructure. Policy-makers, politicians, and other stakeholders interested in African food systems will find this article informative and engaging.

This article is organised as follows: The following section discusses the components of AI under sub-sections. An outline of the research methodology for the study follows this. Thereafter, the article discusses how AI applications can be leveraged to enhance food systems policies in Africa. It then outlines AI integration challenges and also proposes policy pathways for promoting the integration of AI in food policy design. Lastly, conclusions and recommendations are drawn from the discussion.

2. Components of Artificial Intelligence

The components of AI can generally be grouped into two categories: capabilities that mimic human intelligence and the technologies or subfields used to achieve those capabilities. Table 1 summarises the specific branches of computer science and methods used to build AI systems. The main goal of AI systems is to simulate human intelligence.

Table 1

Components of Artificial Intelligence

Sub-field/Technology	Description	Key Function
Machine Learning (ML)	Algorithms that allow systems to learn patterns and make predictions directly from data. It is the engine of modern AI.	Enables learning and decision-making.
Deep Learning (DL)	A subset of ML that uses deep, multi-layered Artificial Neural Networks (ANNs) to analyse vast amounts of complex data (images, text, audio).	Powers advanced Learning, Computer Vision, and NLP.

Continuation Table 2

Natural Language Processing (NLP)	Focuses on the interaction between computers and human language, allowing machines to read, understand, and generate text or speech.	Enables language understanding.
Computer Vision (CV)	Equips machines to 'see' and interpret visual data from images or videos, enabling tasks such as object recognition, facial recognition, and image classification.	Enables perception (specifically visual).
Robotics	The integration of AI with physical machines, allowing robots to perceive their environment, plan movements, and execute tasks autonomously.	Integrates AI for physical action and perception.
Expert Systems	AI programmes are designed to mimic the decision-making of a human expert in a specific domain, using a knowledge base and a set of inference rules.	Supports specialised reasoning and problem-solving.
Generative AI	A recent branch focused on creating new, original content (text, images, code, video) rather than just analysing existing data.	Enables new forms of language understanding and creation.

Source: Authors

2.1. Machine Learning

ML is a subset of AI that focuses on developing statistical algorithms (models) that enable computer systems to learn from data and make predictions or classifications without being explicitly programmed for the specific task [11]. When an ML model is fed a large amount of data, it can learn the underlying patterns and relationships within that data, enabling it to perform the task effectively. Its performance improves progressively with more 'experience' (data) [2].

The general process of machine learning typically involves several phases, including data pre-processing. This is when raw data is cleaned, transformed, and prepared to be suitable for the algorithm (e.g., handling missing values, normalising data). The pre-processed data is used to train the algorithm (Training the Model). The algorithm iteratively adjusts its internal parameters to find a mathematical relationship that minimises the difference between its predictions and the actual known outcomes in the training data. A separate dataset is used to check if the model can accurately generalise its learning to new, unseen data (Evaluating the Model). The model is then refined further to improve its accuracy and efficiency (Optimisation).

ML systems are generally categorised into four main types based on how they learn:

- *Supervised Learning*: The model is trained on labelled data (input data paired with the correct output/answer). The goal is to map an input to a known output and make predictions. This system can classify (categorise data, such as identifying a picture) and perform regression (predict a numerical value).
- *Unsupervised Learning*: This model is trained on unlabelled data. The goal is to identify meaningful patterns, structures, and groupings within the data without relying on external information. Common tasks include clustering (grouping similar data points and association (discerning correlations).
- *Reinforcement Learning:* An ‘agent’ learns by interacting with an environment through a trial-and-error process. The goal is to find the best sequence of actions to maximise

a cumulative reward (positive reinforcement) and minimise penalties (negative reinforcement). This includes training robots to perform tasks and developing AI to solve complex issues.

- *Generative AI*: This focuses on creating new content (text, images, audio, video) that resembles the patterns learned from the existing training data.

ML powers many technologies, including recommendation engines, fraud detection, predictive maintenance, autonomous vehicles, and translation apps and chatbots [12, 13].

ML profoundly impacts society by automating tasks, boosting efficiency, and enabling data-driven decisions across industries. In food systems, ML boosts efficiency, sustainability, and safety from farm to fork, enabling precision agriculture, optimising supply chains to cut waste, automating quality control, predicting demand for better inventory, and even creating personalised nutrition, though ethical concerns about data access and cost remain [14, 15]. By analysing vast datasets from sensors, images, and the Internet of Things (IoT) devices, ML helps farmers manage resources more effectively, processors ensure quality, and businesses tailor products, resulting in significant cost savings and environmental benefits [16, 17]. In essence, ML offers powerful tools to build a more resilient, efficient, and sustainable food system by making data-driven decisions across all stages; however, ethical deployment and broad accessibility remain crucial for realising its full potential.

2.2. Deep Learning

DL is a highly effective subset of ML that utilises artificial neural networks with multiple layers to learn complex patterns directly from large datasets [18]. It is inspired by the structure and function of the human brain's neural circuits [19]. The key component of DL is the deep neural network (DNN). Unlike traditional ML, DL models can automatically discover and learn the relevant features directly from the raw data, eliminating the need for manual, human-guided feature extraction [18]. DL performance generally continues to improve as the volume of data increases, which is crucial in the age of big data. It excels at tasks involving unstructured data such as images, audio, and text [20]. Table 2 summarises common DL architectures. DL is the backbone of many modern AI technologies, including CV and NLP.

Table 3

Common Deep Learning Architectures

Architecture	Primary Use Case	Key Mechanism
Feedforward Neural Networks (FNN)	Simple classification and regression tasks.	Information flows in one direction from input to output.
Convolutional Neural Networks (CNN)	Image and video processing (Computer Vision).	Utilises convolutional layers to automatically extract spatial features, such as edges and patterns.
Recurrent Neural Networks (RNN)	Sequential data (time series, text).	Nodes have "memory" to retain information from previous steps in the sequence.
Transformers	Natural Language Processing (NLP) and Large Language Models (LLMs).	Utilises an attention mechanism to prioritise the significance of various parts of the input data.

Source: Authors

DL can revolutionise food systems by boosting precision agriculture (yield prediction, pest/disease ID, smart irrigation), optimising the supply chain (waste reduction, traceability, quality control, fraud detection), and improving food safety and nutrition (contaminant detection, personalised diet). Benefits include increased efficiency, reduced environmental impact, enhanced food security, and greater sustainability through better resource management and predictive insights across the entire food chain.

2.3. Natural Language Processing

NLP is a subfield of AI, computer science, and computational linguistics that focuses on enabling computers to interpret, manipulate, and comprehend human language, both spoken and written [21]. Its ultimate goal is to bridge the communication gap between humans and machines, allowing people to interact with technology using natural language in daily activities. NLP models, often based on ML and DL, process human language by breaking it down and analysing its structure and meaning. The process typically involves several core techniques, such as breaking down text into individual units (tokens), such as words, phrases, or symbols and simplifying words to their root form to reduce vocabulary size and allow the computer to treat different forms of a word (such as 'running,' 'ran,' 'runs') as the same base word ('run'). In addition, NLP can identify the grammatical role of each word (such as noun, verb, or adjective) to understand how words relate to each other. It can analyse the grammatical structure of a sentence to ensure it is structurally sound and can extract relationships between words [23]. It can also determine the meaning of the language, encompassing the individual word meanings and the overall meaning of the sentence.

NLP is an integral part of many modern technologies and workflows. It is generally divided into two main branches, namely, Natural Language Understanding (NLU) and Natural Language Generation (NLG) (see Table 3).

Table 4

Branches of Natural Language Processing

Branch	Focus	Example Applications
NLU (Understanding)	Parsing text or speech to understand what is being said (intent, sentiment).	Sentiment Analysis (analysing reviews), Entity Recognition, Key-Phrase Extraction.
NLG (Generation)	Generating new, coherent, and meaningful text or speech as a response.	Chatbots, Machine Translation, Text Summarisation, Large Language Models (LLMs).

Source: Authors

The common real-world examples of NLP include Siri, Alexa, and Google Assistant, which use NLP for speech recognition and command interpretation. Tools like Google Translate utilise NLP to translate text between languages. It is also used in sentiment analysis by businesses to gauge public opinion from social media, customer reviews, or surveys. Chatbots also rely heavily on NLP for understanding queries and generating responses. In addition, NLP helps search engines to understand the intent behind the query, not just matching keywords.

In food systems, NLP can help unlock insights from text data to inform better decisions, automate tasks such as quality control and customer service, enhance food safety through compliance monitoring, personalise nutrition, optimise supply chains, and improve food security by analysing public discourse and policy. It helps analyse consumer feedback,

manage food donations, identify dietary trends, and create efficient, data-driven food management systems from farm to table.

2.4. Computer Vision

CV is a field of AI that focuses on enabling computers to perceive, interpret, and comprehend visual data from the world, much like humans use their eyes and brains [25]. Essentially, CV teaches machines to extract meaningful information from digital images, videos, and other visual inputs and then make decisions or take action based on that information. CV systems typically rely on ML and DL models, especially Convolutional Neural Networks (CNNs), which are trained on massive amounts of visual data [26]. The general process involves a few core steps, such as capturing visual data using devices like cameras, sensors, or scanners, and cleaning and enhancing the raw data (e.g., resizing, adjusting brightness, reducing noise). Algorithms process the data to detect and recognise patterns by comparing them against an extensive database of known patterns. The system then identifies patterns (like objects or faces) and outputs information or triggers an action.

CV performs a range of tasks to interpret visual data, including image classification. It can assign a single label or category to an entire image. It can also identify and locate multiple objects within an image, typically by drawing a bounding box around each one and providing a label (e.g., locating all cars and pedestrians in a street scene). In addition, CV can monitor the movement of one or more objects across a sequence of video frames over time. It can also convert printed or handwritten text within an image into editable digital text. The CV technology has a wide range of real-world applications across various industries (see Table 4).

Table 5

Computer Vision Real-World Application

Industry	**Example Application**
Automotive	Autonomous vehicles (detecting pedestrians, traffic signs, and lanes).
Healthcare	Analysing medical images (X-rays, MRIs) to detect diseases like tumours or abnormalities.
Security/Surveillance	Facial recognition for identification and monitoring public spaces.
Manufacturing	Quality control by detecting defects on a production line in real-time.
Retail/E-commerce	Visual search, inventory management, and analysing customer behaviour.

Source: Authors

CV revolutionises food systems by boosting efficiency, safety, and sustainability from farm to fork, enabling automated crop monitoring for precise resource use, real-time quality control in processing to detect defects and contamination, accurate yield prediction, waste reduction through better logistics, and enhanced traceability for regulatory compliance and consumer trust, making the entire food chain smarter and less wasteful.

2.5. Robotics

Robotics is an interdisciplinary branch of engineering and computer science that involves the design, construction, operation, and use of robots, machines programmed to

perform tasks traditionally done by humans [27]. The primary goal of robotics is to develop intelligent machines that can assist humans in various ways, particularly in tasks that are repetitive, hazardous, or require precise execution [28, 29].

Regardless of its complexity or level of autonomy, every robot system consists of three fundamental components, namely, mechanical construction. This is the physical body of the robot, comprising the frame, motors (also known as actuators), and manipulators (such as arms or wheels). It is designed to achieve a specific task and address the physics of its environment. It also includes electrical components. These are the power and sensory systems of the robot. This includes the power source (such as a battery), the electrical circuits, and the sensors that enable the robot to perceive its environment (e.g., cameras, touch sensors, and GPS). In addition, it includes software or programming. This is the 'brain' that dictates how the robot operates. Programs determine when and how a robot moves, processes sensor data, and makes decisions. Robotics software can range from simple remote control to advanced AI, allowing the robot to operate autonomously and learn from its environment. Robotics is a highly collaborative field that draws knowledge from several key disciplines, including mechanical and electrical engineering. Robots are deployed across a wide range of industries to enhance productivity, efficiency, and safety (Table 5).

Table 6

Examples of fields where robotics is used

Industry	**Examples of Robotic Use**
Manufacturing	Industrial Robots perform assembly, welding, painting, and quality control, especially in the automotive and electronics sectors.
Healthcare	Surgical Robots (like the da Vinci system) perform minimally invasive procedures with high precision. Rehabilitation Robots (exoskeletons) assist patients in regaining mobility.
Logistics & Warehousing	Autonomous Mobile Robots (AMRs) manage inventory, transport goods, and automate order fulfilment and packaging.
Exploration	Space Probes and Rovers (like the Mars rovers) explore dangerous or remote environments. Underwater Robots explore the deep sea.
Agriculture (Agri-Robotics)	Autonomous systems perform planting, harvesting, weed management, and collect crop health data (often using UAVs/drones).
Consumer/Service	Robotic vacuum cleaners, social robots for elderly care or education, and automated food preparation systems.

Source: Authors

In food systems, robotics boosts efficiency, safety, and quality by automating tasks like harvesting, processing, and packaging, reducing labour costs and human error, while improving consistency and traceability from farm to table, leading to less waste, better resource use (precision agriculture), and enhanced food safety through consistent handling and real-time monitoring, creating a more resilient and sustainable food supply chain.

2.6. Expert Systems

An Expert System is a computer programme, a subset of AI, that emulates the decision-making ability of a human expert in a specific, specialised domain [30]. Instead of using conventional procedural programming, they solve complex problems by reasoning through a body of knowledge, often represented as 'if-then' statements, some statements that define relationships and guide decision-making [31]. The effectiveness of an expert system relies on

its main components working together. These are the knowledge base, the core of the system, containing domain-specific facts, rules, and heuristics (rules of thumb) gathered from human experts. The quality and completeness of the knowledge base are critical to the system's performance [30]. The other component is the inference engine. This is the reasoning component. It applies logical rules to the knowledge base to derive conclusions, recommendations, or new facts. It typically uses methods like forward chaining (begins with known facts and applies rules to infer new facts until a goal is reached (data-driven) and backward chaining (begins with a goal (hypothesis) and works backward to find the facts and rules that support that goal (goal-driven) [32]. Another component is the user interface. This is the system's communication bridge, allowing users (who are often non-experts) to input queries and receive and understand the system's advice or diagnosis [30].

Expert systems have been successfully applied across diverse fields, including healthcare, where they aid in diagnosis and treatment planning, and finance, where they are utilised for fraud detection, credit risk assessment, and investment analysis. The use of expert systems offers several advantages. They capture human knowledge, preventing its loss when an expert retires or leaves [32]. They provide consistent and unbiased recommendations based on established rules, make expert-level knowledge available quickly to non-experts across various locations, and can justify their conclusions, which is important for critical applications such as medical diagnosis.

Expert systems offer numerous benefits across the entire food system, primarily by replicating human expertise to provide consistent, data-driven decision support, which leads to improved efficiency, enhanced sustainability, and greater food safety and quality [33].

2.7. Generative Artificial Intelligence

Generative Artificial Intelligence (Generative AI) is a powerful subfield of AI that focuses on creating new content and ideas [34]. Unlike traditional AI, which may analyse existing data for insights or predictions, Generative AI utilises ML models to generate novel and realistic text, images, code, and other forms of data [35].

Generative AI is powered by large and complex machine learning models, often based on neural networks and DL. The core process involves training on massive datasets. In this regard, the model is fed vast amounts of existing content. During training, the model identifies the underlying patterns, relationships, and structures of the data. For instance, a language model learns grammar, syntax, and how words relate to each other. When given a prompt (an input or request), the model uses the patterns it learned to predict and produce the most statistically likely or coherent next piece of data, whether it is the next word in a sentence, the next pixel in an image, or the next note in a song [36].

The key types of models include Large Language Models (LLMs). Like the GPT series, this model is focused on language-based tasks such as text generation, conversation, and summarisation. The other model is Generative Adversarial Networks (GANs). This consists of two competing neural networks (a Generator and a Discriminator) that work together to produce increasingly realistic output. Another key model is diffusion models. This class of models generates new data by iteratively removing noise from an initial random input [37].

Generative AI is revolutionising food systems by creating new recipes, personalised nutrition plans, and marketing content, while also optimising farming (disease detection, yield prediction) and supply chains (demand forecasting, waste reduction) [38]. It serves as a powerful tool for innovation, sustainability, and efficiency, enabling data-driven decisions

from farm to table, generating novel products, and enhancing consumer engagement through hyper-personalisation. However, ethical considerations surrounding data and bias remain crucial [39].

Considering the revolutionary role that AI is playing in various fields, including food systems, it is also vital to explore how it can be utilised to enhance policy formulation and implementation, a significant challenge for most African countries.

3. Materials and Methods

This article adopts a conceptual research methodology. This is not only because AI solutions are still evolving, but also because their adoption and integration in Africa's food systems are still in their early stages. The article uses current abstract ideas about AI solutions and existing literature on AI integration in food systems to examine how these solutions can be leveraged to improve food systems policy frameworks and strategies. In utilising this methodology, the authors first defined the concept of food systems, drawing from reputable policy and research networks including the HLPE and the FSNet Africa. The authors then identified the types of AI solutions and their applications in various activities across the food system chain. It then explored how such AI solutions can be utilised to inform policy frameworks and strategies, as well as improve food systems in the African context.

Underpinned by this conceptual approach, the article draws from both grey and academic literature on AI-driven solutions. The synthesis of these texts was then combined with personal abstraction. The argument was that not all problems can be resolved by empirical evidence. Instead, abstraction provides a valuable tool for making comments when empirical evidence is not yet available. This methodology provided a clear roadmap, defining key variables and guiding the entire study from design to analysis, ensuring focus and consistency in analysis, especially because very few studies explore how AI can be used in policy formulation. The methodology also clarified the study's context, justified the research, and helped identify gaps, leading to more structured arguments and propositions on the possibilities of integrating AI in policy formation.

The conceptual research methodology, however, is not without limitations. These include the lack of empirical grounding, reliance on existing literature, difficulty in proving causality, and challenges in demonstrating validity and reliability without data, making findings harder to generalise or verify compared to empirical studies. Nonetheless, this article effectively highlights key instances where AI solutions can be leveraged to design food systems policies and strategies. It is hoped that future studies will build on the arguments presented here, using empirical evidence to ground them more firmly.

4. AI Applications for Enhancing Food Systems Policy Frameworks and Strategies

Africa's policy formulation and implementation face significant hurdles, including weak governance, corruption, political interference, poor stakeholder engagement, and a gap between policy goals and local realities, which often lead to policy failures despite good intentions. This is evident in stalled development goals and inconsistent service delivery. These issues stem from a disconnect between conceptual policy design and on-the-ground realities, often resulting in unrealistic policies, a lack of local buy-in, or being derailed by political interests. This review revealed that AI offers transformative potential to enhance food system policy frameworks and strategies in Africa by providing data-driven insights, improving efficiency, and fostering resilience throughout the entire value chain.

4.1. Climate and Disaster Resilience Policy

AI solutions can be leveraged to both formulate and implement climate and disaster resilience policies in African countries. For instance, AI-driven predictive analytics can be crucial for developing policies that mitigate the impacts of climate change. This can be achieved by using AI solutions to analyse satellite imagery, historical weather data, and real-time sensor information to provide accurate, localised weather forecasts and predictive alerts for droughts, floods, and pest/disease outbreaks (like locust invasions). This data can enable governments to implement preemptive policies, such as adjusting planting calendars, coordinating the distribution of drought-resistant seeds, and launching early disaster response efforts. India is one of the best examples of countries where AI directly influences farmers' decisions, which are then scaled up into policy recommendations for the national agricultural strategy. In India, Microsoft's AI Sowing App uses ML to compare 30 years of historical climate data with real-time weather. It advises farmers (*via* SMS) on the optimal time to sow crops, leading to a reported 30% increase in productivity per hectare [40]. This model directly informs best practices for agricultural extension services and resource management.

In the United States (US), AI is being used primarily to enhance efficiency, food safety, and compliance with federal programmes. In the School Nutrition Programme Management, the US utilises AI to assist school districts in managing, reporting on, and maintaining compliance with the US Department of Agriculture's (USDA) Nutrition Standards for School Meals [41, 42]. By automating data extraction and reporting, AI influences the efficiency and integrity of national food assistance programmes. The US agriculture also heavily utilises AI-driven precision farming, which involves using satellite data, drones, and sensors to optimise planting, water, and fertiliser use. This data-driven efficiency can inform policies related to resource conservation, sustainability, and climate-smart agriculture. Reliable yield data can also inform national food reserve policies, import/export decisions, and resource allocation (e.g., fertiliser subsidies).

Several African countries are already integrating AI solutions, primarily to address logistical issues and enhance the resilience of smallholder farmers, a key focus for food security policy. Companies such as Twiga Foods in Kenya use AI-driven logistics to connect small farmers directly with urban retailers [43]. By optimising supply routes and predicting market demand, they reduced post-harvest losses from 30% to just 4% [43]. Policy can be influenced by demonstrating how technology can streamline national food distribution and reduce waste. Additionally, AI-powered smartphone apps in countries such as Uganda, Tanzania, and South Africa utilise computer vision to diagnose plant diseases from leaf images [16]. By enabling early corrective measures, this technology has improved crop resilience and significantly reduced yield losses, informing national plant health and protection strategies. In Malawi, AI is being applied to improve early warning systems for humanitarian aid and policy intervention [44]. An ML approach in southern Malawi was developed to infer predictors of food insecurity and forecast household-level outcomes up to four months in advance with high accuracy [45]. This directly informs and strengthens government and humanitarian early warning systems for timely intervention in food-insecure regions. This data is critical for policy-makers to address drought preparedness and resource allocation.

AI-powered mobile apps deliver timely, context-specific agronomic advice (e.g., optimal planting/harvesting times, irrigation needs) directly to smallholder farmers in several

countries [16]. The data and insights generated by these AI tools can, therefore, be used to inform policies that ensure that farmers and other food system stakeholders have access to the knowledge to adapt to climate volatility, leading to more stable food production.

4.2. Enhancing Supply Chain and Market Efficiency

AI can optimise the movement of food, from farm to consumer, reducing waste and strengthening market mechanisms, which can then be regulated and supported by policies. AI algorithms can predict demand and optimise transportation routes to minimise post-harvest losses (a major challenge in Africa) and improve the efficiency of food distribution, especially from rural to urban centres. AI-driven insights can inform policies for infrastructure investment and logistical protocols. These can include predictive policies designed to reduce losses. In this regard, ML algorithms analyse data from IoT sensors on transport vehicles and storage facilities (temperature, humidity, time), combined with data on product type, external weather, and route conditions. This enables policymakers to pinpoint the specific geographic 'hotspots' or 'pinch points' where losses are highest. Policies can then be targeted, focusing investments on building new cold chain infrastructure along those routes, providing subsidies for smart storage facilities, or implementing mandatory quality control checkpoints informed by AI risk scoring.

AI-driven insights can also be used to develop policies and strategies that optimise route and inventory. In this regard, AI routing software can be used to dynamically process real-time traffic, weather, and market demand to find the most fuel-efficient and fastest delivery paths. Policy can incentivise the use of these platforms (e.g., through tax breaks for certified logistics tech adoption) and mandate data sharing for logistics providers to improve overall network flow, ensuring perishable goods reach markets efficiently, thereby reducing spoilage and emissions.

AI solutions can be used to improve market price transparency and stability. Market volatility and information asymmetry often disadvantage smallholder farmers. AI can inform policies that create a fairer, more transparent marketplace. DL models (such as CNNs) analyse historical prices, production volumes, weather patterns, global trade data, and consumer trends (including social media sentiment) to predict future commodity prices with high accuracy. This data can enable the development of policies that stabilise farmer income. African governments can establish data-driven minimum support prices or futures contracts informed by forecasts, thereby protecting farmers from sudden price fluctuations. The data can also be used to design policies that regulate market interventions. Policy can establish rules for when and where governments should release strategic grain reserves or introduce subsidies to cool down or stabilise prices.

AI solutions can also be used to ensure transparent digital marketplaces. AI-powered digital platforms can connect farmers directly with buyers, removing exploitative intermediaries. AI algorithms can instantly verify product quality (*via* CV) and automatically suggest the fairest price based on real-time market data. African governments can enact mandates or incentives for the use of such platforms, increasing market access for smallholders and ensuring transparency in transactions, which is crucial for reducing corruption and guaranteeing fair trade.

Several African countries like Kenya, Nigeria, South Africa, Zimbabwe, and Ghana are leveraging AI in agriculture to boost food supply chains and market efficiency, using solutions for smart farming (Apollo Agriculture in Kenya, Zenvus in Nigeria), crop disease diagnosis (PlantVillage Nuru app), supply chain logistics (Twiga Foods in Kenya), predictive spoilage in

storage (Zimbabwe's AI silos), and precision agriculture *via* drones (Aerobotics in South Africa) [14, 46]. These technologies reduce losses, improve yields, cut costs, and enhance market access for smallholder farmers [4413]. Improved logistics help reduce post-harvest losses (a major policy concern), while better traceability aids in enforcing food safety standards and tackling illegal trade. Therefore, African countries can utilise these insights to design policies and strategies that further enhance their systems.

4.3. Improving Resource Management and Sustainability

Africa's food systems face central resource management and sustainability hurdles, primarily driven by climate change (droughts, floods), poor infrastructure, land degradation, food loss (post-harvest), poverty, limited technology adoption (irrigation, seeds), and reliance on rain-fed agriculture, all straining water, soil, and food security for a growing population [41, 45]. Addressing these challenges requires sustainable practices, improved inputs, better infrastructure, and policy support for resilient and inclusive food systems. Resource management and sustainability are vital for Africa's food systems to ensure food security, boost economic growth, combat climate change, and achieve social equity by improving soil health, water efficiency, biodiversity, and empowering smallholder farmers, preventing resource depletion, and building resilience against climate shocks, which is critical given Africa's growing population and environmental pressures [46].

AI can be leveraged to support policies aimed at the sustainable and efficient use of finite resources, which are critical for long-term food system resilience. African governments can enact policies and incentives that promote AI-driven precision farming. AI tools, often accessible *via* mobile apps, provide hyper-localised recommendations on when and how much to water or apply fertiliser, reducing input costs for farmers and minimising environmental run-off [45]. AI-powered mobile apps can also help farmers instantly diagnose crop diseases and pests from photos, providing treatment recommendations. This supports sustainability policies by optimising the use of scarce resources, reducing costs for farmers, and lowering environmental impacts. Policies can promote these tools to reduce crop losses, minimise the reliance on broad-spectrum pesticides, and ensure food safety through rapid diagnosis.

Africa has been a primary testing ground for AI in agriculture due to the high density of smallholder farmers and the threat of regional crop failures. Countries such as Kenya, Tanzania, and Ethiopia have extensively utilised PlantVillage Nuru, an AI assistant developed by Penn State University in collaboration with the FAO, to identify diseases like Brown Streak and Mosaic Virus in crops like cassava, potatoes, and maise (Consultative Group on International Agricultural Research [48]. In Kenya, it was also used to track desert locust outbreaks. In the Democratic Republic of Congo and Benin, the Tumaini app is used, specifically designed for banana farmer [48]. The app can detect six major banana diseases and pests with over 90% accuracy by analysing photos of any part of the plant (leaf, fruit, or trunk) [49]. In Cameroon, local farmers utilise AI-powered apps that provide offline functionality, enabling them to upload photos in remote areas with limited internet connectivity and receive instant treatment advice [50]. In Nigeria and the Ivory Coast, AI is used to monitor the health of cassava and cocoa, often integrated with satellite data to track the spread of the 'swollen shoot' virus (Global System for Mobile Communications Association [51].

African policy frameworks and strategies can promote the development and scaling of these AI tools to curb the massive crop losses that currently undermine food security on the continent.

4.4. Policy for Enhanced Traceability and Food Safety

AI, often combined with blockchain technology, can create policy frameworks that guarantee the safety and provenance of food by providing real-time traceability systems. AI systems can aggregate data from IoT sensors, farm records, and processing logs, linking this information to an immutable blockchain ledger. This creates an end-to-end digital record of a product's journey from farm to fork. Policies can mandate these transparent traceability standards for high-value or exported goods. In the event of a food safety issue, AI can isolate the contaminated batch and identify the source within seconds [52], allowing for rapid, targeted recalls rather than widespread disruptions.

AI-driven solutions can also provide automated quality control across the food chain. CV and ML are used in processing facilities to automatically inspect, sort, and grade produce based on size, colour, and defect identification, ensuring consistency and safety [13]. Policy can incentivise the adoption of these automated sorting systems to meet international quality and safety standards, which is vital for accessing profitable export markets. AI moves policy from relying on outdated, slow-moving surveys to using real-time, granular data. This ensures policy interventions are effective, financially viable, and directly address bottlenecks in the supply chain and market system.

4.5. Financial Strategies and Agri-Finance Enhancement

AI and ML are key to de-risking and expanding access to financial services. Traditional financial institutions often lack data on smallholder farmers [15]. AI can utilise alternative data sources, such as satellite images of farm health, mobile money transactions, and historical crop yields, to create more accurate credit risk profiles. This enables financial institutions to offer tailored microfinance and small loans to farmers who were previously considered unbankable, thereby boosting investment in their farms. AI can be used for credit scoring among smallholder farmers, utilising non-traditional data sources (e.g., mobile money transactions, satellite imagery of farm health). Policies supporting these models expand access to finance and insurance, enabling farmers to invest in productivity-enhancing tools and technologies. Policies that support financial access for African smallholder farmers are crucial for boosting food security, reducing poverty, and promoting sustainable development by enabling investment in modern inputs, technology, and resilience. This, in turn, fosters economic growth and creates a more inclusive agricultural system through measures such as credit guarantees, digital identity, and tailored financial products.

Several African countries are developing national AI strategies that either directly mention agriculture as a key application area or support AI-driven initiatives (often *via* public-private partnerships), which, in turn, facilitate farmer access to finance. Countries with policies or significant government-backed initiatives influenced by AI to improve financial access by farmers include Kenya. The government supports a thriving agri-fintech scene. The Central Bank of Kenya has implemented policies to facilitate mobile money transactions, which are crucial for digital payments in the agricultural sector. Government entities also collaborate with private firms, such as Apollo Agriculture and FarmDrive, which utilise AI and ML to develop alternative credit scoring models for smallholder farmers who lack traditional collateral [53]. Likewise, Rwanda has a National AI Policy in development and has also implemented the Smart Nkunganire System (SNS), a digital platform that uses data on soil conditions and weather patterns to streamline input distribution. This system supports e-farmer IDs and cooperative registries, which enable farmer groups to access pooled loans and insurance products supported by the government. In Ethiopia, the government has launched

the Digital Agriculture Roadmap (DAR) 2032, which aims to improve farmers' access to financial services through digital tools. State banks and private partners (such as the Cooperative Bank of Oromia) are piloting digital lending platforms that integrate satellite imagery and mobile data to fast-track loan approvals.

In West Africa, several countries are integrating AI to enhance financial access for smallholder farmers. For instance, Ghana has a National AI strategy (launched in 2022) and an emphasis on digital agriculture. The Development Bank of Ghana (DBG) is partnering with organisations to pilot AI-driven chatbots for agricultural guidance and provide authoritative data for hyper-specific farming advice. The government also supports the Ghana Incentive-Based Risk Sharing System for Agricultural Lending (GIRSAL), which incentivises banks to lend to the agricultural sector, leveraging digital platforms and warehouse receipts. In Nigeria, the government supports private sector-led initiatives. Fintech companies such as ThriveAgric and Farmcrowdy utilise predictive data to assess risk and extend credit, a model that benefits from a supportive regulatory tone set by the central bank, which enables digital IDs and flexible collateral laws.

In Zambia, agritech companies such as Apollo Agriculture leverage AI to assess creditworthiness and prevent fraud in farmer lending programmes, operating within a policy environment that is becoming increasingly conducive to digital agriculture solutions. These countries demonstrate a growing recognition of the role AI can play in overcoming traditional barriers to agricultural finance in Africa. However, many are still in the early stages of implementing their policies.

4.6. Addressing Policy Challenges and Promoting Inclusivity

Africa's food systems are widely documented as facing major policy and inclusivity challenges, including marginalisation of women, youth, and smallholder farmers; limited access to resources, finance, and technology; weak infrastructure (energy, transport, storage); power imbalances favouring large corporations; and climate change impacts worsening existing inequalities, all leading to persistent hunger, malnutrition, and unequal economic opportunities despite agriculture's importance [42, 54].

AI can help address systemic policy challenges related to equity and governance. For instance, ML can be used to analyse socio-economic and farming data to improve the targeting of government subsidies and financial aid (such as fertiliser and seeds) to ensure they reach the intended smallholder farmers, youth, and women, reducing leakage and inefficiency [42, 55]. AI can promote inclusive African food systems by empowering smallholders with tailored advice, boosting access to finance, optimising supply chains for equity, and improving sustainability through data-driven insights, all while requiring supportive policies, ethical data use, and a focus on local languages to ensure technology serves marginalised groups like women and youth, aligning with Africa's development goals [56]. In addition, since AI relies on vast amounts of data, policy must focus on establishing clear data governance frameworks. This includes regulations on data ownership, privacy, ethics, and ensuring that AI models are trained on diverse, localised data to avoid bias against indigenous crops, soil types, or marginalised communities.

5. Challenges to AI Implementation and Policy Gaps

For AI to truly transform food systems in Africa, several structural challenges must be addressed through targeted policy and investment. Table 6 summarises the AI implementation and policy gaps in Africa's food systems.

Table 7

AI Implementation and Policy Gaps in Africa's Food Systems

Challenge	Policy / Investment Gap
Data Gaps	Lack of localised, high-quality data on indigenous crops, soil types, and local climates. Most AI models rely on foreign training data.
Digital Infrastructure	Low internet connectivity in rural areas and a lack of reliable, affordable computing power.
Digital Skills Divide	Many smallholder farmers and extension workers lack the basic digital literacy needed to use AI-powered apps and services effectively.
Cost and Access	High cost of AI-enabled hardware (drones, sensors) and software, creating a digital divide between commercial farms and smallholders.
Governance and Ethics	Lack of clear policy frameworks concerning data ownership, privacy, ethical use, and algorithmic bias. AI must empower, not marginalise, smallholder farmers.

Source: Authors

To successfully harness AI in Africa's food systems, African policymakers must focus on creating an inclusive and enabling environment, emphasising connectivity, compute, context, and competency. To invest in connectivity and computing, governments must prioritise public-private partnerships to expand low-cost rural internet infrastructure and shared computing resources. This will make AI accessible to Africa's farmers, most of whom are smallholder farmers and peasants. African policy-makers also need to promote data localisation and governance [57]. This can be achieved by developing national and regional open data policies and incentives for collecting and sharing high-quality, localised agricultural data and by establishing clear ethical guidelines and data privacy regulations. In addition, African countries need to ensure the context and affordability of AI solutions. This requires AI solutions to be multilingual, user-friendly, and designed specifically for the needs of smallholder farmers and local crops. This should be supported by subsidies for low-cost, smartphone-based tools. African countries also need to build competency and capacity. This can be achieved by integrating digital literacy and AI-use training into agricultural extension programmes and farmer field schools.

6. Conclusion

AI is revolutionising the world, including the food system sector. AI is being integrated to address a range of issues in the food system. This article speculated on how AI can be used to improve food system policies and strategies in Africa. Africa's key policy challenges involve overcoming poor governance, corruption, and weak institutions; addressing massive infrastructure deficits and economic dependence on resources; and tackling widespread poverty and inequality. These issues intertwine, making policy implementation challenging and necessitating improved regional cooperation and innovative solutions that transcend traditional approaches. The article revealed that AI holds transformative potential for improving food system policies in Africa by enhancing efficiency, productivity, and resilience across the entire agricultural value chain. By leveraging data-driven insights, AI can help policy-makers and farmers make more informed, timely, and localised decisions. However, poor digital infrastructure, high costs, data gaps, low digital literacy, lack of skilled AI experts, weak regulations, and governance issues, as well as cultural barriers, often combine to create a digital divide, where smallholders are left behind, hindering effective policy

implementation and equitable benefits, despite AI's potential for efficiency and sustainability. The article also proposed some policy directions to bridge the digital divide within Africa's food systems.

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MEASURING THE ORGANIZATIONAL RESILIENCE OF ORGANIZATIONS IN THE REPUBLIC OF MOLDOVA THROUGH ABSORPTIVE, ADAPTIVE AND TRANSFORMATIVE CAPACITIES

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Abstract. The motivation for the study derives from the need to assess the level of resilience of organizations in the Republic of Moldova in the face of economic uncertainty and contemporary crises. The central hypothesis claims that organizational resilience is determined by the interaction between absorptive, adaptive and transformative capacities, and their balance reflects institutional maturity. The purpose of the research was to measure and compare these dimensions using the integrated organizational resilience questionnaire, applied to a sample of respondents from private companies, public institutions and NGOs. The methodology included descriptive statistical analysis, transformation of criterion means on a percentage scale (0–100). The results showed an average level of organizational resilience of 56.9, with close values for absorptive capacities 57.3, adaptive 58.0 and transformative 55.5. The conclusions highlight the need to strengthen transformative capacity and invest in innovation and digitalization, as premises for the maturation of organizational resilience in the post-crisis context.

Keywords: *organizational resilience, absorptive capacity, adaptive capacity, transformative capacity, change management, institutional sustainability, empirical evaluation, organizational maturity*

Rezumat. Motivația studiului derivă din necesitatea evaluării nivelului de reziliență al organizațiilor din Republica Moldova în fața incertitudinii economice și a crizelor contemporane. Ipoteza centrală susține că reziliența organizațională este determinată de interacțiunea dintre capacitățile de absorbție, adaptare și transformare, iar echilibrul acestora reflectă maturitatea instituțională. Scopul cercetării a fost măsurarea și compararea acestor dimensiuni utilizând chestionarul integrat de reziliență organizațională, aplicat unui eșantion de respondenți din companii private, instituții publice și ONG-uri. Metodologia a inclus analiza statistică descriptivă, transformarea mediilor criteriale pe o scală procentuală (0–100). Rezultatele au arătat un nivel mediu de reziliență organizațională de 56,9, cu valori apropiate pentru capacitățile de absorbție 57,3, adaptive 58,0 și transformative 55,5.

Concluziile evidențiază necesitatea consolidării capacității transformative și a investițiilor în inovare și digitalizare, ca premise pentru maturizarea rezilienței organizaționale în contextul post-criză.

Cuvinte cheie: *reziliență organizațională, capacitate de absorbție, capacitate adaptivă, capacitate transformativă, managementul schimbării, sustenabilitate instituțională, evaluare empirică, maturitate organizațională.*

1. Introduction

Currently, we have various studies that describe, measure, present, analyze resilience as an economic, managerial, technical, political, functional characteristic, etc. This term has become increasingly popular since the moment when society collided with major shocks for which it was not quite prepared, and the capacity to resist them would be the meaning of the term resilience. For the study proposed by the authors, the particularities of the organizational management of entities in the Republic of Moldova to adapt, conform and transform resiliently to the action of shocks were studied, analyzed and discussed.

The most important studies on the subject of resilience are focused on measuring and assessing the capacity of organizations to withstand and adapt to shocks. The most important thing is to understand how an organization can not only withstand adverse events, but also adapt and thrive in the aftermath of them. We find such statements in several authors. Thus, we mention that Jenkins, B. M. in his study states that resilience assesses the capacity of a system to withstand and recover from disturbances, while maintaining its structure and function. The paper identifies potential failure paths, critical variables and their thresholds related to system failure. This assessment informs management interventions aimed at reducing vulnerability and improving recovery [1]. A more complex approach that describes circular resilience assessment tools in four steps is described in De Marchi, M.,et al. [2]. The study conducted by this team of researchers constitutes a qualitative risk and vulnerability assessment of resilience factors. The paper also addresses the identification of appropriate strategies and a quantitative assessment of organizational performance after shocks. This multifaceted approach assesses a company's resilience before, during, and after crises, balancing qualitative and quantitative aspects between technical, social, and organizational dimensions. In the same vein, the research group Aradhya, S. G. B., et al. [3] also states measuring an organization's capacity to adapt and recover from adversity. They propose a comprehensive framework for measuring resilience, which should include conceptual clarity, operational definitions, assessment tools, and contextual considerations. The paper delineates and characterizes the 3 categories of resilience, such as individual, community, and systemic resilience. This multifaceted approach allows for a nuanced understanding of resilience as both a process and an outcome, enabling organizations to effectively assess and improve their resilience capabilities, the authors argue in the published study.

With a global approach to measuring resilience, the authors Kyzym, M. O., et al. address the scientific community in their work entitled The Instruments for Assessing the Vulnerability and Resilience of Economies Around the World [4]. The authors argue that assessing resilience involves assessing the capacity of an economy to adapt, recover and maintain stability in the face of shocks, identical to the phenomenon at the microeconomic level. The key criteria studied and assessed include adaptability, reliability, recovery speed, redundancy, flexibility and diversity. The authors state that methodological approaches to measuring key criteria can be classified based on the assessment objectives and time

intervals, using various methods, such as baseline conditions, threshold values, comparative assessment and recovery rate scores. However, despite the diversity of existing and proposed measurement tools, a comprehensive indicator is needed to effectively compare levels of resilience worldwide.

A recent study, which has made an important contribution, is presented by the team of authors who developed a new assessment method called CERA (Critical Entities Resilience Assessment) [5]. The research is related to the European regulatory framework on the resilience of critical entities, that is, those organizations that provide vital services to the population such as energy, transport, water or healthcare. The authors make direct reference to the European Union Directives on the Resilience of Critical Entities CER Directive - 2022/2557 [6]. This is a semi-quantitative method designed to allow critical entities to comprehensively self-assess their internal resilience. The CERA method stands out in that it assesses resilience on two essential dimensions, organizational resilience and infrastructure resilience, which are often treated separately by other tools. The results of the CERA assessment help critical entities identify specific vulnerabilities, based on which they can define and implement concrete measures with the establishment of service instructions and technical actions to increase their level of resilience.

Given that the most recent shocks to which organizations worldwide have been subjected are related to the fields of health and environment, studies in these fields have also contributed to the development of resilience assessment methods. In this context, resilience assessment according to Makhoul, N., & Argyroudis, S. involves the assessment of the capacity of cities, infrastructure and societies to withstand and recover from disasters [7]. The authors use various tools that incorporate modules for loss assessment, hazard identification, damage assessment and recovery planning. These tools aim to facilitate decision-making and increase preparedness against different hazards. The paper reviews existing resilience assessment tools, discussing their developments, limitations and future needs, highlighting the importance of supporting the functionality and operability of critical infrastructure during and after hazard events.

Tonga, C., et al. present a study with reference to healthcare organizations, focusing on the approach to resilience through the lens of three elements: mapping, capacity, and strategy [8]. The mapping would present the basic functions of the organization, capacity being based on the characteristics of resilience, and strategy being represented by those strategies for the period of resilience.

In the same field we also find the research of the authors Yu, P., et al., who talk about resilience assessment methods for hospitals, especially during earthquakes, to assess their ability to maintain medical and social services [9]. These methods are classified into indicator-based and functionality-based approaches. Performance measures for quantifying hospital functionality include availability, productivity, quality, and hybrid values. This assessment helps stakeholders and managers understand the resilience levels of hospitals, which is essential for designing new facilities and optimizing existing ones for better earthquake preparedness and response.

Approaching the subject of resilience at the organizational level, attributes the concept directly to enterprises, institutions and other forms of organization. In the view of several authors, organizational resilience represents the capacity of an entity to survive, adapt and thrive in the face of sudden changes or adversity. In other words, resilience is the ability to recover quickly or to adapt effectively to unfavorable situations or major and significant changes.

As a result of the studies, we have come to the conclusion that organizational resilience is the capacity of an organization to anticipate, absorb the impact and recover from a disruption or crisis, allowing it to achieve its objectives and emerge stronger from the respective experience. So, we concretize the three elements that we will evaluate through the qualitative method using a sample of respondents who are representatives of organizations in the Republic of Moldova and who will expose their own perceptions on the three elements resulting from the confrontation of the organizations they are part of with shocks. The analysis of these data will allow us to outline an opinion regarding the level of resilience of local organizations when confronting shocks.

2. Materials and Methods

The purpose of the study is to measure the level and identify the typology of organizational resilience of enterprises in the Republic of Moldova in relation to fundamental dimensions such as absorption, adaptation and transformation in the post-crisis period.

The research in question is based on several hypotheses in the context of establishing the capacity of organizational resilience for organizations in the Republic of Moldova represented by their absorptive capacity, adaptive capacity and transformative capacity. These three dimensions are interdependent and ensure the sustainability of organizations in their confrontation with the turbulent environment created by various external factors. It is considered that organizations that have resilience mechanisms to shocks that they have accumulated from experience can demonstrate a higher level of organizational resilience. Measuring each dimension of the complex index of organizational resilience created premises for several hypotheses, however, the main hypothesis is:

H There is a positive and significant interdependence between the absorptive, adaptive and transformative capacities of organizations, which together contribute to the formation of the global index of organizational resilience. In complementing the hypothesis, we state that the level of organizational resilience differs significantly depending on the size and type of organization, and organizations with previous experience in managing crisis situations obtain higher scores on the adaptive and transformative dimensions.

The hypothesis is tested on data collected from a sample of 150 respondents, representatives of 150 organizations from the territory of the Republic of Moldova who participated in a survey organized by the authors over a period of 3 months. The representativeness of the sample is validated by the control question through which 99% of respondents confirmed the organization's confrontation with shocks and the undertaking of resilient measures, as well as by the uniform distribution of the sizes of the organizations involved in this study. Interpreting the results and measuring the assessed dimensions as well as determining the average level of resilience for the segment of organizations involved in the study allows validating the hypotheses, as well as identifying the priority dimensions for strengthening organizational resilience in the analyzed context. The study will constitute a theoretical-applicative foundation for further research, but also for creating the premises for strengthening actions for maintaining and increasing organizational resilience.

The methodology used in this study is based on several tools for the achievement of each separate element. Data collection by questionnaire method, item formulation using the grouping method, item estimation by Likert scale, analysis of the collected database by statistical method, interpretation of the results by graphical methods.

The dimensions studied are: Absorptive capacity (A), Adaptive capacity (D), Transformative capacity (T). The calculation of the average value on each item of the evaluated dimensions will be done by the formula:

$$\overline{x} = \frac{\Sigma(f_j * j)}{N} \quad (1)$$

Where $\overline{x}$ is the mean on each item

f_j is the number of ratings on each value

j is the rated value

N is the total number of values

The determination of the average value on each item will be determined by the arithmetic mean method. And the transformation of the size coefficient on the interval will be calculated according to the formula

$$Q_{RO} = \frac{(\overline{\Delta} - 1)}{4} \quad (2)$$

The assessment of organizational resilience is structured in the requirements of the ISO 22316:2017 Security and resilience standard. Organizational resilience. Principles and attributes. The interpretation of the study results according to this standard is presented in Table 2. This represents the extent to which an organization is able to absorb the impact of changes expressed by adapting to the conditions of change, transforming internal phenomena and ensuring continuity capacity. According to the standard, there are no established numerical values but conceptual levels Q that would express low, medium and high capacity maturity for measuring and interpreting the level of organizational resilience in order to ensure the long-term sustainability of the organization. Therefore, the established conceptual levels Q are < 50; 50–74.9; ⩾ 75 according to the standard, which will allow the assessment and comparison of the level of resilience for the transposition of the established real facts.

Table 1

Interpretation of results

Q_{RO} or (0–100)	**Resilience Level**
< 50	Low
50–74,9	Average
⩾ 75	High

Source: compiled by the author based on data from the ISO standard

The Q level < 50 tells us about a partial fulfillment of the requirements of the standard and in conclusion constitutes a low resilience. This value characterizes our organizational resilience with aspects of leadership, coordination of activities, learning characterized by reduced mechanisms, and adaptive culture, anticipation of phenomena and resources as uneven and poorly integrated.

To correspond to the stage of resilience included in the range Q = 50–74.9, according to the standard the organization fulfills a significant part of the attributes for which management processes are considered insufficiently consolidated. The estimation of organizational resilience processes characterized by the absorptive, adaptive and transformative attributes of the organization is considered as medium resilience. The value Q⩾ 75 represents a high resilience and is characteristic of those organizations that demonstrate a capacity for

anticipating crises, a high adaptive and transformational reaction according to the conceptual requirements of the standard of operational continuity and strategic adaptability.

The results of the database analysis accumulated through the Google Forms platform will be used to interpret the data.

3. Results and Discussion

In achieving the research objectives, the authors resorted to various theoretical and applied tools to select and correctly interpret the results, while special attention was paid to the representativeness and nuance of organizations at the national level in order to create a representative conclusion. When identifying specific factors to anticipate, respond to and adapt to shocks faced by organizations in the Republic of Moldova, two parallel directions were analyzed based on the constraints and economic realities in which they carry out their economic activity. Segmenting organizations by type is important in studying and measuring organizational resilience. Organizations from different fields of activity face different risks and shocks dependent on the internal environment of the organization such as supply chains, organizational culture, management and governance of financial resources, human resources. At the same time, we mention that external factors generate more risks and shocks to which organizations must adapt, among which the most frequent are price fluctuations, the technical-scientific revolution, political changes, public financing, foreign investments, regulations. Thus, we find the need to diversify the sample as much as possible depending on the type of organization with reference to the main viable sectors but also by the number of employees to ensure national representativeness. The size of the organization is an important variable on the one hand, being one of the international criteria for classifying enterprises, and on the other hand, a control variable that directly influences the organization's ability to be resilient. Thus, large organizations have sufficient financial resources and have a diversified human capital, which allows them to be more receptive to shocks and to more easily absorb the changes initiated. They have priority over medium and small ones in that they can afford investments in long-term adaptation solutions.

Small and medium-sized organizations are limited in resources, thus being even more vulnerable to shocks. For the Republic of Moldova, the segment of organizations in this category is particularly important because 90% of the organizations in the country are in this category. Therefore, one of the objectives of the study will be oriented towards identifying viable solutions to increase the level of organizational resilience for this category. Unlike large organizations that have greater adaptability to shocks, small organizations do not suffer from factors such as bureaucracy, complex processes and slow decision-making and have more chances to increase agility and flexibility to compensate for the lack of resources. The dominance of this segment of organizations in the survey results ensures a major representativeness and makes the results viable for an effective policy of the economy of the Republic of Moldova.

Analyzing the database collected to measure the organizational resilience of organizations in the Republic of Moldova, through respondents, it has the following characteristics. The research sample was made up of a representative number of respondents coming from organizations of different legal types and sizes, so as to reflect the structural diversity of the analyzed organizational environment.

According to the data illustrated in the first diagram, the majority of respondents 73.9% come from private companies, indicating a predominance of the business environment in the study. Public institutions hold a share of 20.9%, and non-governmental organizations

represent 5.2% of the total participants. This structure suggests a predominantly economic orientation of the research, but also a balanced representation of the public sector, which allows for useful comparisons on how different institutional entities manage resilience in contexts of uncertainty.

The data in the second diagram reveal a significant diversity in the size of the participating organizations: 27.8% of the organizations are microenterprises; 43.5% are small enterprises; 21.7% fall into the category of medium-sized enterprises; 7% represent large organizations, with over 250 employees. Thus, over 70% of the respondents come from small and microenterprises, which confirms that the study mainly reflects the resilience capacity in the SME sector, a segment extremely sensitive to risks and environmental changes. At the same time, the inclusion of large organizations and public institutions provides a useful comparative perspective in the analysis of differences in resilient maturity.

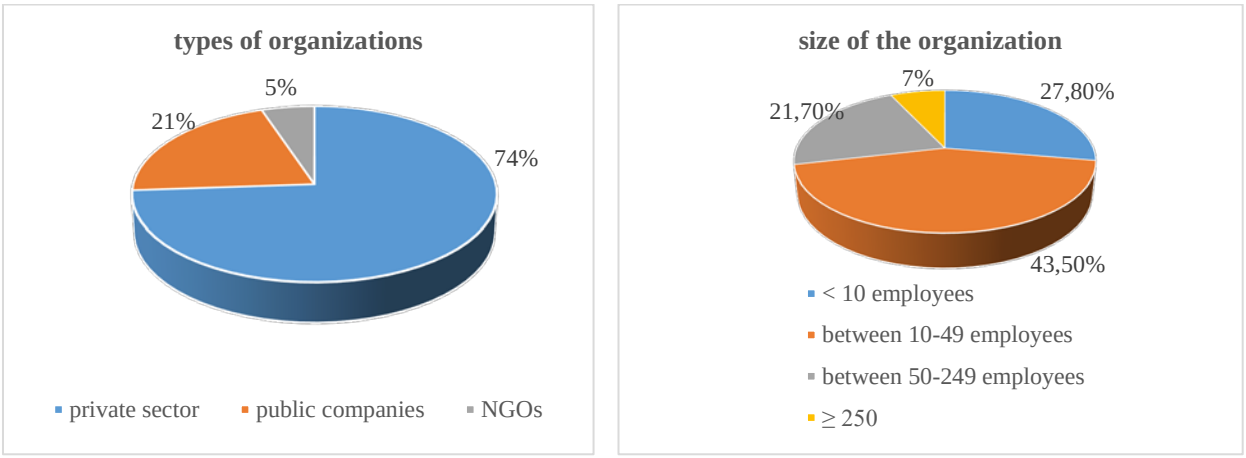

Figure 1. Sample characteristics.
Source: developed by the authors based on survey results.

Overall, the sample profile can characterize its representativeness and allows for the measurement of the organizational process, but also for testing hypotheses regarding the relationship between the type of organization, its size and the level of organizational resilience. This sample structure gives the study empirical relevance and comparative validity, allowing for the analysis of how different types of organizations manage the three fundamental dimensions of resilience – absorptive, adaptive and transformative.

By analyzing the results of the respondents' evaluation of the absorptive capacity of the organizations they belong to, we were able to build a table of estimated values from 1 to 5 interpreted from the lowest value to the highest.

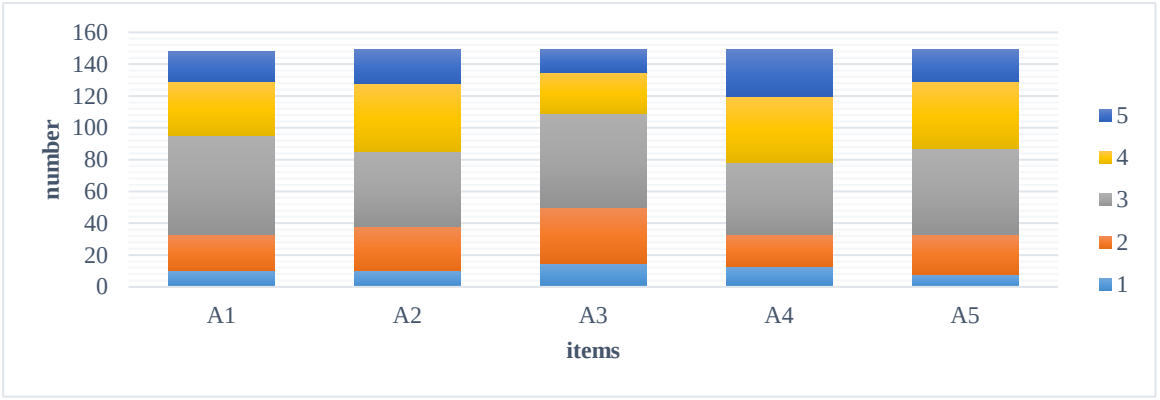

Figure 2. Distribution of the estimation of absorptive capacity items A1-A5.
Source: developed by the authors based on survey results.

We establish that this profile is determined by a moderate functionality of the reaction mechanisms and operational continuity, which is characteristic of an average level of resilience. This trend is built by the dominance of the appreciation value with a score of 3 out of 5 for all five items proposed for evaluation. This fact confirms the hypothesis that all organizations have basic structural elements for managing crisis situations, but it is found that these are not sufficient to strengthen the absorption capacity and the uniform application of resilience to all internal processes of the organization. Analyzing the absorption capacity items separately, we observe that on A1 there are still continuity plans within the organizations in the case of certain shocks. The weak position being defined by the poor financial preparation of the organizations to face the shocks being presented as a vulnerability by item A2. Respondents estimating the functioning of critical processes for item A3 led us to the conclusion that there is a fairly low level of operational security. This estimate is supported by fundamental theories that tell us that small and medium-sized organizations are more exposed to technological malfunctions and human resource fluctuations, which influence these processes in the case of external shocks. On the other hand, the existence of certain instructions regarding crisis situations and certain shocks that have previously existed suggests that most organizations are cautious in analyzing risks based on elements of certainty. This fact can also be attributed to the latest major manifestations of the shock created by the COVID 19 pandemic, to which organizations have already created several intervention procedures in this crisis situation. Regarding the evaluation of external support networks, we observe a balanced distribution between the award of scores from 3 to 5, indicating a developed collaborative capacity.

Overall, the structure of the results estimated by the respondents confirms that the organizations are in a relatively intermediate stage of absorptive resilience regarding the establishment of organizational resilience. This attests to the fact that the organizations draw attention to the mechanisms of functioning and reaction in case of the occurrence of shocks, but nevertheless they should not neglect the strengthening of protection against shocks and the implementation of plans at the departmental level for confronting certain crisis situations.

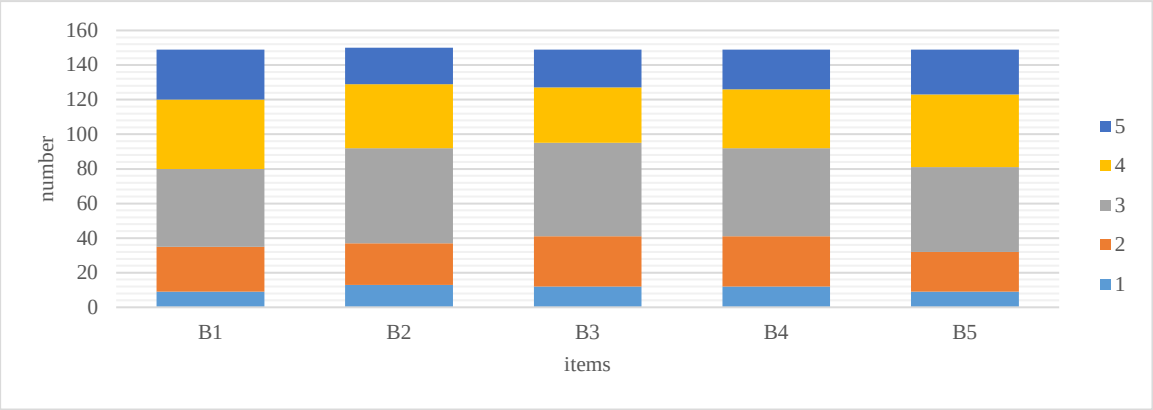

Figure 3. Distribution of the estimate of adaptive capacity items B1-B5.
Source: developed by the authors based on survey results.

Figure 3 presents the results of the respondents' assessment of the adaptive capacity of the organizations they belong to. This assessment leads us to the conclusion that the adaptive capacity has a moderate to high level, which denotes better abilities of organizations to learn to adjust and reorganize resources depending on the changes that occur in the internal and external environment. For the items in category B, the average score is 3

completed in equal proportions of 4 and 5, which indicates the presence of functional adaptive mechanisms within the organizations but uneven. The assessment of item B1 by respondents with the highest weight out of the 5 estimated, demonstrates that all organizations are aware of the danger of the presence of shocks, and from the lessons learned after successfully overcoming some of them, they implement post-crisis processes to ensure effective organizational resilience.

From the results of the assessment of the adaptation of processes to the external context, i.e. B2, the respondents feel a level of flexibility of the organizational management. However, there are premises for increasing operational maturity and strengthening the implementation of the conditions of the reference standard. Item B3 of the assessment appears as a relevant structure of the process of rapid reallocation of resources, thereby ensuring a reasonable capacity for internal mobility. At the same time, for small and medium-sized enterprises this constitutes a difficulty related to the limit of available resources. Organizations are open to periodic training of personnel for unforeseen situations, however, the frequency of personnel training is not sufficient to ensure a complete reaction by the members of the organization. For item B5, the respondents created a good image of the culture of learning and innovation, which denotes an organizational climate developed towards innovation and experimentation.

These two conditions constitute the main stage of confrontation of adaptation to transformation for organizations, and the positive estimate of this item leads to promising conclusions for organizational resilience for the analyzed enterprises from the Republic of Moldova participating in this questionnaire. Overall, items B1-B5 indicate an adaptive capacity with a medium to high value, marked by strengths focused on learning from previous crises in the organizational culture. This demonstrates to us that organizations from the Republic of Moldova are at an intermediate stage of maturity regarding organizational resilience, and the results of the study will strengthen the directions of increasing resilience to achieve a higher level of adaptability.

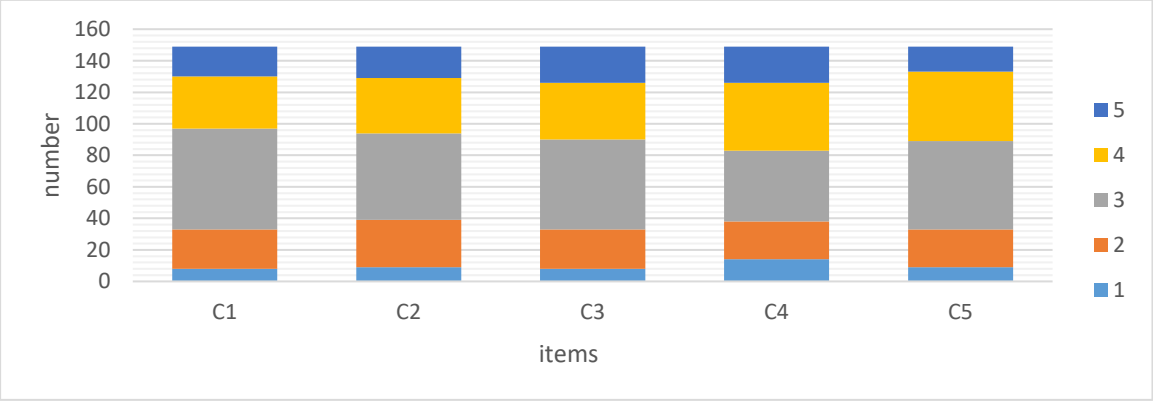

Figure 4. Distribution of the estimate of transformative capacity items C1-C5.
Source: developed by the authors based on survey results.

The results related to transformative capacity, which represents the third characteristic of organizational resilience estimated by the respondents co-opted to the questionnaire, indicate a moderate to medium level of the organization's abilities to initiate and implement structural changes, strategic investments and innovation processes. This result is expected, due to the small and medium-sized enterprise segment, predominantly of the national economy, which is less characterized by strategic investments and receptivity to innovation processes, although the government has established strategic objectives for supporting and

developing innovations for this segment of enterprises, including concrete support measures. The distribution of responses regarding the estimation of these items is the value 3, which represents a middle value and characterizes the transformative capacity as one at the early stage.

From the detailed analysis of each item, it is found that C1 represents a presence of changes in some organizations, but not at the level of transformation but at the level of structural change. However, changes cause some risks, and organizations are not prepared to face several risks simultaneously. Estimating item C2, respondents marked a moderate level of digitalization and modernization to face certain substantial transformations of the organizational process. The result is explained by financial constraints and the reduced capacity for adoption of technologies by the small and medium-sized enterprise segment. Adaptation of organizational policies and values indicates a capacity of organizations to adapt to the needs created by certain global crises through operational processes and not with long-term strategic objectives. Item C4 is one of the strongest of the transformative capacity, which is focused on intersectoral partnerships. Developing collaboration with the external environment is a major opportunity to withstand certain shocks, while also ensuring an important component of organizational resilience, also defined by some international organizations as a primary objective for confronting external shocks. However, C5 expresses the lack of tools for organizations to create vulnerability analysis mechanisms, although they are aware of their importance.

From the analysis of the three elements of organizational resilience formation, we find that most organizations in the Republic of Moldova are at the emerging stage of transformation with certain characteristics oriented towards the formation of strategies oriented towards strengthening resilience. These results clearly point us to the need to strengthen organizational processes to stimulate innovations, investments in new technologies and the development of strategic analysis mechanisms.

Using the results of the estimates with values for each item that corresponds to an element of the organizational resilience characteristic, we apply the calculation formula to determine the average value for items and areas of influence. The calculated values are presented in Table 1.

Table 2

Calculation of the average value on items and domains of organizational resilience

Items (A)	$\overline{x}_A$	Items (D)	$\overline{x}_D$	Items (T)	$\overline{x}_T$
A1	3,22	D1	3,47	T1	3,18
A2	3,35	D2	3,22	T2	3,20
A3	2,95	D3	3,20	T3	3,32
A4	3,61	D4	3,22	T4	3,24
A5	3,30	D5	3,47	T5	3,16
$\overline{\Delta}_A$	3,29	$\overline{\Delta}_D$	3,32	$\overline{\Delta}_T$	3,22

Source: made by the authors based on the interpretation of the results of the accumulated database.

The data presented in the table indicate a relatively balanced distribution of the mean scores for the three dimensions of organizational resilience, ranging between 3.22 and 3.32 on the Likert scale with values between 1–5. The highest mean value is recorded for the adaptive capacity $\bar{x}_D$ = 3.32, which suggests that organizations demonstrate a moderately developed ability to learn and continuously adjust to changes. This is followed by the absorptive capacity $\bar{x}_A$ = 3.29, which reflects a good reaction to shocks and the existence of

continuity mechanisms, but still insufficiently consolidated. The lowest value is observed for the transformative capacity $\bar{x}_T$ = 3.22, signaling that innovation and structural change are processes at an early stage.

Table 3

Integrated assessment of organizational resilience

Size	Q_{RO}	Organizational Resilience Level	Main meaning according to ISO 22316:2017	Recommended measures
Absorptive capacity	57,3	Average	Resilience and resilience	Annual BCP review, crisis simulations, IT plan testing
Adaptive capacity	58,0	Average	Continuous learning and adjustment	Creating an internal learning and experience exchange platform
Transformative capacity	55,5	Average	Systemic reform and innovation	Introducing a "Strategic Innovation Committee" and annual transformation report
$\overline{Q}_{RO}$	56,9	Average		Strengthening the components of continuous learning, digitalization and strategic innovation can contribute to the transition to a high level of resilience, according to international standards

Source: made by the authors.

Overall, the results highlight an average level of organizational resilience, with a positive tendency towards adaptability, but with the need to strengthen the transformative dimension in order to achieve a higher degree of resilient maturity.

To interpret the data, an analysis of the size coefficient by interval was performed for each dimension (A), (D), (T) and the level of resilience was determined in accordance with the norms established for each type.

The hypothesis mentioned at the beginning of the study was tested by analyzing the data collected from the questionnaire applied to an eligible sample of 150 respondents with pronounced characteristics of the business environment representing small and medium-sized enterprises. The integrated organizational resilience estimate QRO demonstrated an average result of absorptive, adaptive and transformative capacity of the organizations participating in the study. The interpretation of the statistical results allows partial validation of the hypotheses and the identification of priority dimensions for strengthening organizational resilience in the analyzed context.

This study becomes a component part of the multiple research conducted by the authors who studied various phenomena related to the resilient management of the Moldovan community. Such studies complementary to our research, but with an impact on organizations, we mention the study conducted by Spătaru T.[10] conducted in 2024 in the Republic of Moldova, using focus groups and in-depth interviews to explore managers' perceptions of community risk management and resilience strategies. We consider important certain studies of resilience estimation conducted in areas of the national economy and which constitute factors of influence or creation of certain risks for organizations in the Republic of Moldova. Thus, Ungur C.[11] conducted a study estimating the insurance market through which he analyzed the aggregate indicators of the market through which he argued its

absorption capacity in shock conditions. Another study by Stratan A., et al. [12] focuses on assessing resilience in agri-food security, highlighting the need to adapt to vulnerabilities in the agricultural sector in the Republic of Moldova. The study by Şavga L. [13] highlights the need for reorganization, digitalization and investments in strengthening the capacities of cooperatives and emphasizes the importance of aligning cooperative policies with EU practices to ensure competitiveness and long-term sustainability. The author Copăceană C. [14] presented the results of a study on financial sustainability in the health system in the Republic of Moldova, in the post-crisis context, for which she considers that the problem of resource allocation is not unique to this sector, but also a problem of resilience and strategic adaptation capacity. A study that confirms the research hypothesis is reflected in the approach of the authors Timuș A., Ulinici A., [15] who state in a study that companies that adopt sustainable and resource-efficient practices strengthen their resilience, becoming less vulnerable to market fluctuations and strict regulations on carbon emissions. Other studies such as the one conducted by a group of researchers PopaV. et al. [16] identify other adaptive factors for the organizational management of enterprises in the Republic of Moldova, such as resistance to vulnerabilities regarding the provision of energy resources, which increases the need to use technologies and innovations to adapt organizations to these shocks.

4. Conclusions

The research has a descriptive-analytical and explanatory nature, being based on the sociological survey method, with a quantitative approach using a 5-point Likert scale and complemented by a qualitative interpretation of the results to identify the level of organizational resilience. The selection of respondents targeted organizational diversity according to the size, field and type of organization to ensure the relevance of the application of the recommendations resulting from determining the average organizational resilience level. The evaluation model used by the authors according to the selected methodology was established based on the ISO 22316:2017 Security and resilience standard. Organizational resilience [17]. Principles and attributes, for assessing the resilience novel, which can be adapted to the economic and institutional context of the Republic of Moldova. The results indicated an average global level of organizational resilience with a value of 56,9 was determined by the three absorptive, adaptive and transformative dimensions with close integrated values. These values place the participating organizations in the “consolidable resilience” category, which reflects an intermediate maturity stage, characterized by developed reaction and adaptation mechanisms, but a still incipient structural transformation. At the same time, we mention the limited nature of the research due to the relatively small sample size and the self-evaluative nature of the responses. However, these limitations do not affect the validity of the descriptive and interpretative conclusions, but provide directions for further research.

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STRATEGIC BRANDING AS A DRIVER OF LONG-TERM EQUITY

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Abstract. In conditions of global market saturation and product parity, firms increasingly rely on intangible assets to sustain competitive advantage. This study is motivated by the hypothesis that systematic branding transforms a registered trademark into a strategic asset capable of generating measurable financial and relational value. The purpose of the research is to conceptualize branding as an integrated managerial process and to examine its impact on market performance and enterprise value. The study applies qualitative synthesis of classical and contemporary brand equity theories, combined with analysis of empirical observations from regional and global markets. The findings demonstrate that consistent brand investment reduces price elasticity, strengthens consumer psychological commitment, and enables firms to achieve sustainable price premiums. The research confirms that branding functions not merely as a communication activity, but as a capital investment embedded in corporate strategy. The novelty of the study lies in clarifying the causal mechanisms underlying trademark-to-brand transformation and in substantiating branding as a long-term value creation instrument with practical implications for strategic marketing and corporate governance.

Keywords: *brand equity, intangible assets, long-term value, marketing, price premium, sustainable advantage, trademark , value creation.*

Rezumat. În condiții de saturație a pieței globale și paritate a produselor, firmele se bazează din ce în ce mai mult pe active necorporale pentru a-și menține avantajul competitiv. Acest studiu este motivat de ipoteza că brandingul sistematic transformă o marcă înregistrată într-un activ strategic capabil să genereze valoare financiară și relațională măsurabilă. Scopul cercetării este de a conceptualiza brandingul ca un proces managerial integrat și de a examina impactul acestuia asupra performanței pieței și valorii întreprinderii. Studiul aplică sinteza calitativă a teoriilor clasice și contemporane ale capitalului de marcă, combinată cu analiza observațiilor empirice de pe piețele regionale și globale. Rezultatele demonstrează că investițiile constante în brand reduc elasticitatea prețului, consolidează angajamentul psihologic al consumatorilor și permite firmelor să obțină prime de preț sustenabile. Cercetarea confirmă faptul că brandingul nu funcționează doar ca o activitate de comunicare, ci ca o investiție de capital încorporată în strategia corporativă. Noutatea studiului constă în clarificarea mecanismelor cauzale care stau la baza transformării de la marcă înregistrată la marcă și în fundamentarea brandingului ca instrument de creare a valorii pe termen lung, cu implicații practice pentru marketingul strategic și guvernanța corporativă.

Cuvinte cheie: *capital de marcă, active necorporale, valoare pe termen lung, marketing, primă de preț, avantaj sustenabil, marcă înregistrată, creare de valoare.*

1. Introduction

In the contemporary environment of global competition and accelerating market saturation, sustainable competitive advantage increasingly depends on intangible assets rather than solely on functional product characteristics. Branding has evolved from a communicative instrument into a strategic mechanism of value creation and long-term differentiation.

The theoretical foundations of brand management were established in classical marketing literature. Aaker conceptualized brand equity as a measurable intangible asset determining firm value, he introduced the concept of brand equity as a key intangible asset, emphasizing consumer awareness, perceived quality, loyalty, and associations [1]. However, Kapferer's framework provides limited operational guidance for integrating branding into long-term corporate strategy. He introduced the brand identity prism, emphasizing internal coherence and symbolic consistency. This model presents the brand as a multidimensional identity system requiring alignment between appearance, personality, culture, consumer relationships, reflection, and self-image [2]. Keller developed the Customer-Based Brand Equity (CBBE) model, linking brand strength to accumulated consumer knowledge and associations [3]. Kotler and Keller positioned branding within strategic marketing management and corporate value creation [4].

Although these approaches differ conceptually — economic resource perspective [1], identity system perspective [2], psychological construct perspective [3] — they converge in recognizing branding as a determinant of sustainable competitive advantage.

Iglesias, Ind, and Alfaro introduced [5] a co-creation model**,** where consumers actively participate in building brand meaning. Recent studies have extended branding theory into digital and co-creation contexts. Iglesias et al. highlighted stakeholder co-creation of brand meaning, while Gensler et al. demonstrated the transformation of brand perception in social media environments [6]. Sustainability-oriented branding research further emphasizes ethical and ecological dimensions of brand trust [7]. However, despite this expansion, the strategic integration of branding into corporate planning processes remains insufficiently systematized. For this reason, the author (as CEO of *Promarketing Agency* (PMA) and university lecturer of *Technical University of Moldova* (UTM)*/ Academy of Economic Studies of Moldova* (ASEM)) conducted a series of branding studies at both regional and international levels within the framework of strategic marketing during 2023–2026. The objective of this study is to conceptualize strategic branding and identify the factors that determine brand strength and failure. The research also seeks to identify the mechanisms that enable the accumulation of brand equity and allow firms to command price premiums for branded offerings [8]. Based on his practical experience and numerous conducted studies, the author began to incline toward the conclusion that brands are developed over time rather than emerging spontaneously.

This divergence reveals a key theoretical gap: whether strong brands primarily emerge from cumulative market interactions or from deliberate strategic design. Despite these advances, the strategic integration of branding into corporate planning remains insufficiently explored. Building upon the evolutionary perspective of market offerings — product → registred trademark → marketed trademark → brand — this study addresses this gap by

conceptualizing branding as a deliberate managerial process that transforms legally registered trademarks into market-recognized, strategically managed brands capable of generating sustainable competitive advantage.

Accordingly, the study proposes the following hypothesis:

Sustainable brand equity is primarily the result of deliberate strategic brand management embedded in corporate strategic branding and marketing planning rather than spontaneous market evolution.

The object of the research is strategic brand management within strategic marketing planning. The subject concerns the mechanisms and instruments through which trademarks are transformed into brands capable of generating long-term competitive advantage.

Recent studies have increasingly emphasized the role of branding in small and emerging economies, particularly in the context of digital transformation. At the same time, the growing importance of digital capabilities has been confirmed by recent research, which shows that firms in emerging markets must develop digital competencies to remain competitive in increasingly platform-driven environment. These findings are complemented by studies on nation and place branding, which underline that small economies face structural challenges but can enhance their global positioning through strategic branding and innovation-oriented communication [9].

Overall, contemporary research confirms that the intersection of branding, digital transformation, and emerging market dynamics represents a rapidly evolving field, reinforcing the relevance and timeliness of the present study.

The purpose of the study is to conceptualize trademark-to-brand transformation as a systematic managerial process and to clarify its role in enterprise value creation. To achieve this objective, the research:

(1) examines the evolution of branding theory;
(2) analyzes classical and contemporary approaches;
(3) evaluates the relationship between strategic planning and brand equity formation;
(4) develops an integrative framework of strategic brand management.

By addressing this theoretical gap, the paper contributes to marketing science by clarifying the causal logic of brand formation and reinforcing branding as a core strategic capability of modern firms. Contemporary researchers emphasize that a brand is formed at the intersection of three components:

- visual identity;
- value-based content;
- communication with the target audience.

At the same time, the role of the brand extends far beyond marketing: it becomes a tool for managing reputation, corporate culture, and even investment attractiveness. The sustainability of a brand is ensured only under conditions of comprehensive strategic brand management — from brand architecture to the development of long-term relationships with consumers.

2. Materials and Methods

The methodological framework of this research is grounded in strategic marketing theory and contemporary brand management research. The study is based on a long-term research program (2003–2026) focused on strategic branding and trademark-to-brand transformation.

Research Design

The research applies a qualitative multi-method design integrating:

- comparative theoretical analysis;
- content analysis of academic publications (1996–2025);
- cross-case comparative analysis of international and national brands;
- interpretive conceptual synthesis.
- marketing researches in Romania, Moldova and Ukraine (2003-2026).

The empirical base includes secondary data from corporate reports, international brand rankings (e.g., Interbrand, Brand Finance), and market databases. Additionally, observational data were collected from branding practices in European, Ukrainian, and Moldovan markets (2013–2026), with particular attention to post-pandemic and Russian-Ukrainian war strategic repositioning.

Sampling and Case Selection

Case selection followed purposive sampling principles. International brands were selected based on consistent presence in global brand valuation rankings, while Moldovan brands were selected based on market leadership and long-term experience, export activity, and strategic brand development initiatives. This allowed comparative evaluation of branding maturity across developed and emerging markets.

Variables and Analytical Procedures

The study operationalized three principal variables:

1. **Brand strength** — measured through qualitative indicators: brand awareness, loyalty, perceived quality, differentiation, symbolic associations.
2. **Consumer perception stability** — assessed via reputation metrics, public positioning consistency, and stakeholder engagement patterns.
3. **Market competitiveness** — evaluated through market share dynamics, price premium capacity, and strategic positioning sustainability.

Although the research is primarily qualitative, descriptive statistical indicators (frequency patterns, comparative ranking positions, capitalization dynamics) were applied where applicable. Data were systematized and processed using Microsoft Excel (Microsoft 365, version 2024) for comparative structuring and trend identification. No advanced econometric modeling was employed due to the conceptual nature of the study. For the visualization and clear presentation of research results, specialized software such as CorelDRAW (ver. 11-16) was used.

The central hypothesis tested is:

H1: Sustainable brand equity is primarily the result of deliberate strategic brand management embedded in corporate planning rather than spontaneous market evolution.

International and Moldovan Context

The comparative dimension of the research highlights that globally recognized brands systematically integrate branding into corporate governance structures, innovation strategies, and long-term investment planning. In contrast, many companies in emerging markets, including Moldova, continue to prioritize short-term sales performance over strategic brand capitalization.

The analysis of Moldovan brand development demonstrates a gradual shift from product-oriented competition toward value-based positioning. However, limited long-term brand investment and insufficient integration of branding into corporate strategy often constrain international scalability.

Strategic Implications

The findings reinforce the proposition that firms striving to create brands rather than merely sell products or services accumulate intangible capital, reduce price sensitivity, enhance stakeholder loyalty, and increase enterprise valuation. In contrast, companies focused exclusively on transactional sales remain vulnerable to price competition and market volatility.

Methodological Limitations

Limitations include the lack of large budgets at PMA and its clients, as well as constraints arising from the pandemic period (2019-2022) and the Russian invasion of Ukraine (2014–2026), which limited the possibility of conducting large-scale contemporary quantitative surveys and econometric modeling. Additionally, the study relied on secondary data sources. Nevertheless, the integrative methodological design ensures conceptual rigor and reproducibility, providing sufficient transparency regarding data sources, selection criteria, and analytical logic for replication in other markets.

3. Results and Discussion

People have long satisfied their needs and necessities through various commodities and goods. A commodity can be defined as any market offering capable of fulfilling a need or desire. Such offerings may take different forms, including tangible products, services, experiences, events, persons, geographical locations, property, organizations, information, and ideas.

Nowadays there is no doubt in the fact that a trademark is one of the company's most valuable assets. However, creation and "nurturance" of an effective trademark takes a lot of time and effort. The word "brand" originates from Scandinavian "brandr", which means "burn, fire." So was called the mark the cattle owners used to mark their animals. The use of branding can be traced back to the times of Ancient Egypt, when craftsmen placed their marks on the bricks they produced in order to identify the creator of each brick. There is also documentary evidence of trademarks appearing on Greek and Roman lamps as well as on Chinese porcelain. Trademarks were used in India as early as 1300 BC. Branding became widely practiced during the Middle Ages, when guild craftsmen marked their goods with distinctive signs. This became necessary as the population grew and more than one blacksmith, mason, shoemaker, or carpenter began to operate within the same territory. In some old European cities, such as Salzburg and Rothenburg, tourists can still see authentic iron "trademarks" that once marked the workshops where the holders of these marks worked. In 1266, English legislation officially required bakers to mark every loaf of bread with their own sign so that the weight of each loaf corresponded to the declared standard. In early American history, brands were often used not only to identify livestock (such as cows and sheep) but also to indicate the particular quality of goods produced by a specific farm or ranch [10].

In practice, the concepts of "registered trademark," "marketed trademark," and "brand" are often used interchangeably. Therefore, clear differentiation between these terms is required, it is necessary to clearly differentiate and define the terms "trademark" and "brand." According to the World Intellectual Property Organization, trademark is a distinctive sign which identifies certain goods or services as those produced or provided by a specific person or enterprise. It allows the customer to easily and fast decide in favor of tried–and–true products, provided by reputable entrepreneurs [8].

David Aaker — the leading world expert in effective brands' building – gives an illustrative comparison: "Each brand is like a separate football player, while design and

advertising are like trainings destined for improvement of shape and effectiveness of such player. Brand architecture — senior coach, who has to put players on their places and make a winning team out of them, not just a star collection [1]." The most important component of brand architecture creation is company's brand portfolio structuring. This task consists of the selection of architectural option, selection of company's brand grouping principle and decision on possible depth and width of spin–off. Aaker identifies three main groups of benefits derived from purchasing a brand:

- functional benefits;
- emotional benefits;
- self-expressive benefits, or symbolic benefits.

Functional benefits represent the type of value directly related to the functional aspects and tangible properties of the products of a particular brand. However, functional value has certain limitations: it can be relatively easy to imitate, especially if it is not protected by a unique secret or a specific unique selling proposition (USP).

Emotional benefits refer to the positive emotions that consumers experience during the use and consumption of a brand's products. Emotional benefits increase the perceived value of owning and consuming a particular product.

Self-expressive benefits (or symbolic benefits) represent the type of brand value that enables individuals to communicate information about themselves and express their identity through the purchase and consumption of products associated with a particular brand [1].

As branding theory developed, numerous interpretations of the term "brand" also emerged.

The understanding of a brand provided by the American Marketing Association, which in many works is considered a basic definition, states: "A brand is a name, term, sign, symbol, or design, or a combination of these elements, intended to identify the goods and services of a particular seller or group of sellers and to differentiate them from those of competitors [8]." In *Principles of Marketing*, Philip Kotler provides a similar definition: "A brand is a name, term, sign, symbol, design, or a combination of them, intended to identify the goods or services of one seller or a group of sellers and to differentiate them from those of competitors [11]." It should be noted that in most translations of Kotler's classical works, the terms *brand* and *trademark* are often presented as synonyms. In one of his later works [12], however, Philip Kotler interprets the term *brand* somewhat differently: "A brand is any name, term, trademark, symbol, or design that carries certain meaning and associations."

Good brand management doesn't come out of the blue, but rather is a result of accurate planning and correctly chosen development path. There are lots of examples of little-known or weak brands becoming strong and successful ones, and vice versa, of well–known and reputable brands falling, vanishing or going into deep crisis (e.g. *Polaroid, Kodak, Xerox*, etc.) Major, old-established brands become symbols, designating not only corporations, but even entire cultures. *Coca-Cola* has not only the most recognizable logo in the world, but the logo itself became the symbol of western lifestyle.

Scientific and methodological basis for substantiation of the thesis that "brands are born to become brands, not raised", besides practical observations and experiments, are the works of renowned managers, businessmen and economic science authorities in the domains of marketing and management, data gathered during field and office studies. As scientific novelty of the hypothesis can mostly be deemed author's attempt to formulate the overall concept of "strategic brand management." It is made by means of direct comparison of

content of such hypotheses with the virtually observed state of things and of establishment of identical relation (or its absence) between facts stated in the hypothesis and facts proved by the results of observations and experiments.

The empirical validation of the proposed hypothesis was conducted through a longitudinal qualitative and comparative analysis of brand development strategies across established international corporations and emerging market entities during the period 2003–2026. The methodological framework combined structural analysis of brand architecture, comparative case evaluation, and synthesis of secondary market data.

The research yielded the following key findings:

1. Strategic intentionality precedes brand strength.

Brands that were conceptualized with clearly defined identity architecture, positioning logic, and long-term strategic alignment demonstrated significantly higher sustainability indicators (market retention, equity growth, customer loyalty) compared to brands that emerged through fragmented or reactive marketing decisions.

2. Brand architecture determines scalability potential.

Companies implementing structured portfolio systems — as conceptualized in the architectural framework of David Aaker — exhibited more stable expansion trajectories and lower reputational volatility. The empirical review confirms that architectural coherence reduces internal cannibalization and strengthens cumulative brand capital.

3. Uncontrolled brand emergence correlates with instability.

Case comparisons reveal that brands developed without predefined strategic identity frequently faced erosion of differentiation and long-term value destruction. Historical examples such as *Polaroid* and *Kodak* illustrate the strategic consequences of delayed adaptation and insufficient brand repositioning.

4. Brand equity formation is a function of systemic management rather than spontaneous growth.

The findings support the argument that strong brands are not accidental outcomes of market forces but the result of deliberate strategic governance. The hypothesis that “brands are born to become brands” should therefore be interpreted as strategic intentionality embedded at the moment of conceptualization rather than spontaneous brand formation.

5. Expansion of branding into geo-cultural territories confirms theoretical scalability.

The emergence of territorial branding practices demonstrates that branding logic extends beyond products and services into macro-economic systems, including cities and countries. This development reinforces the universality of strategic brand management principles.

The results refine and extend classical brand management theory. While the definition of trademark provided by the World Intellectual Property Organization focuses on legal distinctiveness, the present study demonstrates that a brand constitutes a higher-order strategic construct characterized by systemic identity fixation within mass consciousness and long-term capital accumulation.

In contrast to traditional life-cycle interpretations that assume gradual brand strengthening through market exposure alone, the findings indicate that structural coherence at the initial stage significantly determines long-term viability. This does not contradict the brand equity model of David Aaker; rather, it complements it by emphasizing the primacy of architectural intentionality prior to equity accumulation.

From a practical standpoint, the findings suggest that organizations should avoid reactive brand formation and instead embed strategic architecture at inception. Early-stage identity design, portfolio alignment, and governance protocols reduce long-term restructuring costs and enhance cumulative equity growth.

At the policy level, the scalability of branding principles into territorial development supports the application of strategic brand management in regional and national competitiveness strategies.

The theoretical implication lies in formalizing **strategic brand management** as an integrative framework combining identity architecture, portfolio structuring, and long-term governance mechanisms. The research advances the conceptual distinction between:

- a product;
- a registered trademark (legal sign);
- a marketed trademark (promoted trademark);
- a brand (successful marketed trademark, market-validated strategic construct) and its strategic brand capital (long-term intangible asset).

Here are the main distinctions.

A **product (commodity)** is any good, service, or item that can be produced by anyone, including individual persons or households. For example, it may be homemade wine from a barrel. Such a product is not legally protected and rarely has any graphic identity, design, or advertising slogan attached to it.

When we decide to elevate the status of such a product and submit its name and graphic style for legal registration — that is, when we formally register it (for example, with "*Agenția de Stat pentru Proprietatea Intelectuală*" (AGEPI)) — it becomes a (registred) **trademark**. A trademark enjoys legal protection, and no one can unlawfully counterfeit or imitate our products without consequences. On supermarket shelves, approximately 99% of products are registered trademarks. For instance, in frozen food sections there are dumplings from various manufacturers, or numerous bottles of wine displayed in supermarket aisles. Many of them do not particularly stand out; they merely possess legal registration and protection against imitation.

If we begin to actively promote our trademark — organizing in-store displays, advertising it on television, promoting it on social media, and investing in marketing communications — the trademark gradually transforms into a (marketed, promoted) **trademark**, meaning a promoted and recognized mark. For example, sparkling wines produced by *Radacini Wines* may represent such a case.

Over time, and with sustained investment in promotion and customer relationships, a trademark may evolve into a fully developed **brand**. For instance, sparkling wines of *Purcari* or champagne from *Moët & Chandon* can confidently be described as brands. In simplified terms, a **brand** can be defined as a successful trademark. It represents the peak — the highest stage in the evolutionary trajectory that products undergo, from basic registration to broad recognition and the devoted loyalty of committed consumers.

A **product** (see Fig. 1) is the material, physical, tangible component of a future brand.

A (registered) **trademark** is a product that has obtained legal protection; it represents the first stage in the process of brand formation.

A (marketed) **trademark** is the differentiation of our trademark from similar trademarks of competitors.

A **brand** is a trade brand that accumulates brand equity; it is a trade brand that, over time, acquires sustainable competitive advantages and becomes successful.

Figure 1. Definition of concepts product, trademark, brand and evolution of product development.
Designed by the author.

Finally, the validation of the hypothesis must be understood within the epistemological limits of empirical social sciences. The confirmation of strategic hypotheses is inherently probabilistic and subject to continuous reinterpretation within evolving market dynamics. Nevertheless, the accumulated empirical patterns provide sufficient grounds to argue that sustainable brand strength is predominantly the outcome of deliberate strategic design rather than uncontrolled emergence.

A **brand** is not merely a visual symbol or a product name, but a complex system of associations, emotions, and trust that is formed in consumers' minds over an extended period of time. The strength of a brand is determined not only by product quality, but also by the stability and consistency of the perception it generates. It is precisely this perception that creates brand value — enabling the justification of premium pricing, enhancing customer loyalty, and securing competitive advantages in saturated markets.

The development of a strong brand requires systematic management of its identity, positioning, and communication strategy. This process includes the consistent application of corporate visual identity, a well-designed brand architecture, continuous quality assurance, and alignment between brand promises and the actual consumption experience.

Who earns the most in business, and on what? The one who knows more than others, about what others know less. One of the key tasks of business and marketing is to know more about your own brand, your competitors, the external environment, and everything that can influence the increase or decrease of sales, as well as the strengthening or weakening of your brand. **Marketing research** (MR) in branding is the systematic collection, analysis, and interpretation of data about brands that is necessary for making marketing decisions within our brand architecture. But where did this discipline come from? How has it developed? Why is it important for a marketing professional? The author has conducted from early 2000s to 2026 dozens of marketing studies in the areas of marketing, branding and surveys as part of PMA's business activities, including focus groups, practical case analyses, and university lectures "Marketing Research" and "Sales Techniques" at UTM and "Branding and Sales Consumer's Psychology" and "Marketing-management" at ASEM and the many other study of consumer behavior and psychology in relation to brands [13].

The importance of applying MR in the field of branding in conditions of high competition and a rapidly changing external environment lies in the following:

Reducing brand portfolio risks. Research allows decisions to be based on real data rather than intuition or assumptions. This reduces the likelihood of mistakes when launching new brands, entering new markets, or adjusting pricing policies in brand management.

Increasing brand competitiveness. A deep understanding of the competitive environment and consumer behavior among brand fans helps the company differentiate itself from competitors, create unique brands, and strengthen its market position.

Optimizing marketing expenditures for effective branding. Analyzing the effectiveness of brand promotion and advertising channels enables rational allocation of the marketing budget, investing in tools that genuinely deliver results.

Improving interaction with brand customers. Based on research, a company can adapt its products, services, and brand communications to consumer expectations, thereby increasing the loyalty and satisfaction of both existing brand fans and potential customers.

In the Republic of Moldova, there is currently no objective government-level assessment of the popularity of specific brands or market valuation of local brands. Such evaluations and studies are carried out only by private agencies or commissioned by individual companies. For three consecutive years (2010–2012), the Ukrainian agency MPP Consulting compiled [8] a ranking of the 50 most valuable Moldovan brands (usually, in the post-Soviet space, a TOP-100 is created, but due to the limited number of Moldovan brands and their relatively low value, a TOP-50 was compiled in this case). The ranking includes only brands created in Moldova or specifically for Moldovan goods and services. In 2012, the total value of the trademarks included in the study was $172.9 million, with market values ranging from $0.44 million to $35 million.

The top ten brands accounted for approximately 70% of the total value of the TOP-50. The authors clarify that the brand value reflects **only the trademark itself (the name)**, excluding production facilities, company infrastructure, patents, inventions, or other tangible or intellectual assets. It is necessary to take into account national characteristics and the mentality of the local population when choosing certain brands. The “noise” from a large number of brands (as in developed countries) has not yet reached Moldova — the market is still in a nascent state, and many companies are either unfamiliar with branding or understand it merely as advertising (see Tables 1-2).

Table 1

Top 10 Moldovan brands in 2012 (with evolution from 2010–2012, by MPP Consulting MR) [8]

Place in 2012	Brand	Brand's cost in 2012, $ mln.	Brand's cost in 2011, $ mln.	Brand's cost in 2010, $ mln.
1	Cricova	35	17	4.4
2	Purcari	21	17	4.4
3	Bucuria	13	11.2	9
4	Chisinau	11.5	10.4	8.5
5	Aroma	8.2	7.3	7
6	Moldcell	7.4	6.3	4.5
7	Victoriabank	6.9	5.5	5.2
8	MAIB	5.1	4.7	3.2
9	Kvint	4.9	4.4	3.25
10	Bostavan	4.7	4.6	4

The data presented in Tables 1 and 2 indicate a significant concentration of brand value within a limited number of leading brands, suggesting an asymmetric structure of brand equity distribution. Such a pattern is characteristic of emerging markets, where branding processes are still evolving and market leadership is often determined by early positioning and accumulated recognition. In contrast, developed markets typically exhibit a more balanced distribution of brand value across a wider range of companies, reflecting a higher level of branding maturity and competitive intensity.

Table 2

Top 50 Moldovan brands in 2012 (by MPP Consulting MR) [8]

Place	Brand	Brand's cost, $ mln
1	Cricova	35
2	Purcari	21
3	Bucuria	13
4	Chisinau	11.5
5	Aroma	8.2
6	Moldcell	7.4
7	Victoriabank	6.9
8	MAIB	5.1
9	Kvint	4.9
10	Bostavan	4.7
11	Buket Moldavii	4.5
12	Green Hills	4.1
13	Moldtelecom	3.7
14	Domnita	3.1
15	Unite	2.9
16	№1	2.3
17	Acorex	2.2
18	Spicul de Aur	1.9
19	Zorile	1.8
20	Maximum	1.75
21	Dionis Club	1.7
22	Moldindconbank	1.65
23	Moldasig	1.5
24	Lapmol	1.42
25	Vinurile Comrat	1.3
26	Gura Cainarului	1.22
27	Carmez	1.15
28	Tomai	1.1
29	Starnet	0.98
30	Bomba	0.97
31	Natur Bravo	0.96
32	BEM	0.93
33	Vitanta	0.92
34	Linella	0.91

Continuation of Table 2

Place	Brand	Brand's cost, $ mln
35	Milestii Mici	0.9
36	Bunatete	0.87
37	Alina Electronic	0.83
38	Bemol	0.82
39	Zernoff	0.79
40	Aqua UniQa	0.77
41	Naturalis	0.68
42	Chateau Varteley	0.64
43	Dionysos Mereni	0.58
44	Argint	0.55
45	Bojo Vin	0.51
46	Floare	0.49
47	Roua Moldovei	0.47
48	Nefis	0.46
49	Incomlac	0.45
50	Alianta Vin	0.44

In 2016, PMA conducted a marketing research study on brands [8] — not only in Chișinău (although, due to significant depopulation, the capital of Moldova remains the most representative area in terms of the presence of the largest number of brands and the extent of their advertising). In this first field study, Moldova was conditionally divided into five regions: center, north, east, south, and west. In each region, the largest or most business-active city was selected, along with one smaller town, urban-type settlement, or village.

For reference, the regions and selected locations were as follows (see Fig. 2):

- **Center** – Chișinău municipality, village of Pănășești
- **North** – Bălți municipality, Briceni city
- **East** – Tiraspol municipality, Pervomaisc settlement
- **South** – Cahul city, Congaz village
- **West** – Ungheni city, Bălănești village

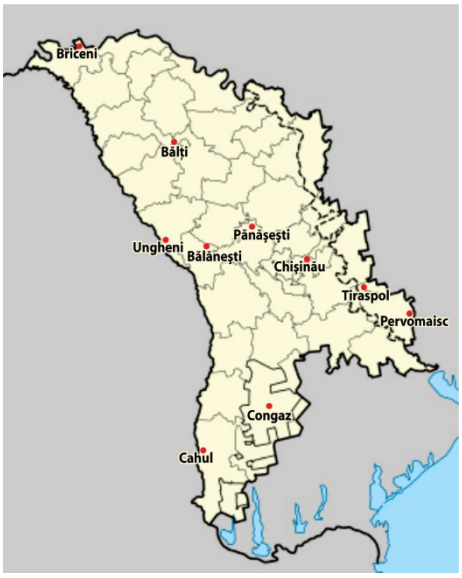

Figure 2. Selected locations for large-scale MR.
Designed by author.

In total, more than 3,500 people were surveyed. The survey was conducted in person on the streets of settlements by Promarketing Agency between May and September 2016. Respondents were asked the question (in one of the languages they understood – Romanian, Russian, or Gagauz):

"Please name the most well-known Moldovan, local brands in your opinion. Which ones do you know best, and use?"

Since not all consumers knew exactly which brands were Moldovan and which were foreign, all answers were taken into account. Thus, this survey reflects which brands, in general, are most recognized by the population in Moldova. Respondents could mention both locally produced brands and brands under foreign ownership. This first field study included costs for transportation, office supplies, meals, employee salaries, and opportunity costs. The overall brand recognition and awareness ranking was calculated using the following system: the first brand mentioned by a respondent received 10 points, the second — 7 points, the third — 5 points, the fourth — 3 points, the fifth — 2 points, and the sixth and subsequent brands — 1 point each. Some respondents mentioned only one brand, others several, and some very knowledgeable participants named more than 10 brands. On average, each of the 3,553 respondents listed 3–5 brands.

The research showed that among the most popular and well-known brands, food products (including also ecological products in daily priorities [14]) and beverages dominate, which again confirms that the population of the Republic spends the largest part of their family budget on sustenance. It is encouraging that among the brands, there are increasingly more young and promising ones gaining strength each year. Unlike in various paid rankings, our study revealed that people are interested in the situation in the country — hence the appearance of two media channels as well-known brands. It is also pleasing to see a university included in this ranking, as people are increasingly paying attention to education.

It is noteworthy that some brands were recognized by consumers across all regions of the republic, while others were known only in their own region or territorial unit. The final report was made representative by combining all responses into a single table (see Table 3).

Interestingly, not all respondents were aware of the bankruptcy of *Banca de Economii* or for other reasons – and although this brand scored more than 30 points, we did not include it in the final ranking.

Thanks to the inclusion of Moldovan citizens from all regions, including the eastern regions of the republic (so-called Transnistria), the survey included brands that are unknown or little known on the right bank of the Dniester (for example, *Sheriff*).

Table 3

Top 40 Moldovan brands in 2016 (by PMA MR) [8]

Place in 2016 by points	Trademark/ Brand	Place in 2016 by points	Trademark/ Brand	Place in 2016 by points	Trademark/ Brand	Place in 2016 by points	Trademark/ Brand
1	Bucuria	11	Moldcell	21	Tucano Coffee	31	Vinuri de Comrat
2	Cricova	12	Incomlac	22	METRO	32	Carmez
3	Gura Căinarului	13	Orange	23	Zorile	33	Publika TV
4	Andy's Pizza	14	Starnet	24	Perfect	34	Rogob

Continuation of Table 3

5	Franzeluța	15	Rompetrol	25	Chișinău (bere)	35	Unimarket
6	Naturalis	16	Călărași	26	Букет Молдавии	36	Doina
7	MAIB	17	Aqua UniQa	27	Avicola Floreni	37	Jurnal TV
8	Linella	18	Kvint	28	Gas Natural fenosa	38	Maximum
9	VIS	19	OM	29	999.md	39	ASEM
10	Purcari	20	Unite	30	Sheriff	40	La Plăcinte

The results presented in Table 3 highlight that brand awareness in Moldova is primarily driven by high-frequency consumer interaction, with food products, retail chains, and telecommunications services dominating the rankings. This structure reflects the consumption-oriented nature of brand perception in emerging markets. In contrast to developed economies, where brand recognition is more evenly distributed across diverse sectors, including technology and services, the Moldovan market demonstrates a stronger dependence on everyday consumption patterns. At the same time, the inclusion of media channels and educational institutions suggests a gradual diversification of brand perception and the early formation of a more complex branding environment.

In parallel with the survey on awareness of local trademarks among the population of Moldova, PMA conducted another type of research – we studied local brands using a focus group approach, this time among more informed consumers. Their presence in Chișinău implies familiarity with local brands, as most brands present in Moldova are concentrated in the capital.

The focus group study involved 100 participants (randomly selected individuals aged 18 to 60, with an equal split between men and women), all of whom live, work, or study in Chișinău – representing the active part of the city's population. The study was conducted in August 2016 in Chișinău over five working days, in groups of 20 people at the PMA office. All participants were either students, employed, or combining both activities. The research was divided into two parts: first, an examination of the most well-known brands in each of the proposed product categories; and second, an analysis of young/promising brands. Participants were asked to name at least five of the most famous, best, or most trusted brands they know in each of the product categories presented for the study [8].

PMA agents also asked participants to indicate their level of awareness, describe, and evaluate several local brands according to specific characteristics. These brands were classified into one of the following groups:

- Young brand;
- Promising brand;
- Actively and successfully rebranded older brand;
- Revolutionary, innovative brand.

The following brands were proposed for evaluation, as they fit the above criteria: *Andy's Pizza, Aqua Uniqa, ASEM, Bombonici, Cool Radio, Darwin, Farmacia Familiei, Jurnal TV,*

Linella, MAIB, Medpark, Moldcell, Promarketing, Publika TV, Simpals, Starnet, Tucano Coffee, Unimedia, X-Style, Zorile.

Participants were asked to briefly describe each brand and rate them on a **5-point scale** according to the following categories (see Fig. 3):

- Awareness
- Brand visual identity
- Brand trust
- Willingness to use the brand
- Modernity
- Brief description

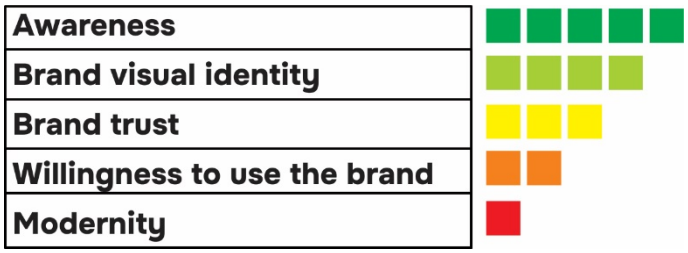

Figure 3. Criteria for evaluating young brands in the focus group.
Designed by the author.

Brief conclusions from this focus group: Chișinău consumers are quite savvy and well-informed about national brands and the brands present in the capital. Most of their evaluations and recommendations are fairly objective. It should be noted that a brand, if it does not itself shape tastes and trends, must orient itself toward consumer preferences and trends. In the second part of the study, all respondents noted the potential of the brands under review, indicating that each brand has a path for growth and that not all available marketing tools have yet been fully utilized to improve the current position. It is encouraging that consumers are responsive and willing to engage quickly even with relatively unfamiliar brands (e.g., *Promarketin*g or *X-Style*), and based on only a superficial analysis of the brand's visual identity, products, and services, they can quickly develop trust and immediately characterize it as a promising brand worthy of their confidence. Some items overlap with well-known brands from the above-mentioned lists in the first part of the study — either from the Ukrainian agency's Top-50 or from the PMA agency's Top-40 list. Chișinău consumers are more aware of brands outside the "food and beverage" category, which dominates the national-level research conducted across Moldova's regions by PMA. Local consumers are more informed through media channels – via the internet, TV channels, and word of mouth — which is why they easily recognize certain brands, such as TV and internet portals, or even "Chișinău minibuses" or the "trolleybus fleet," perceiving them as full-fledged "brands" due to their daily interactions with them. Their "savviness" is also evident in the fact that, for example, after the well-known scandal involving the "theft of billions" from a series of Moldovan banks that later went bankrupt (*Banca de Economii* – the former largest state bank, *Banca Socială, Unibank*) and the subsequent investigations, they are aware of *Kroll* as the most famous "local" auditing company (even though it is international and has no local office here). The Chișinău consumer is the most informed in the country, requiring marketers to work "harder and more subtly" to capture their desires and influence their thinking.

This indicates that, with a properly structured marketing strategy, long-term and strategic brand planning, it is possible to gain the trust of nearly any consumer, even the

most discerning ones. This once again confirms that if you create a high-quality product with a clear brand purpose and understandable communications, customers will adopt it relatively quickly as "their brand."

Next, PMA conducted a fourth field study [8] using surveys and interviews with selected local experts, top managers, marketing and sales specialists, branding professionals, and business owners – specifically those whose brands we considered to have successful management experience. The goal was to discuss with them their perspectives on promoting their own or third-party brands in the local market, as well as their views on the overall market situation in the long term – from the day Moldova gained independence up to the present.

The value of this type of research lies in obtaining insider information firsthand, providing 100% practical insights into the execution of marketing tasks in a real-world setting. The core questions were largely consistent across interviews, differing only when specific circumstances required it. The main common questions discussed were:

- Do managers strictly follow marketing promotion rules, or do they rely more on their intuition?
- What is the local specificity of brand promotion? Does it conflict with international practices, or does it offer unique advantages or local character?
- Is it possible to create a strong brand with limited financial resources?
- What is necessary to maintain a brand's strength over the long term?
- Are brands "born" or "raised"?

The expert evaluation method allows researchers to uncover many interesting aspects and nuances of local marketing and branding that cannot be captured through other types of brand research. Interviewed experts:

- Ruslan Cojocaru, CEO & Founder, *Tucano Coffee*.
- Dmitry Voloshin, owner of *Simpals Studio* and brands *999.md, play.md, drive.md, sporter.md, forum.md*, etc., organizer of the first *Chișinău International Marathon*.
- Pavel Zingan, marketing and sales specialist, owner of several brands, with experience in promoting third-party brands.
- Radu Albot, top Moldovan tennis player (85th in singles and 68th in doubles in the 2016 world ranking).
- Irina Strajescu, Marketing Director at *Moldcell* (2012–2015), Communications and Events Director at Moldcell since 2015.
- Gennady Tanurkov, founder and director of the *Fedorov Eye Microsurgery Center* in Chișinău.
- Victor Guzun, former Moldovan ambassador to Estonia, promoted Moldova as a brand in the Baltic countries, Europe, and specifically Estonia.
- Vadim Gore, marketing and sales specialist at Visapina-Impex (brand *Visapina*).
- Alena Sorokina, marketing and brand specialist, currently working in Ukraine as Marketing Communications at *IT-Cluster Odessa*; Brand Keeper at *TEDx Odessa*.
- Victoria Condrat, Director of *Trimbos Moldova*, National Manager of the project "*Mental Health System Reform in Moldova*."

Brief Conclusions from the Expert Brand Evaluation: most top managers primarily rely on intuition, especially during the early stages of promoting their brands in the 1990s and early 2000s. At the same time, they recognize and agree that for even more successful brand promotion, it is necessary to adhere to professional marketing standards, strategies, and

planning. Nearly all emphasize that a successful brand must first and foremost be a quality product with a clearly defined goal and mission, and with understandable communication toward customers. The brand must also keep pace with the times, monitor market trends, competitors' actions, and customer behavior.

Moldova is not yet a well-known or fully developed brand on the international stage, which leaves room for development. National specificity and consumer culture strongly influence how brands should be sold and promoted, and this must be taken into account. Strategic marketing planning for brands should necessarily incorporate innovative marketing-mix tools and actively use them when traditional methods have been exhausted.

Are brands "born" or "raised"? Opinions are divided, but the majority believe that brands are raised. There is considerable potential in Moldova for creating and supporting strong brands, which requires applying a competent marketing approach and attracting the necessary financial resources. Some managers believe that a good brand can even be created with a modest financial budget.

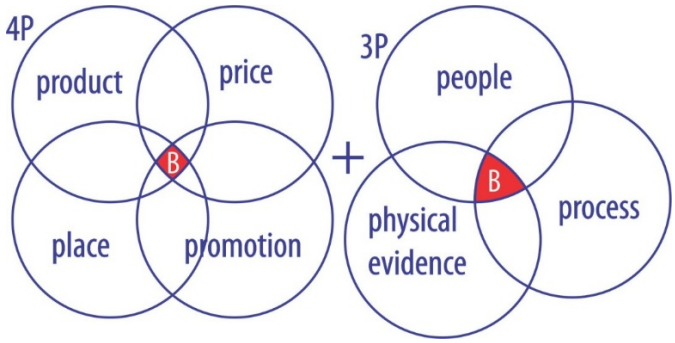

Figure 4. Marketing tools – 7P Mix.
Designed by the author.

Possessing up-to-date information, conducting continuous marketing intelligence, and implementing professional and pragmatic marketing research in branding make it possible to create, develop, and sustain strong brands – the key to success in any strategic marketing. Also, if you consistently monitor the marketing mix (7Ps) tools [15] and research all its components (see Fig. 4), conducting marketing research in the field of branding specifically across these areas, you will always stay one step ahead of your competitors. Guerrilla marketing, observations, implementations, protecting your research data from competitors, and Open Source Intelligence (OSINT) — all of these practices enable the Marketing Department of any company to achieve strong results and **increase the brand equity** of its brands.

Creating and maintaining brands, as well as increasing brand equity, brings the following advantages:

1. **Higher price levels** – demand for branded products is characterized by lower price elasticity.
2. **Greater sales volume** – brands can operate "at scale" and at relatively lower costs per unit.
3. **Cost reduction** – the cost per unit of a branded product is significantly lower than that of its non-branded competitor.
4. **Economies of scale** – high consumer demand for brands allows companies to reduce capital expenditures and dictate terms to distributors.

The main task of a marketing specialist is to create a bright, memorable brand that lasts for many years. Your brand must stand out among the unnoticed ones. To achieve this,

we need a strong name (naming), high-quality support with texts, advertising slogans, and taglines (copywriting), a professional logo and well-executed design, memorable print and video advertising (your videos should be showcased at events like the "Night of the Ad Eaters" and the "Cannes Lions"), pragmatic digital marketing, and brand personalization through SMM and online channels. A full set of ATL/BTL activities, PR, the mandatory presence of a brand book/corporate code of conduct with strict adherence, and periodic guerrilla and "viral" marketing methods are also essential.

All of this together will guarantee the success of your brand. You cannot cut corners on naming, logos, slogans, design, or advertising, nor delegate these tasks to incompetent company staff or agencies if you want to build a true brand, not just a name.

As per the diagram No. 1 the author proposes **to create brands and use strategic brand management on a long–term basis!**

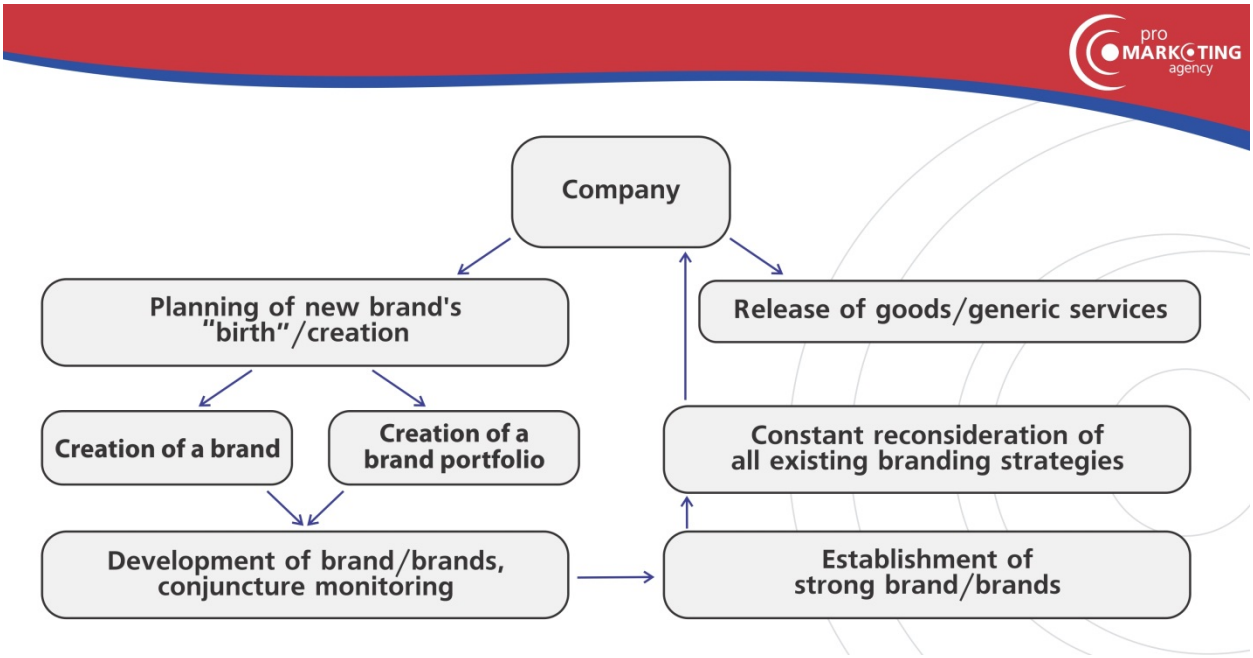

Diagram 1. Generalized diagram of strategic brand management.
Designed by the author.

Strategic brand management shall be performed in such a way, so that your brand becomes a "star", which not only shines, but also brings joy and satisfaction, and, what's more important – profit, to you and your clients. The strongest one wins. The one who will be capable of building the entire brand management strategy in his own team.

In our case it will take time to prove the validity of the hypothesis that the brands are born as brands, that a brand cannot "grow" out of nothing, or by uncontrolled chance. It is much harder to verify the validity of general empirical hypotheses, let alone theoretical ones, especially those underlying scientific theories, being their axioms. Such verification can only be indirect, by means of drawing conclusions from general hypotheses, establishment of identity or difference in the content of the latter with the state of things being observed, and, finally by means of assumption of the subject of scientific cognition as a decision about sufficient number of verified consequences from the general hypothesis for making a judgment about its validity or invalidity (in a particular case, falsity). The process of taking a decision by scientific community about validity of scientific hypotheses often takes a lot of time, and at that it is never final. Certain hypotheses and truths are relative, dialectical, mobile categories in the real dynamics of scientific knowledge.

Brand equity is not always directly reflected in accounting records or financial statements. However, if we decide to sell our business, the premium we expect to receive from the sale of our brand (see Fig. 5) often represents precisely this accumulated brand equity. Brand equity embodies all the investments made over many years and even decades in product development, quality enhancement, advertising, innovation, and the cultivation of trustworthy and ethical relationships with customers.

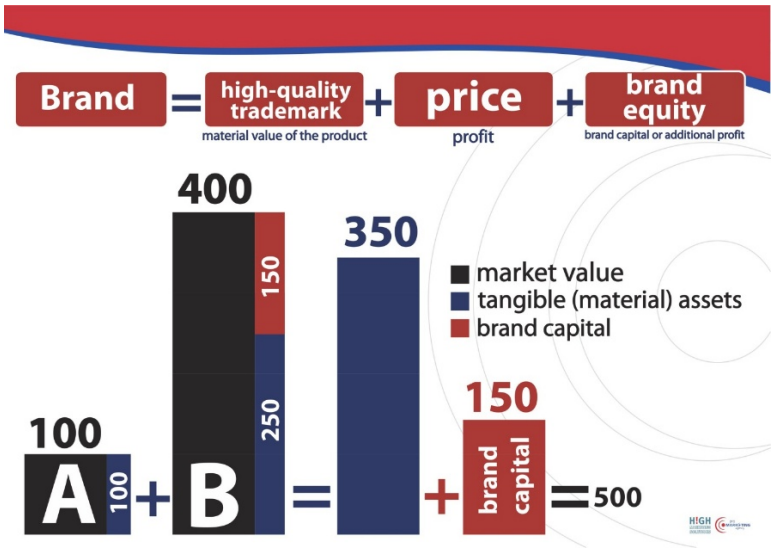

Figure 5. Structure of Market Value: Tangible Assets and Brand Equity Components.
Designed by the author.

As illustrated in Fig. 5, suppose we acquire *Company A* — for example, an ordinary rural cannery that has never been advertised and has never produced branded juices or canned goods (its products may have been used merely as raw materials for other branded manufacturers) — for 100 million. We then merge it with a second acquired company, say, a well-known producer of juices, carbonated and soft drinks under *Brand B*. Over many years, *Brand B* has accumulated recognition and brand equity. Consequently, the second company is sold to us at a significantly higher price: in addition to its tangible assets — land, equipment, technology, and active workforce — valued at 250 million, it includes an additional 150 million attributable to brand equity. Thus, within our newly formed brand portfolio valued at 500 million, we possess tangible assets worth 350 million and additional brand equity amounting to 150 million.

Recently there came up a lot of new things in marketing economic theory, in particular – geo-cultural territory branding – as a method of development of entire territories (regions, cities, even countries), although some 35 years ago no one even made hypotheses about the possibility for the whole country or a city to become a brand.

In the 1950s, David Ogilvy proposed the use of the concept of "brand image [16]." In the 1980s, major entrepreneurs noticed that brands were being sold and bought for enormous sums of money. The difference between a brand's valuation for accounting purposes and the price a buyer is willing to pay for the brand increasingly came to be recognized as the "value of the brand." The brand ceased to be an abstraction and became a tangible asset with real value for its owners. This rethinking of the brand's significance led to the traditional term "brand image" increasingly being replaced by the financial equivalent "brand equity."

The evolutionary trajectory of development in marketing and branding theory is understood as the progression of a product from a simple mark to a fully established brand.

Over time, any brand accumulates **brand equity** (brand capital) — the added value that transforms it into a high-quality and attractive offering in the eyes of devoted customers who gradually become loyal, repeatedly purchasing the brand again and again.

The value of brands has been assessed annually for decades by leading and reputable firms such as *Interbrand, Millward Brown, Forbes*, and *Brand Finance*. In 2013, *Interbrand* estimated the value of seven brands at over $40 billion each (*Apple, Google, Coca-Cola, IBM, Microsoft, GE*, and *McDonald's*). By 2025, the value of the *Apple* brand alone exceeds $400 billion. While brand owners generally do not disclose the proportion of a brand's value relative to the total value of the associated business, *Interbrand* data from 2013 indicate that for brands such as *GE, Allianz, Accenture, Caterpillar, Hyundai*, and *Chevrolet*, this proportion ranges between 10% and 25%. For brands like *Google, Nike*, and *Disney*, it ranges from 40% to 50%, and for *Jack Daniel's, Coca-Cola*, and *Burberry*, it exceeds 60% [17].

In recent years (see Table 4), the world's most valuable brands have been predominantly high-tech companies with substantial brand equity. Whereas several decades ago these rankings were largely dominated by Japanese, European, and American firms, an increasing number of Korean, Chinese, and other Asian companies have now entered the top tier. In such leading brands, the proportion of brand equity can constitute 50% to 90% of the total brand and business value, while tangible assets typically account for only 10% to 50%.

Table 4

Top 100 World brands in 2025 (by Interbrand) [17]

Place	Brand	Cost, bn $	Change to 2024, %
1	Apple	470.9	-4
2	Microsoft	388.5	+10
3	Amazon	319.9	+7
4	Google	317.1	+9
5	Samsung	90.5	-10
6	Toyota	74.2	+2
7	Coca-Cola	60.1	-2
8	Instagram	57.3	+27
9	McDonald's	53	+0.1
10	Mercedes-Benz	50.1	-15

The fundamental task of any marketing specialist is to continuously increase brand equity. It provides a "safety cushion" that allows companies to offer discounts while maintaining high price positioning, to sell products at premium prices, and ultimately, if the business is sold, to secure a higher valuation due to substantial brand equity.

It is worth noting that in the world's most valuable and high-technology companies — those that have adopted strategic marketing and branding — brand equity can account for 50% and even up to 90% of total market capitalization.

In the specific context of the Republic of Moldova, strategic branding is currently undergoing a transition from a tactical communication tool to a core business asset. Recent market dynamics suggest that local enterprises are increasingly moving beyond simple trademark registration toward complex brand identity systems. This shift is particularly evident in the wine and food sectors, where Moldovan brands are beginning to align their value propositions with international quality standards and emotional positioning, effectively bridging the gap between regional traditions and global consumer expectations.

Author's perspective on the justification for using branding in strategic marketing planning: as understood by the author of this thesis, a **brand** — is a name of a sale object and a symbol attached to it (firm, goods, service, idea, personality, etc.), the peculiarities of which are widespread notability and stable fixation in mass consciousness. Thus, a **brand is virtually a successful trademark.** Only strong brand can generate profit on a long-term horizon; it, without relatively large investments, increases brand capital, makes a customer more loyal and less flexible in terms of price towards brand's offer.

The creation and long-term maintenance of a brand enable the accumulation of brand capital and allow branded products to be sold in greater volumes and at higher prices, with lower price sensitivity among loyal customers.

4. Conclusions

Brands are used in marketing and management to achieve their specific objectives. In marketing, brands are primarily necessary to enhance influence on consumer behavior, increasing consumer demand both in the short term and over the long term. For management, brands mainly serve as a tool for improving key economic and financial performance indicators of the firm.

This study develops **strategic brand management** as an integrated and independent framework within marketing and strategic management. While branding, brand management, and corporate strategy are often examined as related but distinct constructs, this research argues that strategic brand management should be regarded as a systemic governance framework that aligns brand identity architecture, long-term market positioning, and corporate development trajectories. The findings demonstrate that branding cannot be reduced to tactical promotional activity; rather, it constitutes a core strategic mechanism that shapes sustainable competitive advantage.

The principal theoretical contribution of this research lies in formalizing the distinction between product, registered trademark, marketed trademark, and brand as successive evolutionary stages of value creation, culminating in the accumulation of brand equity as a strategic intangible asset. Within this framework, a brand is conceptualized not merely as a legally protected sign or communication tool, but as a stable cognitive and emotional construct embedded in collective perception. This perspective extends conventional trademark-centered definitions and reinforces the understanding of a brand as a long-term, value-generating system.

From a strategic management standpoint, the study shows that brand governance increasingly functions as the nucleus around which corporate strategies are structured. In contemporary economic conditions, where firms emphasize capitalization growth and long-term market valuation, the brand serves as a central coordinating mechanism linking corporate identity, stakeholder trust, and financial sustainability. Effective strategic brand management requires coherence between declared brand promises and actual consumer experiences, systematic control over brand architecture, and alignment with overarching corporate objectives.

The broader significance of these findings extends beyond individual firm competitiveness. The principles of branding are scalable to territorial and macroeconomic contexts, suggesting that strategic brand management may serve as a developmental instrument not only for corporations but also for regions and national economies seeking

sustainable positioning in global markets. In this sense, branding emerges as both an economic and socio-cultural phenomenon influencing long-term structural competitiveness.

The study is subject to several limitations. It relies predominantly on qualitative comparative analysis and conceptual synthesis, which, while suitable for theory development, limits the potential for statistical generalization. Although the empirical observations are longitudinal, they remain interpretative and do not incorporate econometric modeling of brand equity dynamics. Furthermore, the framework has not been quantitatively validated across diverse industries or emerging digital ecosystems, where brand formation mechanisms may differ substantially.

These limitations create avenues for further research. Future studies could focus on the development of quantitative indicators for measuring strategic intentionality in brand creation, econometric modeling of long-term brand capital accumulation, and cross-sector validation of the proposed framework. Additional investigation into digital platform environments and AI-mediated consumer interactions may refine understanding of strategic brand management in technologically accelerated markets. Comparative cross-country analyses could also clarify how institutional environments influence the evolution from trademark to fully developed brand.

In conclusion, the research supports the proposition that sustainable **brand strength** is not an accidental by-product of market presence but the result of deliberate, structured, and strategically coordinated governance. Strategic brand management thus represents not only a marketing function but also a central pillar of long-term corporate development and value creation. While every brand is designated by a trademark, **not every trademark constitutes a brand**. Legal registration alone does not create objective prerequisites for enhancing competitiveness; sustainable advantage arises only through long-term, intensive brand development, which strengthens the firm's value system and ensures durability in competitive markets.

A comparative analysis between Moldovan and international branding practices reveals that while global leaders focus on systemic brand governance and long-term equity accumulation, many regional players still face challenges related to short-term orientation. However, the study confirms that successful Moldovan brands – much like their international counterparts – achieve sustainable price premiums when they transition from being "marketed trademarks" to "strategic constructs" with high consumer trust. Integrating international strategic planning models into the local business environment remains a critical factor for enhancing the global competitiveness of Moldovan intangible assets.

Key conclusions:

1. Business practice and the analysis of theoretical research in the fields of marketing, trademarks, and brands demonstrate that the concept of **strategic branding** is relatively new and still developing.
2. A truly strong brand is essentially a successful trademark.
3. Brands, like products, have their own life cycle.
4. A brand possesses a unique property: its price includes **brand equity**. All expenditures on brand promotion should therefore be considered investments in its brand equity. Strategic marketing planning in branding is carried out with the aim of achieving market dominance. Companies can not only follow existing market demand but also shape this demand through brands.

5. A vivid and memorable slogan, effective design, and advertising help create a recognizable and positive brand image.
6. Most national Moldovan brands originate from the Soviet period; however, new and young brands are increasingly entering the top rankings.
7. The picture of the most popular and widely recognized brands often differs significantly from rankings and lists created on a commissioned basis.
8. Brands always function as leading trademarks in competitive market rivalry.
9. There is an outflow of professional labor abroad, including specialists in marketing and branding.
10. A dynamic era of brands is emerging. Brands are penetrating virtually all spheres of life.
11. In Moldova, the **top-40 most recognized brands** mainly consist of brands associated with food consumption.
12. Consumers in **Chișinău** are fairly well informed about national brands.
13. A successful brand is, first and foremost, a high-quality product with a clearly defined goal and mission.
14. Moldova is not yet a widely recognized and fully developed brand on the international stage, but there are prospects for its development. National specificity and the culture of consumption strongly influence how brands should be marketed and promoted.
15. Some managers believe that a strong brand can be created even with limited financial resources. Are brands made or raised? There is no unequivocal answer. They are both made and born. A brand can be created from scratch, nurtured, and developed through continuous investment. It is also possible to transform an inconspicuous trademark into a strong and recognizable brand. With a slight clarification, the conclusion is as follows: a brand can indeed be created from the ground up, and if investments are made wisely and consistently, the growth of brand equity over time will ensure the formation of a successful and strong brand.

Main recommendations:

1. Based on the conducted research, it can be concluded that strategic planning with regard to brands should always be carried out with a long-term perspective. Companies should apply the principles of branding in their daily activities.
2. Before starting a business, it is necessary to choose one of two paths: either to produce unbranded generic products or to develop, create, and consistently support a brand or a portfolio of brands. When creating a new brand or implementing rebranding, it is important to structure the entire communication system both inside and outside the company so that relationships with customers are built strictly on fair and ethical principles.
3. To create a strong brand, managers must first develop a high-quality product with a clear and understandable brand purpose and mission for consumers. It is necessary to invest in brand development and thereby increase its brand equity — something that will make the brand less sensitive to price elasticity among loyal customers and allow the product to be sold at a higher price than competing alternatives.
4. Demand can be actively influenced and shaped through the offering of a unique brand by using the full range of marketing mix instruments (7P).
5. To attract attention to a brand, it is necessary to evoke emotions among consumers. Communication strategies should be designed in such a way that customers do not remain indifferent to the brand. The development of a brand book, corporate fonts and colors, corporate ethics, slogans, and a simple, clear, memorable, and original visual identity should

be entrusted to professionals (either in-house specialists or external agencies), rather than handled in an amateur manner.

6. To assess the real popularity and recognition of a brand, companies should conduct exploratory activities and their own marketing research rather than relying solely on paid contests, rankings, and brand lists.

7. All marketing strategies — short-term, medium-term, and long-term — must be interconnected and continuously reviewed and updated.

8. To build a successful brand in the long term, it is necessary to establish a strong brand identity and develop solid partnership relationships with consumers. The idea of a unified brand should be shared by everyone — not only customers but also the company's employees.

9. Building a strong brand requires sincerity and honesty in relationships. Deceiving customers, partners, or even competitors should be avoided, as this leads only to minor short-term victories. Honest partnership relations are the foundation of a strong brand–customer relationship.

10. For a brand to be strong, it is necessary to offer customers a unique value proposition — an original value that enables consumers to choose the brand without constantly comparing it with competitors.

11. If a brand does not shape tastes and trends or generate demand through its offerings, it must orient itself toward consumer preferences and trends, forming its offerings in accordance with market demand.

12. When marketing policy and brand marketing planning are properly structured, it becomes possible to quickly gain the trust of almost any consumer, even highly demanding ones.

13. Strategic marketing planning should incorporate innovative marketing mix instruments and actively apply them when the potential of the classical tools (7P = 4P + 3P) has been exhausted.

14. The key components of a brand — product quality, price, and brand image (brand equity)— should be used to influence the brand itself, as well as consumer perception and the degree of customer loyalty.

15. It is always necessary to act quickly and decisively. A strong and successful brand can be built even with relatively modest financial resources, but it requires the efforts of the entire organization. In Moldova, there is significant potential for the creation and development of strong brands; achieving this requires the application of a competent marketing approach and the mobilization of the necessary human and financial resources.

From a strategic perspective, **producing branded products is significantly more advantageous than offering no-name or generic goods**. Brands enable firms to differentiate themselves in saturated markets, reduce customer price sensitivity, and maintain more stable demand through loyalty formation. Unlike generic products, which compete primarily on price and are easily substitutable, brands generate emotional attachment, trust, and perceived quality — factors that drive long-term profitability and resilience under competitive pressure.

Brand is a successful trademark. Brands are not inherently strong at the outset; they acquire strength over time through effective, comprehensive, and forward-looking marketing management. A strong brand provides multiple advantages to both the company and its customers compared to depersonalized goods and services. Over time, a strong brand allows for the accumulation of brand equity — an intangible asset that attracts clients and enhances the firm's market value.

Research Data Availability Statement: The study is based on both secondary and primary data. Secondary data were obtained from publicly available analytical reports, scientific publications, and brand rankings (MPP Consulting, Interbrand, Brand Finance etc.) cited in the reference list. Primary data were collected by the author through independent marketing research (PMA, University researches etc.) conducted during the study. The datasets used and analyzed in the current research are available from the author upon reasonable request.

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Contribution of Authors:

Igor Belostecinic: Conceptualization, Methodology, Investigation, Formal analysis, Writing — original draft, Writing — review & editing.
Lilia Chiriac: Validation, Writing — review & editing, Supervision.

Conflicts of Interest: The authors declare no conflict of interest

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PERCEPTION OF ECOLOGICAL PRICE ACCEPTANCE: CONSUMER ATTITUDE AND PRICE JUSTIFICATION FOR ECOLOGICAL PRODUCTS IN THE REPUBLIC OF MOLDOVA

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Abstract. The impact of eco-pricing on the formation of consumers' purchasing decisions is becoming increasingly decisive, influencing the level of adoption of ecological products. In the context of growing concerns for environmental protection and a healthy lifestyle, ecological products are attracting rising interest; however, price levels remain one of the main barriers to the expansion of consumption. The study aims to highlight how consumers perceive the price difference between ecological and conventional products, the degree of acceptance of eco-costs, and the factors that influence their willingness to pay a higher price. The research methodology is based on a quantitative study conducted through a questionnaire applied to a sample of 231 respondents, with data analysis carried out using descriptive statistical tools and the Likert scale. The results indicate that interest in ecological products is high, predominantly manifested at an occasional level, being conditioned by price sensitivity and the level of information. Consumers acknowledge the benefits of ecological products, particularly those related to health and safety, and accept a moderate price premium ranging between 0–20%. The conclusions emphasize the need for pricing strategies oriented toward perceived value, clear communication of eco-costs, and transparent labeling capable of stimulating the consistent adoption of ecological consumption.

Keywords: *ecological products, eco-pricing, consumer behavior, perceived value, willingness to pay, eco-costs, ecological marketing, sustainable consumption.*

Abstract. Impactul prețului ecologic asupra formării deciziilor de cumpărare ale consumatorilor este tot mai hotărâtor, influențând nivelul de adoptare a produselor ecologice. În contextul intensificării preocupărilor pentru protecția mediului și pentru un stil de viață sănătos, produsele ecologice câștigă un interes tot mai mare, însă nivelul prețurilor rămâne una dintre principalele bariere în extinderea consumului. Studiul își propune să evidențieze modul în care consumatorii percep diferența de preț dintre produsele ecologice și cele convenționale, gradul de acceptare a eco-costurilor și factorii care influențează

disponibilitatea de a plăti un preț mai ridicat. Metodologia cercetării se bazează pe un studiu cantitativ realizat prin chestionar, aplicat unui eșantion de 231 respondenți, iar analiza datelor a fost efectuată utilizând instrumente statistice descriptive și scala Likert. Rezultatele indică faptul că interesul pentru produsele ecologice este ridicat, manifestându-se preponderent la nivel ocazional, fiind condiționat de sensibilitatea la preț și de nivelul de informare. Consumatorii recunosc beneficiile produselor ecologice, în special cele legate de sănătate și siguranță, și acceptă un suprapreț moderat, situat în intervalul de 0–20%. Concluziile subliniază necesitatea unor strategii de preț orientate spre valoarea percepută, a unei comunicări clare a eco-costurilor și a unei etichetări transparente, capabile să stimuleze adoptarea constantă a consumului ecologic.

Cuvinte cheie: *produse ecologice, preț ecologic, comportamentul consumatorului, valoare percepută, disponibilitatea de plată, eco-costuri, marketing ecologic, consum sustenabil*.

1. Introduction

Human beings are entities that, in order to exist and develop, require a wide spectrum of products, needs that can be hierarchically structured across distinct levels, from fundamental to higher-order ones. Thus, throughout the entire life cycle - from birth to the end of existence - the individual manifests as an active consumer of various categories of goods.

In the contemporary context, alongside industrial development and the intensification of technological processes involved in the production, cultivation, and manufacture of consumer goods, there has been a significant increase in productivity and in the diversity of products available on the market. At the same time, modern industry frequently relies on the use of chemical substances intended to enhance yield, apparent quality, and the shelf life of agri-food products.

Nevertheless, in order to maintain health, consumers are increasingly oriented toward natural agri-food products, namely ecological products. These have been used since ancient times and are characterized by cultivation or production under strict conditions, without the use of synthetic pesticides, chemical fertilizers, genetically modified organisms, antibiotics, or growth hormones.

Ecological products are obtained through production methods that comply with rigorous environmental protection standards, contribute to the preservation of biodiversity, and ensure a high level of quality of the final product. In recent years, both consumption and consumer interest in this category of products have increased, with such goods being marketed through various channels, including specialized retail networks, supermarkets, and pharmacies.

In this context, the need arises for an in-depth analysis of issues related to the pricing of ecological products, as well as of the pricing strategies applicable to this category. Producers, processors, and distributors - whether wholesalers or retailers - must take into account not only the nutritional and qualitative value of ecological products, but also the need to satisfy consumer requirements and to ensure the profitability of all stages involved in the distribution process. This objective can be achieved through the establishment of appropriate prices, grounded both in cost analysis and in research into consumers' perceptions and attitudes toward the prices of ecological products.

2. Materials and Methods

Domestic and international literature sources concerning the assessment of consumer attitudes toward the pricing of ecological products are used, and the systemic approach is applied to the study of market phenomena.

A questionnaire was developed to understand how consumers in the Republic of Moldova perceive the pricing of ecological products. The research was conducted between 08.01.2025 and 10.01.2025 [1]. The study sample consists of 231 respondents with the following socio-economic and geographical characteristics:

- ✓ by age: under 20 years – 130 respondents (56.3%), 21–30 years – 86 respondents (37.2%), 31–40 years – 4 respondents (1.7%), 41–50 years – 6 respondents (2.6%), over 60 years – 5 respondents (2.2%);
- ✓ by gender: female – 152 respondents (65.8%), male – 79 respondents (34.2%);
- ✓ by level of education: secondary – 59 respondents (25.5%), higher education – 158 respondents (68.4%), postgraduate – 14 respondents (6.1%);
- ✓ by net monthly household income: under 5,000 MDL – 43 respondents (18.6%), 5,001–10,000 MDL – 59 respondents (25.5%), 10,001–15,000 MDL – 51 respondents (22.1%), over 15,000 MDL – 78 respondents (33.8%);
- ✓ by type of place of residence: rural – 90 respondents (39.0%), urban – 141 respondents (61.0%);
- ✓ by region of residence: north – 38 respondents (16.5%), center – 164 respondents (71.0%), south – 29 respondents (12.5%).

3. Results

The study presented in this article is based on a survey conducted among consumers in the Republic of Moldova, aimed at analyzing their perceptions and the level of acceptance of eco-pricing. The sample is predominantly composed of young respondents, with the majority being under 30 years of age and having a higher level of education. The gender distribution is relatively balanced, with a moderate predominance of women, reflecting their increased interest in ecological consumption. Participants' income levels are diverse; however, the largest share is represented by individuals with medium and above-average incomes. Respondents originate from both rural and urban areas, proportionally covering the northern, central, and southern regions of the country. Such a sample structure allows for the formulation of relevant conclusions regarding consumer behavior and attitudes toward the prices of ecological products.

The results of the survey related to the thematic questions are presented below. The questionnaire began with a question aimed at confirming the purchase of ecological products, and the distribution of responses is illustrated in Figure 1.

The distribution of responses presented in Figure 1 outlines a predominantly occasional consumption behavior among respondents. The largest category is "occasionally," comprising 145 individuals or 62.8%, which indicates that a substantial share of consumers choose ecological products only in certain situations, without this behavior constituting a consistent habit. This is followed by the segment of respondents who purchase such products monthly, represented by 44 individuals or 19%, reflecting a moderate level of interest that is still insufficient to indicate loyalty to these products. Consumers who integrate ecological products into their routine consumption are fewer in number, namely 26 respondents or 11.3% who report weekly purchases, while the segment of daily buyers is negligible, with only 10 respondents or 4.3%.

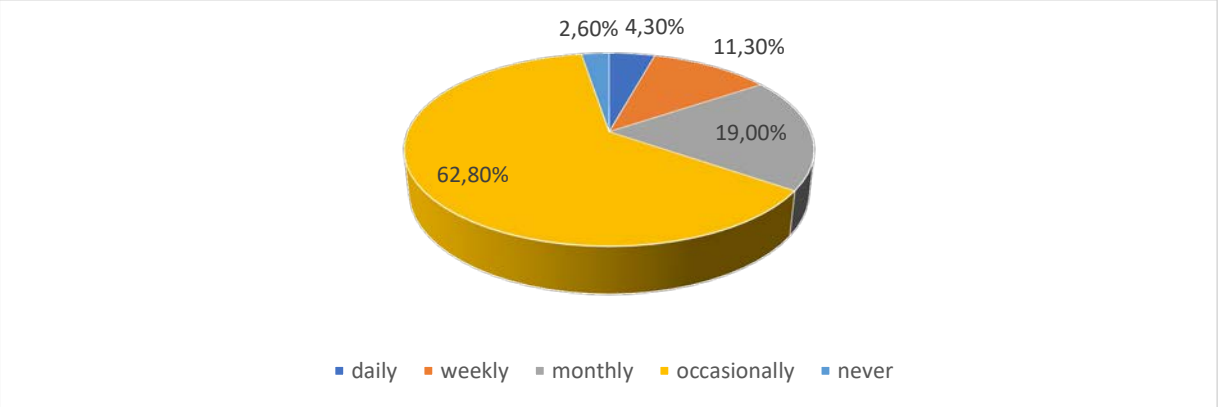

Figure 1. Respondents' answers to the question "How often do you buy organic products?"

This situation confirms that the consistent integration of ecological products into daily consumption remains limited, most likely due to higher prices, limited accessibility, or perceptions regarding their immediate utility. There are also 6 respondents or 2.6% who state that they have never purchased ecological products; this share remains marginal and indicates that complete rejection is relatively rare.

Overall, the data presented in Figure 1 suggest that interest in ecological products does exist but is manifested predominantly at an occasional level. The current behavior of respondents points to a consumer base that is open to ecological consumption, yet still situated in a transitional stage between curiosity and regular adoption.

Figure 2 presents the distribution of consumer preferences regarding the purchase of the most frequent categories of ecological products, and the results highlight a strong interest concentrated on basic products and those with an immediate impact on health. Among the most demanded products, food items rank first, being selected by 194 respondents. This predominance indicates that, for most consumers, the transition toward a healthier lifestyle is closely linked to daily food consumption. Ecological food products are perceived as having a direct connection to health, food safety, and quality of life, which justifies their high share.

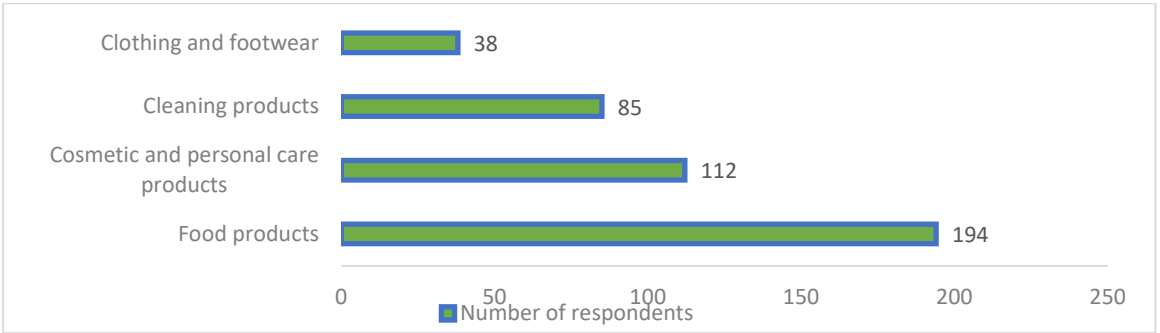

Figure 2. Respondents' answers to the question "Which category of organic products do you buy most often?"

Cosmetic and personal care products follow, with 112 respondents, suggesting a sustained concern for avoiding aggressive chemical substances in products applied to the skin. In this case, consumers become more attentive to the ingredients used in cosmetic products and to the long-term risks associated with conventional alternatives, which in turn stimulates demand for organic options. Cleaning products rank third, with 85 respondents. Although less popular than the previously mentioned categories, there is a noticeable openness toward reducing exposure to detergents and toxic substances in the household

environment. This segment is expanding, being influenced by campaigns related to respiratory health and environmental protection.

The least demanded category is ecological clothing and footwear, selected by only 38 respondents. The reasons for this situation may vary, but they mainly relate to the fact that the impact of these products is perceived as less immediate compared to food or cosmetic products, as well as to the notion that, for many consumers, sustainable fashion remains a secondary concern.

Thus, it can be observed that the adoption of ecological products is closely linked to their perceived importance and direct impact on health. Consumers prioritize ecological food products as a core element of a healthy lifestyle, cosmetic and personal care products for reasons of personal safety, and cleaning products out of a desire to avoid toxic substances within the household.

The data presented in Figure 3 highlight a strong dependence of consumers on supermarket chains as the primary purchasing channel for ecological products. With 195 respondents, this category clearly dominates consumer preferences, suggesting that accessibility, relatively competitive prices, and a wide product assortment play a decisive role in this orientation. Supermarkets are perceived as convenient spaces where consumers can find everything in one place, including ecological alternatives.

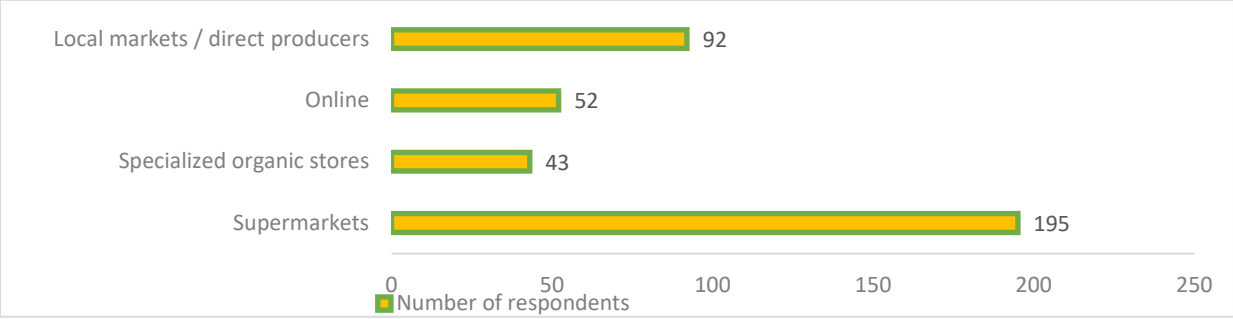

Figure 3. Respondents' answers to the question "From what type of stores do you most often buy organic products?"

Local markets and direct producers rank second, with 92 respondents. This significant share indicates that a substantial segment of the population prefers authentic and traditional sources, where trust in production methods, freshness, and quality is higher. Direct purchasing from producers aligns with traditional values and the desire for clear traceability, reflecting both an attachment to natural products and support for the local economy.

Online sales, chosen by 52 respondents, occupy the third position. Although not representing the dominant segment, their growing presence is evident. This trend reflects consumers' appetite for convenience, home delivery, and a broader product range, particularly for niche products. Nevertheless, the adoption rate remains moderate, possibly due to logistical constraints, varying levels of trust, or delivery costs.

At the bottom of the ranking are specialized organic stores, with 43 respondents. Despite offering carefully selected and certified products, their relatively low share may be explained by higher prices, limited accessibility, and a more restricted territorial presence. Consumers may perceive these stores as targeting a narrower and more sustainability-educated segment.

Overall, the information in Figure 3 shows that the purchase of ecological products is primarily influenced by accessibility and convenience, criteria that favor supermarkets.

However, nearly one third of respondents prefer local markets and direct producers, signaling a genuine interest in natural, local, and trustworthy products.

Online purchasing and specialized organic stores remain secondary options, yet they represent segments with growth potential, especially if factors such as price, product diversity, and trust in ecological certifications are improved.

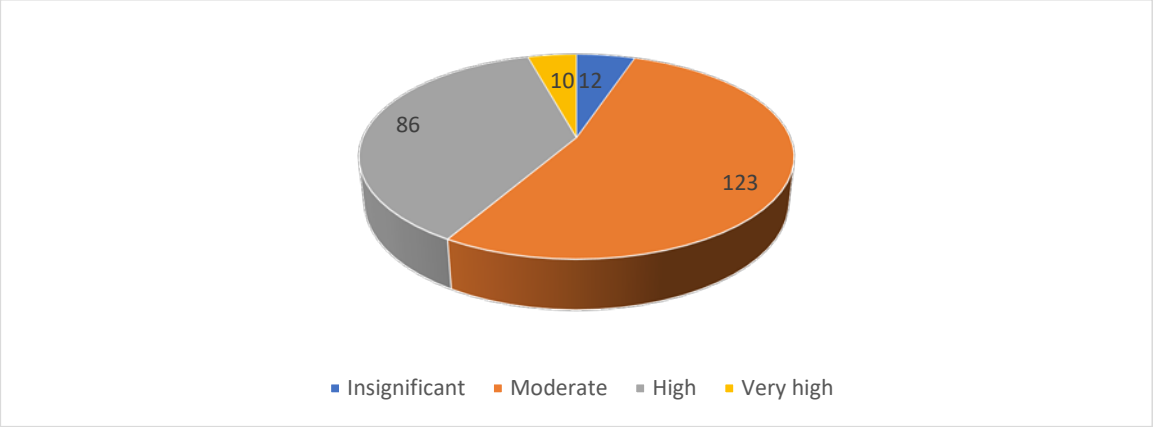

Figure 4. Respondents' answers to the question "How do you perceive the price difference between organic and conventional products?"

Figure 4 clearly illustrates how consumers perceive the price difference between ecological and conventional products, with the distribution of responses highlighting a predominantly moderate to high perception.

The largest share of respondents, 123 individuals, consider the price difference to be moderate, suggesting that although ecological products are perceived as more expensive, this level is not regarded as excessive or unaffordable. Such a perception may encourage consumers' openness toward occasional or regular purchases of ecological products, especially when the health and environmental benefits are clearly communicated.

A significant segment, comprising 86 respondents, perceives the price difference as high. This group signals heightened price sensitivity, which may represent a barrier to the consistent adoption of ecological products. The perception of a substantial cost increase can limit purchase frequency and redirect consumer behavior toward more affordable conventional alternatives.

The "insignificant" category, with 12 respondents, indicates that only a small number of consumers consider the price difference to be unimportant. These individuals represent the segment with the highest potential for loyalty, likely being less influenced by cost and more by factors such as health, quality, or ecological responsibility.

At the opposite end, 10 respondents perceive the price difference as very high, reflecting a critical view of the costs associated with ecological products. For this group, price constitutes a major barrier that almost completely inhibits the adoption of this type of product.

Overall, perceptions of the price difference are dominated by moderate and high evaluations, indicating a tangible sensitivity to costs among consumers. Although most respondents do not consider the difference to be exaggerated, price nevertheless remains a determining factor in the purchasing decision.

Therefore, in order to expand ecological consumption, clearer communication of the benefits of ecological products, more accessible or promotional pricing policies, and diversification of product ranges with a balanced price–quality ratio would be necessary.

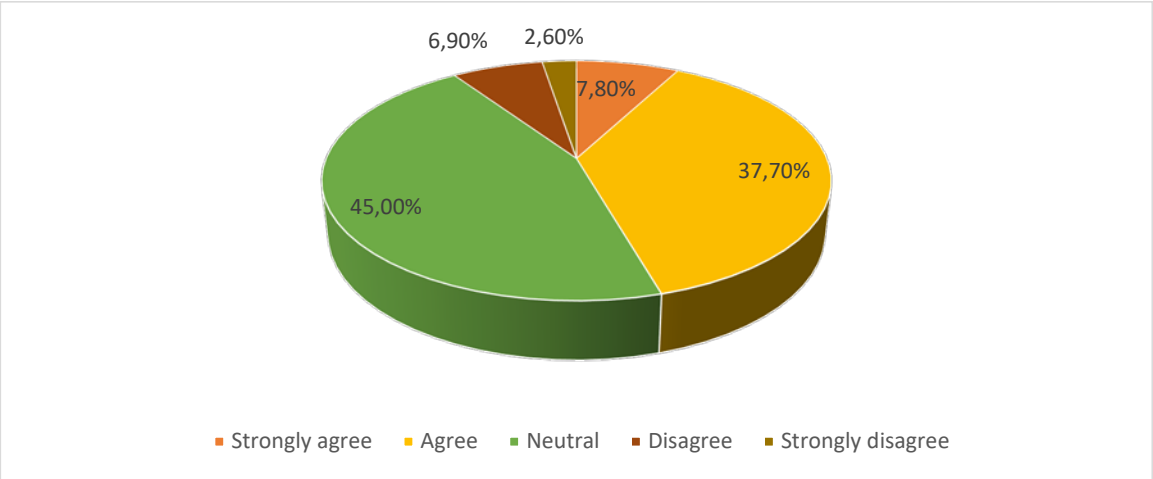

Figure 5. Respondents' answers to the question "Are organic products more expensive because they include environmental protection costs?"

Figure 5 indicates that consumers' perceptions regarding the reason why ecological products are more expensive are predominantly inclined toward acceptance, with a significant proportion of respondents considering the inclusion of environmental protection costs in the price to be justified.

The largest category is the neutral one, accounting for 45% of respondents. This high proportion indicates a considerable level of uncertainty or a lack of clear information regarding the cost components of ecological products. Many consumers neither reject nor fully accept the idea, which suggests an evident need for more effective communication from producers and retailers.

A total of 45.5% of respondents fall within the agreement range (37.7% agree and 7.8% strongly agree). This majority category suggests that nearly half of consumers understand the rationale behind higher prices and accept the fact that sustainable production processes involve additional investments—in certification, the quality of raw materials, green energy, responsible resource management, or emission reduction. These consumers are more likely to adopt ecological products even under conditions of higher prices.

On the other hand, a relatively small yet present proportion—9.5% (6.9% disagree and 2.6% strongly disagree)—rejects the idea that ecological prices reflect real environmental protection costs. This group may perceive prices as exaggerated or artificially imposed, or may lack trust in the differences between ecological and conventional products.

The distribution of responses indicates a clear tendency toward accepting the justification for higher prices of ecological products, although nearly half of respondents remain undecided. These results suggest that the market still lacks transparent information about the real costs of ecological production. At the same time, they point to a considerable potential for increasing consumer trust through educational campaigns and clear communication regarding ecological benefits and the investments required to produce goods with minimal environmental impact.

The analysis of responses shows that consumers' perceptions of the price difference between ecological and conventional products are, overall, slightly favorable toward justifying these costs. Although a significant share of respondents—104 individuals—adopt a neutral position, indicating uncertainty or insufficient information about cost structures, approximately 45.5% of participants (87 agreeing and 18 strongly agreeing) believe that the higher price genuinely reflects investments in environmental protection.

The group contesting this justification is relatively small—only 22 respondents—indicating that opposition to the rationale behind ecological pricing is marginal. The Likert scale calculation confirms this trend, with an aggregated score of +0.41, oriented toward agreement, though with moderate intensity.

Overall, public opinion is shaped in a cautiously favorable direction, in which consumers tend to accept the logic of higher prices but do not do so firmly. The results suggest that clearer communication regarding ecological benefits, certification processes, and the real costs of sustainable production could transform neutrality into trust and, consequently, into a greater willingness to pay ecological prices.

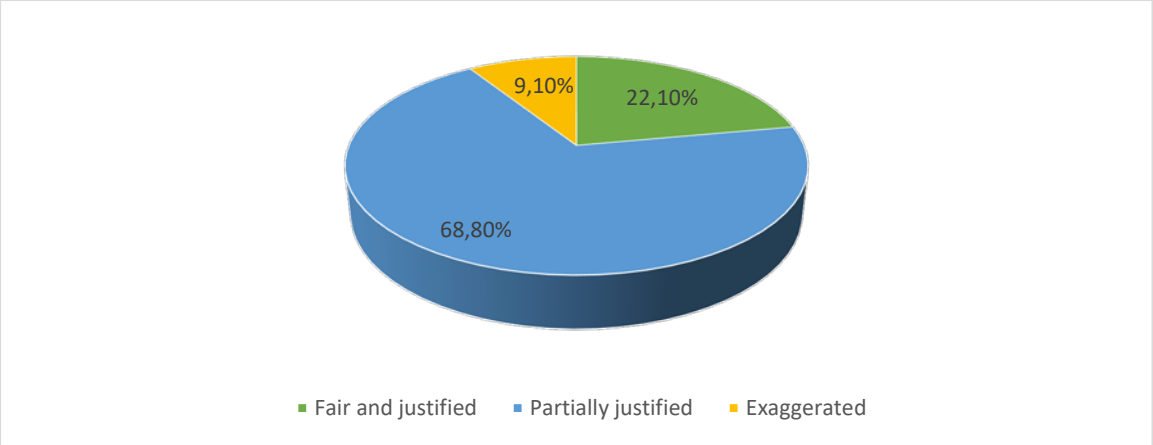

Figure 6. Respondents' answers to the question "Do you consider the prices of organic products to be:"

Figure 6 presents a clear structure of consumers' perceptions regarding the price level of ecological products, suggesting a predominantly moderate evaluation.

The largest share of respondents—68.8%, representing 159 individuals—consider the prices to be partially justified. This majority proportion indicates that the public recognizes, to a certain extent, the reasons behind the higher costs of ecological products, while also perceiving the existence of elements that could be optimized. At the same time, 22.1% of respondents (51 individuals) believe that prices are fair and justified. This group represents the segment of consumers who are fully aware of and accept the fact that ecological production involves additional costs. These consumers are the most likely to adopt ecological products on a consistent basis, as they perceive the price–value relationship as balanced and fair.

On the other hand, 9.1% of participants (21 individuals) consider the prices to be exaggerated, reflecting a critical perception and a low tolerance for increased costs. For these consumers, high prices constitute a direct barrier to the purchase of ecological products, and this segment indicates that a small but relevant share of the public is not convinced by the justification of current prices.

The results show that the majority of respondents (nearly 70%) place the prices of ecological products in an intermediate zone, viewing them as partially justified, while only about one fifth perceive them as fully justified. The relatively small proportion of those who consider prices exaggerated suggests that negative perceptions are limited, yet still present. Overall, consumers display a moderate openness toward the prices of ecological products, combined with a need for more transparent explanations regarding the real costs of production, traceability, and ecological benefits. Clearer communication of these aspects could reduce the neutral zone and contribute to strengthening the perception of a "fair price."

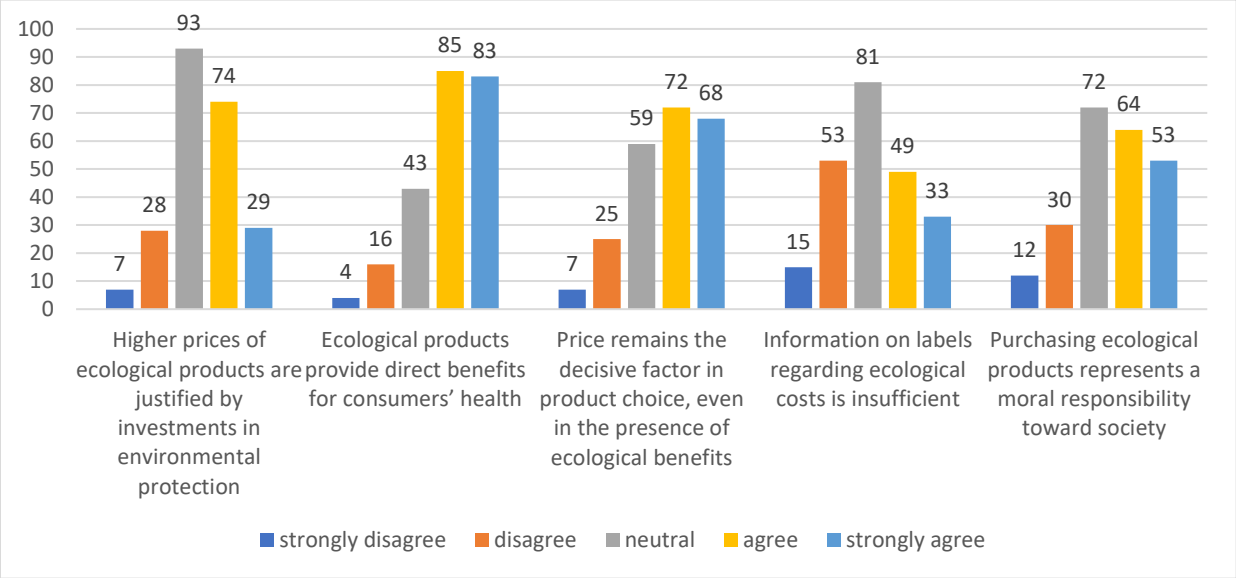

Figure 7. Respondents' answers to the question "Please rate how much you agree with the following statements about organic products."

Figure 7 presents a set of five key statements about ecological products, evaluated on a five-point scale (from strongly disagree to strongly agree). The distribution of responses provides a comprehensive picture of consumer perceptions regarding price, benefits, transparency, and the moral responsibility associated with ecological consumption.

The statement *"Higher prices of ecological products are justified by investments in environmental protection"* generates a relative balance between agreement and neutrality, with a slight predominance of respondents who support price justification (the combined categories of strongly agree and agree total 103 respondents), followed by neutral responses (93 respondents), while disagreement and strong disagreement account for 35 respondents. However, the high number of neutral responses indicates a considerable level of uncertainty or mistrust regarding cost transparency. Only a minority rejects the argument of ecological investments. Overall, consumers partially accept the justification but likely expect clearer explanations.

The statement *"Ecological products provide direct benefits for consumers' health"* records the highest level of agreement (strongly agree and agree total 168 respondents), compared to 43 neutral responses and only 20 respondents expressing disagreement. Consumers are thus largely convinced that ecological products have a positive impact on health. This perception represents the main driver of ecological product purchases and confirms the strong association between ecological and healthy consumption.

For the statement *"Price remains the decisive factor in product choice, even in the presence of ecological benefits"*, the results are very clear: the combined agreement categories total 140 respondents, neutral responses account for 59 respondents, and disagreement totals 32 respondents. This indicates that most consumers consider price to be the primary purchasing criterion, even when they acknowledge ecological benefits. This perception helps explain why many individuals purchase ecological products only occasionally. While benefits are recognized, they are not always sufficient to offset price considerations. The size of the neutral segment suggests that purchasing behavior may vary depending on the type of product.

The statement *"Information on labels regarding ecological costs is insufficient"* is the most polarized, with the combined categories of strongly agree and agree totaling 82 respondents,

neutral responses accounting for 81 respondents, and the combined categories of disagree and strongly disagree amounting to 68 respondents. This distribution indicates that the market suffers from a lack of transparency and that information on ecological costs is not yet communicated clearly enough. At the same time, the relatively high level of disagreement shows that some consumers consider the information currently provided on labels to be sufficient or not strictly necessary.

For the statement *"Purchasing ecological products represents a moral responsibility toward society,"* the balance tilts toward agreement, with strongly agree and agree totaling 117 respondents, neutral responses accounting for 72 respondents, and disagree and strongly disagree totaling 42 respondents. Nearly half of the respondents perceive the purchase of ecological products as a moral and responsible act. However, the substantial neutral group suggests that the idea of social responsibility, while growing, is not yet dominant. A significant share of respondents does not perceive a direct moral link.

The final conclusion for Figure 7 highlights a complex and nuanced consumer perception of ecological products. Health benefits are the most strongly recognized (by over 70% of respondents), price remains the main obstacle to purchase (140 respondents), and the justification of higher prices through ecological costs is accepted, but with reservations. Transparency regarding labeling is perceived as insufficient, with opinions being highly divided, while nearly half of respondents consider ecological purchasing to be a moral gesture.

Overall, consumers are favorable toward ecological products and acknowledge their benefits, yet they remain price-sensitive and in need of clear information. This combination explains the predominance of occasional purchases and the continued preference for conventional products.

Figure 8 illustrates how respondents assess the importance of five key factors that may justify the price of an ecological product. The distribution of responses shows a clear orientation toward recognizing the decisive role of durability, sustainable raw materials, and ecological technologies, with more moderate variations in the case of taxes, regulations, and subsidies.

The category *"Sustainable raw materials used"* is perceived as one of the most relevant factors in justifying price. Nearly half of respondents (149 out of 231) consider sustainable raw materials to be important or very important, reflecting a strong concern for the quality of inputs and their origin. Only 16 respondents regard this factor as of little relevance. Sustainable raw materials thus represent a central anchor in the perceived value of ecological products.

The factor *"Ecological technologies in the production process"* records the highest number of "important" responses (79 respondents) and a consistently high number of "very important" responses (70 respondents), totaling 149 respondents who recognize the relevance of clean technologies in price justification. This result highlights that the public attaches considerable value to how products are manufactured, appreciating investments in technologies with reduced environmental impact.

For the factor *"Environmental taxes and regulations,"* a more balanced distribution can be observed, though it is less polarized than in the first two categories. Approximately 121 respondents consider this factor important or very important, while 73 place it in a moderate range. However, a higher number of respondents consider this category to be of little or no relevance, suggesting that taxes and regulations are perceived as a more technical element, less visible to the final consumer.

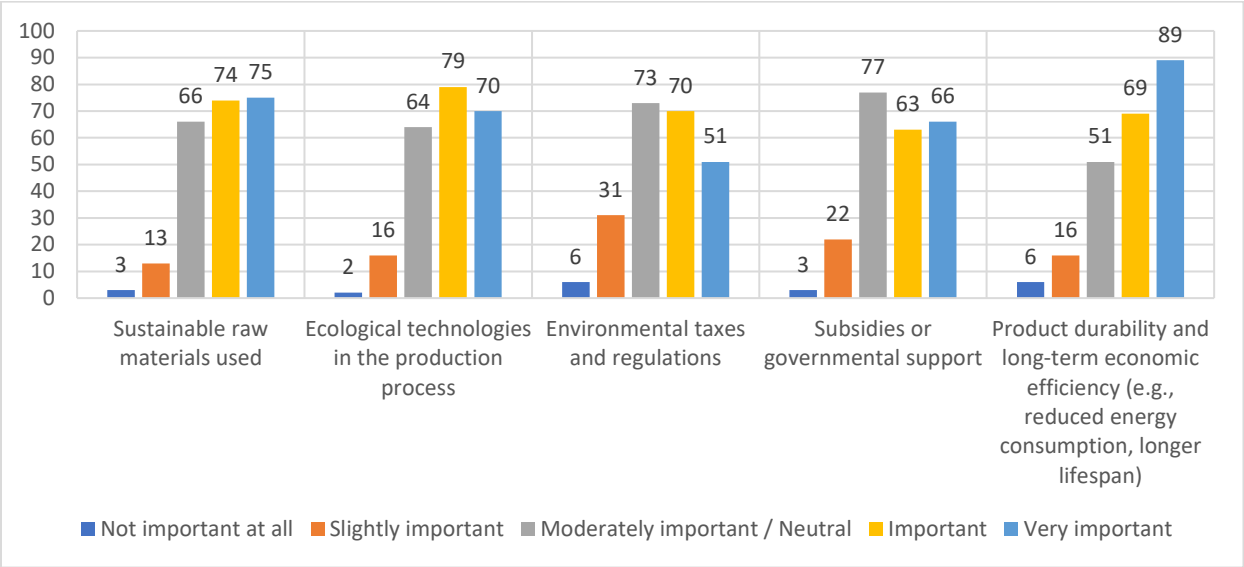

Figure 8. Respondents' answers to the question "How important do you consider the following factors in justifying the price of an organic product?"

The perceived importance of subsidies is significant, although weaker than in the first two categories. A total of 129 respondents consider this factor important or very important. The high number of neutral responses (77 respondents) indicates uncertainty regarding the actual role of the state in the final price of ecological products. Nevertheless, only 25 respondents consider this factor irrelevant, suggesting a general acknowledgment of the potential role of public policies.

"Product durability and long-term economic efficiency" is the category with the highest number of "very important" responses (89 respondents). Consumers strongly value durability and long-term economic benefits, elements that directly contribute to the perception of profitability of an ecological product. Approximately 140 respondents consider this factor important or very important, confirming that a long-term perspective is becoming an increasingly influential criterion in price justification.

Overall, the results presented in Figure 8 show that respondents assign high importance to factors reflecting quality, sustainability, and durability. Consumers therefore value investments in processes and tangible outcomes of sustainability, while being less influenced by administrative or fiscal aspects. The figure confirms the existence of a rational orientation whereby buyers accept higher prices when these are justified by quality, reduced environmental impact, and extended product lifespan.

Figure 9 provides insight into how consumers integrate five important factors into the decision-making process related to the purchase of ecological products.

The factor *"Price–quality ratio of the product"* has the strongest impact on purchasing decisions. A total of 175 respondents (over 75%) state that they frequently or always take the price–quality ratio into account. This result confirms that, despite the growing interest in ecological products, consumers remain highly attentive to the economic value of the product. Perceived quality and the balance between price and performance are decisive in the purchasing process.

Although the importance of transparency is acknowledged, the distribution shows that a significant number of respondents fall within the moderate category (78 respondents). Nevertheless, 120 individuals evaluate this criterion as frequently or always relevant. This

finding suggests that a considerable proportion of consumers seek clear information about ecological costs; however, the lack of standardization and consistent labeling may reduce the influence of this factor on final purchasing decisions.

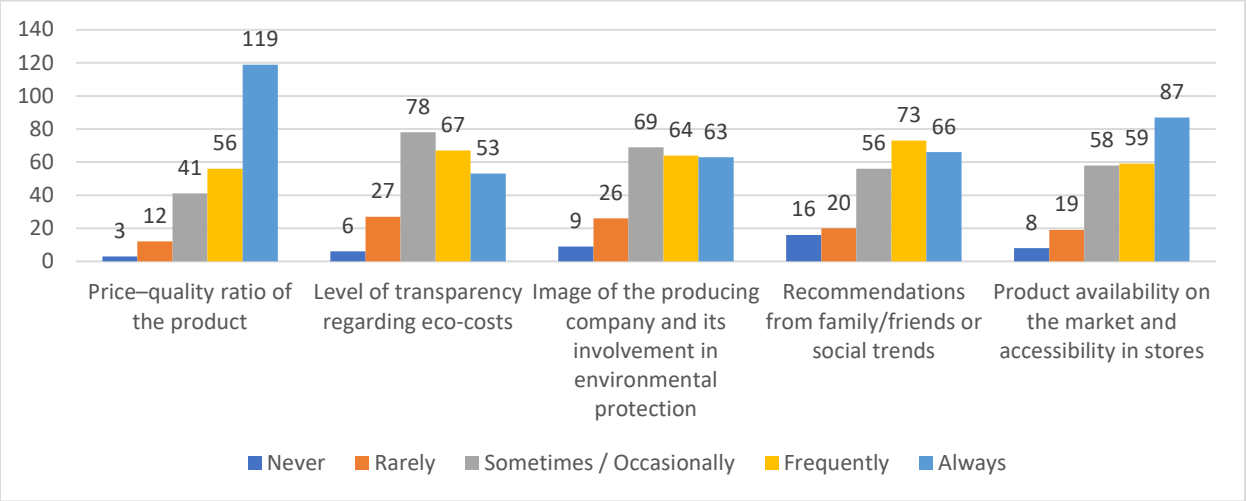

Figure 9. Respondents' answers to the question "When deciding whether to buy an eco-friendly product, to what extent do you consider the following aspects?"

Approximately 127 respondents frequently or always consider the reputation of the company and its involvement in ecological practices. This criterion is becoming increasingly important against the backdrop of concerns related to greenwashing. The majority of respondents pay attention to corporate responsibility, indicating the strengthening of an ethical consumption culture.

Social recommendations exert a significant influence, with 139 respondents taking them into account frequently or always. This aspect highlights the strong role of social influence and validation through reference groups. In decisions regarding the purchase of ecological products, the opinions of close social circles function as a source of trust and confirmation.

Product availability is an extremely important factor, with 146 respondents considering it frequently or always. Thus, even when purchase intention exists, it is conditioned by the actual presence of ecological products in stores. Limited or uneven supply remains one of the major barriers to the consistent adoption of ecological consumption.

In conclusion, the results presented in Figure 9 indicate that purchasing decisions are primarily guided by economic considerations and trust, complemented by social influence and product availability. Overall, consumers seek ecological products that are affordable, high-quality, and transparent, originating from credible companies and easily accessible on the market. Their decisions reflect a balance between personal values, budget constraints, and social environment influences.

Figure 10 illustrates how five key elements influence consumers' decisions to pay a higher price for an ecological product.

Ecological certification represents an essential element in justifying the price, as 117 respondents are influenced either strongly or very strongly by this factor. This finding confirms the importance of visible evidence of authenticity and standardization. However, the high number of moderate responses (74 respondents) suggests that the impact of certification also depends on consumers' familiarity with labeling systems.

Evidence of reduced environmental impact has a considerable influence, with 119 respondents stating that they are influenced strongly or very strongly, and 84 respondents indicating a moderate influence. This result points to a high level of sensitivity toward environmental arguments. Consumers value transparency regarding the positive ecological effects of a product, indicating that authentic green messaging can justify a higher price.

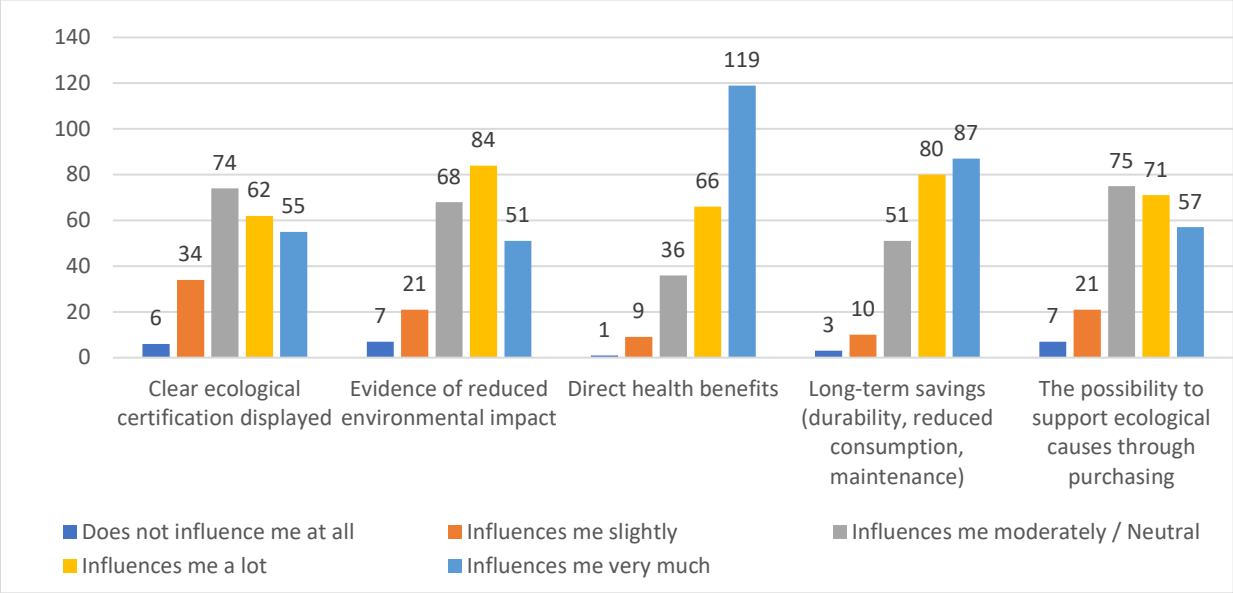

Figure 10. Respondents' answers to the question "If an organic product is more expensive than a conventional one, how would the following factors influence your purchasing decision?"

Direct health benefits represent the factor with the strongest emotional and decisional impact. An impressive total of 132 respondents report that health benefits influence them strongly or very strongly, while only 10 individuals state that the influence is low or nonexistent. This confirms that health remains the primary motivation for consumers to pay higher prices for ecological products.

The factor *"Long-term savings"* records the highest score in the category "influences me very much" (87 respondents). Overall, 167 respondents are influenced strongly or very strongly, highlighting that perceptions of efficiency and durability constitute an extremely convincing argument for accepting a higher price. Consumers pay attention to the total cost of use, not only to the initial purchase price.

With 128 respondents influenced strongly or very strongly, the element *"The possibility to support ecological causes through purchasing"* confirms the moral dimension of ecological consumption. However, its influence is slightly more modest compared to health benefits or long-term savings. The results show that ecological solidarity is important, but its persuasive power depends on consumers' personal connection to these causes.

Figure 11 illustrates the perceived level of preparedness of individuals, families, the community, the market, and state institutions to accept higher prices for ecological products. The majority of respondents position themselves in the categories *moderately prepared* and *prepared* (109 respondents), indicating a considerable personal openness to paying a higher price for ecological products. Nevertheless, the 46 respondents who consider themselves *slightly prepared* suggest that, for a significant share of consumers, price remains an obstacle. The segment of those who feel *very prepared* (27 respondents) is still relatively small, indicating that firm willingness to pay higher prices is limited.

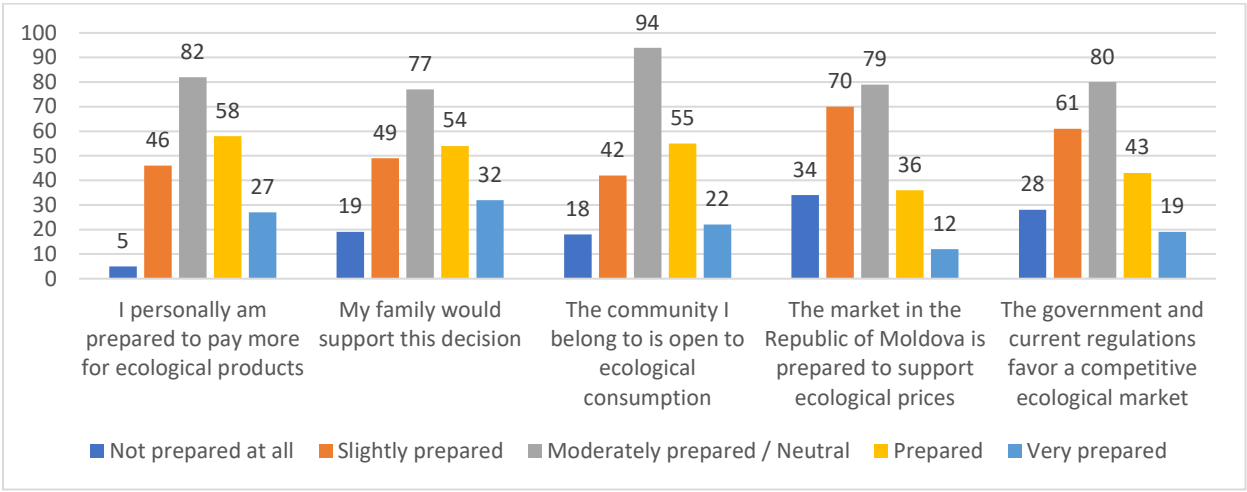

Figure 11. Respondents' answers to the question "On a scale of 1 to 5 (not at all prepared – very prepared), how prepared do you think society (including yourself) is to accept higher green prices?"

Respondents' perceptions indicate that their families are generally moderately supportive of higher ecological prices (77 respondents). However, a substantial number believe that their families would be *prepared* (54 respondents) or *very prepared* (19 respondents) to support such decisions. This distribution suggests a potential for positive influence within the family environment, alongside a certain degree of hesitation.

The community is perceived as the least prepared element for accepting ecological prices. With 94 responses in the moderate category and 60 respondents indicating that the community is *slightly* or *not at all prepared*, participants point to the absence of a strong collective culture of ecological consumption. Although 77 respondents (*prepared* and *very prepared*) represent a meaningful segment, it is insufficient to suggest broad acceptance at the community level.

The preparedness of the market in the Republic of Moldova reflects the highest level of reluctance. A total of 104 respondents (*slightly prepared* and *not at all prepared*) consider that the market is not ready t o support ecological prices. Only 48 respondents believe that the market is *prepared* or *very prepared*. This perception reflects the limited availability of ecological products, significant price differences, the lack of stable demand, and the slow development of the ecological sector in Moldova.

Regarding *the role of government and regulations*, perceptions are dominated by the *moderately prepared* category (80 respondents), indicating unclear expectations concerning public policies. Only 62 respondents consider the government to be prepared, while 40 express the opposite view. These results suggest a perception of insufficient state involvement in subsidizing ecological agriculture, promoting organic products, regulating labeling, and creating a competitive ecological market.

The data presented in Figure 12 highlight a substantial openness among consumers toward paying a price premium for ecological products, albeit within moderate limits. The largest share of respondents, 60.6%, state that they would be willing to pay up to 10% more, indicating a psychological threshold at which the additional cost is perceived as reasonable in relation to the benefits associated with ecological consumption. This segment represents the core group of consumers with high potential for the consistent purchase of ecological products, provided that the price difference remains within affordable limits.

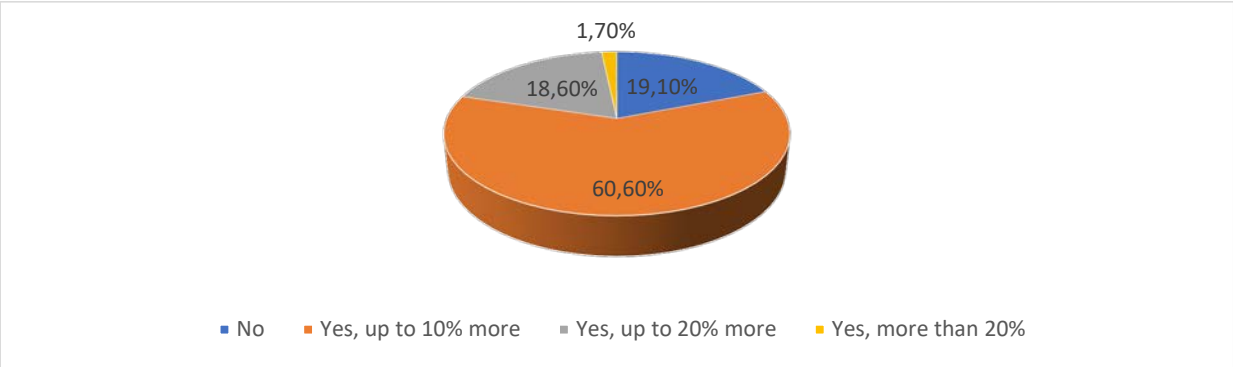

Figure 12. Respondents' answers to the question "Would you be willing to pay more for organic products?"

Another significant group, accounting for 18.6%, is willing to pay up to 20% more, reflecting a strong motivation, whether related to health considerations or environmental responsibility. These consumers appear to perceive the added value of ecological products as sufficiently important to justify a more substantial price increase. By contrast, only 1.7% of respondents are willing to pay more than 20% extra, highlighting a small but highly committed segment that strongly values ecological benefits and is prepared to bear significantly higher costs. In contrast, 19.1% of participants state that they would not be willing to pay more, underscoring the fact that a considerable proportion of the population remains price-sensitive and less convinced of the justification for the higher costs of ecological products.

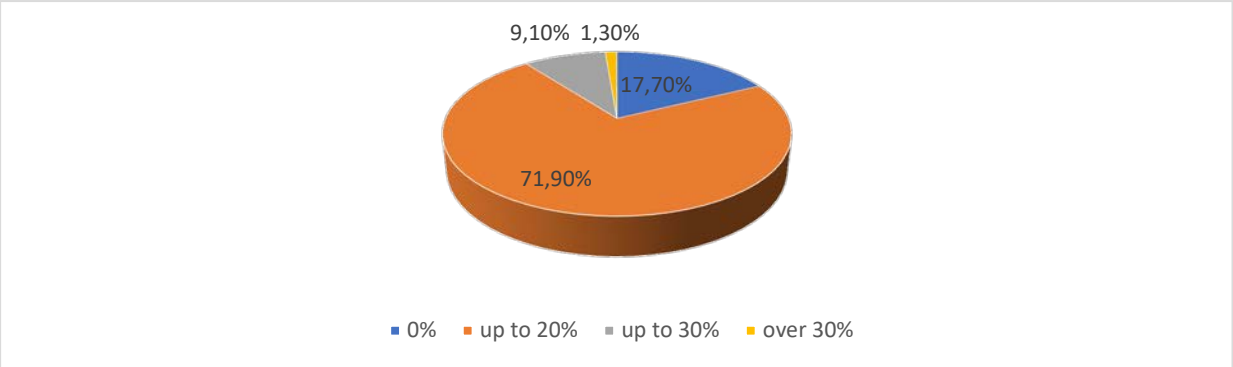

Figure 13. Respondents' answers to the question "What is the maximum price premium you would accept for organic products?"

Figure 13 highlights a clear and dominant trend regarding consumers' willingness to accept price premiums for ecological products. The largest segment, representing 71.9% of respondents, indicates a willingness to accept a price premium of up to 20%. This level appears to be the most comfortable psychological threshold for the majority of participants, reflecting the perception that a moderately higher ecological price is reasonable and justified in relation to the benefits offered.

Another notable segment consists of respondents who would not accept any price premium (17.7%). This group reflects a high level of price sensitivity and, likely, a lower willingness to pay more for ecological products, either due to economic constraints or a lack of conviction regarding the added value of such products. This finding represents an important indicator of a significant market barrier shaped by perceptions related to costs, trust, or income levels.

The segment of consumers willing to accept price premiums of up to 30% (9.1%) represents a group with stronger motivation and a higher level of commitment to ecological consumption. These respondents are more aware of the beneficial impact of ecological products on the environment and health and are therefore willing to invest more accordingly.

The smallest share, 1.3%, is represented by those who would accept a price premium above 30%. This very limited segment is characteristic of highly dedicated consumers who are strongly oriented toward ecological values, for whom perceived benefits outweigh higher costs.

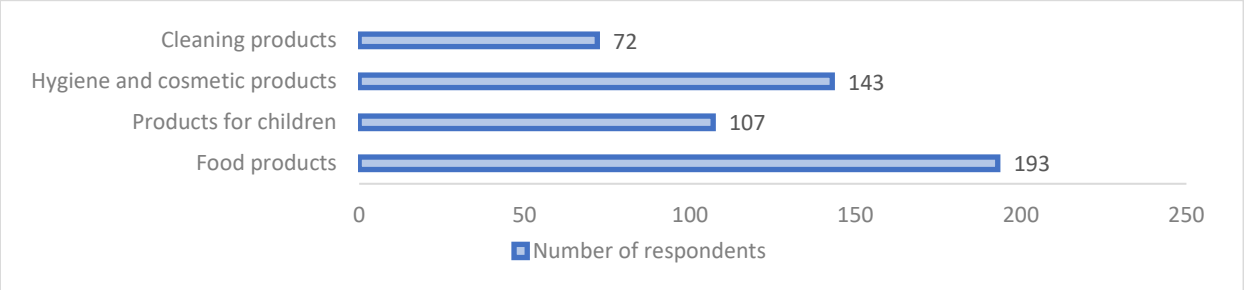

Figure 14. Respondents' answers to the question "For which product category would you be willing to pay the most for the ecological attribute?"

The distribution of responses indicates a clear consumer orientation toward specific product categories in which the ecological attribute is perceived as having high value. Accordingly, Figure 14 reflects consumer priorities based on the direct impact on health, personal safety, and environmental sensitivity. The results reveal a clear hierarchy of consumers' willingness to pay more for the ecological attribute, with the highest priority assigned to food products, which are perceived as having a direct and immediate impact on health.

A high level of interest is also observed for hygiene and cosmetic products, where product composition is considered important for personal well-being. Additionally, there is significant interest in products for children, driven by their vulnerability and the demand for safe and reliable products. At the lower end of the hierarchy are cleaning products, which attract a moderate level of interest, as their benefits are perceived more at the environmental level than at the personal level.

Overall, consumers are more willing to make additional investments in product categories where ecological attributes are closely associated with health, safety, and quality of life, confirming the trends observed in the previous figures.

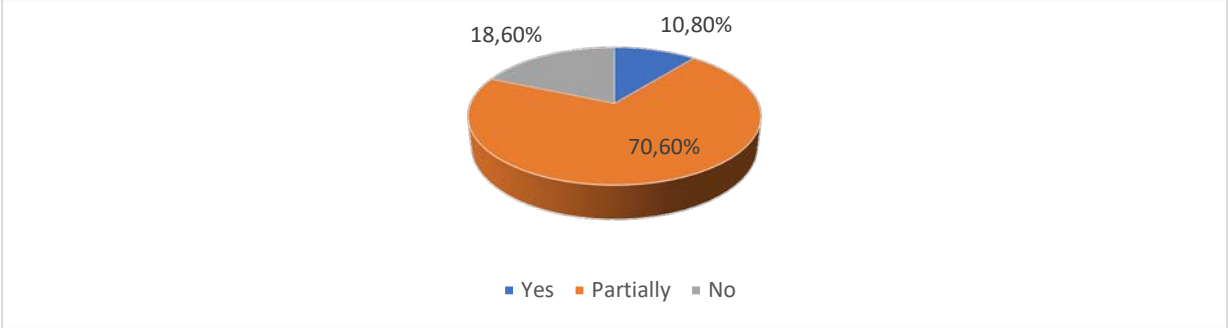

Figure 15. Respondents' answers to the question "Do you think manufacturers provide sufficient explanations about eco-prices?"

Figure 15 highlights that the majority of consumers believe producers do not provide sufficient explanations regarding the formation of ecological prices, and that this communication deficit influences how the public perceives price differences between ecological and conventional products. In this regard, a major lack of communication concerning ecological pricing can be observed: approximately 7 out of 10 consumers consider the explanations to be only partial and therefore insufficient to generate full trust; nearly 2 out of 10 believe that no clear justification exists at all, which may foster suspicion and reluctance to purchase; and only 1 out of 10 consumers is fully satisfied, thus indicating a structural transparency problem at the producer level.

Consequently, the lack of clear information regarding the formation of ecological prices remains one of the main barriers to accepting price differences, affecting both consumers' willingness to pay and their trust in ecological products.

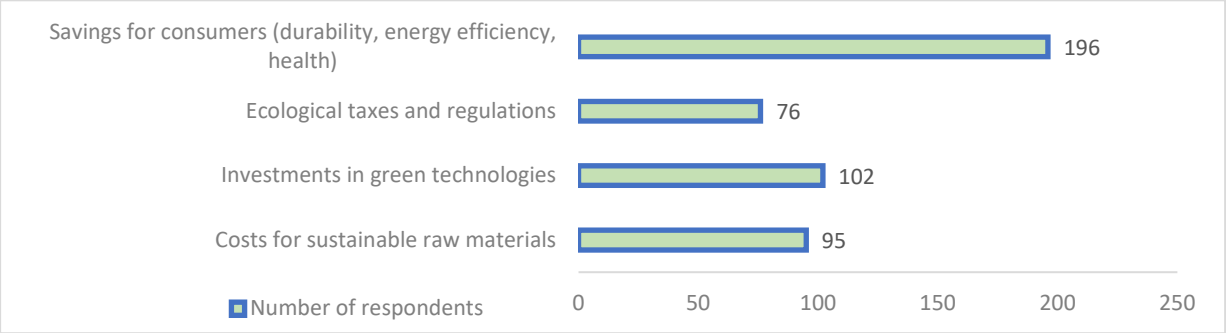

Figure 16. Respondents' answers to the question "What information would you like to see on the label of organic products in order to understand the price?"

Figure 16 clearly highlights that transparency is an essential element in the acceptance of the price of ecological products. Respondents express a strong desire to better understand the reasons that justify the higher costs of these products, and the types of information requested reveal consumers' main concerns. Accordingly, it can be observed that respondents are primarily interested in the clarity of the economic justification of ecological prices. They seek information that explains not only production costs, but also the concrete long-term benefits, both financial and health-related.

In this context, the most frequently requested information concerns direct savings for the consumer, followed by technical information—such as green technologies and sustainable raw materials—which is considered relevant but secondary. The least requested information relates to taxes and regulations. These results reflect the need for more transparent, consumer-oriented labeling that clearly explains the reasons for price differences and strengthens trust in ecological products.

Figure 17 highlights an essential aspect for understanding consumer behavior, namely the role of information in justifying ecological prices. The results show that the majority of respondents fall between neutrality and agreement (based on Likert scale analysis, an aggregated score of +0.45 was obtained), suggesting that better information can positively influence willingness to pay, although a considerable segment remains unconvinced of this relationship.

Thus, it can be clearly observed that the level of information regarding eco-costs has a potentially positive impact on consumers' willingness to pay a higher price. Nearly half of respondents (48.5%) indicate that they would be more open to higher prices if they

understood eco-costs, while a very large proportion (40.2%) remains undecided, suggesting that greater transparency could transform this neutral segment into a favorable one. Only one out of ten respondents reports not being influenced by additional information. This finding once again confirms that a lack of information represents a major barrier to the acceptance of ecological prices, and that clear and detailed communication regarding the real costs of ecological products can significantly improve consumers' willingness to pay.

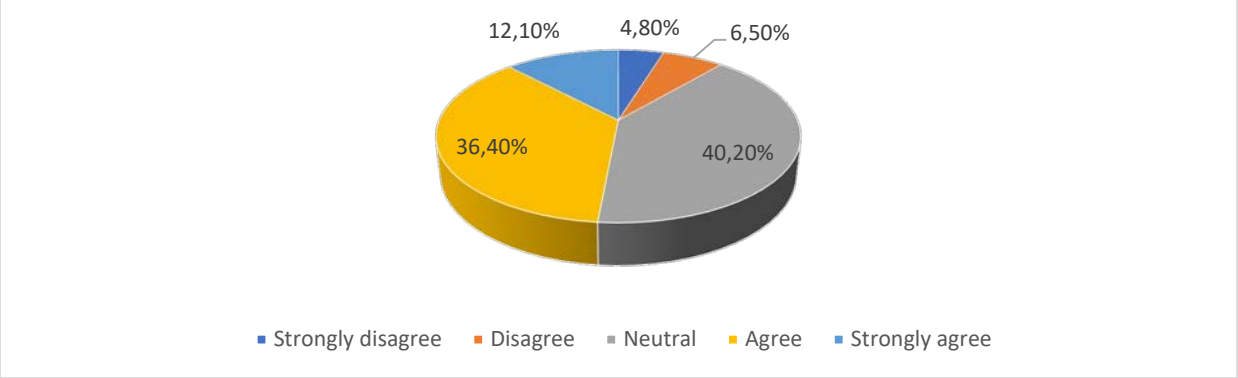

Figure 17. Respondents' answers to the question "If I were better informed about eco-costs, would I be more willing to pay a higher price?"

Figure 18 reveals an essential aspect of consumer behavior, namely that in the absence of price differences, the ecological product becomes the overwhelmingly dominant choice. The results indicate a clear and stable preference for ecological products once the price barrier is removed, highlighting a fundamental reality: under equal price conditions, consumers overwhelmingly choose ecological products.

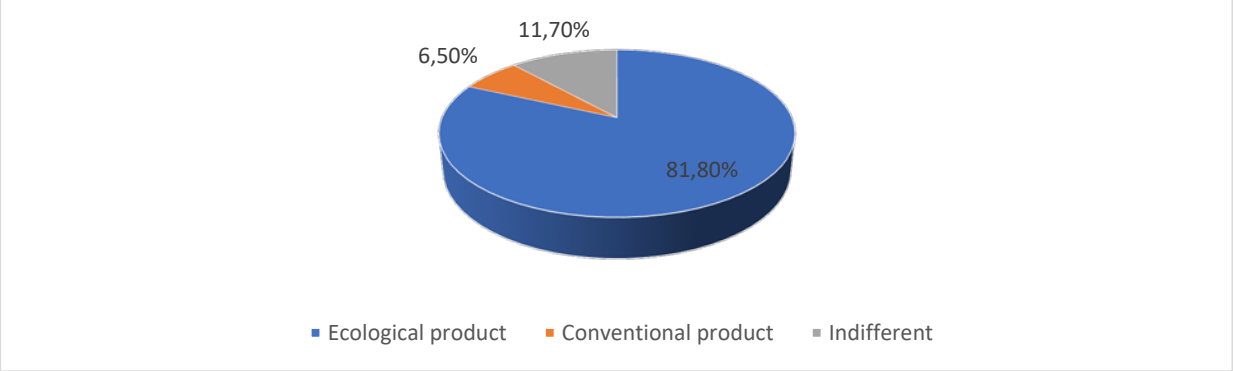

Figure 18. Respondents' answers to the question "If an organic product had the same price as a conventional one, which would you choose?"

This finding demonstrates that interest in ecological products is very high and that the primary barrier to adoption is price rather than perception or lack of trust. Eliminating cost differences would likely lead to a rapid increase in ecological consumption, a result that retailers and producers could capitalize on primarily through pricing and communication strategies. Overall, the data presented in this figure confirm that the potential of the ecological market is very high and that price accessibility is the key factor for expanding ecological consumption.

Figure 19 reflects how consumers evaluate the importance of the "ecological" attribute in relation to product price. The results suggest that, although price remains a strong decision criterion, the ecological attribute has acquired a comparable level of importance for the majority of respondents.

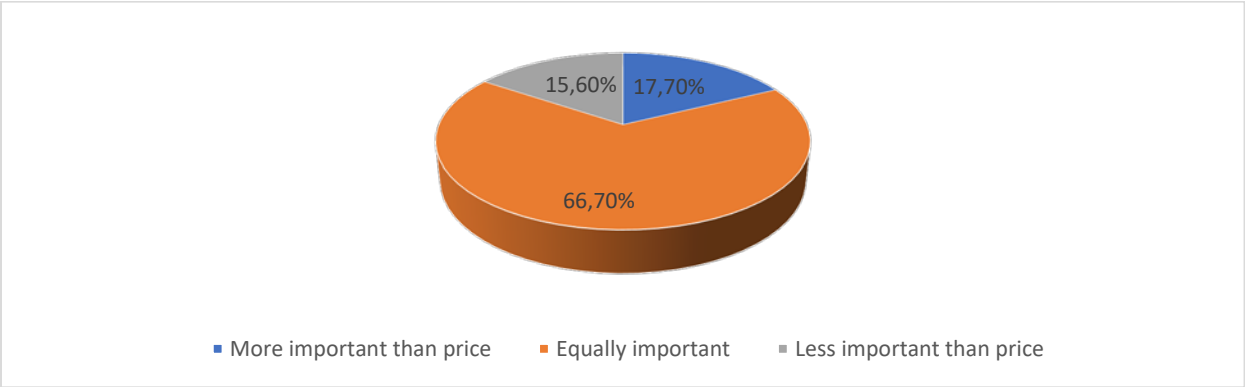

Figure 19. Respondents' answers to the question "How important is the 'eco-friendly' attribute in choosing a product compared to price?

Thus, an overall balanced perception structure can be observed, with an overwhelming majority for whom the ecological attribute is at least as important as price. Specifically, 84.4% of respondents consider the ecological attribute to be equally important or more important than price, while only 15.6% prioritize price over the ecological characteristic.

These findings confirm that ecological products have strong market potential and that effective communication of their value can transform the ecological attribute into a decisive purchasing criterion for an even broader segment of consumers.

4. Results and Discussion

Ecological interests and needs of individuals manifest both at the personal level and within the groups and social structures to which they belong, and they can be delineated across several levels of analysis. At the national level, ecological interests express society's aspiration to ensure a healthy environment capable of supporting the normal course of life and the continuity of future generations. At the regional level, ecological interests are determined by the degree of pollution specific to each area, with populations in heavily affected regions exhibiting a more pronounced concern for environmental protection compared to less exposed areas.

Local ecological interests are particularly evident in communities located in proximity to major sources of pollution, such as metallurgical enterprises, mining operations, power plants, or chemical complexes, where the impact of anthropogenic activities is high and directly experienced by the population. At the individual level, personal ecological interests are characteristic of those who directly perceive the effects of environmental quality on health and quality of life, this direct experience constituting a determining factor of behavior and attitudes toward environmental protection [2]. Although consumption of ecological products is not very high in the Republic of Moldova, the new generation of consumers is showing a growing interest in such products [3]. Aligning production with these specific needs allows economic agents to transform the population's ecological concerns into development opportunities, ensuring an effective correlation between the supply of organic products and the real expectations of the market [4].

Considering the role of price as a fundamental element of the marketing mix, it not only indicates the value of a transaction but also reflects the conditions of commercialization through mechanisms such as quantity discounts, bonuses, or other granted facilities. From this perspective, price acquires particular importance in shaping consumers' ecological behavior. Through price, the seller formulates an offer addressed to the buyer, which may be accepted or rejected depending on the perceived value created.

The results presented in Figures 1–4 clearly confirm this decisive role of price. The low frequency of regular purchases of ecological products, highlighted in Figure 1, suggests that price level constitutes a limiting factor in their consistent integration into daily consumption. Although interest in ecological products exists, it is manifested predominantly at an occasional level, indicating acceptance that is conditional upon favorable circumstances such as promotions or financial availability.

The preferences illustrated in Figure 2 show that ecological products are primarily chosen in categories where health benefits are perceived as immediate, particularly food products and cosmetics. This orientation suggests that when perceived value is high, consumers are more willing to accept a higher price. Similarly, the data in Figure 3 indicate that accessibility and the possibility of price comparison favor the purchase of ecological products from supermarkets, to the detriment of specialized stores, where prices are perceived as higher.

The perception of price differences, illustrated in Figure 4, highlights consumers' heightened sensitivity to the costs of ecological products. Even though the majority of respondents assess the price difference as moderate, the existence of a significant segment that perceives it as high or very high confirms that price remains an essential criterion in purchasing decisions. "When the price is too high, the manufacturer is placed in a rather unstable position, as customers will usually look for other manufacturers" [5]. Thus, price acts not only as an economic indicator but also as an instrument influencing ecological behavior, determining the degree of acceptance, purchase frequency, and orientation toward specific distribution channels.

Globally, there is a trend that on average, one in three consumers worldwide is willing to increase their spending if they are confident in the environmental safety of products [6]. Consumers' willingness to bear additional costs is directly proportional to their degree of certainty about the environmental attributes of the product. This link demonstrates that price sensitivity, discussed earlier, can be reduced if the perceived value of environmental safety is substantiated by credible evidence, thus transforming price from a barrier into an indicator of sustainable quality.

Since price generally represents a decisive factor in the purchasing decision-making process, it directly influences the degree of acceptance or rejection of ecological products. For proponents of market mechanisms as instruments of sustainable development, the integration of ecological costs into the structure of production costs—and implicitly into price levels—is essential. In the absence of reflecting environmental protection costs in prices, the expansion of consumption will inevitably lead to the intensification of ecosystem degradation [7].

The extent to which an enterprise integrates ecological considerations into its policy is directly reflected in the structure of the costs it assumes. In most cases, ecological products involve additional costs generated by expenditures required to preserve and improve environmental conditions. These expenditures are incorporated into the total cost of the product, and the final price must reflect both the value of the core benefits demanded by consumers and the full range of costs specific to traditional marketing, to which are added the costs associated with conferring ecological attributes. These include cost increases resulting from the use of ecosystem-compatible raw materials, investments required for the greening of production processes and technologies, as well as additional expenses imposed by compliance with new environmental regulations. In the Republic of Moldova, the increase in the prices of ecological products is driven by the integration of additional costs specific to

the national context, such as expenses related to compliance with environmental legislation, ecological certification costs, the use of organic agricultural inputs, imported ecological packaging, investments in less polluting technologies, and payments associated with environmental taxes. These elements increase production costs and are inevitably reflected in the final price of ecological products. "Bioproducts for the domestic market are sold at 15-20% higher prices than similar products without ecological labelling" [8].

At the same time, the implementation of ecological attributes may also generate certain cost savings, as a result of reduced consumption of raw materials, materials, and energy required for product realization, the "dematerialization" of packaging processes, as well as the use of more efficient and less polluting energy sources or fuels in the enterprise's internal transport activities, such as the use of unleaded gasoline.

In the process of substantiating decisions regarding the setting of "green" prices, it is necessary to take into account three essential dimensions: the structure of unit costs, consumer perceptions, and the price levels practiced by competitors.

Unit costs play a central role in price formation, as they allow for the estimation of unit cost corresponding to the production volume, define the lower bound of price, and constitute one of the two determining factors of profit. Given that profit represents a fundamental criterion for economic activity, erroneous or incomplete cost evaluation—particularly through the failure to identify and integrate eco-costs—leads to distorted signals regarding the profitability of products and economic activities.

In most situations, the higher price level of ecological products results from the inclusion of environmental protection expenditures. In this regard, Ken Peattie formulates a relevant observation that offers an alternative perspective on this issue, arguing that the perception that ecological products are unusually expensive is largely illusory. In reality, "grey" (conventional) products are artificially cheaper, as the costs generated by environmental degradation are not reflected in their prices, with the environment effectively functioning as a form of implicit subsidy [9].

Consequently, the main issues to be addressed concern the identification of the multiple sources of eco-costs and the development of appropriate mechanisms for allocating them to the products responsible for generating them. The results presented in Figures 5 and 6 confirm that, from the consumers' perspective, the prices of eco-friendly products are largely perceived as being associated with additional costs generated by environmental protection, but the level of understanding and acceptance of these costs remains moderate. Although almost half of the respondents consider the inclusion of environmental costs in the price of organic products to be justified, a significant proportion adopt a neutral position, which indicates a lack of clear information on the sources and structure of eco-costs.

This situation supports the need for the rigorous identification of the multiple sources of eco-costs and for the development of appropriate mechanisms to allocate them to the products responsible for generating them. Consumer perceptions indicate that, in the absence of transparent explanations of these costs, price differences are only partially accepted, and the level of trust remains limited.

At the same time, the results emphasize the importance of a distinct reflection of eco-costs in enterprises' accounting records, through their separate registration from other operational expenses. Such an approach enables the proper integration of environmental costs into the decision-making process regarding product portfolio structure, the selection of technologies employed, and the choice of materials compatible with sustainability

requirements. Moreover, clear accounting records facilitate the credible communication of ecological value to consumers, contributing to the transformation of neutral perceptions into firm acceptance of ecological prices.

The results of other studies show that there is a need for greater clarification and education of the population regarding the concepts of "ecological food," "bio," "natural," and "organic [3].

Even if some producers claim that they do not use pesticides, additives, or other synthetic chemicals in the cultivation/processing of their products, they may indicate in the product description that it is "naturally grown," but without eco-certification, it is illegal to use the terms "eco," "bio," or "organic" [10]. The communication gap is not just a marketing issue, but also one of compliance, where the misuse of "green" terminology without a legal basis undermines the credibility of the entire market. This state of affairs requires rigorous consumer information so that buyers can distinguish between vague commercial claims and certified organic quality, thereby reducing the risk of "greenwashing."

Furthermore, pressures exerted by the regulatory framework, public opinion, and organizations' commitments to the community necessitate the adoption of transparent reporting of efforts aimed at ecosystem protection. In this context, clarity regarding eco-costs represents not only a managerial and accounting requirement, but also a strategic instrument for strengthening consumer trust and supporting pricing policies oriented toward sustainable development.

Philip Kotler argues that, ultimately, the consumer is the one who decides whether a product's price is fair, which implies that perceived value plays a determining role in the pricing process. From this perspective, the central element is not the costs borne by the seller, but the value perceived by the consumer. Establishing a consumer-oriented price therefore requires an in-depth understanding of the value that consumers attribute to the benefits obtained through the consumption or use of a product. Perceived value results from the relationship between perceived primary and secondary benefits and the monetary sacrifice associated with the purchase [11].

The results presented in Figure 7 confirm Philip Kotler's assertion that, ultimately, the consumer is the one who decides whether a product's price is fair, this decision being grounded in the perception of the value offered. The data obtained highlight that the evaluation of the price of ecological products is not carried out exclusively by reference to the costs incurred by producers, but rather through a comparison between perceived benefits and the monetary sacrifice associated with the purchase.

Thus, the high level of agreement recorded for the statement referring to the direct health benefits of ecological products demonstrates that this type of primary benefit makes a major contribution to the formation of perceived value. For most consumers, the association of ecological products with a positive impact on health represents the main argument in favor of purchase, confirming that clear and immediate benefits increase price acceptance.

At the same time, the results related to the statement that price remains the decisive factor in product choice, even in the presence of ecological benefits, indicate that monetary sacrifice continues to play a determining role in purchasing decisions. Although ecological and health benefits are recognized, they are not always sufficient to offset the perception of a higher price, which explains the low frequency of consistent purchases of ecological products.

The partial acceptance of the justification for higher prices through investments in environmental protection, accompanied by a significant level of neutrality, suggests that secondary benefits-such as ecological or moral benefits-are not always clearly understood or sufficiently valued. This situation directly affects perceived value and points to the need for more effective communication regarding the content and impact of these benefits.

Moreover, divergent opinions regarding the sufficiency of label information reflect a non-uniform perception of transparency, an essential element in strengthening perceived value. The lack of clear and credible information about ecological costs reduces consumers' ability to accurately assess the balance between benefits and price.

The transparency promotion strategy requires companies to communicate detailed and explicit information about the raw materials used, the manufacturing process, and any sustainable practices implemented in order to gain consumer trust [12].

Consequently, the purchasing decision is directly influenced by the advantages perceived by consumers. In the case of ecological products, environment-related benefits are generally manifested in the form of intangible promises regarding future improvements in quality of life and are therefore perceived mainly as secondary benefits. Although these are positively valued when present, they are not regarded as essential in the decision-making process. Moreover, a segment of consumers either lacks sufficient information about ecological attributes or does not show interest in them; in such situations, a clear correlation between perceived value and the ecological characteristics of the product cannot be established, and the willingness to pay a higher price remains limited. Nevertheless, the specialized literature highlights that, as the level of education and awareness of environmental issues increases, ecological attributes gain relevance in purchasing decisions, especially when price and quality are perceived as similar across multiple alternatives.

The results presented in Figures 8 and 9 support the idea that purchasing decisions are directly influenced by perceived advantages, and that the value attributed to ecological products is constructed through a combination of tangible and intangible benefits. The analysis shows that the factors justifying the price of an ecological product are particularly appreciated when they can be linked to clear and easily understandable benefits, such as the use of sustainable raw materials, the application of ecological technologies, and long-term product durability.

In this regard, the data in Figure 8 indicate that respondents assign high importance to elements reflecting product quality and performance, namely durability and long-term economic efficiency, which are perceived as concrete advantages. These results confirm that ecological benefits are more readily accepted when they are associated with practical outcomes and with perceived economic value, rather than solely with abstract promises related to environmental protection. By contrast, administrative or fiscal factors—such as environmental taxes and regulations or subsidies—are assessed as less relevant, as their impact is not directly visible to the final consumer.

At the same time, Figure 9 highlights that, within the decision-making process, the price–quality ratio remains the dominant criterion, confirming that monetary sacrifice plays a central role in the acceptance of ecological products. Although information transparency and corporate reputation are taken into account by a significant number of respondents, they remain secondary to the evaluation of immediate economic value. This behavior suggests that ecological benefits are often perceived as secondary benefits: they are positively valued when

present, but they do not constitute decisive elements in the absence of a favorable price–quality ratio.

Simultaneously, the influence of social recommendations and the importance of product availability indicate that the adoption of ecological consumption is conditioned both by social validation and by the actual accessibility of products. The lack of clear information or limited interest in ecological attributes—reflected in the moderate response levels regarding transparency—weakens the correlation between perceived value and the ecological characteristics of products, thereby reducing consumers' willingness to pay a higher price.

Nevertheless, the structure of responses suggests the existence of potential for the evolution of consumption behavior. As education levels and awareness of environmental issues increase, ecological attributes tend to gain greater importance in purchasing decisions, particularly in situations where competing products are perceived as having similar price and quality levels. Under such conditions, ecological benefits may become a differentiating criterion and an additional factor justifying the price of ecological products.

Building on the previously presented results, Figure 10 further demonstrates that the acceptance of higher prices for ecological products is determined primarily by directly perceived benefits at both the individual and environmental levels, as well as by the prospect of long-term economic efficiency. These findings confirm that purchasing decisions are not exclusively emotional or moral in nature, but rather reflect a balance between economic rationality, trust in the product, social responsibility, and personal benefits. Consumers are willing to accept a higher price insofar as it is justified by concrete and credible advantages integrated into a coherent perception of value.

Figure 11 brings into focus a significant gap between the individual and systemic levels of preparedness regarding the acceptance of ecological prices. At the personal level, the majority of respondents declare themselves to be moderately prepared or prepared to pay higher prices for ecological products, and this willingness is largely maintained at the family level, albeit with a slight decline. By contrast, at the community level, a lower degree of collective openness toward ecological consumption is observed, while the market is perceived as the least prepared to support ecological prices. Moreover, perceptions regarding state involvement are moderate and marked by a certain degree of distrust in current institutional support. Overall, these results suggest that, although consumers are willing to financially support the ecological transition, market infrastructure, social culture, and public policies are not yet perceived as sufficiently consolidated to facilitate the widespread adoption of ecological prices.

At the same time, Figure 12 indicates a clear tendency toward accepting a slightly higher price for ecological products, but within strictly defined limits. The majority of respondents state that they would accept a moderate price premium of up to 10%, while approximately one fifth are willing to tolerate an increase of up to 20%. However, only a very small proportion would accept significantly higher price increases, and nearly one fifth of respondents are unwilling to pay any additional cost. These results highlight a high degree of price sensitivity, which constrains the acceptance of ecological products beyond a certain threshold.

The data synthesized in Table 13 reinforce this conclusion, indicating a clear orientation toward the acceptance of a moderate price premium, situated within the 0–20% range. This interval may be considered the economically optimal zone for positioning ecological products on the local market. While most consumers accept a moderate additional

cost, nearly one fifth reject the idea of any price premium altogether, and only a small segment—approximately 10%—is willing to exceed the 20% threshold. Price increases above 30% are acceptable only to a negligible proportion of consumers, which significantly limits the potential expansion of this segment.

Continuing the analysis of consumer behavior toward the prices of ecological products, Figure 14 highlights that the willingness to pay a higher price for the ecological attribute varies significantly depending on the product category. Consumers clearly prioritize ecological food products, which are perceived as having a direct and immediate impact on health, ranking first in the hierarchy of willingness to pay. A high level of interest is also observed for hygiene and cosmetic products, where composition and direct contact with the body increase the importance of the ecological attribute. Products intended for children likewise receive heightened attention, due to the vulnerability of this segment and concerns related to safety. By contrast, cleaning products register a moderate level of interest, as their benefits are perceived primarily at the environmental level rather than at the personal level. These results confirm that willingness to pay a price premium is closely correlated with perceived impacts on health, safety, and quality of life.

Figure 15 brings to light one of the most significant barriers to the acceptance of ecological prices, namely the communication deficit on the part of producers. The majority of consumers consider the explanations regarding the formation of ecological prices to be insufficient or only partial, which directly affects trust levels and the justification of price differences. The small proportion of fully satisfied respondents indicates a structural transparency issue that may fuel skepticism and reluctance toward ecological products, even when their benefits are perceived positively.

This conclusion is further supported by the results presented in Figure 16, which clearly highlight consumers' need for more detailed and relevant information on ecological product labels. Respondents primarily request explanations regarding the economic justification of prices and concrete long-term benefits, both for health and for personal budgets. Information about green technologies and sustainable raw materials is appreciated but occupies a secondary position, while details concerning taxes and regulations are considered the least relevant. These findings indicate the necessity of consumer-oriented labeling that clearly explains the added value of ecological products and strengthens trust in price fairness.

"We can say that eco-labeling acts as a bridge between the producer and the consumer, providing information about the quality and safety of products for the environment" [13]. This statement highlights the strategic function of eco-labeling. If price is the main economic barrier, the label acts as a social and informational facilitator, restoring the balance between cost and value. Completing the purchase process in favor of the green product depends on the strength of this "bridge", which must be built on accounting transparency, official certification, and communication of the direct benefits to health and the environment.

Figure 17 confirms the decisive role of information in increasing willingness to pay for ecological products. Nearly half of respondents state that they would be more willing to accept a higher price if they better understood eco-costs, while a very large segment remains undecided, suggesting significant potential for influence through adequate communication. Only a minority completely rejects the idea that information could alter payment behavior. These results demonstrate that a lack of information represents one of the main barriers to

the acceptance of ecological prices and that transparency can transform neutrality into genuine willingness to pay.

At the same time, Figure 18 (the question regarding choice under equal price conditions) convincingly shows that when the price difference is eliminated, preference for ecological products becomes overwhelming. This finding demonstrates that interest in and trust toward ecological products are already high, and that price constitutes the primary barrier to their widespread adoption. Consequently, the potential of the ecological market is considerable, and pricing and communication strategies can play a decisive role in harnessing this potential.

Finally, Figure 19 shows that, for the majority of respondents, the "ecological" attribute is at least as important as, or even more important than, product price. The fact that over four fifths of consumers assign comparable or greater importance to the ecological characteristic confirms the consolidation of this attribute as a relevant decision-making factor. Although price remains an important criterion, the results suggest that ecological value can become a decisive differentiating element, particularly under conditions of effective communication and a clear perception of benefits. "The continuously growing market for organic products [...] also poses certain challenges. To ensure the presence of organic qualities [...] reliable control tools are needed" [14].

The success of pricing and communication strategies ultimately depends on the market's ability to provide indisputable proof of authenticity. Control tools and certifications are not just administrative barriers, but pillars of trust that allow consumers to validate the rationality of their decision to accept a premium price, thus ensuring the sustainability of the entire organic economic ecosystem.

5. Conclusions

The analysis of the results obtained through the empirical research highlights that the price of ecological products represents the main constraint in the consistent adoption of ecological consumption, not due to a rejection of their value, but as a result of high price sensitivity and an information deficit. Consumers recognize the benefits of ecological products—especially those related to health, safety, and quality of life—and are willing to accept a moderate price premium within the 0–20% range, which is considered the optimal zone of acceptance.

The results indicate that willingness to pay more is conditioned by a clear perception of value, transparency regarding eco-costs, and trust in producers. The lack of detailed explanations concerning the formation of ecological prices and labeling that is insufficiently consumer-oriented constitute significant barriers to the expansion of the ecological market. At the same time, the data confirm that, in the absence of price differences, preference for ecological products becomes dominant, highlighting a high growth potential for this segment. The development of ecological product consumption depends on maintaining prices within a reasonable affordability range, strengthening communication about real benefits and eco-costs, and increasing transparency and trust throughout the production and distribution chain. The ecological attribute has the capacity to become a decisive purchasing criterion, provided that its value is clearly understood and credibly supported in consumers' perceptions.

Based on the results obtained, there emerges a clear need for producers and retailers of ecological products to keep price levels within a reasonable zone of economic acceptability. Given that most consumers accept only a moderate price premium, pricing strategies should

avoid excessive positioning in premium segments. The use of flexible pricing mechanisms—such as temporary promotions, promotional bundles, or assortment differentiation—can help reduce the initial cost barrier and stimulate product trial, thereby encouraging the formation of repeated consumption behavior.

The marketing of green products must navigate between the imperative of profitability and satisfying consumer desires, which involves increasing the degree of satisfaction of consumer desires and expectations on the one hand, and setting prices that ensure the profitability of the business involved in production, distribution, and marketing on the other [15].

At the same time, producers and retailers should focus their efforts on product categories for which consumers demonstrate a higher willingness to pay for the ecological attribute. Food products, hygiene and cosmetic products, as well as products intended for children are perceived as having a direct impact on health and personal safety, which justifies heightened interest and greater price tolerance. Prioritizing these categories in offer development strategies allows for the efficient valorization of ecological investments and the strengthening of positioning in segments with the highest growth potential.

Another essential aspect concerns increasing transparency regarding the formation of ecological prices. The communication deficit identified among consumers suggests the need for clear explanations of the cost components associated with ecological production, such as the use of sustainable raw materials, the implementation of clean technologies, or certification costs. Simple and accessible communication—delivered through explanatory labels, informational materials, or digital tools—can contribute to building trust and facilitating acceptance of price differences.

At the same time, the labeling of ecological products should place greater emphasis on highlighting concrete benefits for consumers. The research results show that the public is primarily interested in direct advantages, such as positive health impacts, safety in use, and long-term savings. Shifting the focus from general messages about environmental protection toward clear explanations of the product's practical value can enhance perceived value and transform the ecological attribute into a decisive purchasing argument.

Building trust also represents a major strategic objective for producers and retailers. In the context of concerns related to greenwashing, it is essential that ecological messages be supported by clear and verifiable evidence, such as recognized certifications and consistent information across all communication channels. Retailers can contribute to this process through the careful selection of ecological products and the creation of dedicated spaces that convey credibility and consistency in the offer.

The role of retailers goes beyond commercial intermediation, as they have the potential to become educators of consumers. Through staff training, the display of explanatory information at the point of sale, and the organization of thematic campaigns, retailers can reduce uncertainty and facilitate understanding of the differences between ecological and conventional products. This approach contributes to increasing awareness and fostering favorable attitudes toward ecological consumption.

Furthermore, it is important for ecological products to benefit from constant availability and adequate visibility within retail spaces. Integrating them into the regular shopping flow—rather than isolating them as niche products—can contribute to the normalization of ecological consumption. A stable and easily accessible offer reduces purchasing barriers and encourages long-term adoption.

Finally, collaboration with public authorities and the effective use of existing support mechanisms can help maintain ecological prices within an accessible range. Subsidies, support programs, or fiscal incentives can alleviate pressure on final costs, while communicating these measures to consumers can enhance trust in ecological products and in the broader efforts undertaken to promote sustainable development.

Contribution of Authors

Sergiu Mîrza: Conceptualization, Methodology, Data curation, Writing – original draft.
Lilia Chiriac: Data curation, Investigation, Administration, Writing – original draft, review and editing. Feodosie Pituşcan: Investigation, Writing, Supervision.

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SUSTAINABLE DIGITAL TRADE AND LOW-ALTITUDE ECONOMY: A NEW PATHWAY FOR GLOBAL WINE MARKET EXPANSION IN CHINA

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Abstract. Although China is one of the largest potential markets in terms of wine consumption, international wine imports are still severely constrained by fragmented logistics, carbon-intensive transport structures, and weak digital interaction with consumers. At the same time, the rapid development of the low-altitude economy in China and its policy-driven expansion of sustainable digital trade are reshaping the conditions under which cross-border supply chains operate. The study presents the hypothesis that the nonlinear integration of digitalization, decarbonization, and distributed logistics yields synergistic effects that surpass conventional linear sustainability approaches. To investigate this hypothesis, a novel 3D Sustainable Trade Model, defined as Digitalization^n × Decarbonization^n × Distribution^n, is developed and analyzed based on policy analysis, scenario-based supply-chain modeling, and secondary data from customs statistics and digital trade platforms. The results indicate that synchronously improving the dimensions may reduce logistics-related carbon emissions by around 40–60%, while enabling delivery efficiency and enhancing responsiveness to the market at the same time. The proposed framework is particularly relevant to time-sensitive and premium wine trade, and it points toward a structured way through which exporters and policymakers can align their low-carbon objectives with digital trade strategies.

Keywords: *carbon efficiency, cross-border logistics, digitalization, distributed systems, import dynamics, supply chain resilience, wine imports.*

Rezumat. Deși China este una dintre cele mai mari piețe potențiale în ceea ce privește consumul de vin, importurile internaționale de vin sunt încă sever constrânse de logistica fragmentată, structurile de transport cu emisii mari de carbon și interacțiunea digitală slabă cu consumatorii. În același timp, dezvoltarea rapidă a economiei de joasă altitudine din China și extinderea comerțului digital durabil, determinată de politici, remodelează condițiile în care operează lanțurile de aprovizionare transfrontaliere. Studiul prezintă ipoteza că integrarea neliniară a digitalizării, decarbonizării și logisticii distribuite produce efecte sinergice care depășesc abordările convenționale liniare ale sustenabilității. Pentru a investiga această ipoteză, este dezvoltat și analizat un nou model 3D de comerț durabil, definit ca Digitalizare^n × Decarbonizare^n × Distribuție^n, pe baza analizei politicilor, a modelării

lanțului de aprovizionare bazate pe scenarii și a datelor secundare din statisticile vamale și platformele comerciale digitale. Rezultatele indică faptul că îmbunătățirea sincronă a dimensiunilor poate reduce emisiile de carbon legate de logistică cu aproximativ 40-60%, permițând în același timp eficiența livrării și sporind în același timp receptivitatea la piață. Cadrul propus este deosebit de relevant pentru comerțul cu vinuri premium și cu termene limită și indică o modalitate structurată prin care exportatorii și factorii de decizie politică își pot alinia obiectivele privind emisiile reduse de carbon cu strategiile comerciale digitale.

Cuvinte cheie: *eficiență în materie de emisii de carbon, logistică transfrontalieră, digitalizare, sisteme distribuite, dinamica importurilor, reziliența lanțului de aprovizionare, importuri de vin.*

1. Introduction

The rapid digitalization of global supply chains and the transition toward low-carbon logistics systems have become central themes in contemporary research on international trade and industrial sustainability. Recent studies have demonstrated that digital supply chain technologies, including real-time data integration and platform-based coordination, significantly enhance resilience and efficiency in complex trade environments [1,2]. At the same time, the decarbonization of logistics systems has emerged as a critical requirement for achieving sustainable development goals, particularly in industries characterized by high transport intensity and global distribution networks [3,4]. In the wine sector, sustainability challenges are further amplified by globalization dynamics, evolving consumer expectations, and increasing regulatory pressure toward environmentally responsible production and distribution practices [5,6].

In parallel, digital platforms have increasingly influenced the internationalization strategies of wine enterprises, particularly in the Chinese market, where cross-border e-commerce ecosystems play a pivotal role in market access and consumer engagement [6]. Furthermore, technological advancements in logistics, such as unmanned aerial vehicles (UAVs) and drone-assisted delivery systems, have introduced new opportunities for optimizing distribution efficiency and reducing last-mile delivery costs [7,8]. These innovations are particularly relevant in the context of emerging low-altitude economies, where integrated air–ground transportation systems are expected to reshape conventional logistics structures. Additionally, consumer behavior in the wine industry is transforming digital experiences, reinforcing the importance of technology-driven interaction models in shaping demand patterns [9].

From a sustainability perspective, the environmental impact of long-distance food transport, often conceptualized through the “food miles” framework, highlights the urgency of reducing carbon emissions across global supply chains [10]. In response, carbon labeling systems and carbon neutrality policies have been increasingly adopted to guide trade practices and regulatory frameworks, particularly in rapidly developing economies such as China [11,12]. These developments are further supported by national-level strategies, including policy frameworks promoting the low-altitude economy and advanced logistics infrastructure [13,14], as well as statistical evidence indicating the continued growth and structural transformation of China’s wine import market [15,16].

Despite these advances, existing studies largely examine digitalization, decarbonization, and logistics optimization as independent drivers of supply chain performance. However, complex systems theory suggests that interactions among multiple

subsystems may lead to nonlinear effects that cannot be captured through isolated analysis [17]. In the context of cross-border wine trade, where market dynamics, regulatory conditions, and technological infrastructures are deeply intertwined, there remains a significant research gap in understanding how these factors interact at the system level to influence overall performance.

Based on this research gap, this study proposes the following hypothesis: improvements in cross-border wine trade performance cannot be fully explained by individual advancements in digitalization, decarbonization, or distribution infrastructure alone. Instead, it is hypothesized that these elements exhibit nonlinear and mutually reinforcing interactions, generating synergistic effects that enhance both efficiency and sustainability.

To address this hypothesis, this paper develops a three-dimensional nonlinear model integrating digital trade technologies, low-carbon transformation mechanisms, and distributed logistics systems. The model aims to capture the dynamic interactions among these dimensions and to evaluate their combined impact on supply chain performance. China is selected as the empirical context due to its advanced digital infrastructure, rapidly evolving regulatory environment, and active promotion of low-altitude economic applications [13,18,19]. The study further conducts a scenario-based analysis of the cross-border wine supply chain to validate the proposed model and to assess its practical implications for improving trade efficiency and sustainability.

2. Materials and Methods

The integration of the low-altitude economy with digital economic systems is creating new opportunities for the intelligent and sustainable transformation of global supply chains, including the wine industry. By enhancing distribution efficiency, expanding market access channels, and supporting low-carbon logistics solutions, this integration is increasingly recognized as a key driver of structural change in international trade systems [7,8,13].

In China, this transformation is strongly supported by national policy frameworks. The low-altitude economy has been formally identified as a strategic emerging industry, and its development has been further reinforced through dedicated policy instruments. According to the Implementation Plan for the Innovation and Application of General Aviation Equipment (2024–2030), the market size of the low-altitude economy is expected to exceed RMB 1 trillion by 2030 [16]. In parallel, recent reports indicate that since 2024, a wide range of stakeholders—including enterprises, capital markets, and local governments—have actively entered this sector, with more than 20 provinces issuing action plans and substantial investment flows supporting industry expansion [20].

At the same time, China's wine import market has shown signs of recovery, reflecting renewed demand and evolving consumption patterns. According to official statistics, wine imports reached USD 1.592 billion in 2024, representing a year-on-year increase of 37.22%, marking the first positive growth since 2021 [17]. Import volumes also increased to approximately 282,800 kiloliters, corresponding to a 13.61% rise compared to the previous year [17]. This upward trend continued into early 2025, with imports reaching USD 258.3 million between January and February, reflecting a 54.1% increase compared to the same period in 2024 [19], as illustrated in Figure 1.

In addition, cross-border e-commerce platforms are playing an increasingly important role in shaping the structure of the wine market.

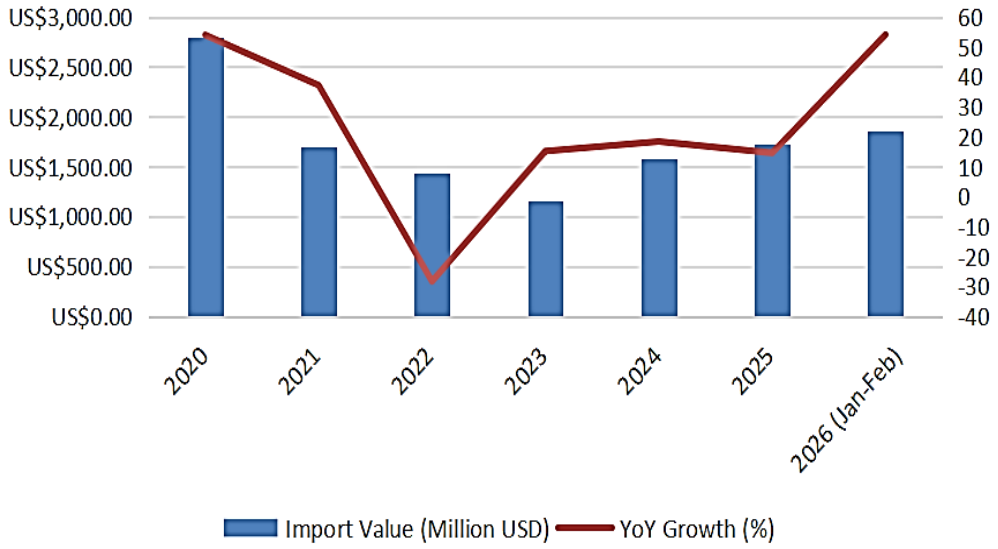

Figure 1. China Wine Import Trends (2020–2025) and Preliminary Data for 2026 (Jan–Feb)**.**

Source: from China customs.

The 2025 Tmall Global Cross-Border Alcohol White Paper reports that the number of alcoholic products available on major platforms increased by more than 40% in 2024, with over 1,700 new products introduced in the first two months alone, indicating a growing consumer preference for diversified and high-quality imported wines [18]. Furthermore, the continuous expansion of digital commerce infrastructure in China provides a favorable environment for international wine producers seeking market entry and brand development [21].

Within this context, the convergence of digital trade systems and low-altitude logistics solutions presents a strategic opportunity for restructuring cross-border wine supply chains. Given the ongoing recovery of import demand, strong policy support, and rapid technological advancement, integrating the wine sector with emerging digital and aerial logistics technologies may provide new pathways for improving efficiency, reducing carbon intensity, and enhancing global market connectivity.

The 3D Sustainable Trade System integrates digitalization, low-altitude logistics, and sustainability to optimize global wine supply chains. Through nonlinear synergy may be calculated by Eq.(1) as follow Digitalization^n × Decarbonization^n × Distribution^n—it enhances efficiency, reduces emissions, and supports adaptive, data-driven growth across production, transport, and retail stages in a coordinated, future-ready model.

$$Sustainability\ Index = \prod_{i=1}^{3}(1 + a_i D_i) \quad (1)$$

where:D_i-represents the implementation level of each dimension (e.g., digital penetration rate, carbon reduction rate, coverage of distributed resources);

a_i-are the weight coefficients, reflecting the strength of each dimension's contribution to overall effectiveness;

The multiplicative relationship (as opposed to additive) reflects the synergistic amplification between the dimensions. In the 3D model, each dimension contributes through a (1 + D) term, and their multiplicative relationship means that improving one enhances the impact of the others. Even if one is absent, the system remains functional, showing resilience.

Weight coefficients vary by industry, and in wine, all three digitalization, decarbonization, and distribution are vital.

3. Results and Discussion

The scenario-based estimation reveals clear structural differences between the linear additive model and the proposed nonlinear multiplicative model, presented in Table 1.

Table 1

Scenario-based illustrative estimation comparing linear additive and nonlinear multiplicative models under assumed implementation levels

Model Type	Initial scenario (D=0.1)	Improved scenario (D=0.5)	Growth Rate, %
Linear Additive Model	0.3	1.5	400
Multiplicative Model	$1.3^3=2.2$	$1.5^3=3.4$	55

Note: The numerical values represent assumed estimates under discrete implementation scenarios, where the implementation level D reflects low and medium system adoption conditions. Equal weighting parameters ($\alpha_i = 1$) are applied for illustrative purposes. Although interval-based estimates are not presented, sensitivity considerations suggest that moderate variation around the assumed D levels would not alter the comparative relationship between the two model structures.

As shown in Table 1, when the implementation level increases from D = 0.1 (low adoption scenario) to D = 0.5 (moderate adoption scenario), the linear additive model increases from 0.3 to 1.5, corresponding to a proportional growth rate of 400%. In contrast, the multiplicative model increases from 2.2 to 3.4, representing a 55% growth rate under the same conditions.

Despite the higher percentage increase observed in the linear model, the multiplicative model maintains consistently higher absolute values across both scenarios, indicating stronger system-level performance. These results demonstrate that the nonlinear model captures compounded interaction effects among system dimensions, which are not reflected in additive structures.

Furthermore, the comparative analysis indicates that the relative advantage of the multiplicative model remains stable under moderate variations in implementation levels. As noted in Table 1, sensitivity considerations suggest that small fluctuations in D values do not alter the dominance of the nonlinear structure, confirming the robustness of the model under different adoption conditions.

The interaction among the three dimensions: digitalization, decarbonization, and distribution, forms a cyclic structure, indicating the presence of interdependent relationships within the system as illustrated in Figure 2. The graphical representation highlights that improvements in one dimension are associated with corresponding changes in the others, reflecting coordinated system behavior.

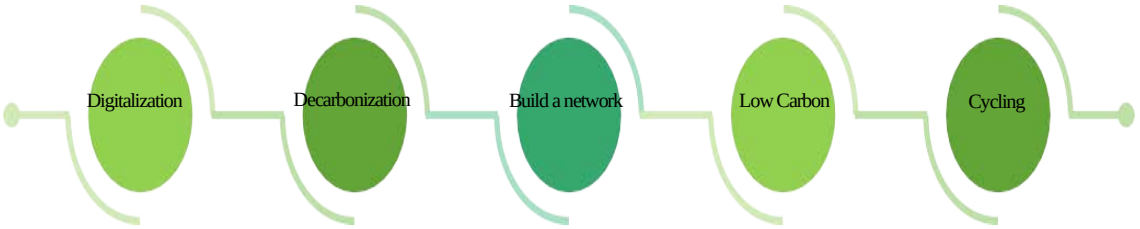

Figure 2. Synergistic Cycling of 3D Model.

Figure 3 presents the structural configuration of the proposed 3D nonlinear model. The model integrates the three dimensions within a unified framework and remains operational under partial implementation conditions, indicating system resilience. Even when one dimension exhibits lower implementation levels, the model continues to generate measurable outputs through the remaining components.

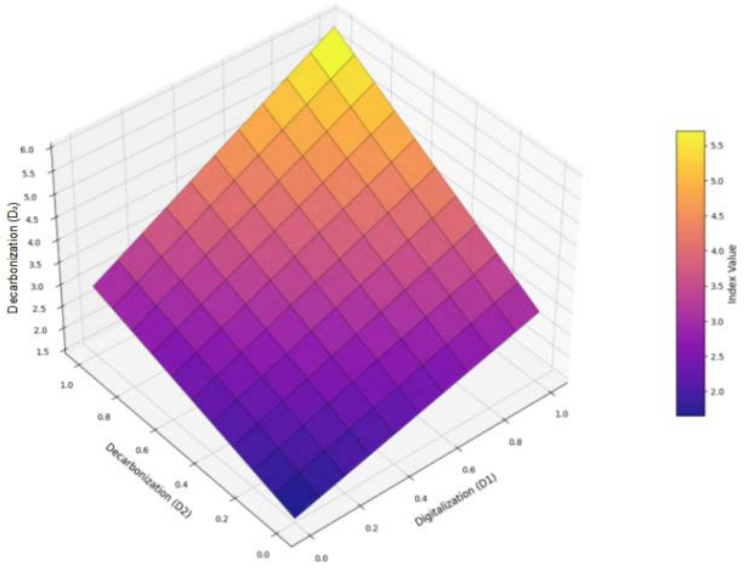

Figure 3. The 3D Nonlinear Synergy Model.

Scenario-based evaluation further indicates that coordinated implementation of the three dimensions is associated with a substantial reduction in logistics-related carbon emissions. Under moderate-to-high adoption conditions, the integrated system demonstrates the potential to reduce carbon emissions by approximately 40–60% compared to baseline linear scenarios.

It should be noted that this estimated reduction is derived from scenario-based modeling rather than direct empirical measurement. The observed reduction reflects the combined effects of improved logistics efficiency, reduced transport distances, and optimized inventory management enabled by system integration. Overall, the results support the hypothesis that cross-border wine trade performance is influenced by nonlinear interactions among digitalization, decarbonization, and distribution systems. Compared with linear models, the proposed 3D structure demonstrates enhanced system performance, stability, and integration capacity under varying implementation scenarios.

The results of the scenario-based analysis confirm that cross-border wine trade performance is influenced by nonlinear interactions among digitalization, decarbonization, and distribution systems, rather than by independent improvements in individual dimensions. The multiplicative structure of the proposed model reflects the presence of systemic interdependencies, where the effectiveness of each dimension is contingent upon the development of the others.

3.1. Synergistic Mechanisms in Logistics Systems

Within the distribution dimension, the integration of low-altitude logistics systems, particularly unmanned aerial vehicles (UAVs), plays a critical role in enhancing supply chain responsiveness. The results indicate that UAV-assisted delivery contributes to reduced transportation time and improved delivery flexibility, especially in geographically complex or high-density urban environments.

This effect can be explained by the interaction between distribution efficiency and digital coordination. UAV systems rely heavily on real-time data processing, route optimization, and intelligent scheduling, which are enabled by digital infrastructure. As a result, improvements in digitalization amplify the operational effectiveness of distribution systems, supporting the multiplicative relationship identified in the model.

3.2. Digitalization as a Feedback Amplifier

The findings also highlight the role of digitalization in strengthening the feedback loop between supply and demand. Technologies such as AI-driven recommendation systems, virtual wine tasting platforms, and digital marketing tools enhance consumer engagement and reduce information asymmetry in cross-border wine markets. From a system perspective, enhanced consumer interaction improves demand predictability, which allows for more efficient inventory allocation and logistics planning. This reduces unnecessary transportation and storage activities, indirectly contributing to emission reduction. Therefore, digitalization acts not only as an independent dimension but also as an amplifier of both distribution efficiency and decarbonization outcomes.

3.3. Integrated Effects on Carbon Reduction

The estimated reduction in carbon emissions observed in the results can be attributed to the combined effects of multiple system-level improvements. These include shorter transportation distances due to distributed warehousing, reduced idle inventory through real-time monitoring, and increased logistics efficiency enabled by digital coordination. Importantly, the reduction effect does not arise from a single technological intervention but from the interaction among multiple dimensions. This finding supports the argument that system-level integration is more effective than isolated optimization strategies in achieving sustainability goals within complex supply chains.

3.4. Policy Context and Implementation Constraints

The applicability of the proposed model is closely linked to the institutional and technological context in which it is implemented. China provides a favorable environment due to strong policy support for digital trade, rapid development of low-altitude logistics infrastructure, and high levels of technological adoption.

However, the results should be interpreted with caution when applied to other regions. The analysis is based on scenario-based modeling rather than firm-level empirical data, and the effectiveness of the model may vary depending on infrastructure maturity, regulatory conditions, and market dynamics.

Despite these limitations, the proposed framework offers a scalable and adaptable approach for restructuring wine supply chains. By emphasizing interaction effects and system integration, the model provides insights that may be applicable to other high-value, time-sensitive agricultural products facing similar logistical and environmental challenges.

4. Conclusions

This study demonstrates that the low-altitude economy and sustainable digital trade function as interdependent components within an integrated system, rather than as isolated developments. The results confirm that nonlinear interactions among digitalization, decarbonization, and distribution significantly influence the performance of cross-border wine supply chains.

The proposed 3D nonlinear model provides a structured and quantifiable framework for capturing these interaction effects. This study contributes to the literature by introducing a nonlinear systems-based approach to cross-border wine trade analysis, highlighting the importance of interaction effects among digitalization, decarbonization, and distribution in shaping supply chain performance and sustainability outcomes. By incorporating a multiplicative relationship among key dimensions, the model offers an alternative to conventional linear approaches and enables a more comprehensive assessment of system-level efficiency and sustainability.

Within the context of China, the rapid development of low-altitude logistics, digital trade platforms, and cross-border e-commerce infrastructure creates favorable conditions for applying the proposed framework. These factors collectively support more flexible, efficient, and environmentally sustainable wine import systems.

From a practical perspective, the findings suggest that wine exporters should adopt integrated strategies that combine digital technologies, low-carbon logistics, and distributed supply networks, rather than relying on incremental improvements in individual areas. Such coordinated approaches are more likely to enhance market responsiveness, reduce operational inefficiencies, and improve environmental performance.

Overall, this study contributes to the growing body of research on sustainable trade systems by providing a conceptual and analytical framework for understanding how emerging technologies can reshape global wine supply chains.

Despite these contributions, the study is subject to several limitations. The analysis is based on scenario-based modeling rather than empirical data, and the results may vary under different institutional and infrastructural conditions. Future research should focus on empirical validation of the proposed model and explore its applicability across different Chine's regions and premium product categories.

Research Data Availability Statement: The data supporting this study are obtained from publicly available sources, including official statistical databases and industry reports, as cited in the references. No new raw data were generated. The dataset constructed and analyzed during the current study is available from the corresponding author upon reasonable request. The analytical procedures and data processing steps are described in sufficient detail to ensure reproducibility.

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Contribution of Authors

Wei Pang: Conceptualization, Methodology, Investigation, Resources, Data curation, Formal analysis, Writing – original draft preparation.

Ecaterina Covaci: Software, Methodological guidance, Validation, Supervision, Writing – review & editing, Visualization, Project administration.

Mariana Godoroja: Validation, Supervision, Conceptual discussion.

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STRATEGIC INTEGRATION OF DIGITAL MARKETING PRACTICES AND E-BUSINESS PERFORMANCE IN EMERGING MARKETS

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Abstract. The rapid growth of digital technologies has transformed business operations, making digital marketing a critical driver of e-business performance, particularly in emerging economies. This study investigates the impact of four key digital marketing strategies, i.e. Search Engine Optimization (SEO), Social Media Marketing (SMM), Content Marketing (CM), and Pay-Per-Click (PPC) advertising on e-business performance. Using survey data collected from online businesses in emerging markets, the study employed Partial Least Squares Structural Equation Modelling (PLS-SEM) to assess the measurement and structural models. Results indicate that all four strategies significantly and positively influence e-business performance, with Social Media Marketing and Content Marketing demonstrating the strongest effects. The measurement model exhibited strong reliability and validity, and the structural model in e-business performance had substantial predictive relevance. The findings provide theoretical support for the Resource-Based View (RBV) and Technology Acceptance Model (TAM), highlighting digital marketing strategies as strategic capabilities that enhance online performance. Practically, the study offers actionable insights for managers to integrate multi-channel digital marketing strategies effectively and for policymakers to support digital infrastructure and literacy initiatives. Future research could explore longitudinal effects, moderating factors, and the role of emerging technologies such as AI and predictive analytics.

Keywords: *content marketing; digital marketing strategies; e-business performance; PPC advertising; SEO; social media marketing*.

Rezumat. Creșterea rapidă a tehnologiilor digitale a transformat afacerile, făcând din marketingul digital un factor critic al performanței e-business-ului, în special în economiile emergente. Acest studiu investighează impactul a patru strategii cheie de marketing digital, și anume optimizarea pentru motoarele de căutare (SEO), marketingul pe rețelele sociale (SMM), marketingul de conținut (CM) și publicitatea Pay-Per-Click (PPC) asupra performanței e-business-ului. Folosind date din sondaje colectate de la afaceri online din piețele emergente, studiul a utilizat modelarea parțială a ecuațiilor structurale prin metoda celor mai mici pătrate (PLS-SEM) pentru a evalua modelele de măsurare și structurale. Rezultatele indică faptul că toate cele patru strategii influențează semnificativ și pozitiv performanța e-business-ului, marketingul pe rețelele sociale și marketingul de conținut demonstrând cele mai puternice efecte. Modelul de măsurare a demonstrat o fiabilitate și o validitate puternice,

iar modelul structural în performanța e-business-ului a avut o relevanță predictivă substanțială. Constatările oferă suport teoretic pentru Perspectiva Bazată pe Resurse (RBV) și Modelul de Acceptare a Tehnologiei (TAM), evidențiind strategiile de marketing digital ca capabilități strategice care îmbunătățesc performanța online. Practic, studiul oferă perspective concrete pentru manageri pentru a integra eficient strategiile de marketing digital multicanal și pentru factorii de decizie pentru a sprijini inițiativele de infrastructură digitală și alfabetizare. Cercetările viitoare ar putea explora efectele longitudinale, factorii moderatori și rolul tehnologiilor emergente, cum ar fi inteligența artificială și analiza predictivă.

Cuvinte cheie: *marketing de conținut; strategii de marketing digital; performanță în e-business; publicitate PPC; SEO; marketing pe rețelele sociale.*

1. Introduction

The rapid advancement of digital technologies has fundamentally transformed the global business environment, giving rise to new forms of electronic business (e-business). E-business refers to the conduct of business processes, transactions, and interactions through digital platforms and internet-based technologies. Over the past decade, emerging economies have witnessed a remarkable surge in e-business activities, driven by increased internet penetration, smartphone adoption, digital payment infrastructure, and supportive government initiatives. Countries such as India are experiencing unprecedented growth in online commerce, digital services, and platform-based business models. In this evolving digital ecosystem, digital marketing strategies have emerged as a critical determinant of e-business success. Unlike traditional marketing, digital marketing leverages online channels such as search engines, social media platforms, websites, and digital advertising networks to reach, engage, and convert customers. For e-business firms operating in highly competitive and digitally connected markets, the effective deployment of digital marketing strategies is no longer optional but essential for survival and growth [1]. Among the various digital marketing approaches, Search Engine Optimization (SEO), Social Media Marketing, Content Marketing, and Pay-Per-Click (PPC) Advertising have gained prominence due to their ability to enhance online visibility, customer engagement, and conversion rates. SEO enables businesses to achieve higher rankings in search engine results, thereby attracting organic traffic. Social media marketing facilitates real-time interaction and relationship building with customers. Content marketing focuses on creating value through informative and engaging content, while PPC advertising provides immediate visibility through paid digital campaigns. Together, these strategies shape the digital presence and performance of e-business firms. Many existing studies analyze digital marketing strategies in isolation, without examining their combined and comparative impact on overall e-business performance [1,2].

While extensive research has examined digital marketing practices in developed economies, empirical evidence from emerging economies remains relatively limited [3,4,5,6]. Emerging markets differ significantly from developed markets in terms of digital literacy, infrastructural development, consumer behaviour, regulatory environments, and resource availability. These contextual differences influence how digital marketing strategies are adopted and how effectively they translate into business performance. Consequently, findings from developed economies cannot be directly generalized to emerging markets. There is also a lack of consensus on which digital marketing strategy contributes most significantly to performance outcomes such as sales growth, customer engagement, brand awareness, and overall competitiveness in emerging economies [8,9,10].

Against this backdrop, the present study aims to empirically examine the impact of SEO, social media marketing, content marketing, and PPC advertising on e-business performance in emerging economies. By employing a structured measurement scale and robust statistical techniques, the study seeks to contribute to both academic literature and managerial practice. The findings are expected to offer valuable insights for e-business managers, digital marketers, and policymakers seeking to strengthen digital commerce ecosystems in emerging markets.

The remaining part of the study is organized as follows: Section 2 provides the literature review that explains the previous studies and helps in exploring the research gaps; in Section 3, the theoretical foundation and the process of development of the hypotheses tested as a part of the research model are explained; in Section 4, data collection and methodology are discussed. Finally, in Sections 5 & 6, results of the hypotheses research model and discussions on practical as well as theoretical implications are provided. The last section 7 provides the conclusion of the study, its future scope and to whom it is beneficial.

2. Review of Literature

2.1 Digital Marketing and E-Business Performance

Digital marketing has been widely recognized as a strategic tool for enhancing firm performance in the digital economy [11]. Previous studies describe digital marketing as the application of digital technologies to create integrated, targeted, and measurable communication that helps acquire and retain customers [12]. In the context of e-business, digital marketing plays a pivotal role in driving traffic, facilitating transactions, and building long-term customer relationships [13].

Several studies have established a positive relationship between digital marketing adoption and business performance [14]. Firms leveraging digital marketing channels experience higher customer engagement and improved brand visibility. Digital marketing capabilities significantly enhance firm competitiveness and market reach. However, most of these studies are concentrated in developed economies, highlighting the need for research in emerging market contexts [15].

2.2 Search Engine Optimization (SEO)

SEO is considered one of the most cost-effective digital marketing strategies, as it focuses on generating organic traffic through improved search engine rankings. SEO enhances website credibility and trust, leading to higher click-through rates and conversions [16]. Previous Studies indicate that firms investing in SEO experience sustained growth in website traffic and customer acquisition [17].

In emerging economies, SEO is particularly important due to price-sensitive consumers who rely heavily on search engines for product information. SEO enables small and medium-sized e-businesses in developing countries to compete with larger firms by improving online visibility at relatively low costs [18]. Despite its importance, empirical studies linking SEO directly to e-business performance in emerging markets remain limited.

2.3 Social Media Marketing

Social media marketing has transformed the way businesses interact with customers by enabling two-way communication, community building, and real-time engagement. Platforms such as Facebook, Instagram, and LinkedIn have become essential tools for e-business firms to promote products, gather feedback, and strengthen brand relationships [19, 20].

Social media platforms empower consumers to actively participate in brand conversations, thereby influencing purchase decisions [21]. Empirical evidence suggests that social media marketing positively affects customer engagement, brand loyalty, and sales performance. Social media strategies significantly enhance firm performance through increased customer interaction and trust [22].

In emerging economies, high mobile penetration and social media usage amplify the effectiveness of social media marketing. However, challenges such as content localization, digital skills gaps, and algorithm dependency can affect outcomes. More empirical research is required to understand its performance impact in these markets.

2.4 Content Marketing

Content marketing focuses on delivering valuable and relevant content to attract and retain customers. Studies argued that content marketing builds long-term relationships by educating consumers rather than directly selling products [23]. Previous studies demonstrated that high-quality content enhances brand credibility and customer trust [24].

Content marketing is closely linked to SEO and social media marketing, as optimized content improves search rankings and social media engagement [25,26]. In emerging economies, content marketing helps overcome information asymmetry and builds consumer confidence in online transactions [27]. However, producing consistent, high-quality content requires resources and strategic planning, which may be challenging for smaller e-business firms.

2.5 Pay-Per-Click (PPC) Advertising

PPC advertising is a paid digital marketing strategy that provides immediate visibility and targeted reach [28]. PPC campaigns are highly effective for short-term promotions, product launches, and competitive markets [29]. Studies indicate that PPC advertising positively influences conversion rates when supported by optimized landing pages and analytics [30].

However, the effectiveness of PPC advertising in emerging economies is mixed. High competition for keywords, budget constraints, and limited analytical expertise may reduce return on investment. As a result, PPC is often used selectively rather than as a long-term strategy.

2.6 Research Gap

The literature review reveals three major gaps:

1. Limited empirical studies on digital marketing strategies in emerging economies
2. Lack of integrated analysis of multiple digital marketing strategies
3. Insufficient evidence linking specific strategies to overall e-business performance

This study addresses these gaps by empirically examining the combined and individual impact of SEO, social media marketing, content marketing, and PPC advertising on e-business performance in emerging economies. The conceptual framework of the present study is developed to examine the relationship between digital marketing strategies and e-business performance in emerging economies. The framework integrates insights from the Resource-Based View (RBV) and digital marketing performance literature, proposing that digital marketing strategies act as strategic organizational capabilities that enhance firm performance.

3. Theoretical Foundation

The Resource-Based View (RBV) posits that firms achieve superior performance when they possess valuable, rare, inimitable, and non-substitutable (VRIN) resources. In the digital

economy, digital marketing capabilities such as search engine optimization expertise, social media engagement skills, content creation competence, and paid advertising analytics are increasingly recognized as intangible strategic resources. These capabilities enable e-business firms to create online visibility, engage customers, and convert digital interactions into measurable performance outcomes.

In addition, the framework is implicitly supported by Technology Acceptance Model (TAM) logic, which explains how consumers' perceived usefulness and ease of interaction with digital platforms influence engagement and purchase behaviour. Digital marketing strategies improve these perceptions by enhancing website usability, content relevance, and communication efficiency.

3.1 Hypotheses Development

Based on the Resource-Based View (RBV) and prior digital marketing literature, digital marketing strategies are considered strategic capabilities that enhance e-business performance. The hypothesised model, given in Figure 1, used in the study.

Accordingly, the following hypotheses are proposed:

H1: Search Engine Optimization (SEO) strategy has a significant positive impact on e-business performance.

H2: Social media marketing strategy (SMM) has a significant positive impact on e-business performance.

H3: Content marketing strategy (CM) has a significant positive impact on e-business performance.

H4: Pay-Per-Click (PPC) advertising strategy has a significant positive impact on e-business performance.

H5: Integrated Digital Marketing Strategies (DSM) collectively have a significant positive influence on e-business performance.

H6: Digital Marketing Strategies has no mediation relationship between SEO and E-Business Performance**.**

H7: Digital Marketing Strategies mediate the relationship between SMM and E-Business Performance

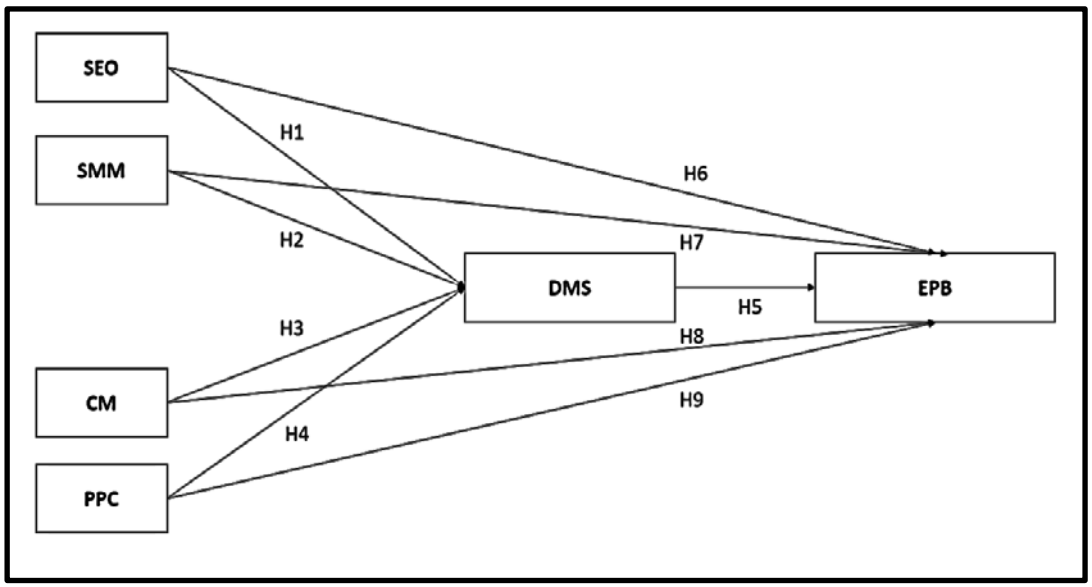

Figure 1. Proposed Model.

Source: Author's Work.

H8: Digital Marketing Strategies mediate the relationship between CM and E-Business Performance

H9: Digital Marketing Strategies mediate the relationship between PPC and E-Business Performance

4. Materials and Methods

The study adopts a quantitative, cross-sectional research design to empirically examine the relationship between digital marketing strategies and e-business performance. A survey method was employed to collect primary data from e-business firms operating in emerging economies.

The target population consists of e-business firms engaged in online retailing, service delivery, and digital platforms. A non-probability purposive sampling technique was used to select respondents who were actively involved in digital marketing decision-making. The sample size of the respondents consists of 300 Indian founders, marketing managers, and digital strategy executives.

A structured questionnaire was developed based on established literature and customized for the study context. The questionnaire comprises 30 items, measured on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Each construct, i.e. SEO Strategy, Social Media Marketing, Content Marketing, PPC Advertising, and E-Business Performance, has 6-items. The study has assessed the reliability and validity of the content and construct. Reliability is assessed using Cronbach's alpha ($\alpha > 0.70$ for all constructs). Content Validity has been conducted by expert review. Construct validity is established by using Confirmatory Factor Analysis (CFA). Convergent Validity is confirmed by Average Variance Extracted (AVE > 0.50). Discriminant Validity was conducted by F-L criterion, where the square root of AVE is greater than inter-construct correlations. Data analysis was carried out using SmartPLS [31].

5. Results

5.1 Descriptive Statistics

In Table 1, Descriptive statistics were computed to understand the central tendency and dispersion of the constructs.

Table 1

Descriptive Statistics

Construct	Mean	Standard Deviation
SEO Strategy	**4.12**	**0.68**
Social Media Marketing	**4.35**	**0.59**
Content Marketing	**4.08**	**0.71**
PPC Advertising	**3.76**	**0.83**
E-Business Performance	**4.21**	**0.64**

Source: Author's work.

The results indicate high adoption of social media and SEO strategies, while PPC advertising shows comparatively moderate adoption.

5.2 Reliability & Validity Analysis

The reliability analysis confirms that all constructs exhibit excellent internal consistency, as evidenced by Cronbach's alpha and Composite Reliability values above 0.80. The AVE values exceeding 0.50 establish strong convergent validity for the measurement model. Additionally, VIF values below the critical threshold indicate the absence of multicollinearity, ensuring the stability and reliability of regression and SEM estimates. Overall, the results provided in Table 2 confirm that the measurement scales used in the study are reliable, valid, and suitable for further hypothesis testing and structural model analysis.

Table 2

Reliability & Validity

Construct	Cronbach's Alpha	Composite Reliability (CR)	AVE	VIF
SEO Strategy	**0.89**	**0.91**	**0.62**	**2.14**
Social Media Marketing	**0.87**	**0.90**	**0.64**	**2.36**
Content Marketing	**0.85**	**0.89**	**0.61**	**2.21**
PPC Advertising	**0.82**	**0.87**	**0.58**	**1.98**
E-Business Performance	**0.91**	**0.93**	**0.66**	**—**

Source: Author's work.

5.3 Discriminant Validity

In Table 3, the Fornell–Larcker criterion evaluates discriminant validity by comparing the square root of the Average Variance Extracted (AVE) of each construct with its correlations with other constructs. Discriminant validity is established when the square root of AVE for a construct is greater than its highest correlation with any other construct. The results indicate that the measurement model is free from construct overlap, ensuring that each construct captures a unique aspect of digital marketing strategy or performance.

Table 3

Discriminant Validity

Construct	SEO	SMM	CM	PPC	EBP
SEO	**0.79**				
SMM	0.62	**0.80**			
CM	0.58	0.66	**0.78**		
PPC	0.51	0.54	0.49	**0.76**	
EBP	0.62	0.71	0.66	0.54	**0.81**

Source: Author's work.

5.4 Structural Model Assessment and Hypothesis Testing

The structural model (Figure 2) was evaluated to examine the direct and overall impact of digital marketing strategies on e-business performance using PLS-SEM in SmartPLS 4. The assessment provided in Figure 2 included path coefficients, t-values, coefficient of determination (R^2), effect size (f^2), and predictive relevance (Q^2).

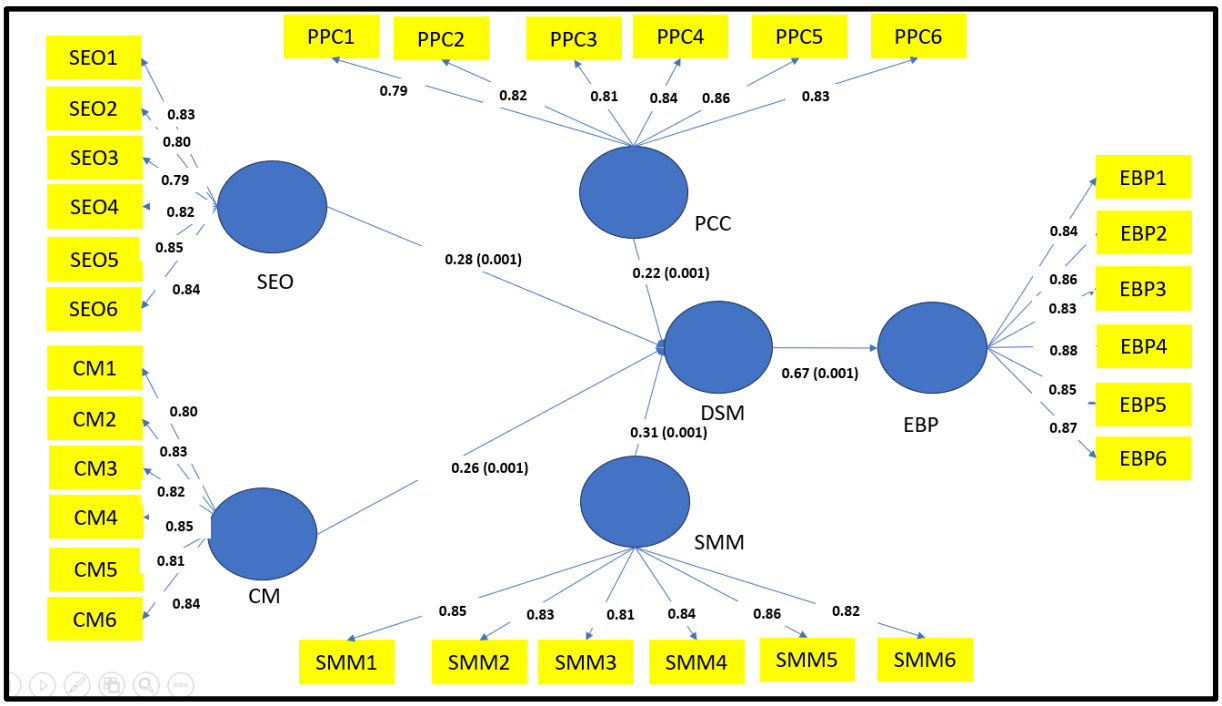

Figure 2. Structured Model.
Source: Author's work.

The results of the structural model, given in Table 4, indicate that all examined digital marketing components exert a significant and positive influence on e-business performance through the mediated framework. The direct paths from Search Engine Optimization (SEO), Social Media Marketing (SMM), Content Marketing (CM), and Pay-Per-Click (PPC) advertising to Digital Marketing Strategies (DMS) are statistically significant, confirming that each component contributes meaningfully to the development of an effective integrated digital marketing strategy. Among these, SMM demonstrates the strongest direct effect on Digital Marketing Strategies ($\beta = 0.31$, $p < 0.001$), highlighting the critical role of social media engagement, responsiveness, and paid promotions in strengthening digital marketing effectiveness. SEO ($\beta = 0.28$, $p < 0.001$) and Content Marketing ($\beta = 0.26$, $p < 0.001$) also show substantial direct effects, indicating that search visibility and high-quality content are essential drivers of digital marketing success. PPC advertising, while slightly weaker in magnitude ($\beta = 0.22$, $p = 0.001$), remains a significant contributor, emphasizing the importance of targeted paid campaigns for immediate online visibility and conversions. Furthermore, Digital Marketing Strategies exhibit a strong and significant direct effect on E-Business Performance ($\beta = 0.67$, $p < 0.001$), demonstrating that an Integrated and well-coordinated digital marketing approach significantly enhances online sales, customer acquisition, engagement, and overall business performance.

The mediation analysis (Table 4) reveals that Digital Marketing Strategies play a crucial mediating role in the relationship between individual digital marketing components and e-business performance. The indirect effects of SEO ($\beta = 0.19$), SMM ($\beta = 0.21$), CM ($\beta = 0.17$), and PPC ($\beta = 0.15$) on e-business performance, through Digital Marketing Strategies, are all positive and statistically significant. This indicates that the impact of these digital marketing tools on business performance is largely realized through their integration into a coherent digital marketing strategy rather than through isolated implementation. Notably, Social Media Marketing exhibits the strongest indirect effect, suggesting that its influence on

e-business performance is maximized when social media efforts are strategically aligned with other digital marketing activities. The significant indirect effects confirm that Digital Marketing Strategies serve as a key mechanism through which SEO, content creation, social engagement, and paid advertising translate into tangible business outcomes. Overall, the findings underscore the importance of adopting an integrated digital marketing framework, as the combined and synergistic use of digital tools yields greater performance benefits than standalone strategies.

Table 4

Path Coefficients

Effects	Hypothesis	β	t-value	p-value	Result
Direct	H1: SEO → DSM	0.28	4.91	0.000	Supported
Direct	H2: SMM → DSM	0.31	5.08	0.001	Supported
Direct	H3: CM → DSM	0.26	3.96	0.001	Supported
Direct	H4: PPC → DSM	0.22	3.41	0.001	Supported
Mediator	H5: DSM→ EBP	0.67	9.84	0.001	Supported
Partial	H6: SEO → DMS → EBP	**0.19***	3.72	0.001	Supported
Partial	H7: SMM → DMS →EBP	**0.21***	4.16	0.001	Supported
Partial	H8: CM → DMS → EBP	**0.17***	3.25	0.001	Supported
Partial	H9: PPC → DMS → EBP	**0.15***	3.04	0.002	Supported

Source: Author's work.

All four digital marketing strategies positively and significantly influence e-business performance in emerging economies. Among them, social media marketing has the strongest impact, followed by content marketing, SEO, and PPC advertising. The results indicate that integrated digital marketing strategies play a critical role in driving online business success. The results confirm that Digital Marketing Strategies significantly mediate the relationship between SEO, social media marketing, content marketing, PPC advertising, and e-business performance. The indirect effects of all digital marketing components on e-business performance are positive and statistically significant, indicating that an integrated digital marketing approach is essential for enhancing firm performance in the online business environment. The model explains 64% (R^2 value) of the variance in e-business performance, which is considered substantial in social science research.

The Q^2 value from the blindfolding procedure assesses the predictive relevance of the model. A Q^2 value greater than 0 indicates the model has predictive relevance for the endogenous construct. The high Q^2 value (0.42) indicates that the model (e-business performance) has good predictive power, suggesting that the four digital marketing strategies can reliably predict e-business performance in emerging economies.

6. Discussion

The measurement model assessment confirmed that the constructs are reliable and valid. Cronbach's alpha and Composite Reliability values exceeded 0.80 for all constructs, demonstrating strong internal consistency. Convergent validity was established through Average Variance Extracted (AVE) values above 0.50, and discriminant validity was confirmed using both Fornell–Larcker criterion and HTMT ratio, ensuring that each construct captures

unique variance. Furthermore, Variance Inflation Factor (VIF) values were below critical thresholds, indicating the absence of multicollinearity among the predictor constructs. Overall, the measurement model provides a robust foundation for interpreting the structural relationships.

The structural model results indicate that the four digital marketing strategies collectively explain 64% of the variance in e-business performance ($R^2 = 0.64$), which is considered substantial in the context of social science research. The predictive relevance ($Q^2 = 0.42$) confirms that the model has strong predictive power, meaning that these digital marketing strategies can reliably forecast online business outcomes in emerging economies. Effect size analysis (f^2) further revealed that SMM and CM have medium effects, while SEO and PPC contribute small but significant effects. These results highlight the importance of prioritizing customer engagement and content-driven strategies to maximize performance.

The findings of this study provide important insights for researchers, managers, and policymakers regarding the impact of digital marketing strategies on e-business performance, particularly in emerging economies. The implications are outlined below.

6.1Theoretical Implications

The study validates the Resource-Based View (RBV) by positioning digital marketing strategies as strategic organizational capabilities that enhance competitive advantage. It also extends the Technology Acceptance Model (TAM) by demonstrating that effective digital marketing improves perceived usefulness, engagement, and customer adoption in online settings. Additionally, by examining SEO, SMM, CM, and PPC collectively, the study provides empirical evidence for multi-channel digital marketing frameworks in emerging economies.

6.2 Managerial Implications

Managers are encouraged to adopt integrated digital marketing strategies that balance short-term visibility (PPC) with long-term engagement and credibility (SMM, CM, SEO). Emphasis should be placed on active customer interaction, high-quality content, and data-driven campaign monitoring to enhance brand trust, traffic, and conversions. These findings provide actionable guidance for firms seeking to strengthen their online presence and performance in rapidly evolving markets.

6.3 Policy Implications

Policymakers should support digital infrastructure development, digital literacy programs, and regulatory frameworks that facilitate ethical and effective digital marketing. Incentives for SMEs and startups to adopt digital marketing can accelerate e-business growth and enhance competitiveness in emerging markets.

7. Conclusions

The present study investigated the impact of digital marketing strategies on e-business performance in the context of emerging economies. By focusing on four key digital marketing strategies: Search Engine Optimization (SEO), Social Media Marketing (SMM), Content Marketing (CM), and Pay-Per-Click (PPC) advertising, the study provides a comprehensive understanding of how strategic digital initiatives contribute to online business success.

The findings from the structural model assessment demonstrate that all four strategies significantly and positively influence e-business performance. Among them, Social Media Marketing emerged as the most influential strategy, highlighting the critical role of online

engagement, customer interaction, and social commerce in emerging markets. Content Marketing and SEO also exhibited significant contributions, reflecting the importance of high-quality content and search visibility in driving traffic, building brand credibility, and fostering trust. PPC advertising, while having a smaller effect size, still contributed positively to e-business performance, indicating its relevance for achieving short-term visibility and conversion objectives.

From a practical perspective, the findings provide actionable insights for managers and business owners operating in emerging markets. To achieve superior e-business performance, firms should adopt an integrated digital marketing approach that balances immediate visibility (PPC), sustainable online presence (SEO), high-quality content (CM), and active social engagement (SMM). Given the dynamic and competitive nature of online markets in emerging economies, leveraging these strategies in combination can create a synergistic effect, enhancing brand credibility, driving traffic, and ultimately improving online sales and customer engagement.

From a theoretical standpoint, the study validates the Resource-Based View (RBV) in the digital marketing context. Digital marketing strategies function as strategic capabilities that are valuable, rare, and difficult to imitate, enabling firms to achieve superior e-business performance. The findings also align with the principles of the Technology Acceptance Model (TAM), as effective digital strategies improve user engagement, perceived usefulness, and ease of interaction with online platforms, ultimately enhancing performance outcomes.

In conclusion, this study demonstrates that digital marketing strategies are crucial drivers of e-business performance in emerging economies. By leveraging SEO, SMM, CM, and PPC effectively, firms can enhance online visibility, engage customers, and improve overall business outcomes. The research underscores the importance of integrating multiple digital marketing strategies into a cohesive framework, providing both theoretical contributions and practical guidance for managers seeking to strengthen their digital presence and competitive advantage in rapidly growing online markets.

Future research can build upon the present study by addressing several avenues. First, adopting longitudinal designs would enable scholars to examine the sustained impact of digital marketing strategies such as SEO, SMM, Content Marketing, and PPC on e-business performance over time, providing insights into their long-term effectiveness. Second, comparative studies across developed and emerging economies could highlight how contextual factors, such as digital infrastructure, consumer behaviour, and market maturity, moderate the effectiveness of digital strategies. Third, investigating potential mediating and moderating variables, such as customer trust, brand engagement, firm size, and technological readiness, could deepen understanding of the mechanisms and conditions under which digital marketing strategies enhance performance. Fourth, integrating objective performance metrics, including website analytics, conversion rates, and ROI, alongside perceptual survey data, would strengthen the robustness and validity of findings. Finally, future research could explore the role of emerging technologies, such as artificial intelligence, machine learning, chatbots, and predictive analytics, in optimizing digital marketing efforts. Collectively, these directions offer opportunities to extend theoretical knowledge and provide actionable insights for managers and policymakers aiming to maximize the impact of digital marketing in dynamic online markets.

Research Data Availability Statement: Access is restricted due to ethical or privacy reasons. During peer review and editorial assessment, I can share the raw datasets analyzed in the manuscript and that will not be accessible to other researchers after publication.

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Contribution of Authors

Rachna Jain: Conceptualization, Methodology, Statistical Testing
Shikha Sharma: Data curation, Writing – review & editing.

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EFFICIENCY OF ECO MATERIALS IN CONTEMPORARY INTERIOR DESIGN

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Abstract. This article analyzes the energy and ecological efficiency of natural materials in modern interior design and brings back into discussion the solutions for their implementation in past periods. The research is developed by the method of analysis, information synthesis, deduction and comparison, which creates new premises for the development and evolution of sustainable interior design. The results of the study consist in cataloging data and indices of optimal ecological materials for energy efficiency of spaces and including in the scientific circuit information about the benefits of using clay or clay products for finishing works in contemporary interior design. The results of the study provide an insight into the most effective practices in the use of eco materials for sustainable interior design, with a discrete presentation of concrete historical data on past building experiences. The practical significance of the study is argued by the benefits and advantages offered by local ecological materials in the field of construction and interior design, with the presentation of past experiences and prospects for future implementation as an optimal solution for improving the eco natural system and human living.

Keywords: *sustainability; ecology; clay; decarbonization; tradition.*

Rezumat. Articolul analizează eficiența energetică și ecologică a materialelor naturale în designul interior modern și readuce în discuție soluțiile pentru implementarea acestora în perioadele trecute. Cercetarea este dezvoltată prin metoda analizei, sintezei informației, deducției și comparării, ceea ce creează noi premise pentru dezvoltarea și evoluția designului interior sustenabil. Rezultatele studiului constau în catalogarea datelor și indicilor materialelor ecologice optime pentru eficiența energetică a spațiilor și includerea în circuitul științific a informațiilor despre beneficiile utilizării argilei sau produselor din argilă pentru lucrările de finisare în designul interior contemporan. Rezultatele studiului oferă o perspectivă asupra celor mai eficiente practici în utilizarea materialelor ecologice pentru designul interior sustenabil, cu o prezentare discretă a datelor istorice concrete despre experiențele de construcție din trecut. Semnificația practică a studiului este argumentată de beneficiile și avantajele oferite de materialele ecologice locale în domeniul construcțiilor și designului interior, cu prezentarea experiențelor trecute și a perspectivelor de implementare viitoare ca soluție optimă pentru îmbunătățirea sistemului eco natural și a vieții umane.

Cuvinte cheie: *sustenabilitate; ecologie; argilă; decarbonizare; tradiție.*

1. Introduction

The construction industry plays an important role in stimulating economic progress and improving the quality of life, but at the same time, it also plays a negative role in environmental degradation. Thus, any involvement in researching and identifying ways to protect the environment and promote ecological solutions in the living space is absolutely necessary. In the context of concerns about sustainability and environmental protection, the use of ecological materials has become an increasingly widespread practice. Research on ecological materials in contemporary interior design emphasizes their functional, aesthetic and ecological benefits, their impact on health and the environment, as well as their performance compared to conventional materials. The scientific approach has been concerned with promoting clay-based materials as a local natural material, which has been widely used in the historical past of many peoples. The scientific analysis showed that clay is an economically convenient, practical and applicable resource, but at the same time it is environmentally friendly, energy efficient and renewable, and can contribute substantially to the improvement of the natural ecosystem. The proposed solutions were substantiated by evidence and descriptions of the opportunities and advantages offered by the raw material in the field of construction, with its effect on the climate and the ecological environment of living spaces.

The aim of the material is to analyze the energy and ecological efficiency of the materials used in contemporary interior design and to create new perspectives for the implementation of eco materials used in ancient times to ensure healthy and comfortable ambience in the indoor environment.

The research methods used in this study included analysis, inferences, surveys, case studies and syntheses of practical experiences from the interior design and architecture industry, through which new premises for development and evolution in the field of sustainable interior design are created.

The results of the study provide an insight into the most effective practices in the use of eco materials for sustainable interior design, with a discrete presentation of concrete historical data on past building experiences. The research highlights technical processes and procedures for the implementation of eco materials in the construction sphere from different time periods and regions. The results of the study are notable for the inclusion in the scientific circuit of the multiple benefits of using clay or clay products for finishing works in contemporary interior design. The scientific endeavor is concerned with the promotion of this material as a local natural product, which has been widely used in the historical past of peoples. The scientific analysis shows that clay is a convenient resource in economic, practical and applicable aspects, but at the same time it is also ecological, energetic and renewable, which can substantially contribute to the improvement of the natural eco system. The proposed solutions are substantiated by evidence and descriptions of the opportunities and advantages offered by the raw material in the construction field, with its effect on the climate and ecological environment of living spaces. The contribution of clay used or combined with other natural materials will consist in increasing the quality of human life, purifying the ecological environment, decarbonizing the natural environment and of course reducing the process of global warming, which is such a pressing problem of the contemporary environment. As a result of the research, some recommendations are made regarding the implementation of clay in finishing techniques and solutions in the field

of construction, proposing new research directions, experiments and practices for the sustainable development of the field.

The scientific novelty of the material lies in the identification and determination of energy-efficient and environmentally friendly solutions for interior design and architecture using natural raw materials used in ancient times. It also brings back into the scientific spotlight the advantages offered by local materials, which have multiple environmental and sustainable benefits.

2. Eco Materials and Implementation Methods

Following the analysis of trends in the field of interior design, there is evidence of the development of specific standards applicable to this sector. Often neglected, interior design highlights unique challenges and opportunities related to the human environment, unlike the construction sector, which emphasizes structural and exterior elements. Looking more closely at the issues of ecology and sustainability in interior design, we observe numerous studies and research that have highlighted multiple aspects [1]. One of these aspects refers to the energy and environmental efficiency of the materials used. In this context, the results of calculations regarding the depletion of natural resources, energy consumption, pollutant production and greenhouse gas emissions are important [2]. It is estimated that the architecture industry, including interior design, "consumes 40% of all raw materials and nearly 10% of global energy, thus underscoring the urgent need for sustainable practices" [2]. According to data from a study conducted by the United Nations Environment Programme, the construction industry accounts for approximately 40% of global energy consumption and approximately 24% of global greenhouse gas emissions [3]. The data confirms that the life cycle of interior design projects leaves a significant ecological footprint and that rising energy costs and environmental degradation problems require inevitable sustainable solutions.

There are numerous debates, discussions and publications in the scientific community regarding the functioning of building sustainability assessment systems. All of this highlights the essential role of systems in promoting sustainability objectives in the construction sector. The concept of systems is based on environmental aspects, economic and social factors of sustainability, which tend to provide a nuanced assessment of the sustainable performance of buildings [4]. The premises of sustainable development have been formulated through multiple global events, mentioned in specialized publications [2]. Worldwide, there are approximately 600 sustainability assessment systems developed by government authorities or expert groups [5, 6]. This diversity allows the adaptation of systems to current trends in sustainability for a local, regional or compartment-specific context. In this context, we can mention the role and importance of energy labels recognized by the European Union, offering a set of methods, solutions and investments, applied in the technological process of reducing energy consumption [7].

Particular importance is also given to the methods of assessing the sustainability of buildings, which provide both qualitative and quantitative measures in the assessment process. These systems provide flexibility for buildings to compensate for poorer performance through better categories and, finally, assess the compliance of buildings through certain evaluation criteria or environmental impact credit points [2]. Many researchers talk about an environmental impact assessment based on the life cycle of buildings, and this is a factor of great importance. Often, the Life Cycle Assessment (LCA)

system is combined with the detailed data analysis tool - Building Information Modeling (BIM), for certain regions and periods of evolution. This approach depends on several factors, such as geographical location, local regulations and cultural differences, which makes it difficult to compare different LCA systems. This diversity allows the adaptation of systems to current sustainability trends for a local, regional or compartment-specific context. Here we can mention the considerable contribution of the European Union energy labels with their set of methods, solutions and investments, which are applied in the technological process to reduce energy consumption while ensuring comfort [8]. The EU target for energy efficiency and reduction of energy consumption has increased by up to 11.7% and is expected to continue to do so until 2030 [5, 6]. Studies highlight the need for energy conservation in all areas of architecture and construction, including: choosing energy-efficient equipment and using renewable energy sources. In setting this intention, architects and designers have a major impact on ensuring the energy efficiency of the building. Their mission is to seek optimal solutions to reduce energy consumption and to make heating, cooling and lighting processes more efficient by introducing renewable energy solutions without carbon emissions [9].

In the context of numerous calculation results in the field of construction, data related to interior design are also distinguished. This industry consumes a large amount of natural resources and has a strong impact on the ecology of the environment. Recognizing the pressing issue of environmental ecology and the consumption of natural resources in the process of creating a comfortable interior design, we focus our attention on sustainability rating systems for the specific segment of interior design. One such rating system is considered to be the Leadership in Energy and Environmental Design (LEED) system, as one of the most widely accepted green building certification schemes [10]. Green buildings present an optimal solution for ecological and sustainable design. The solution is energy efficient by using environmentally friendly materials. In the field of sustainability in interior design, the term and science of biomimicry is known, which is based on natural systems, which aims to imitate the efficiency and resilience of natural systems [3]. Starting from the basic building sustainability assessment systems, we identify specific interior design issues - such as material selection, indoor air quality and environmental comfort, which are included in the general building assessment compartment. Unlike construction, interior design is much more dynamic and responsive to frequent changes during the exploitation of the space. This provides ease and accessibility to the environmental performance of the space [11].

Recent research in the field addresses the issue of water conservation, which offers solutions and means to reduce water consumption through rainwater harvesting, wastewater filtration, and careful selection of sanitary fittings. Research describes ways to choose water-efficient sinks, smart faucets, and sanitary fittings that facilitate water reuse for various purposes [9]. The technical performance of these materials is evaluated by their high resistance to wear, efficient thermal and acoustic insulation and adaptation to different climatic conditions. The materials are also manifested by benefits for human health, with a reduced impact on the environment. Ecological materials, characterized by their renewable origin, reduced processing and minimal impact on the environment, represent a viable and efficient alternative to traditional materials [7, 8]. Here we can talk about sustainable materials that can be obtained by integrating remanufactured, recycled, recovered, locally

sourced, renewable or certified materials. Reconditioned materials, taken from destroyed or renovated buildings, can be used without undergoing significant modifications.

A highly promoted solution is the recycling of materials, which we can consider efficient in decomposition or recommending a new product. Recycling offers an extension of the life of materials, conserving natural resources. Recycled material can be used to produce other materials such as: steel, products such as ceiling tiles, countertops, drywall, various carpets and ceramic tiles. Renewable materials can regenerate naturally in less than 10 years. In this process, the materials provide long-term ecological benefits, saving resources for future generations. The phenomenon minimizes the impact on the natural ecosystem. Renewable materials include: bamboo, cork, cotton, hemp, etc. In interior design, materials from local sources, compatible with human life and optimal in reducing energy consumption, can be used. Local materials include a wide range of new, refurbished, recovered, recycled, renewable or certified materials, depending on their availability and the choices made by interior designers [12].

In general, the researched materials (over 20 articles) in the field of sustainability in interior design are different in terms of methodology, geographical scope and objectives, but together they contribute to completing the sustainability criteria that can be applied in contemporary interior design.

The rapid growth of industries and technologies has led to increased consumption of natural resources, which has a negative impact on the natural environment, which in turn has a negative impact on people. Modern lifestyles require many industries to mass produce technical equipment, which leads to high consumption of natural resources and devastates the natural ecosystem.

This cycle of problems can be improved through scientific and practical approaches in all fields and at all levels. In this context, the interior design industry can also be reoriented towards a trend of reducing the negative impact on the environment, opting for the promotion of living spaces that are beneficial to human health. Sustainable realization of interior design ensures the fulfillment of essential requirements in terms of ecological protection of the environment and, at the same time, encourages research into ways and solutions to improve the natural ecosystem [13]. Thus, research into the sustainability segment in interior design is absolutely necessary to achieve the possibilities of growth, improvement and performance of ecological solutions.

In the present research, several research methods were used, including the analysis and synthesis of existing information on the research topic or problem, as well as the comparative study of bibliographical sources, through which a classification of information was achieved. In this case, the theoretical comparison method was also used to more clearly assimilate the theoretical content described in the specialized literature. Throughout the work, the deduction method was also used, necessary in formulating results, decisions or findings. Through this method, it was possible to understand in stages all theoretical and practical processes in the field of Architecture and Construction, including Interior Design. It is worth mentioning that the historical-theoretical method was also approached, because the work made references to various time periods and various stages of the evolution of society. In order to look in detail at an evolutionary process manifested over a certain period of time, of course, the historical-theoretical method is very convenient.

In the process of identifying technical solutions or materials used in the study periods, the analytical method was used, which gave us the opportunity to observe, study

and conclude. This favored the optimal determination of the technical aspects of the materials used with the identification of specific parameters (region, culture and stage of evolution).

The research was carried out in several stages, initially carrying out a historical research of phenomena and evolution. Here, the temporal space parameters of the research were established, with the specific aspects of the social environment. Then the theoretical part was analyzed, which includes the classification of various techniques, methods and technologies for the practical application of materials. Also here, international energy efficiency strategies were identified with the particularities of description, identification and use.

This study had a dual vision, describing some results from both an international and national perspective, identifying traditional practices, carried out by previous generations. In the last stage, a study was developed based on the implementation of clay in the technology of interior plastic finishes, following the tradition from the beginning of the 20th century. Historical solutions are analyzed in the context of contemporary implementations, bringing proposals and recommendations for its use. This issue was also analyzed in the context of interior design with students of the Interior Design program at the Technical University of Moldova, who also conducted several simulations of the implementation of clay in plastic finishing materials.

The work used numerous scientific publications, published in specialized scientific journals. These include research both from the country (Republic of Moldova) and from abroad, carried out by researchers and scientists [14]. The category of bibliographical materials is from the field of architecture and construction, art and life sciences, so as to provide a broad vision of the subject. Historical bibliographical sources present the use of clay or clay in the construction of peasant houses, describing them as modest dwellings, built of adobe with straw, or of beams smeared with clay and lime, with a roof of shingles, or of straw, reed or reed.

3. Results and discussion

In the specialized literature, there is increasing talk about a healthy indoor environment, sustainable materials and ecological materials [15]. Given that approximately 90% of the time is spent indoors, of course, indoor air and climate, thermal, visual, acoustic and ecological comfort are of particular importance [16, 9]. Often, in the field of interior design, all these globally recognized practices are considered to belong to a style called ecological. This includes certain criteria, such as wooden furniture, stone and marble elements, linen fabrics, cotton, wool, natural fiber upholstery, ceramic objects, etc. Green solutions in interior design are in a continuous process of implementation. Therefore, green solutions in interior design are in a continuous process of implementation. Companies evaluate information on the impact of practices with the implementation of green solutions to design new products that meet society's expectations and contribute to improving the living conditions of customers [17].

In the context of green materials, there is the scope of local materials, which is a determining factor in the choice or decision regarding design solutions [18]. In each region there is a wide range of methods, technologies or materials used at various times, often put into practice by ancestors, who obtained considerable benefits from their use. Of particular importance is the resource of the regional natural environment, with its distinct particularities of soil and mineral resources [16]. According to the Institute of Pedology,

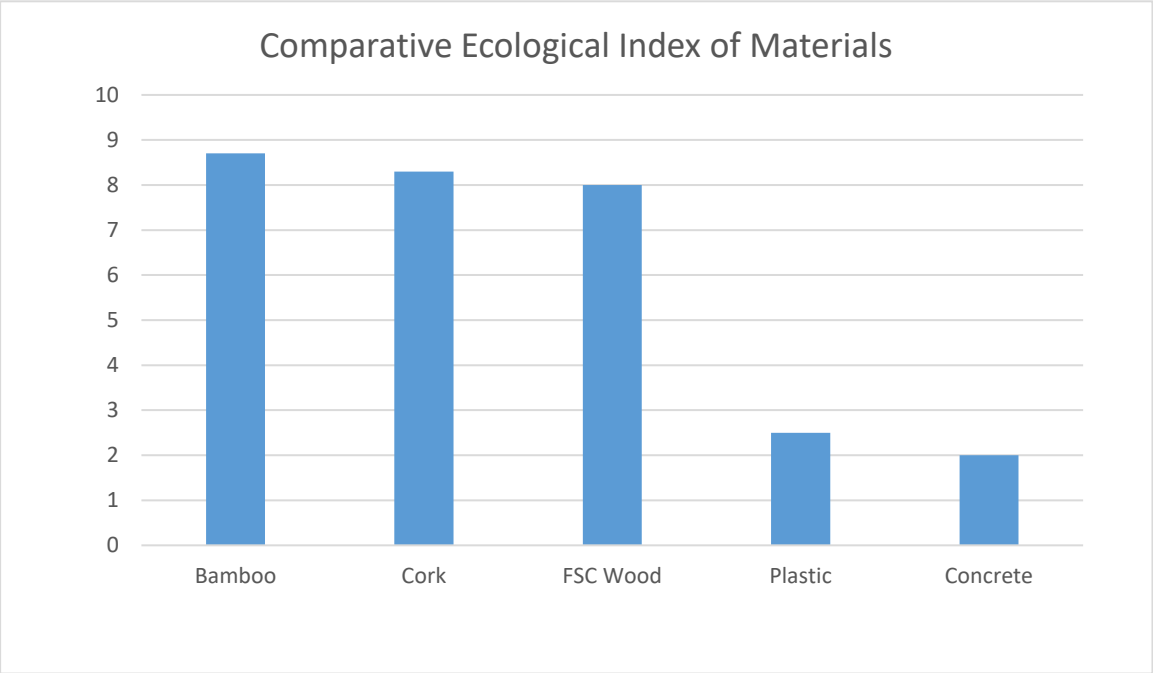
Agrochemistry and Soil Protection "Nicolae Dimo" of the Republic of Moldova [19] during the period 2009-2012 all agroecosystems studied demonstrate that the soil in the Republic of Moldova has a loamy texture, the physical clay content (< 0.01 mm) is in the range of 30-45%, varying insignificantly in all investigated ecosystems (34-36% for the depth of 0-10 cm and in the range of 33-36% for the depth of 50-60 cm).

Thus, the data show that the hygroscopic index (analytical coefficient) is directly influenced by the soil texture. In all investigated variants it corresponds to the clay texture [19].

The effectiveness of ecological materials in interior design is increasingly analyzed in research, providing data and findings that refer to their basic characteristics: they are recyclable or biodegradable; come from renewable sources; have a manufacturing process with low CO_2 emissions [15], do not contain toxic substances (formaldehyde, volatile organic compounds, etc.); are durable and reusable [20, 21]. For example: bamboo, cork, natural wool, water-based paints, natural stone, recycled glass, ecological MDF, organic textiles, etc. can demonstrate a comparative ECO-index. Table 1.

Table 1

Comparing the environmental score of building materials



Other sources speak of the Raut Valley region with clay deposits approximately 1.8 million - 10.0 thousand years old [22]. The research conducted finds a soil content with extraordinary particularities for the construction system, and these data confirm the historical construction practices known in the regions of the Romanian people. Historical bibliographic sources present the use of clay or clay in the construction of peasant houses, describing them as modest dwellings, built of adobe with straw, or of beams smeared with clay and lime, with a roof of shingles, or of straw, reed or reed. As for their constructive location, it is said that some dwellings were deeper in the ground, because in this way they kept warm in winter and cool in summer [23]. Other bibliographical sources describe the homes of Romanian-Moldovan peasants as sun-dried clay brick constructions, today welcomed as ecologically healthy homes, thanks to the eco-natural materials used [24].

The technology of blocks or so called clay "adobes" used in the construction of houses offers an effective solution in saving energy, reducing waste, reducing environmental impact and designing a healthy eco system. (Fig. 1).

Figure 1. House-museum in Butuceni village, Orheiul Vechi, Republic of Moldova.

Source: www.moldovenii.md, library. https://www.moldovenii.md/library/photo/album/301/id/3829

Bibliographic sources describe in detail experiences and practices from 100 years ago, when houses were built using an old technique, from raw materials that were: stone, wood and clay. According to tradition, the walls were “glued” with large pieces of clay mixed with wheat straw, kneaded well with a hoe and feet until it had a consistency similar to bread dough [24].

In the accounts of the city of Chisinau from the 15th century and the first half of the 17th century, it is described that the hut was a dwelling with a single cell, dug into the ground. The roof was built in two slopes, and its skeleton was made of rafters and wooden beams, over which the covering material was fixed: straw and reeds, covered with earth and smeared with clay. In the middle of the room was the oven with the mouth turned towards the entrance, with a chimney woven from twigs and smeared with clay. After the stove, in the inner part of the room, a clay elevation was built, used as a sleeping place for the entire family and which occupied approximately a third of the room. The old house was buried in the ground, and the floor was made of clay [25]. Clay was widely used in the interior and exterior architecture of traditional peasant houses.

Analyzing the properties of clay, we deduce important values that advocate the choice of this material, including: the ability to absorb and release moisture; balancing the indoor climate; absorbing and neutralizing pathogens; accumulating and maintaining heat; saving energy and reducing environmental pollution; reusability; low cost; ease of use and others. Among the disadvantages, we mention the fact that clay is subject to biological degradation, which requires good ventilation during construction so that clay surfaces dry quickly. During drying, cracks or fissures may appear that must be carefully filled after drying. Also, the clay mixture shrinks when it dries, and in this case, moisture is needed to activate the binding power and for better malleability [26]. Clay shrinkage can be limited by reducing the clay and water content, optimizing the distribution of granules and using additives [27].

The use of clay in construction is not an invention of a single people, but a practice of several countries and regions. For example, in France, the technique of compacted clay, called "terre pise", has been widely used since the 15th century; in Germany, old houses made of compacted clay are known, dating back to 1795; and in Western Europe, the advantages of clay for creating comfortable living conditions have been appreciated [20, 18]. Thus, several researchers have argued that houses that have clay as the main building material have a characteristic or particular exterior appearance, with a freedom of plastic modeling [15, 23]. Signaling some parallels with other cities from the 17th century, found in some documentary sources about the city of Chisinau, regarding the material from which the houses were built, wood was the basic material, then gluing the walls was present in the construction techniques, the poorest houses were covered with straw, the best material was reed, used for the roofs of the houses, shingles were a more precious and expensive material [25]. (Fig. 2 a,b,c,d,e,f).

a) b) c)

d) e) f)

Figure 2. Concept projects of interiors in traditional style with the implementation of ecological materials (a,b,c,d,e,f).

Source: collage of traditional elements in the interior, made by student Bortova Daria of the Interior Design program of the Technical University of Moldova.

According to current research, the construction industry is increasingly concerned about the problem of environmental pollution, seeking solutions to reduce gas emissions and raw material consumption [25, 27]. The concerns of manufacturers of finishing materials include trends in the creation of water-diluted resins; solutions for increasing the adhesion performance of materials to the substrate; the creation of different types of silicone paints; the coexistence of organic and inorganic products; the creation of crosslinking applications under the action of radiation; the creation of coatings designed to save energy and resources, and others. In search of a solution to the existing ecological problem, an important solution would be to return to natural raw materials, verified and practiced many generations ago.

According to M. Miron & V. Miron (2021) [25] it was found that the evolution of housing types in the Chisinau locality was specific by approaching the constructive systems and materials from the country's stone rocks. In the research of Agiurre et al., (2022) [21] more general geoclimatic aspects are analyzed. The researcher mentions the problem of global warming as a consequence of the pollution of the natural environment and the depletion of resources. The idea promoted in this material refers to the advantages of eco materials, especially clay, both for conserving natural resources and for stopping climate degradation. The use of clay in interior finishes is possible due to the fact that the earth's natural ecosystem is always in a process of forming clay layers and these can be an unlimited resource in generating construction materials.

Eco-friendly materials tend to bring a very convenient solution both in terms of conserving natural resources and stopping climate degradation. The hypothesis is due to the fact that the natural and natural process of forming clay layers provides an unlimited resource in generating the given material for construction.

In the context of scientific analyses, the authors Spreafico & Landi, (2022) [17], Utama et al., (2022) [15] consider that there is a need to create hybrid manufactures to provide all the materials needed for construction. The authors present the achievements obtained in previous scientific works, explaining their benefits and opportunities. The results are associated with the solutions proposed in this work, in particular through products obtained from clay, which have all the properties of the natural material [26]. Also, the strength and durability obtained through lightweight combinations with harder or sustainable materials bring considerable benefits. In the research works of specialists in agriculture and soil ecology, such as Andriuca et al., (2023) [19], the possible problems of soil degradation following geoclimatic changes are discussed. One of the reasons for this phenomenon may be the decrease in ecological norms and their consequences. In this context, the most active use of clay as a raw material in the creation of techniques or technologies for finishing plastic materials becomes opportune in stopping the pollution of the natural environment, and this fact favors the achievement of normal life cycles of ecological materials.

The studies and discussions presented create an overview of eco-efficiency methods through materials used in interior design. Scientific research describes and introduces sustainable techniques and technologies, renewable materials and resources in the creation of interior design [10, 17] and following some general deductions, new solutions with benefits that improve the living environment are highlighted. These are the use of natural resources that are abundant in the lands of the Republic of Moldova and neighboring countries, low material costs, ease of use and most importantly, ecological effects on

people's life and health. The deductions made in this study complement the information field with solutions and experiences previously practiced in the construction sector. The use of local materials was a very well-known practice 50-100 years ago. The given solutions can be brought back to the construction and interior design industry as an optimal way to increase the energy efficiency of homes, increase the ecological ambiance of interiors and reduce toxic residues.

Based on the previous practice of using clay in house construction, known from numerous bibliographic sources, the benefits and advantages offered by the material can be determined, based on past favorable experiences in making decisions about its use [24, 26]. Among the Advantages of eco materials are: protecting and improving the environment; positive impact on the psychological state; the presence of minimalism; lower heating costs; easier dismantling and increased recycling potential; durability, functionality and efficiency. Among the disadvantages are: expensive materials; expenses and difficulties in repair; competition with cheap synthetic materials; difficulties in cleaning and maintenance. The peculiarities of eco-design are classified according to technical and aesthetic qualities that can be used depending on the type and category of rooms. Previous practices in the use of eco materials have a positive impact on the restoration of the natural ecosystem and the improvement of the human living environment [25]. Due to its benefits, clay and clay-based products have gained great importance in the current living environment as a solution to solve and maintain the natural ecosystem.

5. Conclusions

As a result, the conclusions of the study provide an insight into the most effective practices in the use of ecological materials for sustainable interior design and specifically for the use of clay in interior finishing materials. The benefits of clay were listed, which consist of: the availability of this natural resource in many regions of the world, the positive effect on energy efficiency, ensuring a very good ecological climate in the interior space and a return to old practices through new uses of clay. The favorable properties of clay were identified through actions of cleaning and protecting the natural ecosystem; ecological purification, decarbonization of the environment and ensuring an optimal climate inside homes. From a chemical point of view, it was found that clay can be adapted to various techniques and technologies of combination in the formation of alloys for interior and exterior finishes. Their composition has the ability to maintain a close connection with nature and the natural ecological environment.

The scientific material has opened new perspectives for further research in the development of optimal strategies for creating new techniques and technologies of plastic interior finishing materials with clay content. Clay-based products have demonstrated extraordinary capabilities in ensuring a healthy indoor environment, effective in solving many environmental problems due to climate change. The recommended solution completes the scope of interior finishing technologies and expands the possibilities for further development of comfort in interior design.

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VISIBILITY AND TRANSFORMATION OF MOLDOVAN SCHOLARLY OUTPUT (2008–2024): A COMPARATIVE BIBLIOMETRIC STUDY

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Abstract. This comparative bibliometric study examines the visibility of scientific publications by authors from the Republic of Moldova between 2008 and 2024. Utilising three complementary data sources – Web of Science, Scopus, and the National Bibliometric Instrument – the analysis assesses temporal trends, document types, linguistic and disciplinary distributions, and the effects of accreditation and indexing policies on publication patterns. The results reveal a dual model of visibility: Web of Science and Scopus capture an internationalised segment dominated by English-language journal articles in the exact sciences and engineering, while the National Bibliometric Instrument reflects an exhaustive national corpus with a prominent role for conference proceedings, publications in Romanian and Russian, and strong representation of social sciences and humanities. Regulatory reforms and accreditation processes since 2013-2016 have contributed to editorial professionalisation and a typological shift in the National Bibliometric Instrument towards conference materials. The study highlights the limitations of single-source evaluations and argues for the integrated use of international and national bibliometric infrastructures to achieve a balanced assessment of research performance. Implications for policy, editorial practices, and future research, including cohort citation analyses and the role of persistent identifiers, are discussed.

Keywords: *research visibility, bibliometrics, Republic of Moldova, Web of Science, Scopus, National Bibliometric Instrument.*

Rezumat. Acest studiu bibliometric comparativ examinează vizibilitatea publicațiilor științifice ale autorilor din Republica Moldova între 2008 și 2024. Utilizând trei surse de date complementare – Web of Science, Scopus și Instrumentul Bibliometric Național – analiza evaluează tendințele temporale, tipurile de documente, distribuțiile lingvistice și disciplinare, precum și efectele politicilor de acreditare și indexare asupra modelelor de publicare.

Rezultatele relevă un model dual de vizibilitate: Web of Science și Scopus surprind un segment internaționalizat dominat de articole din reviste în limba engleză din domeniul științelor exacte și ingineriei, în timp ce Instrumentul Bibliometric Național reflectă un corpus național exhaustiv, cu un rol important pentru lucrările conferințelor, publicațiile în limba română și rusă și o reprezentare puternică a științelor sociale și umaniste. Reformele de reglementare și procesele de acreditare din perioada 2013-2016 au contribuit la profesionalizarea editorială și la o schimbare tipologică a Instrumentului Bibliometric Național către materialele conferințelor. Studiul evidențiază limitele evaluărilor dintr-o singură sursă și pledează pentru utilizarea integrată a infrastructurilor bibliometrice internaționale și naționale pentru a realiza o evaluare echilibrată a performanței cercetării. Sunt discutate implicațiile pentru politici, practici editoriale și cercetări viitoare, inclusiv analize de citări de cohortă și rolul identificatorilor persistenți.

Cuvinte cheie: *vizibilitate a cercetării, bibliometrie, Republica Moldova, Web of Science, Scopus, Instrumentul Bibliometric Național.*

1. Introduction

The visibility of scientific publications is a central aspect of contemporary academic performance, closely linked to processes of evaluation, funding, and the internationalisation of research. In the context of the expansion of bibliometric infrastructures and the use of citation indicators in institutional rankings and science policy decisions, visibility is no longer merely a consequence of disseminating results but has become a key criterion for assessing the relevance and impact of research [1, 2]. The literature also emphasises that visibility is a construct dependent on indexing infrastructures, database selection criteria, and the publication strategies adopted by authors and institutions [3, 4].

For small or emerging scientific systems, such as that of the Republic of Moldova, the issue of visibility assumes particular importance. Integration into selective international databases, such as Web of Science (WoS) and Scopus, is associated with external recognition and global competitiveness; however, these infrastructures may represent only a portion of the national scientific output, especially in the exact sciences and engineering. Concurrently, national recording tools, such as the National Bibliometric Instrument (IBN – https://ibn.idsi.md/), aim to capture the production comprehensively, including publications in Romanian and works from the social and human sciences, which are often under-represented in international databases.

Over the past decade, the national research system of the Republic of Moldova has undergone significant institutional changes, characterised by the revision of regulations concerning the evaluation and classification of scientific journals, as well as the regulation of the recognition of scientific events. These changes have influenced publishing behaviour and the structure of scientific output, thereby creating conditions conducive to a reconfiguration of visibility patterns. In this context, a comparative analysis that transcends evaluations based on a single data source and integrates perspectives offered by various bibliometric infrastructures is necessary.

The aim of the present study is to compare the visibility of scientific publications by authors from the Republic of Moldova over the period 2008-2024, using three complementary sources: WoS, Scopus, and the IBN. The study seeks to identify structural differences in terms of volume, document typology, disciplinary and linguistic distribution of publications, as well as the impact of the regulatory framework on the dynamics of indexed output.

Accordingly, the research is guided by the following questions:

1) What are the structural differences between the visibility reflected in international databases and that captured by national infrastructure?
2) To what extent have changes in the regulations governing journals and scientific events influenced publishing patterns and the typological distribution of documents?
3) How is visibility distributed across scientific fields and publication languages, depending on the database used?
4) To what extent does the integrated use of sources facilitate a more balanced assessment of national scientific performance?

By adopting a comparative approach, this study contributes to clarifying the relationship between indexing infrastructures and the configuration of scientific visibility, providing an empirical basis for interpreting the research performance of the Republic of Moldova in relation to the dynamics of internationalisation and the specificities of the national context.

2. Literature Review

The visibility of scientific publications has become a bridging concept linking the dynamics of academic communication, institutional research policies, and the digital infrastructures that facilitate the circulation of knowledge. Contemporary approaches often associate visibility with the notion of impact, particularly when discussions concern journals evaluated by citation indicators such as the impact factor, which function as reputational signals within the editorial ecosystem [5]. The literature also emphasises that visibility cannot be reduced to a single indicator; rather, it encompasses a set of processes through which research findings become accessible, discoverable, recognised, and utilised both within the scientific community and in broader contexts of reception. This multifaceted understanding provides the necessary framework for comparative bibliometric studies that employ multiple sources – such as WoS, Scopus, and national tools – because differences in coverage, selection criteria, and indicator calculation methods substantially influence what is measured as "visible" [3, 4, 6].

Conceptual delimitations proposed in both classical and recent literature indicate that visibility has been analysed as a product of the social structure of science as well as an outcome of dissemination infrastructures. Within the sociology of science tradition, Stephen Cole and Jonathan R. Cole [1] discuss visibility as "awareness" constructed through mechanisms of scientific communication, arguing that it is influenced by research quality – reflected in citations – honorary distinctions, departmental prestige, and specialisation. According to the authors' interpretation, other factors, such as output volume or name position in collective works, do not have an independent effect. In parallel, bibliometrics and digital communication studies offer operational definitions linking visibility to accessibility and integration into indexing and citation circuits. De Looze [7] notes that peer-reviewed publications included in reference databases are perceived as high quality, suggesting that visibility also depends on institutional validation mechanisms. Similarly, Miguel et al. [8] demonstrate that visibility is determined both by the quality of work and its accessibility, emphasising the role of open access and indexing in relevant databases in facilitating international citation and readership.

In the open-access literature, visibility is discussed with reference to dissemination routes and their effects on citation. Miguel et al. [8] report differences between Gold Open

Access and Green Open Access: self-archiving (Green OA) is generally associated with a higher citation count per article than direct publication in open-access journals (Gold OA). However, Gold OA does not consistently yield similar citation gains. The authors caution that open access alone does not fully explain visibility, as journal prestige and the intrinsic quality of articles significantly influence recognition. Thus, OA is presented more as an amplification mechanism than as a substitute for quality [8]. Longitudinal analyses of the effects of journal choice show that Gold OA journals have experienced substantial growth in publication share without a proportional increase in citations or representation among the most-cited articles, suggesting that full open access does not automatically confer a competitive citation advantage [9]. This nuance is important for comparative evaluations based on WoS, Scopus, and national tools, since editorial policies and access levels vary, and coverage differences can produce divergent effects on indicators.

An extension of this conceptualisation appears in works that shift the emphasis from mere publication to active promotion strategies and the management of digital identity. Portuguez Castro et al. [10] argue that visibility presupposes the use of digital media, academic networks, and standardised profiles to enhance the impact of works, treating visibility as a prerequisite for integrating results into social, economic, or institutional use circuits. Similarly, Rodríguez Camacaro [11] shows that research outcomes may remain little known if confined to local repositories and not disseminated via open channels and collaborative platforms that facilitate knowledge circulation. In this context, visibility acquires a clear institutional dimension, being associated with universities' positioning and legitimacy, accreditation processes, stakeholder trust, and academic rankings that use bibliometric indicators – especially citations – as measures of research influence [11]. The relationship between visibility and internationalisation is described as circular: internationalisation contributes to increased visibility, which in turn supports internationalisation processes and consolidates institutional reputation [11].

Recent literature also emphasises the distinction between academic visibility and public visibility. Ou et al. [12] differentiate academic impact, measured by citations, from societal visibility, measured by altmetric scores, suggesting that visibility is a composite indicator capturing reception beyond specialised literature. In analyses of research funding, the authors highlight a paradox: studies funded primarily by governmental agencies typically exhibit high academic impact but lower societal visibility, whereas industry funding is associated with greater public exposure owing to its applied orientation and relevance to practical problems [12]. Although "visibility" is often operationalised through quantifiable indicators, these contributions support the idea that types of visibility depend on distinct production and dissemination mechanisms, which justifies using different metrics and databases when comparing national publication profiles [12]. The proposed "alt-index" demonstrates the possibility of quantifying social visibility via digital mentions; the authors identify positive correlations between this index and the h-index, suggesting that online visibility can complement, without replacing, traditional academic impact [13].

Complementarily, [14] conceptualises visibility in science communication as a multifaceted phenomenon applicable to both knowledge and researchers, structuring it into availability, approval, and accessibility. Metag demonstrates that visibility implies not only the existence of content but also permission to share it and the audience's capacity to access and understand it. This framework helps explain why indexing or open access may produce different effects: they can increase availability and accessibility but remain conditioned by

approval mechanisms and the channels through which content becomes visible and discoverable to diverse communities [14]. Similarly, [15] observe that some authors reduce visibility to internet accessibility and indexing, while others link it to journal recognition through the capacity to meet an academic community's informational needs; they reaffirm the major roles of online presence and database inclusion in journal visibility. [16] develop this view further by identifying factors such as the publishing entity, editorial-board representativeness, geographic diversity of authors, electronic publication, publication languages, number of databases indexing the journal, downloads and readings, citations, and impact factor, thereby outlining an ecology of visibility in which editorial infrastructure and indexing policies become explanatory variables.

A consistent strand of literature analyses the factors influencing visibility, viewing it as the product of interactions among researchers' individual practices, institutional support, and technological infrastructures. Cojocaru and Cojocaru [17] describe research visibility as an integrative characteristic reflecting dissemination, accessibility, recognition, and impact, emphasising the importance of social networks and academic platforms in accelerating dissemination and broadening reach. Similarly, Fachin et al. [18] demonstrate that altmetric indicators, derived from online activity, can complement traditional bibliometrics by offering a more nuanced picture of publication circulation and reception, emphasising the role of platforms such as Mendeley and Twitter (now X) in increasing contact points between researchers and their professional audiences. From this perspective, visibility is not solely a consequence of indexing but also of communication and distribution behaviours that can accelerate attention and, under certain conditions, support academic recognition.

In the realm of strategies, the literature emphasises digital identity and the standardisation of author signatures as mechanisms that facilitate discoverability and accurate attribution. González-Fernández-Villavicencio [19] defines visibility as the potential for research outputs to be accessible, identifiable, and recognised, emphasising that consistent author signatures are a crucial factor, as variations in name or affiliation reduce retrieval in databases and compromise bibliometric accuracy. This perspective aligns with the definition of digital identity by Fernández-Marcial and González-Solar [20], who describe it as the result of a deliberate effort to be identified and recognised online through standardisation, the use of identifiers, and dissemination across diverse networks and platforms. Recent empirical analyses indicate that associating publications with an ORCID identifier correlates with significant increases in usage and citations, suggesting that persistent identifiers enhance retrieval and visibility in international databases [21]. Basantes-Andrade et al. [22] conceptualise visibility as web presence expressed through recognition, positioning, and citations, arguing that digital technologies, the conversion of journals to electronic formats, and open-access publishing can boost citations and audience reach when integrated into proactive identity and dissemination management. Consistently, Zimba and Mueller [23] situate visibility at the level of researcher exposure within the academic community, suggesting that the accessibility of ideas and works consolidates professional presence, even if exposure is not, by definition, equivalent to quality evaluation.

From a structural perspective, studies on the geographic distribution and domain specialisation of scientific output indicate that visibility is unevenly distributed and influenced both by the presence of a critical mass of researchers and by orientation towards high-citation disciplines. Milard and Grossetti [24], analysing the regional development of scientific production and visibility in France, argue that the number of citations associated

with a locality is largely explained by production volume, which depends on the number of researchers, and that a second significant factor is specialisation in disciplines that generate many citations internationally. This conclusion reinforces the idea that, in bibliometric comparisons, a scientific community's visibility profile is shaped by both quantity and thematic orientation, and that differences between databases can accentuate or obscure these effects depending on which disciplines are better represented.

The role of indexing in databases is regarded in the literature as a structural dimension of visibility, as indexing facilitates discoverability, validation, and the ability to measure impact through standardised indicators. Chávez-Martínez and Nez-Hernández [25] emphasise that indexing – via metadata standardisation and integration into search infrastructures – enables the identification, evaluation, and large-scale reuse of results, thereby influencing the visibility of works and institutional profiles. Indexing also supports integration into search engines such as Google Scholar and digital libraries, broadening access points to a work and enhancing exposure [26]. From a bibliometric evaluation perspective, selective databases provide the infrastructure necessary for calculating indicators used in research and career assessment. This infrastructure can generate network effects, whereby increased visibility promotes citation accumulation and consolidates academic reputation [4, 27, 28]. Empirical data on citation trends following a journal's inclusion in international databases demonstrate that indexing can significantly influence a publication's citation levels and dynamics [29].

However, the literature cautions that indexing effects depend on the selection philosophy and database coverage, and that differences among WoS, Scopus, and more inclusive sources influence bibliometric conclusions. Stahlschmidt and Stephen [30], together with Singh et al. [31], discuss coverage differences between databases, while Mongeon and Paul-Hus [3] highlight discipline- and language-related limitations with consequences for comparative assessments and for local fields, especially in the social sciences and humanities. The concept of "relative visibility" demonstrates that the proportion of an author's publications indexed in a given service can be significantly smaller than their total output, indicating that the bibliometric representation of visibility depends directly on the source used [32]. Martín-Martín et al. [2] and Rossoni and Rosa [33] link selective databases to the Matthew effect, whereby already visible journals tend to become more cited, thereby amplifying inequalities, while inclusive databases can reduce asymmetries and broaden visibility to different regions. From this perspective, the recommendation to triangulate – using multiple databases to obtain a more balanced picture of visibility – becomes methodologically justified in comparative studies [4, 6, 34]. At the same time, the literature highlights ethical risks associated with the pressure to be indexed, including metric-driven behaviours and potential editorial misconduct, suggesting that the objective of indexing must be balanced with rigorous evaluation and transparency in editorial practices [35].

Overall, the literature indicates that scientific visibility cannot be reduced to a single indicator or dimension of academic performance; rather, it should be understood as the outcome of a combination of interdependent factors acting simultaneously at individual, institutional, and systemic levels. Visibility is shaped by research performance and profile, as well as by the editorial environment, indexing infrastructures, dissemination practices, and the context in which knowledge circulates. Within this framework, differences among databases, their selection criteria, and the methods by which they aggregate and present indicators significantly affect the representation of scientific output.

Therefore, assessing visibility requires a comparative and integrated approach that considers multiple sources and analyses results in relation to the specific characteristics of each information infrastructure. Such a perspective enables the identification of genuine differences in exposure and recognition of publications, as well as an understanding of the mechanisms through which they gain relevance in the academic sphere and, in some cases, the public domain. This approach provides the methodological foundation for the comparative investigation of the visibility of publications by authors from the Republic of Moldova in WoS, Scopus, and IBN.

3. Materials and Methods

The research methodology was designed to facilitate a rigorous comparative analysis of the visibility of scientific publications by authors from the Republic of Moldova through the utilisation of complementary data sources. The analysis drew on information extracted from three bibliometric databases – WoS, Scopus, and IBN – each offering distinct perspectives on national scientific output and its integration into the international knowledge network. Additionally, data on scientific events and collected works registered by the National Book Chamber of the Republic of Moldova (CNCRM) were incorporated.

Data from WoS and Scopus were collected on 3 November 2025, and information from IBN was extracted on 7 November 2025. For the analysis of publications associated with the editorial activities of conferences and symposia, the sources "Cronica Cărții" (Book Annals) [36] and "Cărți în curs de apariție" (Books-in-print) [37], managed by CNCRM, were consulted. These resources enabled the identification of volumes of scholarly works, conference proceedings, and academic events relevant to the assessment of national scientific output.

The study period was from 2008 to 2024, selected to capture both long-term publishing trends and the impact of institutional regulations on publishing behaviour. Particular attention was given to changes resulting from the Regulation on the Evaluation, Classification and Monitoring of Scientific Journals and the Regulation on the Recognition, Classification and Recording of Scientific Events, initially adopted by the National Council for Attestation and Accreditation (CNAA) and subsequently by the National Agency for Quality Assurance in Education and Research (ANACEC). These regulations influenced editorial standards and publishing strategies, factors incorporated into the interpretation of the results.

The units of analysis were scientific journals and scientific events. For each data source, variables relevant to characterising scientific output were extracted, including the total number of publications, annual distribution, scientific fields, document types (articles, conference papers, monographs), and language of publication. These indicators enabled a comparative assessment of the visibility of researchers from the Republic of Moldova in national and international indexing systems.

Data processing was conducted using descriptive and comparative methods, with the aim of identifying major trends and structural differences between the analysed databases. The results were synthesised in tables and graphical representations to highlight temporal dynamics, thematic distribution, and typological variations in publications. The analysis addressed both quantitative changes, such as increases or decreases in publication volume, and structural transformations, including a shift towards internationally indexed journals and the consolidation of participation in recognised scientific conferences.

Thus, the adopted methodology sought to reveal the relationship between national scientific output and its international visibility. The integrated analysis of the three databases, supplemented by information from national editorial records, provides a comprehensive perspective on the evolution of the Republic of Moldova's scholarly publishing system and allows for the interpretation of results both in quantitative terms and in relation to the institutional and regulatory framework that has shaped this evolution.

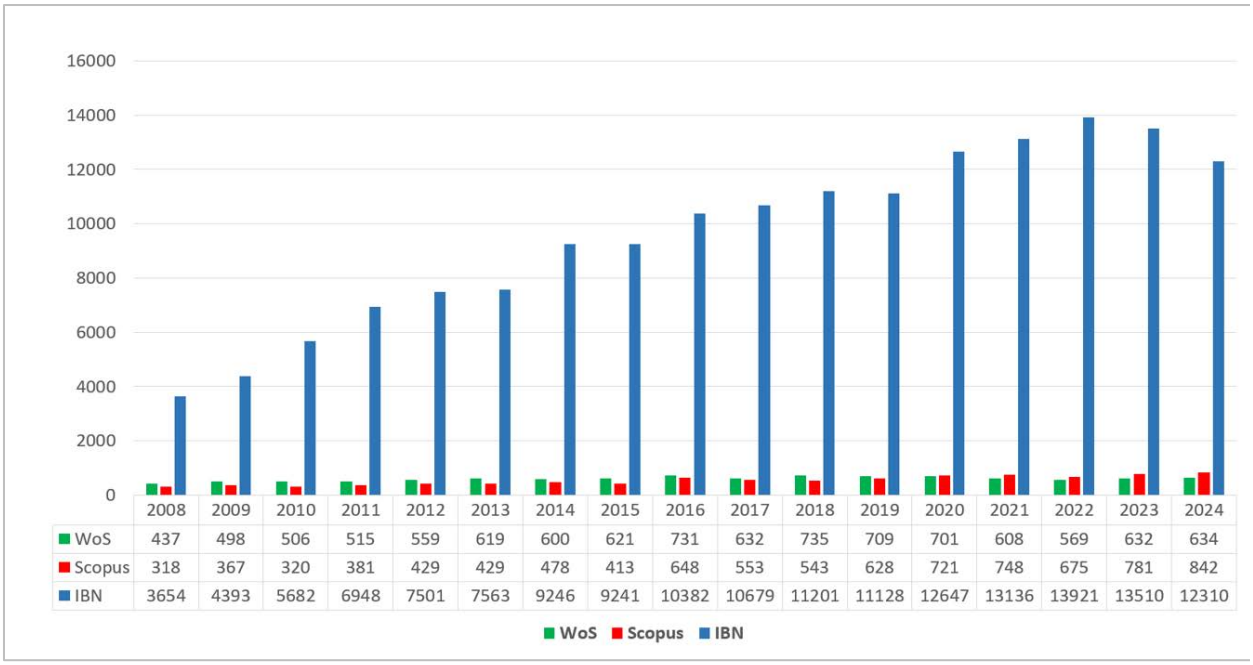
4. Results

4.1. Dynamics of Scientific Publications by Authors from the Republic of Moldova (2008-2024)

Analysing the evolution in the number of scientific publications is a relevant indicator for assessing the dynamics of national research visibility and its level of integration into international indexing infrastructures.

The data summarised in Figure 1 illustrate the annual evolution of publications by authors from the Republic of Moldova indexed in WoS, Scopus, and IBN from 2008 to 2024. A comparison of the three sources highlights both a general upward trend and structural differences resulting from the selection policies and coverage of the databases.

Between 2008 and 2012, the international presence of publications from the Republic of Moldova was relatively modest. According to the data presented in Figure 2, only four journals were indexed in the WoS and one in Scopus, which limited the international exposure of research findings. At this stage, the national publishing system was predominantly oriented towards internal dissemination, with evaluation and peer-review standards still in the process of consolidation. The development of IBN contributed to structuring an internal monitoring framework; however, integration into global citation networks remained limited.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
WoS	437	498	506	515	559	619	600	621	731	632	735	709	701	608	569	632	634
Scopus	318	367	320	381	429	429	478	413	648	553	543	628	721	748	675	781	842
IBN	3654	4393	5682	6948	7501	7563	9246	9241	10382	10679	11201	11128	12647	13136	13921	13510	12310

Figure 1. Dynamics of publication indexing by authors from the Republic of Moldova in WoS, Scopus, and IBN databases (2008-2024).

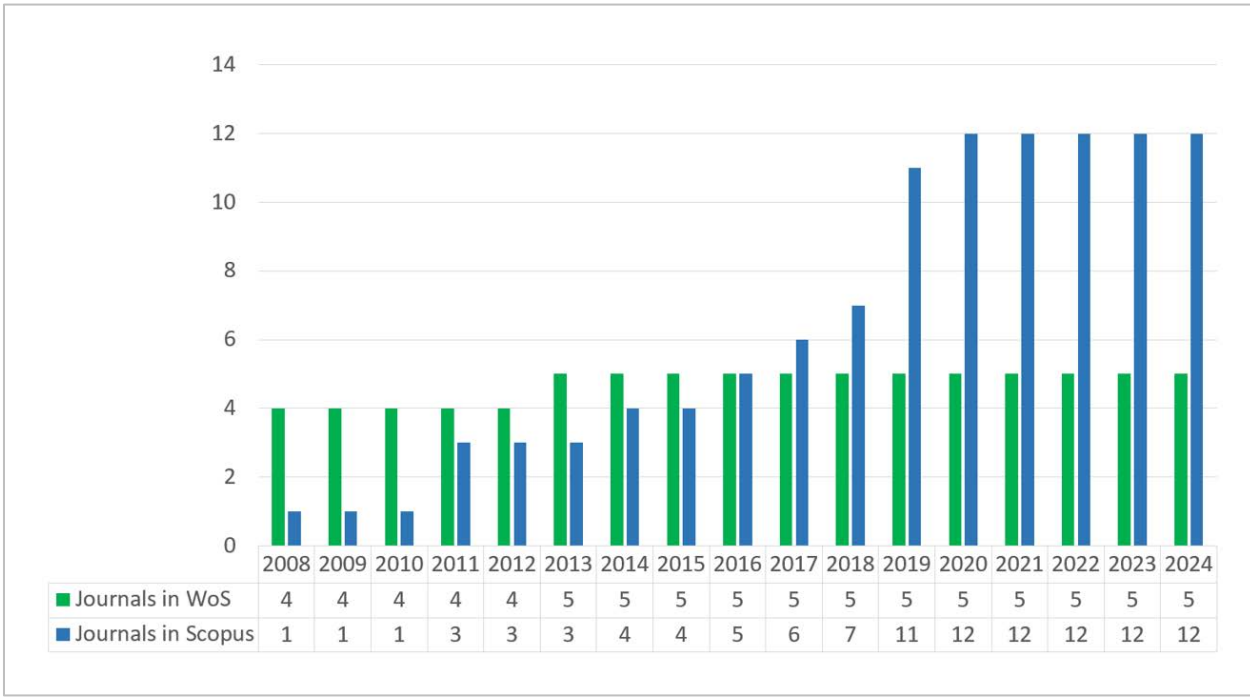
The period from 2013 to 2015 marks the beginning of significant institutional restructuring, driven by the implementation of the CNAA Regulation on the evaluation and

classification of scientific journals. The introduction of formal peer-review criteria, journal classification, and an emphasis on editorial transparency led to a gradual increase in the number of journals eligible for international indexing. Scopus data reveal a steady expansion in the presence of Moldovan journals, signalling progressive adaptation to the quality standards required by global databases.

The transformation became more pronounced between 2016 and 2019, coinciding with the adoption of a new regulatory framework by ANACEC. Requirements concerning publication ethics, the use of internationally recognised languages, and indexing in established databases led to a marked increase in the number of journals indexed in Scopus, while the number indexed in WoS remained relatively stable. This development reflects the consolidation of editorial infrastructure and a strategic focus on internationalisation.

Between 2020 and 2024, digitalisation and harmonisation with international practices intensified through the implementation of DOI identifiers and the adoption of electronic editorial management systems. The stabilisation in the number of indexed journals suggests that an institutional level of maturity has been reached, with the focus shifting from numerical growth to maintaining standards and enhancing editorial quality.

Overall, the dynamics illustrated in Figure 1 reveal an upward trajectory in scholarly output and a gradual integration into international databases. The increase in the number of indexed publications, alongside the consolidation of the presence of journals from the Republic of Moldova in WoS and Scopus, indicates that the international visibility of Moldovan research is the result of a gradual process of normative alignment, editorial professionalisation, and adaptation to global standards of scholarly communication.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Journals in WoS	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5
Journals in Scopus	1	1	1	3	3	3	4	4	5	6	7	11	12	12	12	12	12

Figure 2. Dynamics of journal indexing from the Republic of Moldova in WoS and Scopus (2008-2024).

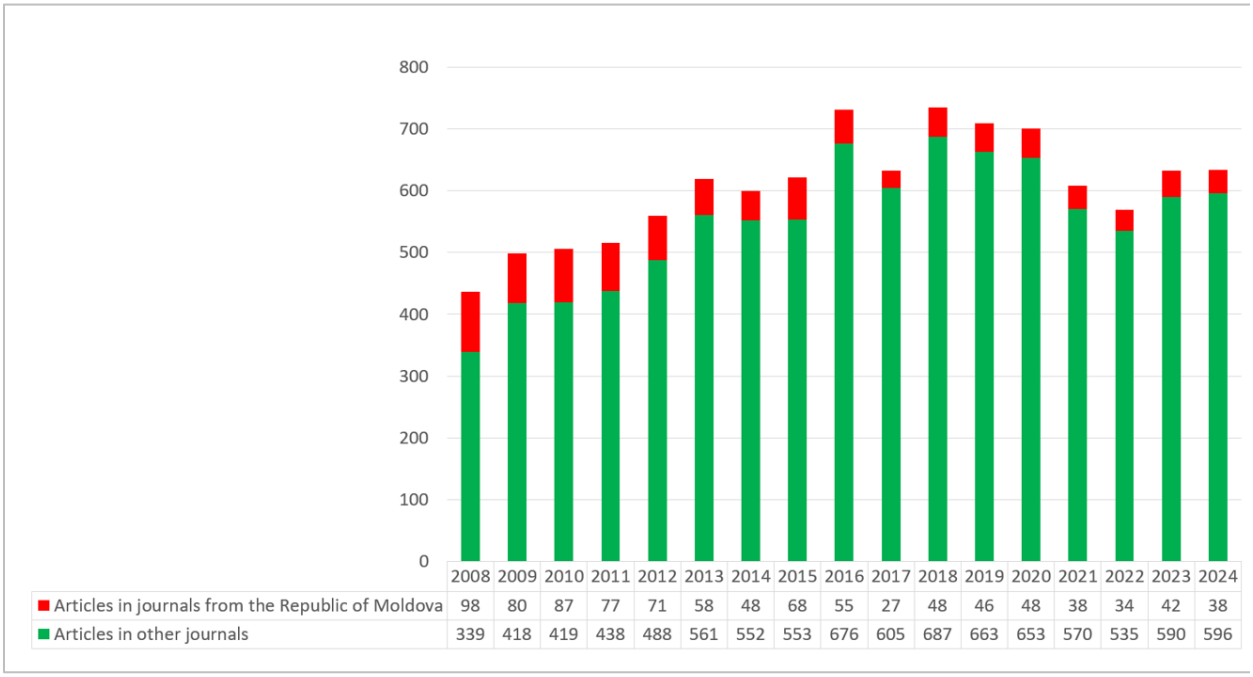
4.2. Impact of Indexing Moldovan Journals in Web of Science and Scopus on the Structure and Volume of Scientific Output

The dynamics of the number of journals indexed in WoS and Scopus, as shown in Figure 2, indicate two distinct trajectories. For WoS, the number of journals stabilises at five titles from 2013 and remains constant until 2024. This stability suggests the existence of a narrow core of publications that have met the selection thresholds and maintained them over the long term. The absence of quantitative growth points to a rigorous selection framework and a high entry barrier, which are characteristic of this database.

In contrast, Scopus records a steady increase in the number of Moldovan journals indexed, rising from a single title at the start of the analysed period to twelve journals after 2020. This expansion is more pronounced after 2016, coinciding with the implementation of new regulations on journal evaluation and classification. This development reflects an enhanced capacity of editorial teams to meet the technical and ethical requirements for indexing, as well as a more flexible inclusion policy compared with WoS.

To evaluate the tangible impact of indexing on scientific output, it is necessary to analyse the structure of articles published in national compared to international journals.

Data in Figure 3 show that, in WoS, articles published in journals outside the Republic of Moldova constitute the dominant segment throughout the entire analysed period. Their number rises steadily between 2008 and 2016, exceeding approximately 650-680 articles annually during 2016-2018. Subsequently, a slight reduction is observed, followed by stabilisation in recent years. This trend suggests a consolidated integration of Moldovan researchers into international publication networks.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Articles in journals from the Republic of Moldova	98	80	87	77	71	58	48	68	55	27	48	46	48	38	34	42	38
Articles in other journals	339	418	419	438	488	561	552	553	676	605	687	663	653	570	535	590	596

Figure 3. Dynamics of article indexing by authors from the Republic of Moldova in Web of Science (2008-2024).

The contribution of national journals indexed in WoS is smaller in volume. In the early years, they published approximately 77 to 98 articles annually; however, after 2013-2014, a decline was observed, followed by stabilisation at around 27 to 55 articles per year. Given the constant number of indexed titles, these variations can be explained by editorial

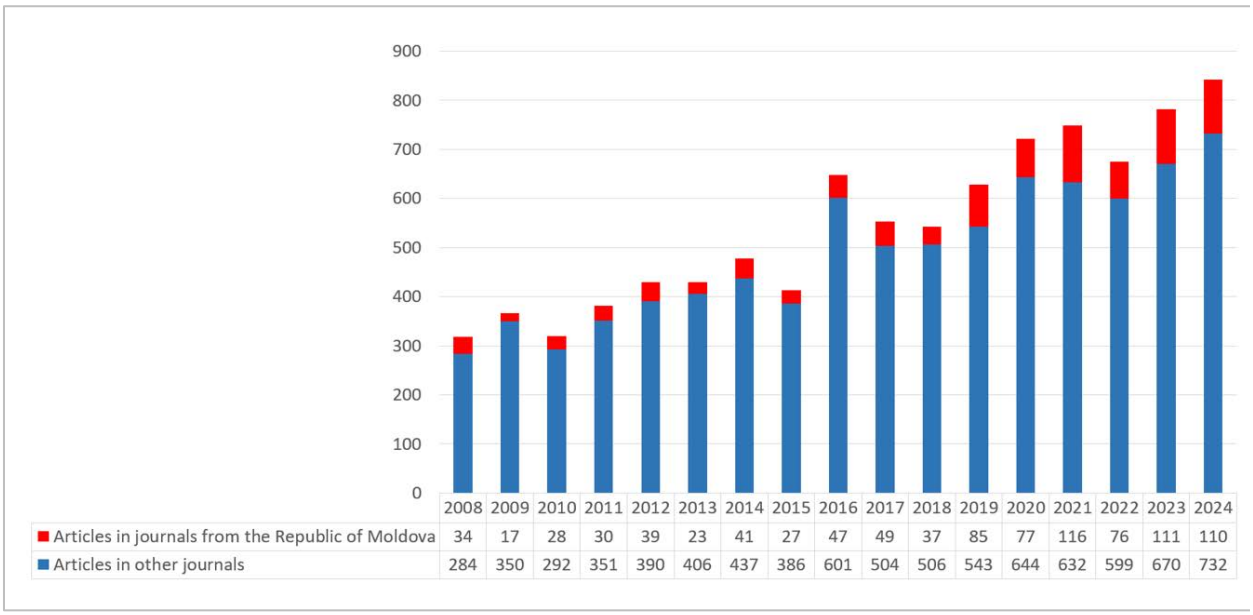
adjustments and increased selectivity. The ratio between the two segments indicates that national journals indexed in WoS function as a complementary channel without altering the dominant production structure, which remains oriented towards established international journals.

The situation in Scopus, as illustrated in Figure 4, demonstrates a more pronounced dynamic. The number of articles published in journals outside the Republic of Moldova has increased almost continuously, from fewer than 300 at the start of the period to over 700 in 2024, with a notable surge around 2016. The growth rate in Scopus is more pronounced than in WoS, indicating an expansion of collaboration networks and a rapid adaptation to indexing requirements.

In parallel, the contribution of Moldovan journals indexed in Scopus has evolved significantly. While in the early years this segment remained below 40 articles annually, a steady increase has been observed since 2015, with values frequently exceeding 70 to 100 articles per year after 2019. This increase coincides with the expansion in the number of indexed journals, indicating a direct effect of the editorial infrastructure on the volume of internationally recognised articles.

Comparatively, the proportion of articles published in indexed national journals is more prominent in Scopus than in WoS. This difference can be attributed to the selection criteria and Scopus's greater openness to emerging journals, which has facilitated the faster integration of Moldovan publications. In WoS, the production structure remains dominated by external international journals, and the indexing of local journals has not resulted in significant structural changes.

Cumulative analysis indicates that the inclusion of Moldovan journals in international databases has a varied effect. In WoS, the impact is primarily qualitative and symbolic, consolidating a small core of stable journals. In Scopus, the effect is also quantitative, evidenced by a noticeable increase in the volume of articles indexed in national journals.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Articles in journals from the Republic of Moldova	34	17	28	30	39	23	41	27	47	49	37	85	77	116	76	111	110
Articles in other journals	284	350	292	351	390	406	437	386	601	504	506	543	644	632	599	670	732

Figure 4. Dynamics of article indexing by authors from the Republic of Moldova in Scopus (2008-2024).

Overall, the data show that indexing local journals in WoS or Scopus does not replace publication in established international journals but rather expands internationally

recognised dissemination options. The total increase in indexed output is driven mainly by intensified publishing in journals outside the Republic of Moldova, while the expansion of indexed national journals contributes to diversifying channels and strengthening editorial infrastructure.

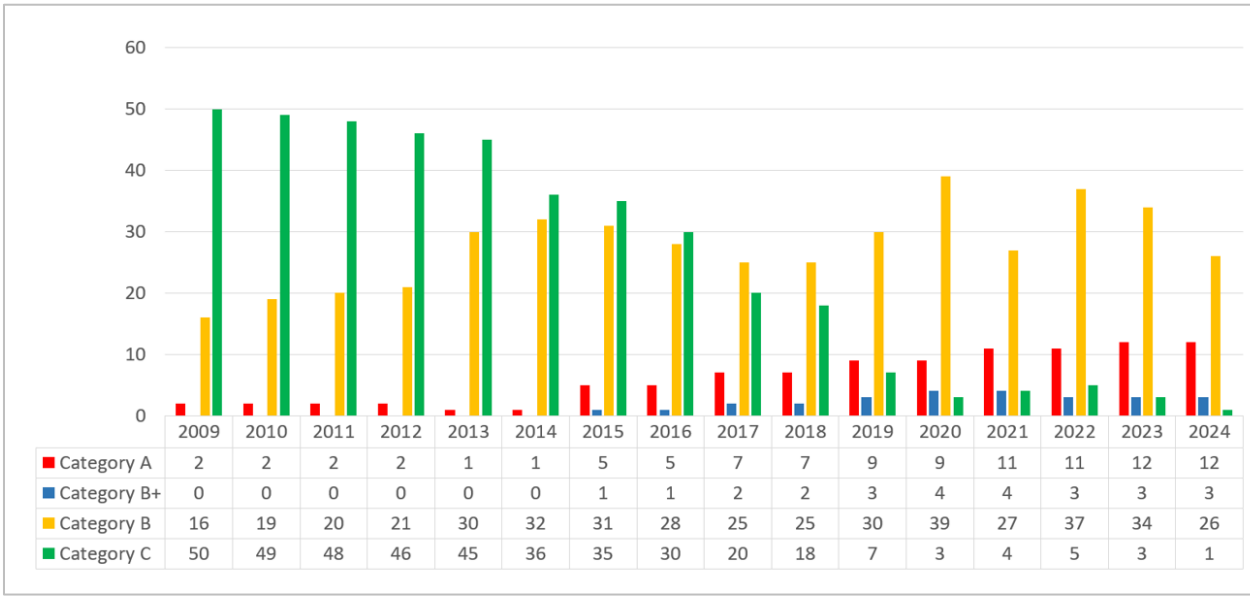
Therefore, the inclusion of Moldovan journals in WoS and Scopus serves both as an indicator of editorial quality and as a mechanism for enhancing international visibility, with more pronounced effects in Scopus, where the dynamics are stronger at both the level of journal titles and indexed articles.

4.3. Dynamics of Accreditation and the Hierarchical Restructuring of Scientific Journals in the Republic of Moldova (2009-2024)

The evolution of accredited scientific journals in the Republic of Moldova between 2009 and 2024 offers a pertinent indicator of how the regulatory framework has influenced the structure and performance of the national publishing system. The accreditation process, formally established by the Regulation on the Evaluation and Classification of Scientific Journals, approved in 2008 and implemented from 2009, introduced unified evaluation and classification criteria for the first time, defining standards concerning periodicity, editorial board composition, peer-review procedures, and formal compliance of publications.

One hundred and one scientific journals were accredited during the analysed period. Their dynamics, illustrated in Figure 5, reveal a significant structural transformation reflected in the distribution across categories (A, B+, B, and C). The evolution does not indicate a linear increase in the total number of journals but rather a gradual reconfiguration of the internal hierarchy.

In the initial stage (2009-2013), category C held a dominant share, representing more than half of the accredited journals each year. This distribution is characteristic of a phase of institutionalisation during which the primary objective was the formal integration of existing publications into a unified evaluation framework. Higher categories (A and B+) had marginal representation, indicating a limited level of compliance with advanced editorial standards and reduced integration into international publication flows.



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Category A	2	2	2	2	1	1	5	5	7	7	9	9	11	11	12	12
Category B+	0	0	0	0	0	0	1	1	2	2	3	4	4	3	3	3
Category B	16	19	20	21	30	32	31	28	25	25	30	39	27	37	34	26
Category C	50	49	48	46	45	36	35	30	20	18	7	3	4	5	3	1

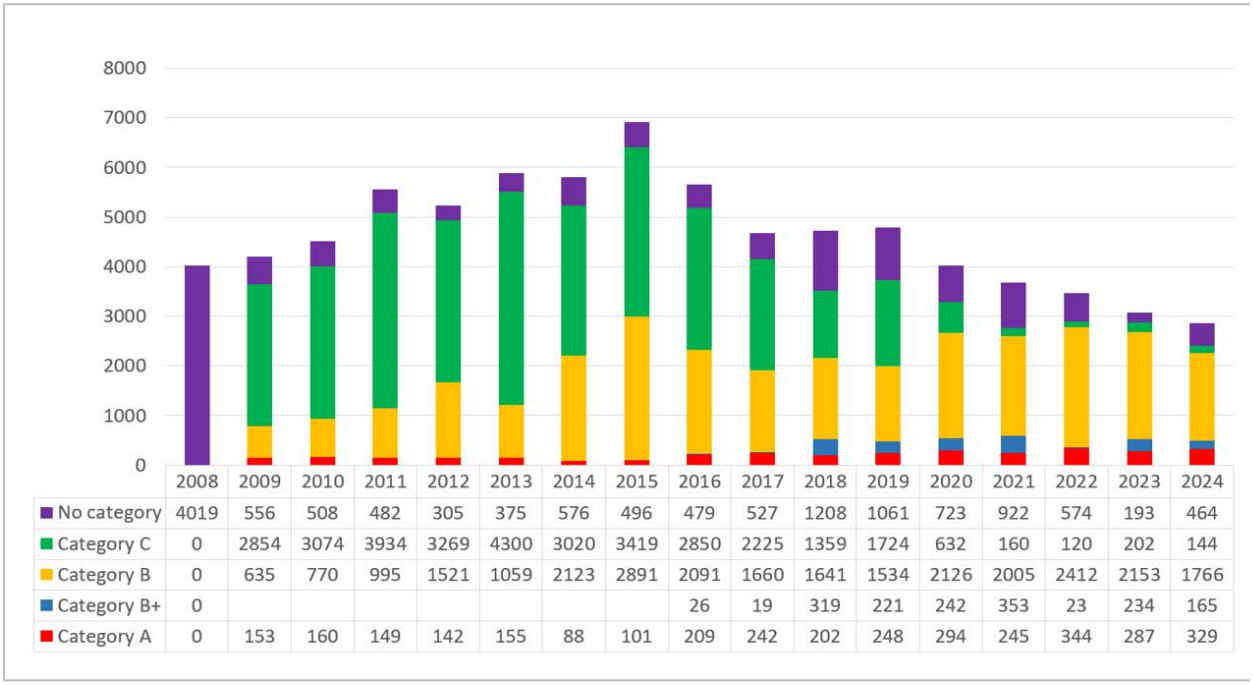
Figure 5. Dynamics of journal accreditation in the Republic of Moldova (2009-2024).

From 2014 to 2015, the category structure began to change noticeably. Revisions to the regulations and the consolidation of requirements concerning scientific peer review, editorial process transparency, and evidence of international dissemination led to a gradual reduction in category C. Simultaneously, the proportion of B-category journals increased, and category A began to exhibit a more stable presence. This evolution suggests a shift from a predominantly formal model towards one focused on editorial performance.

The period from 2017 to 2020 marks an acceleration in the reclassification process. The significant reduction in category C was accompanied by the consolidation of category B and a more consistent emergence of category B+. This reconfiguration reflects a stricter application of evaluation criteria and the removal from the system of journals that did not demonstrate the capacity to adapt to the new requirements. The dynamics indicate an institutional filtering process rather than numerical expansion.

Between 2021 and 2024, the hierarchical structure stabilises. Category B becomes dominant, while Category A reaches 12 journals in 2023-2024, indicating the consolidation of a small segment of publications with superior editorial performance. Category C is reduced to minimal levels, confirming its transitional role. This evolution aligns with recent regulatory directives that explicitly condition journal recognition on the use of the national information infrastructure (IBN), the application of international editorial standards, and the demonstration of scientific impact.

The analysis of the structure of articles indexed in IBN, as presented in Figure 6, complements this perspective. In the early years of the analysed period, a significant volume of articles was associated with journals lacking categorisation, reflecting the initial stage of classification and the absence of systematic control over editorial performance. Following the systematic application of evaluation mechanisms, the proportion of uncategorised articles progressively declined, indicating the integration of journals into the formal accreditation system.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
No category	4019	556	508	482	305	375	576	496	479	527	1208	1061	723	922	574	193	464
Category C	0	2854	3074	3934	3269	4300	3020	3419	2850	2225	1359	1724	632	160	120	202	144
Category B	0	635	770	995	1521	1059	2123	2891	2091	1660	1641	1534	2126	2005	2412	2153	1766
Category B+	0								26	19	319	221	242	353	23	234	165
Category A	0	153	160	149	142	155	88	101	209	242	202	248	294	245	344	287	329

Figure 6. Evolution of the indexing of articles from accredited journals in the Republic of Moldova (2008-2024).

Category C initially dominates the structure of indexed articles, maintaining high values until around 2015. Subsequently, a steady decline in this segment is observed, concurrent with an increase in articles published in category B journals. After 2015, category B becomes the predominant segment of articles indexed in the IBN, reflecting the consolidation of a core group of journals with stable editorial performance.

Category B+ has a small numerical share, but its consistent presence indicates the emergence of an intermediate segment with performance superior to that of category B, albeit limited in volume. Category A, while representing the smallest segment by number of articles, has recorded gradual growth since 2016, confirming the consolidation of a select group of journals with advanced editorial standards.

From a structural perspective, the data suggest a transition from a volume-oriented system to one focused on quality. The reduction in uncategorised articles and those in category C, alongside the increase in higher categories, indicates the effectiveness of evaluation and classification mechanisms. This process did not result in uncontrolled numerical expansion but rather in a hierarchical reconfiguration of the system.

Overall, the dynamics of accreditation between 2009 and 2024 highlight a cumulative process of editorial professionalisation. The regulatory framework functioned as an instrument of selection and adjustment, driving both the reclassification and removal of publications that failed to meet established criteria. The evolution presented in Figures 5 and 6 confirms the maturation of the national publishing system and its progressive orientation towards editorial performance standards compatible with international scholarly publishing practices.

4.4. Scientific Conferences and Traceability of Results: Organisation, ANACEC Recognition, and IBN Indexing (2008-2024)

Scientific events constitute a distinct component of scholarly output, characterised by a complex relationship between organisation, formal recognition, and the documentation of editorial outcomes. The evolution of this sector in the Republic of Moldova permits an assessment of the degree of alignment between organisational activity and institutional mechanisms for the validation and recording of scientific results. Data on organised events, those officially recognised by ANACEC, and the dynamics of published and indexed proceedings enable an evaluation of the level of formalisation and professionalisation within this segment of scientific communication.

The data in Table 1 show that, for the period 2011-2024, a high but fluctuating volume of scientific events was organised within the territory of the Republic of Moldova, with varied distributions by type. National events recorded the highest absolute values and the most pronounced variability. Minimums were observed in 2012 (14) and 2019 (22), followed by substantial increases after 2020, peaking in 2022 (173) and remaining at high levels in 2023-2024 (136). Events “with international participation” exhibited a more moderate dynamic, with a minimum in 2012 (3) and a maximum in 2023 (86), followed by a decline in 2024 (58). International events also showed considerable variability, peaking in 2021 (90) and maintaining high values in 2022-2023 (79-88), before decreasing in 2024 (62). Overall, the data in Table 1 indicate an increase in scientific activities after 2020; however, the significant year-to-year fluctuations suggest that the “organised” register primarily reflects the organisational dimension rather than a consistent validation of scientific quality and publishable outcomes.

Table 1

Register of events organised in the Republic of Moldova (2011–2024)

Events organised in the Republic of Moldova	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
National scientific events	79	14	50	57	66	67	69	61	22	65	69	173	136	136
Scientific events with international participation	50	3	30	29	49	46	48	50	22	59	76	69	86	58
International scientific events	43	7	31	51	46	74	64	75	34	68	90	79	88	62

This contrast becomes clearer when the data on organised events are compared with ANACEC's register of recognised events (Table 2). Between 2020 and 2024, the number of events validated by ANACEC is considerably lower than the number recorded in the general register. This discrepancy indicates the application of a selective mechanism based on criteria concerning the scientific nature of events, the composition of scientific committees, the level of international participation, and the existence of publishable results eligible for national records. Thus, the ANACEC register reflects not only organisational activity but also the outcome of evaluation against the standards established by the regulations.

Table 2

Register of events Register of events recognised by ANACEC (2020-2024)

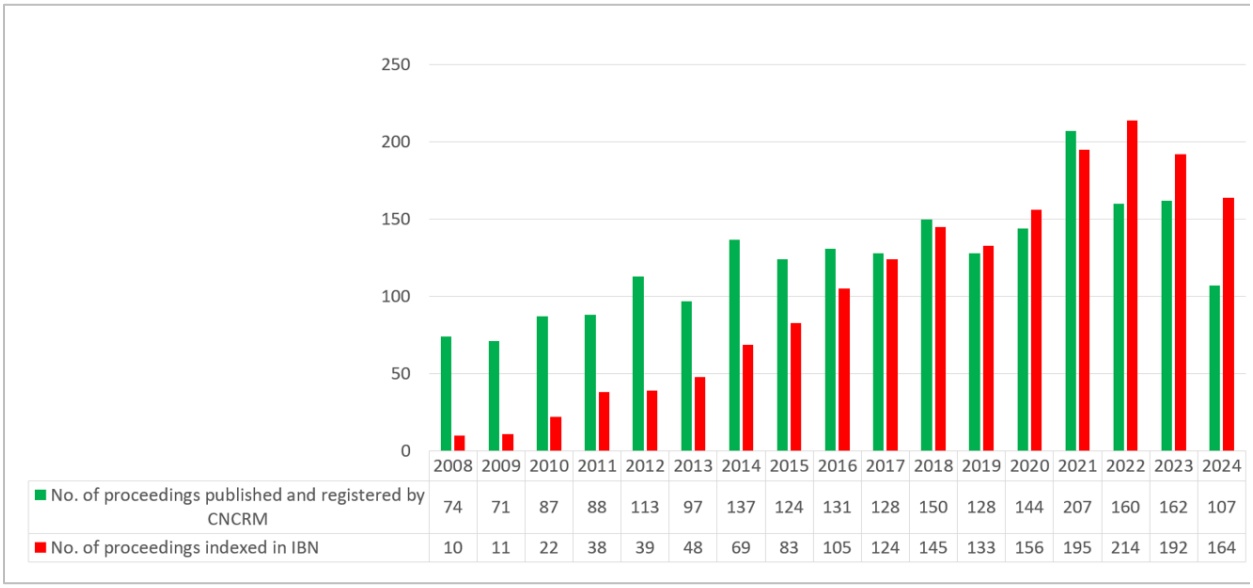
National Scientific events	2020	2021	2022	2023	2024
National scientific events	28	37	49	35	46
Scientific events with international participation	20	47	82	73	30
International scientific events	25	26	12	25	42

Within the category of recognised national events, there are moderate variations between 2020 and 2024, with lower levels at the start of the period, a marked increase in 2022, and similar values in 2023 and 2024. Events "with international participation" display a more pronounced dynamic: from a relatively low level in 2020, they rise sharply until 2022, followed by a decline in 2023 and 2024. For recognised international events, the trend is relatively stable, with a pronounced drop in 2022 and a gradual recovery over the subsequent two years.

Comparing these data with the total volume of organised events reveals a persistent gap between "organisation" and "recognition". For example, between 2022 and 2024, the number of national events organised is considerably greater than the number recognised. This discrepancy suggests the operation of an institutional selection mechanism whereby only events that meet criteria concerning scientific structure, committee composition, and the eligibility of publishable results are validated. Similarly, the status of "international participation" does not automatically confer recognition; demonstration of conformity with regulatory standards is required.

The third dimension of the analysis, illustrated in Figure 7, examines the editorial outcomes of conferences through two capture channels that do not perfectly overlap: the registration of proceedings at the Camera Națională a Cărții din Republica Moldova (CNCRM)

and their indexing in the Instrumentul Bibliometric Național (IBN). Between 2008 and 2012, there is a consistent lag between the number of proceedings registered at CNCRM and those indexed in IBN, indicating limited bibliometric capture of conference outputs relative to the recorded editorial volume. This pattern is consistent with a phase in which editorial registration functioned primarily as a bibliographic record, while bibliometric indexing had not yet been systematically integrated as an evaluative tool.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
No. of proceedings published and registered by CNCRM	74	71	87	88	113	97	137	124	131	128	150	128	144	207	160	162	107
No. of proceedings indexed in IBN	10	11	22	38	39	48	69	83	105	124	145	133	156	195	214	192	164

Figure 7. Dynamics of publication and indexing of conference proceedings organised in the Republic of Moldova (2008-2024).

Between 2013 and 2016, there was an accelerated increase in the number of proceedings indexed in the IBN, accompanied by a reduction in the gap relative to proceedings registered at CNCRM. This convergence suggests a gradual alignment of conference editorial output with the inclusion criteria of the bibliometric record; that is, improved traceability of results in the instruments used for monitoring and evaluation. After 2017, a much stronger convergence emerged; from 2018 to 2022, the values became very close, and in certain cases, the number of proceedings indexed in the IBN exceeded those registered at CNCRM. Operationally, this indicates that indexing in the IBN has become a major channel for capturing conference outputs, reducing the separation between editorial publication and inclusion in the bibliometric record.

For 2023-2024, the data suggest a decline in the total number of proceedings registered at CNCRM, alongside a sustained high level of indexing in IBN. The most cautious interpretation is that the system has recently shifted towards a smaller volume of proceedings with a higher eligibility for indexing and recognition. In other words, bibliometric capture remains high even when the registered editorial volume falls, which may indicate stricter selection of events or the internalisation of compliance criteria within organisational practices.

Methodologically, differences between CNCRM and IBN must be interpreted with caution. The relationship between the two records does not imply complete overlap, as they serve different functions. CNCRM primarily operates as a bibliographic register, typically linked to ISBN assignment. In contrast, IBN functions as an instrument for recording and monitoring scientific output, using criteria oriented towards the scientific eligibility of

volumes, independent of formal editorial status. Consequently, instances in which proceedings indexed in IBN exceed those registered by CNCRM do not indicate inconsistency but rather reflect differing coverage determined by each system's criteria and purpose. Practically, IBN can capture outputs from conferences for which standard editorial registration or ISBN was not obtained, but for which metadata, scientific structure, and eligibility conditions for recording exist.

Overall, the combination of data from Tables 1 and 2 and Figure 7 indicates two levels of selection. The first is institutional, demonstrated by the difference between organised events and those recognised by ANACEC, reflecting the application of validation criteria. The second concerns editorial and bibliometric traceability, evidenced by the progressive convergence of CNCRM and IBN, indicating improved capture of conference outputs in tools used for monitoring and evaluation. Therefore, scientific events should not be assessed solely by the number of events organised but also by their level of recognition and the system's capacity to document and index associated publishable results.

4.5. Document-type structure indexed in WoS, Scopus, and IBN: a comparative analysis

The analysis of document types indexed in WoS, Scopus, and IBN reveals significant structural differences between the segment of output with international visibility and that reflected at the national level. The distributions indicate distinct models of scholarly communication and different functions of indexing infrastructures.

In WoS and Scopus (Figure 8), scientific articles are the predominant form of publication. The number of articles significantly exceeds that of other document types, confirming the orientation of researchers from the Republic of Moldova towards publication in peer-reviewed journals, which are considered the principal channels for validation and international recognition. This pattern aligns with the selective policies of both databases, which prioritise original research articles and, to a lesser extent, review articles.

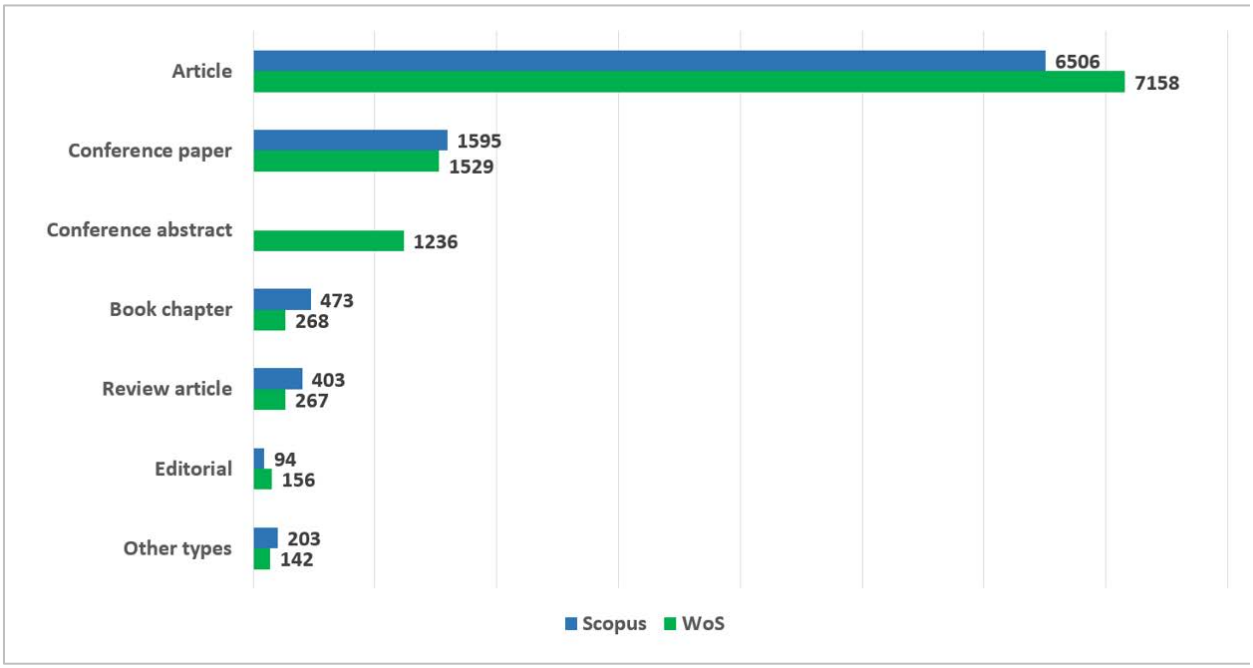


Figure 8. Document types of authors from the Republic of Moldova indexed in Web of Science and Scopus (2008-2024).

Conference papers represent the second most common document type in WoS and Scopus, with comparable volumes across both databases. Their presence reflects researchers' integration into international academic networks, particularly in technical and engineering disciplines where conferences serve as a recognised channel for the rapid dissemination of findings. Nevertheless, the proportion of these documents remains significantly lower than that of journal articles, indicating that international visibility is primarily linked to journal publication.

Other document types–such as book chapters, editorials, and reviews–are underrepresented in both international databases. This distribution reflects selection criteria that restrict the inclusion of edited volumes and editorial materials to those published by recognised publishers or appearing in journals of international standing. A slight typological diversification is observed in Scopus, confirming its broader coverage compared with WoS.

In contrast, the document structure indexed in IBN (Figure 9) exhibits a markedly different profile. Although journal articles constitute an important and numerically consistent segment, the dominant category comprises proceedings and chapters published in conference volumes. This distribution highlights the central role of scientific events in the dynamics of national scholarly output and confirms the importance of conferences as a mechanism for the internal dissemination of research findings.

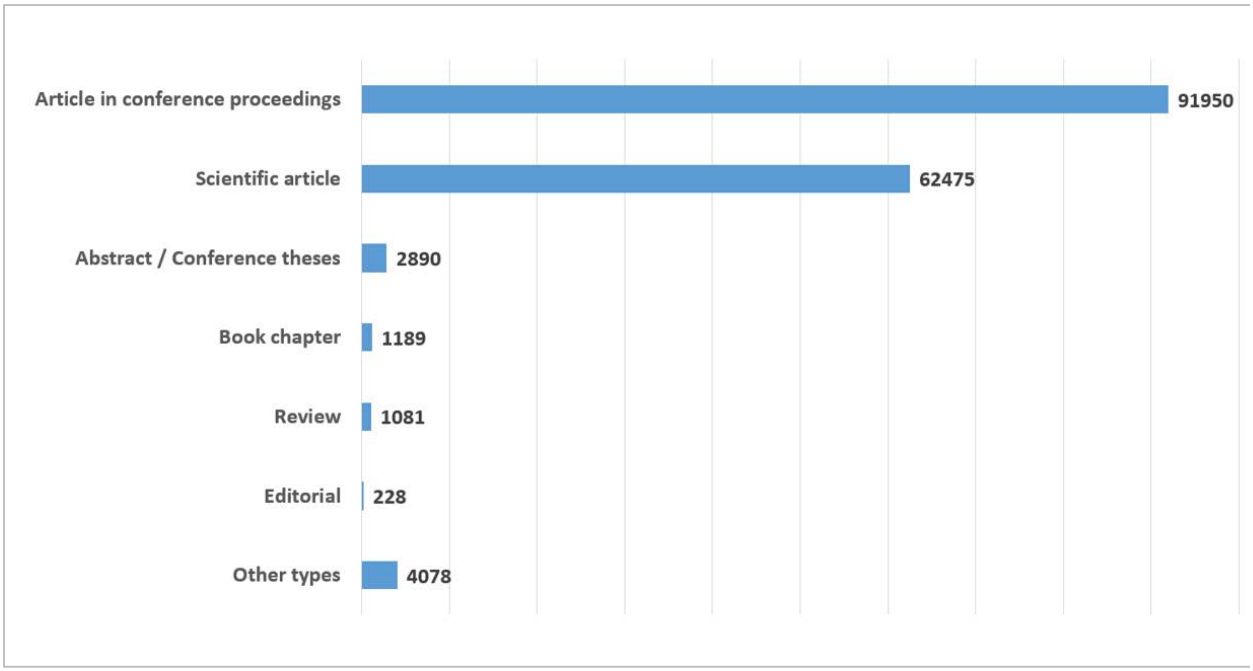


Figure 9. Document types authored by individuals from the Republic of Moldova, indexed in IBN.

IBN also encompasses a broader range of document types – abstracts, reviews, editorials, and other forms of communication–that are underrepresented in international databases. This diversity reflects the comprehensive purpose of the national tool, which aims to capture the full extent of scientific activity regardless of the level of internationalisation or external impact.

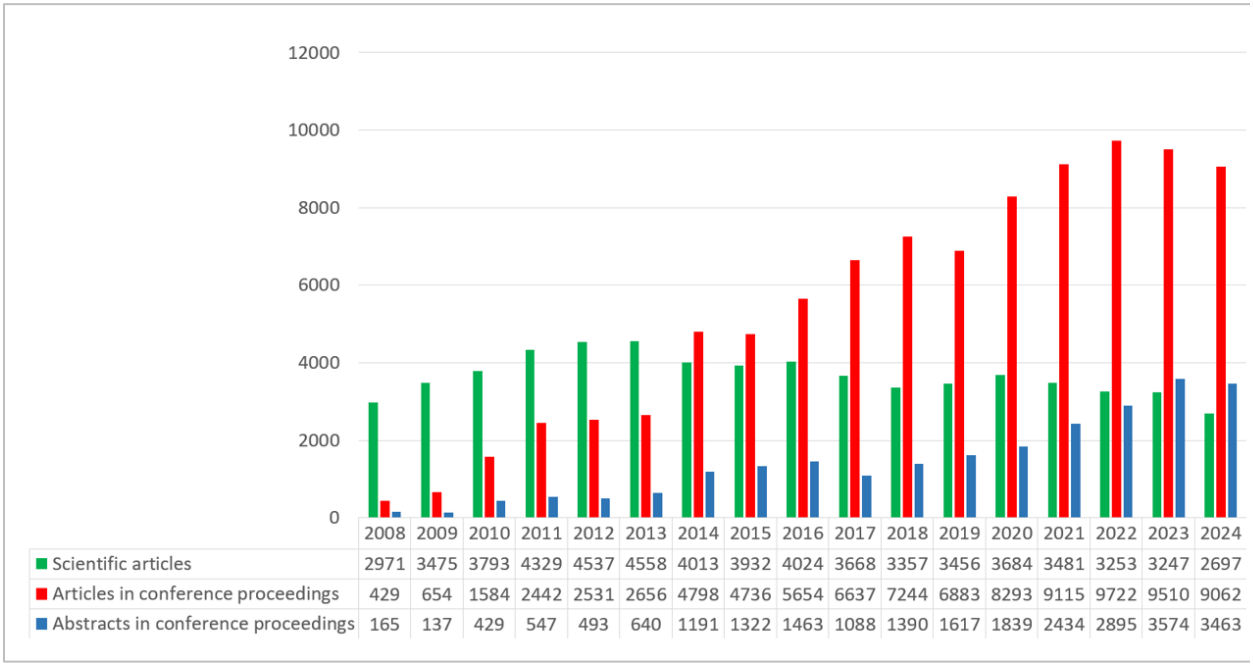
Comparison of the three sources highlights a clear functional distinction. WoS and Scopus capture the internationalised segment of the output, characterised by the predominance of journal articles and a restrictive typological selection. In contrast, IBN reflects the complete structure of national scientific production, including forms of

communication with local or regional relevance. This structural difference has direct implications for visibility assessment: exclusive use of international databases provides a picture focused on the externally impactful segment, whereas integration of IBN allows for an understanding of the actual distribution of document types and the publishing strategies adopted by the academic community in the Republic of Moldova.

Therefore, the comparative analysis of document typologies confirms the necessity of an integrated approach that differentiates between selective international visibility and a comprehensive representation of national scientific output.

4.6. Structural Reconfiguration of Publications Indexed in IBN (2008-2024)

The evolution of publications by authors from the Republic of Moldova indexed in IBN between 2008 and 2024 reveals significant structural changes in the distribution of document types, correlated with regulatory changes in journal evaluation and the recognition of scientific events. Data in Figure 10 indicate a transition from a model predominantly centred on journal articles to a mixed structure in which conference materials constitute a major share.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Scientific articles	2971	3475	3793	4329	4537	4558	4013	3932	4024	3668	3357	3456	3684	3481	3253	3247	2697
Articles in conference proceedings	429	654	1584	2442	2531	2656	4798	4736	5654	6637	7244	6883	8293	9115	9722	9510	9062
Abstracts in conference proceedings	165	137	429	547	493	640	1191	1322	1463	1088	1390	1617	1839	2434	2895	3574	3463

Figure 10. Evolution of publication types by authors from the Republic of Moldova indexed in IBN (2008-2024).

In the initial phase of the analysed period, articles published in journals constituted the predominant segment of the indexed output. Growth in this document type is linked to the introduction of accreditation and classification mechanisms for journals, which stabilised a core of publications eligible for indexing and formalised the national evaluation process. The consolidation of criteria regarding peer review and periodicity contributed to greater predictability of editorial output.

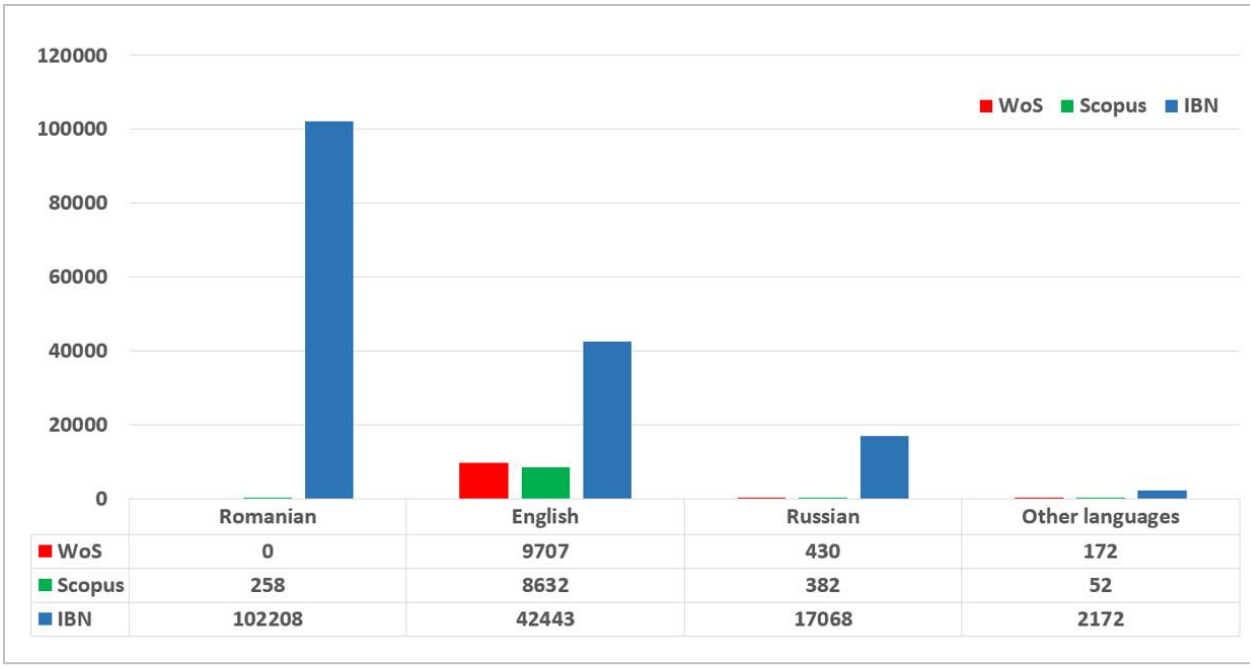
From 2014 to 2015, the typological structure changed noticeably. Articles published in conference proceedings experienced accelerated growth and came to outnumber journal articles. This development coincided with the strengthening of regulations governing scientific events, which enabled the systematic indexing of works presented at conferences and broadened the range of results eligible for the national record. At the same time, the number of indexed abstracts increased, reflecting a widening of the criteria for capturing scientific activity.

After 2016, the number of journal articles stabilised, no longer exhibiting the previous growth rate. This trend suggests a redistribution of publishing strategies in response to stricter editorial requirements and the appeal of conferences as platforms for rapid dissemination.

Overall, the dynamics of publications indexed in IBN reflect the cumulative effect of successive regulations: the professionalisation of the journal editorial sector and a substantial expansion of conference-based output. The result is a diversified bibliometric profile that captures internal transformations within the national scientific system and the adaptation of communication forms to the institutional evaluation framework.

4.7. Linguistic Structure of Indexed Publications: Convergences and Differences Between National and International Databases

The distribution of publication languages in documents authored by researchers from the Republic of Moldova, indexed in WoS, Scopus, and IBN, reveals consistent structural differences between international and national infrastructures. The data summarised in Figure 11 reflect both the functional orientation of these databases and the language strategies adopted by the scholarly community.



	Romanian	English	Russian	Other languages
WoS	0	9707	430	172
Scopus	258	8632	382	52
IBN	102208	42443	17068	2172

Figure 11. Linguistic structure of documents indexed in WoS, Scopus, and IBN (2008-2024).

In WoS, the linguistic profile is heavily dominated by English, which accounts for nearly all indexed documents. The presence of other languages is marginal, with Romanian being virtually absent. This distribution confirms the selective, international nature of the database, where English serves as the implicit standard for academic communication and a prerequisite for global visibility.

Scopus displays a similar pattern, with a clear predominance of English but a slightly greater diversity of secondary languages. Although documents in Romanian and Russian constitute a small proportion, their presence indicates a more flexible indexing policy compared with WoS. Nevertheless, English remains the principal vehicle for internationalisation and integration into the global scientific community.

By contrast, the linguistic structure of documents indexed in IBN is considerably more diverse. Romanian constitutes the dominant share, reflecting IBN's role as a tool for recording national scientific output and supporting internal evaluation. Simultaneously, the substantial proportion of documents in English indicates a progressive orientation towards internationalisation, while the presence of Russian and other languages reflects the multilingual nature of the Moldovan academic environment.

Comparatively, these distributions confirm a stratified system of scholarly communication. Publication in Romanian is predominantly associated with national dissemination and integration within the IBN infrastructure, whereas English is the primary language for accessing the international visibility provided by WoS and Scopus. Therefore, the choice of publication language is not neutral but reflects authors' strategic positioning between internal recognition and integration into the global research community.

4.8. Disciplinary Structure of Indexed Publications: Differentiating International and National Profiles

The disciplinary distribution of publications by authors from the Republic of Moldova in WoS, Scopus, and IBN reveals systematic differences between the internationalised segment of research and the output reflected at the national level. The data presented in Figures 12-14 indicate a stratified structure of visibility, determined both by the research profile and by the indexing criteria of each database.

In WoS database (Figure 12), publications are predominantly concentrated in the exact sciences and engineering. Materials science, applied physics, condensed matter physics, multidisciplinary chemistry, and nanotechnology are among the leading fields. This distribution suggests that the international visibility of Moldovan research is primarily supported by disciplines with well-established experimental infrastructure and a tradition of international collaboration. Social sciences and humanities are underrepresented, reflecting both the communication characteristics specific to these disciplines and WoS's stringent selection criteria.

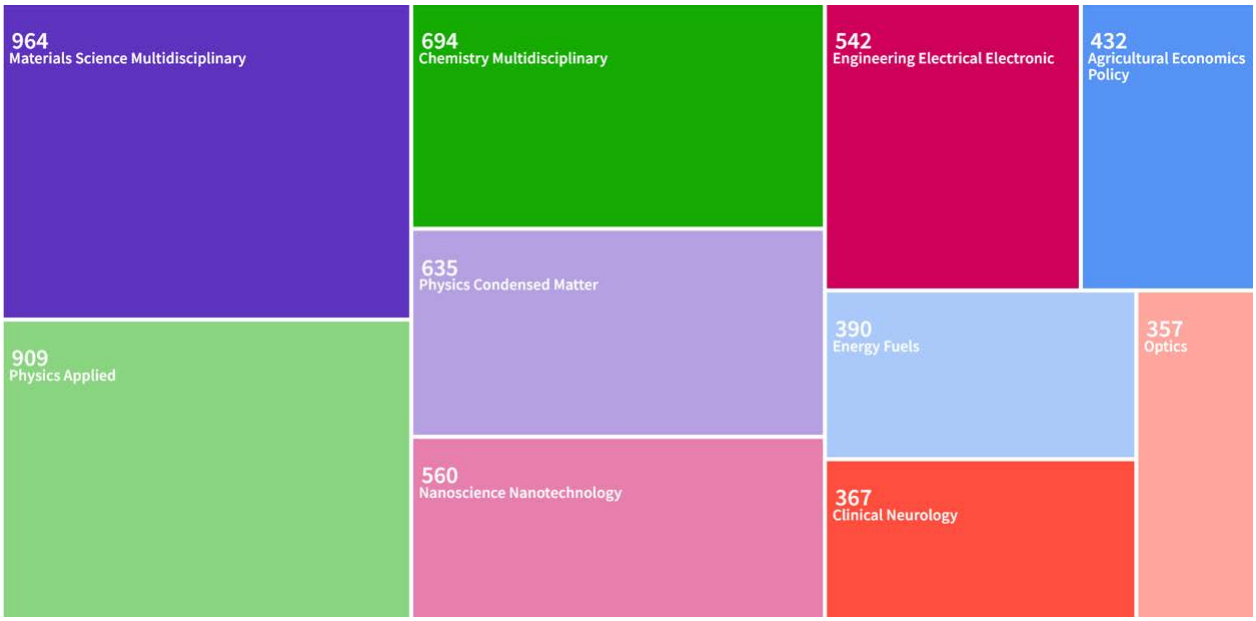


Figure 12. Distribution of publications by authors from the Republic of Moldova indexed in the Web of Science, categorised by scientific field.

Scopus (Figure 13) exhibits a more diversified structure. Although engineering, physics, and materials science remain well represented, there is a significant proportion of medicine, chemistry, mathematics, computer science, and the social sciences. This distribution indicates Scopus's greater capacity to integrate varied and interdisciplinary fields, including areas with limited representation in WoS. From this perspective, Scopus reflects an intermediate level of international visibility, characterised by broader disciplinary coverage and more extensive integration of biomedical and socio-economic fields.

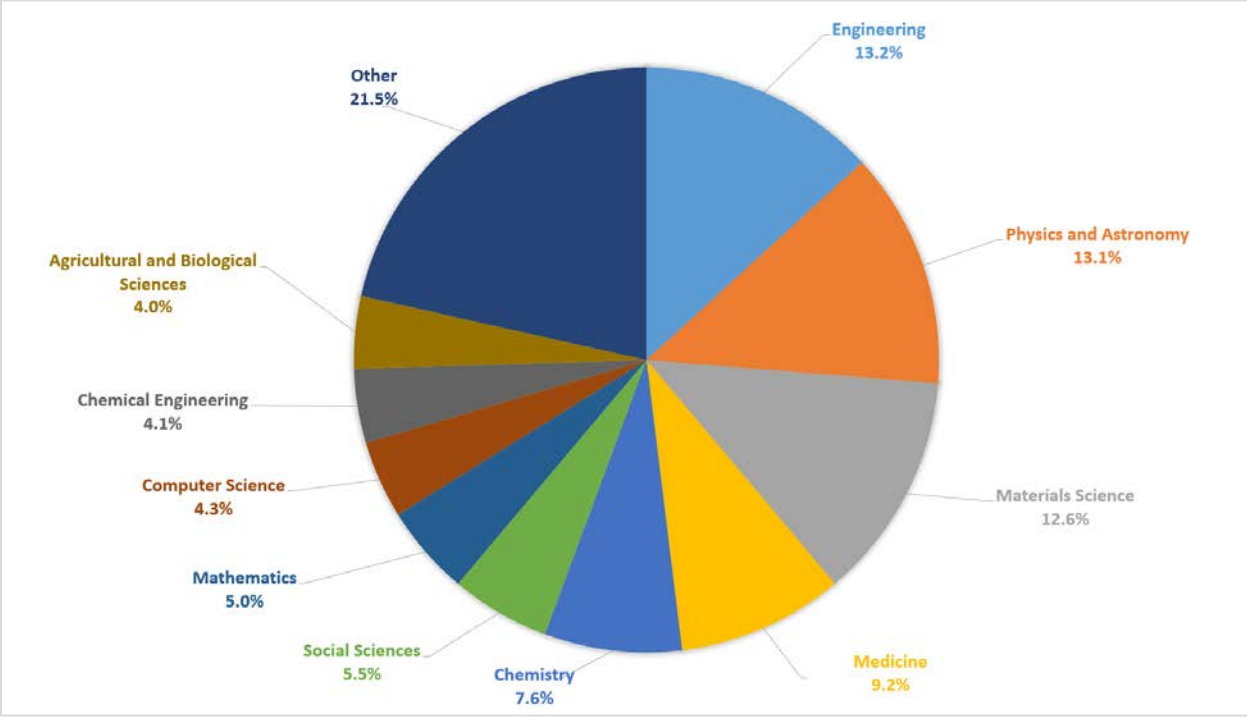


Figure 13. Distribution of publications by authors from the Republic of Moldova indexed in Scopus, categorised by subject area.

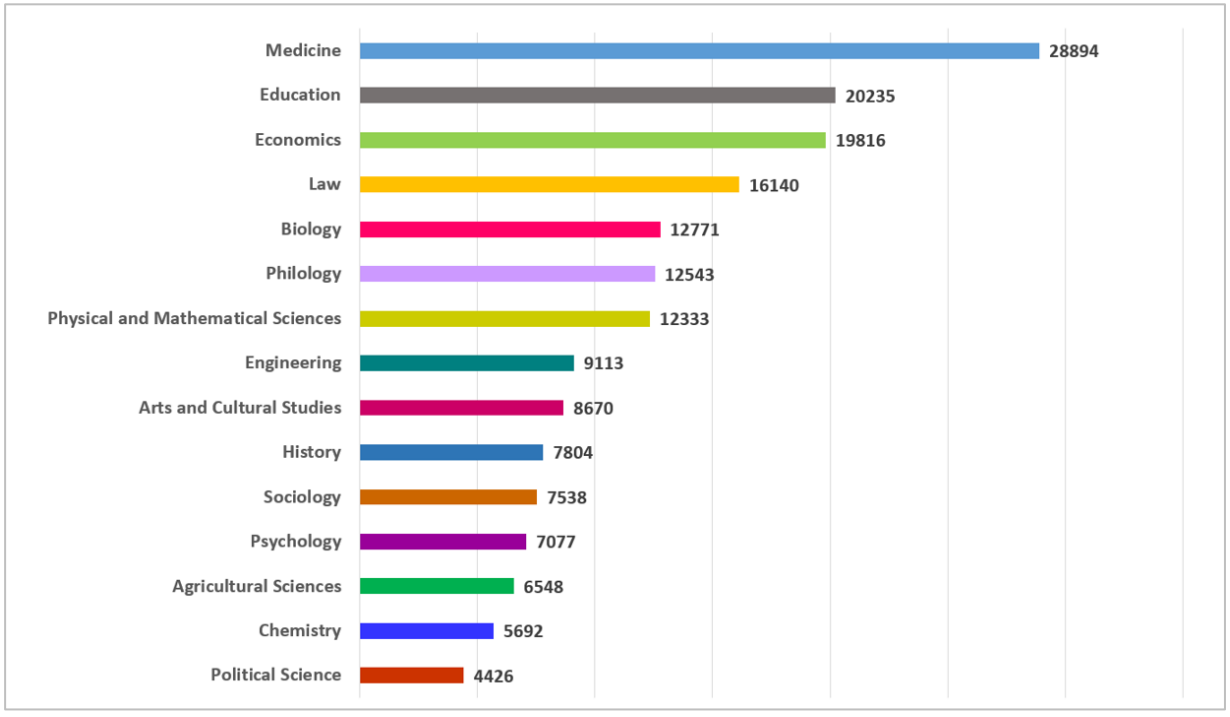


Figure 14. Distribution of publications by authors from the Republic of Moldova indexed in IBN, categorised by scientific field.

In IBN (Figure 14), the disciplinary profile differs substantially. Dominant fields include medicine, pedagogy, economics, law, biology, and philology, alongside the physical-mathematical sciences and technical domains.

The high proportion of social and human sciences reflects IBN's role as a comprehensive national record, encompassing both articles in accredited journals and materials from scientific events. In these disciplines, publication in the national language and in local journals or volumes remains predominant, which explains the differences relative to international databases.

A comparison of the three distributions confirms the existence of a dual model of scientific visibility. WoS captures the disciplinary core, with high international performance concentrated in the exact sciences and engineering. Scopus reflects broader thematic diversification, while IBN provides a comprehensive overview of the entire spectrum of national research, including fields with a predominantly internal orientation. This differentiation underscores the complementarity of the analysed databases and the importance of their integrated use in assessing the visibility of research from the Republic of Moldova.

5. Conclusions

Correlating the empirical results with the specialised literature confirms the infrastructural nature of scientific visibility. As the bibliometric and sociological approaches discussed above suggest, inclusion in a selective database is not only a measurement mechanism but also a means of validation and amplification of recognition. The disciplinary, linguistic, and typological coverage differences identified between WoS, Scopus, and IBN demonstrate that visibility depends on the internal logic of each infrastructure. Consequently, the assessment of scientific performance must be interpreted with reference to these structural mediations, avoiding extrapolations based on a single data source.

The comparative bibliometric analysis of publications by authors from the Republic of Moldova between 2008 and 2024 highlights a progressive restructuring of the national scholarly communication system, driven by the interaction among evaluation policies, accreditation criteria, and indexing infrastructures. The results indicate that normative and institutional changes have affected not only the volume of scientific output but also its distribution by document type, publication language, and disciplinary field.

The study confirms the existence of a dual model of scientific visibility. On the one hand, WoS and Scopus reflect the internationalised segment of research, characterised by the predominance of journal articles, the near-exclusive use of English, and a concentration in fields such as materials science, physics, chemistry, and engineering. On the other hand, IBN captures the full structure of national scientific output, including national journals, conference materials, and publications in Romanian and Russian, as well as social sciences and humanities fields that are under-represented in international databases.

A notable finding is the typological reconfiguration of publications indexed in IBN after 2014, characterised by a marked increase in conference materials. This development correlates with regulations concerning the recognition of scientific events and indicates an adaptation of publishing strategies to institutional evaluation criteria. Concurrently, the analysis of conferences reveals a systematic distinction between organised events and those officially recognised, as well as between editorial publication and bibliometric indexing, highlighting successive filtering mechanisms in the capture of scientific output.

The linguistic and disciplinary distributions further confirm the stratified nature of visibility. English serves as the primary medium for accessing international visibility, whereas national languages facilitate internal dissemination and societal relevance. Similarly, the exact sciences and engineering benefit from broader integration into global citation networks, while the social sciences and humanities are predominantly represented within the national infrastructure.

These findings suggest that assessing the visibility of research from the Republic of Moldova cannot be adequately achieved using international databases alone. An integrated approach, combining indicators from WoS and Scopus with data from IBN, allows for a more balanced interpretation of scientific performance, taking into account disciplinary, linguistic, and typological differences.

For future research, studies could investigate the relationship between publication types and citation impact, the effects of persistent identifiers (such as ORCID and DOI) on visibility, and the correlation between funding, international collaborations, and integration into selective databases. Longitudinal evaluations of the effects of regulatory changes on publishing behaviour could also provide an empirical basis for refining evaluation policies.

Overall, the study emphasises the need to align internationalisation strategies with the maintenance of a robust national infrastructure that can fully reflect the diversity and specificity of research in the Republic of Moldova.

Limitations of the Study: This comparative bibliometric analysis is subject to several methodological and structural limitations that should be taken into account when interpreting the results.

First, the findings depend on the coverage and indexing policies of the databases used. WoS and Scopus apply different selective criteria, while IBN serves a distinct, more exhaustive function. Consequently, the observed differences may reflect both genuine characteristics of scientific output and specific features of the indexing infrastructures. Therefore, measured visibility is contingent upon the source employed.

Second, the analysis relies on data extracted at specific points in time, which may influence the results due to the continuous updates of bibliographic databases. Possible indexing delays or subsequent corrections could marginally alter the presented distributions.

Another limitation relates to the classification of disciplines and document types. The assignment of publications to scientific fields varies between WoS, Scopus, and IBN, and these discrepancies may affect the direct comparability of the data. Furthermore, the analysis did not include impact indicators (such as citations or altmetric scores), focusing predominantly on the structure and volume of output.

Finally, the study does not examine in detail variables such as international collaboration, research funding, or institutional affiliation–factors that can significantly affect visibility. Incorporating these dimensions could provide a more nuanced understanding of the mechanisms through which publications attain international recognition.

Despite these limitations, the combined use of international databases and national infrastructure provides a robust comparative perspective on the structure and dynamics of scientific visibility in the Republic of Moldova.

Research Data Availability Statement: The research data are available upon request.

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Contribution of Authors

Nelly Țurcan: Conceptualization, Methodology, Investigation, Visualization, Writing – Original Draft;
Rodica Cujba: Resources, Formal analysis, Writing – Review & Editing, Supervision;
Vitalie Minciuna: Data curation, Validation, Writing – Review & Editing.

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INTEGRATING THE TECHNIQUE OF DETECTING SIMULATED BEHAVIOR INTO THE PROCESS OF FORENSIC INVESTIGATION OF CORRUPTION

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Abstract. Corruption crimes generate complex and far-reaching effects on the functioning of institutions, affecting not only administrative efficiency, but also social cohesion and economic stability. In the public sector, such acts undermine the integrity of decision-making processes and compromise the transparency, objectivity and accountability of the administrative act. As a result, financial and material resources may be allocated inefficiently or in a biased manner, institutional priorities are distorted, and essential public projects may be delayed or directly compromised. These effects lead to a decrease in citizens' trust in state institutions, affect the perception of the fairness of laws and social rules, and can diminish civic participation and the collaboration of communities with authorities. In the private sector, corruption creates an unstable economic environment, characterized by unfair competition, favoritism and defective business practices. Companies that follow the rules are often disadvantaged, while those who resort to corrupt practices can obtain temporary advantages, distorting market mechanisms. This leads to increased operational costs, inefficiency, reputational risks and can negatively affect domestic and foreign investments. In addition, the general economic climate becomes uncertain and volatile, which influences sustainable development and long-term social stability.

Keywords: *case study, evidence, recidivism, claim, unjustified wealth, goods and services.*

Rezumat. Infracțiunile de corupție generează efecte complexe și de anvergură asupra funcționării instituțiilor, afectând nu doar eficiența administrativă, ci și coeziunea socială și stabilitatea economică. În sectorul public, astfel de acte subminează integritatea proceselor decizionale și compromit transparența, obiectivitatea și responsabilitatea actului administrativ. Drept urmare, resursele financiare și materiale pot fi alocate ineficient sau părtinitor, prioritățile instituționale sunt distorsionate, iar proiectele publice esențiale pot fi întârziate sau compromise direct. Aceste efecte duc la scăderea încrederii cetățenilor în instituțiile statului, afectează percepția asupra echității legilor și a regulilor sociale și pot diminua participarea civică și colaborarea comunităților cu autoritățile. În sectorul privat, corupția creează un mediu economic instabil, caracterizat prin concurență neloială, favoritism și practici comerciale defectuoase. Companiile care respectă regulile sunt adesea dezavantajate, în timp ce cele care recurg la practici corupte pot obține avantaje temporare,

distorsionând mecanismele pieței. Acest lucru duce la creșterea costurilor operaționale, ineficiență, riscuri reputaționale și poate afecta negativ investițiile interne și străine. În plus, climatul economic general devine incert și volatil, ceea ce influențează dezvoltarea durabilă și stabilitatea socială pe termen lung.

Cuvinte cheie: *studiu de caz, probe, recidivă, pretenție, avere nejustificată, bunuri și servicii.*

1. Introduction

According to data presented by the National Bureau of Statistics [1], in 2023 there was a reduction of approximately 10% in the total number of crimes, including corruption.

At the same time, according to the Annual Report of the National Anticorruption Center [2], 287 criminal cases were initiated for corruption crimes.

It is worth noting that the difference between the figures reported by the National Bureau of Statistics and those reported by the National Anticorruption Center is due to the different scope of competence: the National Anticorruption Center investigates only a part of these crimes, but the downward trend is visible in both reports.

From a forensic point of view, these crimes have the following general characteristics [3, p.95]:

- High complexity. These crimes are often well planned and organized, involving multiple individuals and structures. The components are often interconnected, making it difficult to identify and prove the involvement of each individual.

- Discretion and secrecy. Corruption often occurs behind closed doors, in informal or private meetings, where decisions are made without leaving any obvious traces. Documents may be forged or incomplete, and communication between those involved is coded or indirect to avoid detection.

- Use of power. Corrupt criminals often use their positions of power or influence to achieve their illicit ends. They manipulate decision-making processes or exploit gaps in control and verification systems.

- Involvement of large sums of money or resources. Corruption crimes frequently involve substantial financial transactions, either in the form of bribes or through the misappropriation of public or private funds. These may include cash, valuables, preferential contracts or other economic benefits.

- Difficulty of proof. In many cases, direct evidence is rare or non-existent, and prosecutors must rely on indirect evidence, such as testimonies, document analysis and financial trail. This often complicates the investigation process and requires a multidisciplinary approach.

- Repetition and recidivism. Corruption crimes often have a repetitive nature, involving the same individuals or groups who continue to commit corrupt acts over a long period of time. Recidivism is common, as corrupt criminals rely on previous success and impunity to continue their illicit activities.

- Involvement of a wide circle of individuals. Corruption often involves a large number of accomplices, from public officials to individuals in the private sector or intermediaries. This wide circle of involvement makes it difficult to isolate individual responsibility and creates a climate of complicity and mutual cover-up.

These characteristics make corruption a major challenge for law enforcement agencies, which must use advanced investigative techniques, including the polygraph, to uncover and combat these crimes.

2. Materials and Methods

In the process of the study, the following methods were applied: analysis, synthesis, comparison and logical awareness. The materials used are the publications of scholars in the field, as well as relevant national and international legislation.

3. Results

The forensic profile of criminals involved in corruption crimes presents several distinct features, influenced by their social position, access to resources and the way they use their influence to achieve their illegal goals. Typically, these criminals fall into the following detailed characteristics [3, p.97]:

- Position of power and influence

Corruption criminals are often individuals who hold leadership or decision-making positions within public or private institutions. They may be politicians, high-ranking civil servants, company directors or influential members of interest groups.

They have direct access to essential financial, material or informational resources and are in a position to make decisions that can significantly influence economic and social activity.

Through their position, corrupt criminals have the ability to manipulate or divert resources in their favor, influence the allocation of public contracts, change regulations or exert pressure on other decision-makers.

- Extensive networks of connections

According to Peter Gottschalk, the support networks of corrupt criminals include civil servants, politicians and businessmen, which allows them to manipulate control systems and avoid detection [4].

Susan Rose-Ackerman highlights that these networks facilitate access to privileged information and the falsification of documents, thus supporting illegal activities [5, p.20]. In addition, Michael Johnston states that, in many cases, corrupt networks operate as true „mutual protection alliances" that reduce the risk of criminal sanctions [6, p.93].

These criminals may also collaborate with organized crime groups to conceal their illegal activities and maximize illicit profits. We believe that partnerships between corrupt networks and organized crime groups increase the sophistication of illicit activities, reduce the risks of exposure, and provide additional protection from law enforcement.

- Advanced legal and economic knowledge

Corrupt criminals are typically very well informed about the legal and economic framework in which they operate. They understand regulations, legislative loopholes, and administrative procedures, and use them to their advantage.

They disguise their illegal activities through complex and well-thought-out transactions, using offshore companies, secret bank accounts, or opaque corporate structures to hide the origin and destination of funds.

In addition, they are aware of the risks associated with their activities and take precautions to minimize the chances of being caught, such as hiring specialized legal advisors or destroying compromising evidence.

- Motivation based on material gains

The main motivation of these criminals is to obtain substantial material gains, whether it is money, property, privileges or other benefits. They are willing to use their position and influence to obtain such advantages illegally.

Corrupt criminals may also be motivated by the desire to maintain or expand the power and influence they hold. In many cases, corruption is used as a tool to strengthen their position within an organization or institution.

In some situations, the motivation may also include protecting a certain social status or avoiding legal or administrative sanctions. Corrupt criminals are often involved in actions of „washing" the public image or influencing public opinion to maintain their reputation and position [7, p.58-61].

The forensic profile of victims of corruption crimes is complex and includes a wide range of entities, from individuals and companies to public institutions and society as a whole. Victims of corruption are not always easy to identify, as the effects of this crime are often indirect and long-term.

- Companies and business

Companies are often forced to pay bribes to obtain contracts, licenses or to avoid unjustified administrative penalties. These additional costs can affect the competitiveness and economic viability of the business.

Corruption creates an unfair economic environment, favoring companies willing to participate in corrupt practices to the detriment of those who comply with the law. This can lead to significant losses for companies that operate fairly, affecting their ability to compete in the market.

Involvement in a corruption scandal can seriously compromise a company's reputation, affecting relationships with customers, business partners and investors. Renowned authors in the field, such as Murphy and Harris, have shown that reputational damage due to corruption has a major impact on the market value of companies and can generate long-term negative effects on business relationships [8, p.275-298]. This reality is also confirmed by recent empirical studies, which demonstrate that public exposure of corrupt practices leads to a decrease in investor confidence and a deterioration in relationships with strategic partners [9, p.581-611].

In the context of the Republic of Moldova, a regrettable experience is the „theft of the billion", a corruption scandal that seriously tarnished the country's international image and affected foreign relations, the investment climate and the trust of development partners [10, p.72].

- Lower-level civil servants

Lower-level civil servants may be forced to participate in corrupt activities by their superiors or by circumstances at work. In many cases, they are put in a difficult situation, having to choose between keeping their jobs or denouncing illegal practices, at the risk of losing their livelihoods.

Although they are not the initiators of the corrupt acts, civil servants who agree to participate may be held criminally liable, with an increased risk of being punished in the event of an investigation, which leads to significant psychological and financial trauma.

Engaging in corrupt practices can lead to a deterioration in ethics and morale within the public service, affecting trust in public institutions and the efficiency of administration.

- Society as a whole

Corruption diverts resources that should serve the public good, leading to the inadequate provision of public services such as health, education and infrastructure. This reduces the quality of life for all citizens and exacerbates social inequalities.

Corruption undermines public trust in government and state institutions, which can lead to civic apathy, diminished respect for the law and reduced involvement in democratic processes. In the long term, corruption can discourage investment, both domestic and foreign, and can lead to economic stagnation, inflation and financial instability, negatively affecting the entire economic system.

We observe that the profile of victims in corruption crimes reveals a variety of negative consequences that extend beyond the immediate impact on the affected individuals, creating ripple effects that weaken both the social structure and the ethical foundation of a society. Corruption not only damages resources and trust, but also amplifies the climate of distrust and vulnerability that, ultimately, affects social cohesion and the long-term development of communities. These systemic effects emphasize the need for rigorous prevention and investigation measures, aimed both at combating the phenomenon itself and at protecting those affected by this scourge. In this regard, it is worth noting the position of Daniel Kaufmann, who, in an article published in the Brookings Institution, highlights that the reputation of a state affected by corruption suffers not only economically, but also in terms of the perception of international partners, the level of foreign investment and political stability [11].

Corruption crimes frequently occur in contexts characterized by a significant imbalance of power and a pronounced lack of transparency, creating an environment conducive to the abuse of authority. One of the most common scenarios is represented by opaque decision-making processes, in which decisions are taken without a clearly defined framework of oversight or control. In such contexts, the lack of effective monitoring allows personal or group interests to prevail over the public interest, facilitating the emergence and perpetuation of corruption.

In this direction, the position expressed at the 7th Conference of States Parties to the United Nations Convention against Corruption (UNCAC) [12], held in Vienna in 2017, under the coordination of the President of the conference, Ambassador Gillian Bird (Australia), is also relevant, where the need to strengthen transparency in decision-making processes and to establish effective monitoring mechanisms to prevent corruption in contexts characterized by imbalances of power was emphasized.

A common circumstance is the lack of transparency in public procurement. The award of public contracts often becomes a fertile ground for corrupt practices, especially when the selection process is manipulated to favor certain companies or individuals. This manipulation can manifest itself by eliminating fair competition, awarding contracts in a discretionary manner, or adjusting specifications to suit the capabilities of a preferred bidder [13].

Direct interactions between the corruptor and the corrupt are also a central element in the dynamics of corruption. These interactions often take place in spaces that ensure discretion, such as private offices, social events, or seemingly official meetings. In these contexts, discussions and agreements take place in an informal setting, where mutual trust is reinforced by material benefits or mutual advantages.

Analyzing these aspects, we observe the following: corruption thrives in environments where lack of transparency, weak control and personal relationships influence official decisions, and reward and sanction systems are hijacked to support and protect corrupt behaviors. Identifying and understanding these circumstances is essential to develop effective strategies to combat corruption and restore institutional integrity.

Behavioral analysis of criminals involved in corruption reveals a complex set of motivations and behavioral patterns, which reflect both individual desires and the power dynamics in the environment in which they operate.

- Financial motivation

One of the most obvious motivations of criminals in the sphere of corruption is the desire for quick and illicit enrichment. This type of criminal sees corruption as an efficient way to accumulate wealth without making legal or ethical efforts. Obtaining substantial financial gains in a relatively short time becomes an end in itself, which prevails over any moral considerations. This motivation is fueled by the socioeconomic context in which large differences in income and lifestyle create constant pressure for material accumulation, and the system of illegal rewards offers a seemingly easy and risk-free way to achieve these goals.

- Lack of remorse

Another characteristic aspect of the behavior of corruption offenders is the complete lack of remorse or empathy for the consequences of their actions. These individuals display a profound insensitivity to the negative impact of corruption on society, on direct victims, or on their colleagues. Instead of taking responsibility for their actions, they often minimize the seriousness of the facts or even justify them through a distorted perception of reality, in which corruption is considered a necessary evil or a legitimate way to "survive" in certain environments. This lack of moral conscience is often associated with narcissistic or antisocial personality traits, which allow them to engage in illegal activities without feeling remorse or questioning their actions [14, p.151].

- Recidivist Behavior

Success in corruption creates a dependency on the flow of illegal income and an exaggerated confidence in their ability to avoid legal sanctions. In the absence of effective control measures and adequate sanctioning, these individuals are prone to continue and expand corrupt activities, thus becoming recidivists. Each successful act of corruption reinforces the belief that they can continue without being caught, which encourages them to explore new opportunities to exploit the system and maximize their illegal gains.

Based on the behavioral analysis of corruption offenders, we found that they display a dangerous combination of financial motivations and a desire for power, associated with a complete absence of remorse and moral responsibility, as well as a pronounced tendency to recidivism. In our opinion, understanding these complex dynamics is essential for the development of effective investigative and preventive strategies aimed at combating corruption and protecting institutional integrity.

According to the observations made by V.A. Varlamov in his research on the application of psychophysiological polygraph testing, the results obtained revealed that approximately 80% of the people assessed consider money, jewelry, shares, real estate and other valuables as determining factors of their behavior, which makes them more prone to acts of corruption. At the same time, approximately 20% of those tested showed an increased attraction to other types of benefits, such as personal relationships, paid vacations, access to exclusive events or career promotions [15, p.112-113].

Therefore, it is important that investigations and the application of the polygraph take this wide range of motivations into account. Understanding the diversity of value systems can help to more accurately identify potential sources of corruption and to develop more tailored and effective prevention strategies.

The theft of the billion in the Republic of Moldova is one of the largest financial scandals in the country's recent history and an emblematic case of high-level corruption. It could serve as a case study to analyze the potential role of the polygraph in investigating complex corruption and financial fraud crimes.

Case context and circumstances

In the period 2012-2014, three of the largest banks in the Republic of Moldova – Banca de Economii, Banca Socială and Unibank – were defrauded through a complex fraud scheme. It is estimated that approximately one billion dollars was stolen from the Moldovan banking system, equivalent to 12% of the country's GDP at the time. The money was transferred to offshore accounts and, in many cases, disappeared without a trace.

The ensuing investigation involved both national authorities and international organizations, such as Kroll [16], which produced a detailed report on how the fraud was carried out. However, despite the reports and efforts to recover the money, many of those involved were not brought to justice and the funds were not fully recovered.

- Verification of witness and suspect statements

In the criminal prosecution, one of the main challenges was to identify and confirm the individuals involved in orchestrating the fraud. In this regard, the application of the polygraph could have helped to validate the statements of witnesses and suspects, providing additional clues about their knowledge of the fraud scheme. The analysis could have aimed to identify the level of awareness and involvement of those questioned in the illegal transfers of funds in the banking system. It would also have been relevant to assess the extent to which they actively participated in the organization and facilitation of these illicit operations.

- Identifying accomplices and corruption networks

Another important application of the polygraph in this context would have been in determining complicity within financial institutions and the political environment. Given the complexity and scale of the fraud, collaboration between different actors was essential for carrying out these illegal transfers. Thus, the use of the polygraph could have clarified the extent to which government officials or civil servants contributed to the fraud. In this way, a more precise assessment of the corruption networks and the mechanisms through which these groups managed to manipulate the banking system would have been possible.

- Details about the route of the embezzled funds

One of the most critical aspects of the criminal prosecution was identifying the route of the embezzled funds [16]. The polygraph could have been used to deepen the investigators' understanding of the financial transfers and the final beneficiaries of these amounts. This would have included a detailed examination of the suspects' knowledge regarding the locations and methods by which the funds were transferred and hidden. Thus, the application of the polygraph could have contributed to elucidating how these amounts were distributed and subsequently used.

Another relevant case, in which the polygraph was used in a corruption investigation, is that of the former governor of Illinois, Rod Blagojevich [17]. He was accused of multiple acts of corruption, including the attempt to sell the vacant seat in the US Senate left by Barack Obama. During the investigation, Blagojevich was subjected to a polygraph test to assess the veracity of his statements, especially regarding the discussions and arrangements related to the Senate seat. The questions focused on details about potential buyers and the involvement of his accomplices. The test results revealed significant discrepancies between the governor's answers and the facts established by investigators, which strengthened the case against him.

These results were later used in the judicial process, providing a clearer picture of Blagojevich's involvement in corrupt activities and contributing to his conviction. The polygraph thus provided additional support in dismantling his defense and facilitating the justice process.

A representative case of corruption investigation is the actions carried out by the NAC officers and the prosecutors of the municipality of Balti on a group of eight customs employees from the Centru Customs Office and the Leușeni Customs Post, identified by the initials D.V., C.I., R.M., S.P., L.N., A.G., B.O. and T.C. They were suspected of having demanded and received illicit remuneration from carriers for facilitating the crossing of goods across the border without declaration and without paying customs duties, for accelerating control procedures and for other illegal services. During the investigation, five of the employees were subjected to polygraph testing. The results indicated significant reactions to the relevant questions in the case of D.V., R.M. and A.G., suggesting active involvement in committing acts of corruption. In contrast, the testing of B.O. and T.C. did not reveal relevant physiological responses, which led investigators to pay differentiated attention to the hypotheses of involvement. This procedure contributed to the consolidation of working versions and the delimitation of individual roles within the investigated group [18].

In corruption crimes, there are certain frequently encountered forensic models and patterns, which can provide valuable clues in the investigation of these facts. A specific modus operandi, also noted by conf. univ. dr. Gheorghe Alecu, is the use of intermediaries. Corrupt people prefer to operate through intermediaries to reduce the risk of being directly associated with acts of corruption, so as to maintain their appearance of innocence. These intermediaries can be trusted individuals, consulting firms or even family members [19, p.67-72].

Another common tactic is document falsification. In corruption schemes, false or altered documents are often created to hide the real nature of transactions and to justify the legality of decisions or resource allocations. This practice, also highlighted in the Guide prepared by experts coordinated by Unit D.2 Fraud Prevention of the European Anti-Fraud Office (OLAF), includes the falsification of contracts, invoices or financial reports, in order to mask illegally obtained funds [20].

Also, means of evasion are frequently used by persons involved in acts of corruption. They resort to advanced techniques to avoid detection and prosecution, including the use of off-shore companies, the opening of bank accounts in jurisdictions with favorable tax regimes and the implementation of complex networks of financial transactions, designed to complicate the tracking of money flows. These practices, also reflected in Sandu Dumitru's analysis of forensic methods for detecting and combating forgery, highlight the degree of sophistication to which concealment strategies used in the field of corruption have reached [21, p.228].

We note that the application of the polygraph in the investigation of corruption crimes brings significant advantages from a forensic point of view, which can positively influence the results of the investigation. An important aspect is the ability of the polygraph to verify the sincerity of the statements provided by the suspects. In corruption cases, where obtaining direct evidence is often a challenge, the polygraph becomes a valuable tool to assess the veracity of the suspect's answers, which is of major relevance in the forensic analysis of these crimes. Thus, well-formulated questions can reveal discrepancies between the suspect's statements and the information already known to the investigators, bringing clarity to the investigation. We also note that the polygraph can facilitate the identification of accomplices

within corruption networks, which is a central element in the forensic approach to these cases. These networks, often complex and well-organized, can be revealed by specific questions asked during the polygraph test, which can reveal the involvement of other individuals, either inside or outside the organization, who contributed to the acts of corruption. Identifying accomplices expands the forensic investigation and provides a more complete perspective on the entire criminal network.

In the complex context of investigating corruption crimes, the use of the polygraph should not be isolated, but strategically integrated with other forensic methods. This combination of the polygraph and techniques such as document analysis, electronic surveillance or behavioral profiling provides a multidimensional approach, thus strengthening the evidentiary foundation and creating a more robust framework for elucidating complex cases. Thus, by combining these tools, investigators can obtain a more complete and detailed picture of the modus operandi of criminals, identifying with greater accuracy the veracity of information and the involvement of suspects in corrupt activities.

- Analysis of documents and financial records

Classic police action: financial experts examine accounting documents, contracts, invoices and bank transactions to discover irregularities, suspicious transactions or falsified documents.

Role of the polygraph: the polygraph can be used to test the sincerity of suspects regarding their involvement in these transactions or their knowledge of falsified documents. For example, if a suspect claims to be unaware of a suspicious transaction, the polygraph can be used to verify that his or her answers are truthful.

- Electronic surveillance and wiretaps

Classical police action: Wiretaps or electronic surveillance can provide crucial evidence of a person's involvement in an act of corruption. These methods are often used to obtain information about the planning or execution of corrupt acts.

Role of the polygraph: The polygraph can be used to verify whether the person being tested recognizes the voice on the wiretapped recordings or whether he or she is directly involved in the conversations captured. It can also be used to validate or invalidate alibis or statements made by suspects following wiretaps.

- Digital evidence analysis

Classical police action: Specialists examine data from computers, mobile phones, and other digital devices to identify evidence of communications, money transfers, or other activities relevant to the investigation.

The role of the polygraph: The polygraph can be used to test whether a suspect has knowledge of certain files or electronic communications discovered during digital analysis. For example, questions can be tested regarding who initiated a particular communication or what the purpose of a specific file is.

- Reenactments and simulations

Classic police action: Reenactment of a crime, often used to verify the versions provided by suspects or witnesses, can provide important insights into how the crime was committed.

The role of the polygraph: during or after a reconstruction, the polygraph can be used to test the suspect's emotional reactions when asked about critical details of the reconstruction. This can help identify moments or details with which the suspect is familiar, even if he tries to hide his involvement.

4. Conclusions

Following the analysis of the specialized doctrine and judicial practice, we conclude that the polygraph can be considered a valid tool for forensic investigation, since the recorded physiological reactions reflect memorial traces relevant for establishing the truth. Thus, the method of testing with the application of the polygraph should be viewed not as an alternative to traditional means, but as a valuable complement, which deserves to be integrated in an argumentative and professional manner into the investigative process.

We conclude that the integration of knowledge from forensic methodology into the logic of forming the polygraph test battery allows adapting the questions to the psychobehavioral specificity of the subject and the particularities of the investigated case, thus increasing the overall accuracy of the testing and the relevance of the conclusions obtained.

The application of the polygraph technique in the investigation of crimes provides the opportunity to verify information and tactically direct investigative activities. Even if it does not currently constitute a means of evidence in the criminal process, it can be applied as a tool that allows obtaining auxiliary or orientation information.

Conflicts of Interest:

The authors declare no conflict of interest. The funding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

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RESEARCH ON THE THEORETICAL CONNOTATIONS, HOT TOPICS, AND TRENDS OF SOCIAL EMOTIONAL RESONANCE

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Abstract. With the evolution of public opinion research from "information flow" to "emotion flow", the importance of "emotion" in social public communication issues has been deeply recognized, and the concept of social emotional resonance has begun to attract the attention of scholars. Taking 2,450 Chinese and English literatures from China National Knowledge Infrastructure (CNKI) and Web of Science(WoS) databases in the past decade as samples, this paper adopts literature analysis method, scientometrics method and scientific knowledge graph analysis method, with CiteSpace software as the analysis tool. It applies analytical methods such as keyword co-occurrence, keyword clustering and timeline graph, and analyzes the visualized network knowledge graph to clarify the research theories, methods, hot topics and dynamic trends of social emotional resonance in the past decade, so as to explore the current situation and future development of domestic and international research on social emotional resonance.

Keywords: *emotional resonance; affective communication; social emotional communication; hot topics.*

Rezumat. Odată cu evoluția cercetării opiniei publice de la „fluxul informațional” la „fluxul emoțional”, importanța „emoției” în problemele de comunicare socială publică a fost profund recunoscută, iar conceptul de rezonanță socio-emoțională a început să atragă atenția cercetătorilor. Luând ca mostre 2.450 de lucrări din literatura chineză și engleză din bazele de date China National Knowledge Infrastructure (CNKI) și Web of Science (WoS) din ultimul deceniu, această lucrare adoptă metoda analizei literaturii, metoda scientometrică și metoda analizei grafurilor de cunoștințe științifice, folosind software-ul CiteSpace ca instrument de analiză. Aplică metode analitice precum co-apariția cuvintelor cheie, gruparea cuvintelor cheie, graficul cronologic și analizează graficul de cunoștințe vizualizat în rețea pentru a clarifica teoriile de cercetare, metodele, subiectele de actualitate și tendințele dinamice ale rezonanței socio-emoționale din ultimul deceniu, astfel încât să exploreze situația actuală și dezvoltarea viitoare a cercetării interne și internaționale privind rezonanța socio-emoțională.

Cuvinte cheie: *rezonanță emoțională; comunicare afectivă; comunicare socio-emoțională; subiecte de actualitate.*

1. Introduction

The "affective turn" originating from the field of psychology has made emotion "a crucial and fashionable theme in the social and behavioral sciences" [1, pp. 98-100]. Long before the development and popularization of new technologies such as big data and artificial intelligence, communication studies on the dissemination of public events had not yet focused on the emotional elements in the communication mechanism [2, pp. 16-20]. Most studies were conducted from the perspective of "information flow", interpreting and improving the theoretical system of public opinion around aspects such as the public, national managers, intermediary social issues and their impacts in even public opinion [3, pp. 115–132]. However, many elements in the public opinion ecosystem, including emotion, were overshadowed. It was not until recent years, with the continuous development and maturity of technologies such as natural language processing and semantic analysis, that the accuracy of sentiment analysis using machine learning has been significantly improved. Since then, scholars' research on public opinion communication has gradually focused on emotional elements. The importance of "emotion" in social public communication issues has been deeply recognized, and an increasing number of studies in the field of communication have begun to attach importance to the concept of "emotional resonance".

With the emergence of relevant studies in recent years, there has not yet been a paper that sorts out and summarizes the existing research in this field to promote more targeted development of subsequent studies. Based on this, this paper takes Chinese and English literatures from CNKI and Web of Science databases in the past decade as samples, and uses the CiteSpace bibliometric visualization analysis method. On the basis of clarifying the theoretical connotation of social emotional resonance, it analyzes the hot topics and trend orientation of social emotional resonance research, so as to present the distribution and evolution context of hotspots and key points in the past decade and reveal the research overview of this field.

2. Analysis of Literature Sources and Research Methods

2.1 Data Sources of Chinese and English Literatures

The Chinese literatures in this paper are derived from the retrieval data of China National Knowledge Infrastructure (CNKI), with the subject terms set as "(Subject: Emotional Resonance + Affective Resonance) OR (Subject: Emotional Communication + Affective Communication)". The English literatures are obtained from the SSCI retrieval data in the Web of Science database, using the subject terms "(Topic: social media sympathy) OR (Topic: social media empathy)". The time range is from January 1, 2014 to December 31, 2024, covering a total of ten years.

After obtaining the initial samples, data cleaning was conducted to exclude non-research literatures (such as news propaganda and column introductions) and literatures obviously irrelevant to the retrieval theme. The valid literatures were exported from the databases in Refworks format, and then converted into operable data entries using CiteSpace software (Version 5.8.R3W). Finally, duplicate removal was performed via CiteSpace, resulting in 1,138 valid Chinese literatures and 1,312 valid English literatures, totaling 2,450 literature samples. The specific annual distribution of these samples is shown in Figure 1 below.

In terms of the number of literatures published at home and abroad, there is an overall significant upward trend. During the six-year period from 2014 to 2019, the number of CNKI and WoS Literatures was basically the same. Since then, the growth rate of Chinese

literatures has been slightly slower than that of English literatures. By 2024, the annual number of published Chinese literatures reached 191, while the annual number of published English literatures stood at 249.

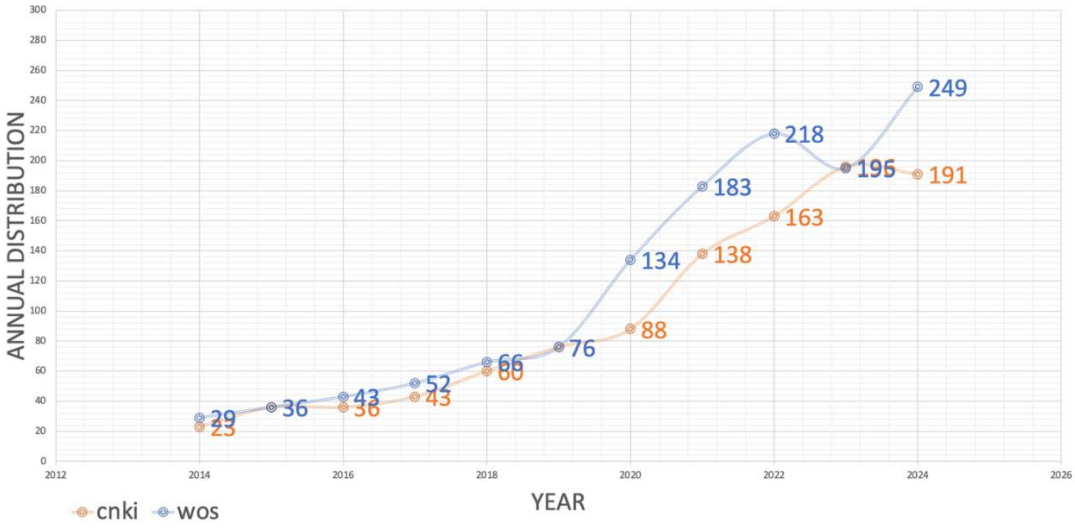

Figure 1. Annual Distribution of CNKI and WoS Literatures (2014-2024).

2.2 Analysis of Research Methods Used in the Literatures

From the perspective of research methods adopted in existing literatures, positivist research is dominant, while humanistic speculative analysis is rarely seen. Among positivist studies, both qualitative and quantitative research approaches are applied. In terms of research nature, applied research takes the leading role, supplemented by theoretical research. In qualitative research, methods such as concept construction, literature analysis, comparative analysis, and case study are widely used. Professor Zeng Qingxiang from Communication University of China argues that more diverse qualitative methods—including narrative analysis, semiotic and rhetorical analysis, and discourse analysis—should be adopted [4, pp. 87–91]. In the current new media environment, scholars have gained insights into the formation process of public emotions in the public opinion field and made preliminary judgments on the causes of such emotions. However, most studies only conduct isolated research based on a single online platform and explore public emotions from a relatively static perspective, which has certain limitations [5]. Therefore, interdisciplinary research integrating natural sciences and studies using new technologies for analysis are particularly important.

At the level of quantitative research, the physical origin of the concept of "emotional resonance" determines the validity of drawing on and analyzing theoretical achievements in the field of natural sciences based on social physics. For example, taking the concept of "stochastic resonance" proposed in paleoclimatology research as a reference, Liang Yanping et al. used the Langevin equation to establish a topic resonance model for multiple public opinion events, exploring the internal mechanism of public opinion resonance from a micro perspective [6, pp. 122-133]. Liao Ruidan [7] combined the social reality context and used virtual simulation to investigate the influencing factors of public opinion resonance.

With the maturity of online text analysis technology and data mining technology, direct measurement of online emotions based on massive online data has gradually been realized [8]. For instance, Maria et al. [9, pp. 733–751] used the text analysis software LIWC (Linguistic Inquiry and Word Count) to analyze content texts from websites: the software

scans texts to identify words in its dictionary, generates reports, and applies word-matching technology for emotion recognition—further enabling detailed analysis of online emotions.

3 Theoretical Connotation of Social Emotional Resonance

3.1 Emotion and Social Emotion

The earliest discussion on "emotion" can be traced back to ancient Greece. Aristotle regarded emotion as "a mixture of high-level cognitive life and low-level sensory life", and argued that human beings' perceptions of things around them trigger emotions. The definition of the concept of emotion mainly focuses on the field of psychology: Clore and Ortony [10, pp.423-474] pointed out that emotion refers to a response involving an individual's internal feelings and external behaviors, and is both a physiological and psychological state. Arnold believed that emotion is a dispositional experience accompanied by patterns of physiological changes; as a psychological phenomenon, it mainly consists of three components: physiological arousal, subjective experience, and external expression. [11] Meng Zhaolan [12] held that emotion is an affective response in psychological activities, and is humans' attitudinal and behavioral experience towards the objective external world, specifically including three elements: internal experience, external expression, and physiological activation. In summary, emotion is the psychological arousal and physiological feedback generated by humans in response to external stimuli. It is a unique subjective experience and feeling that accompanies human activities, manifested through the subject's external behaviors. As a special type of information, emotion possesses the characteristics of infectivity, cumulativeness, and guiding nature [13, pp.145-149].

In communication and sociology studies, "social emotion" is a macro concept in contrast to micro individual emotion. It is the result of interactions between individuals, between individuals and groups, and between groups—not a simple superposition or mixture of individual emotions. Compared with individual emotion and group emotion, social emotion is more complex [14, pp.58-60] Sha Lianxiang [15] argued that social emotion is the perception and attitude towards social life formed based on interactions between subjects; it exerts strong dynamic and guiding influences on individuals and groups and has high stability. In terms of the dynamic dimension, social emotion can be divided into positive emotion and negative emotion: positive emotion plays a positive role in promoting social harmony and stability, while negative emotion has a negative impact on social development and thus requires timely guidance and mitigation. Wang Junxiu [16, pp.55-63] further pointed out that social emotion refers to the emotional experience shared by a certain group, multiple groups, or the majority of people in the entire society under a specific social environment, and it forms an inherent, sustained, and stable social sentiment.

3.2 Social Emotional Resonance

Professor Chen Lidan [4, p. 88] pointed out that emotion is infectious, and its infection spreads rapidly in the public opinion field. Emotional resonance occurs when the emotional expressions of a small group quickly infect the majority, leading to collective emotional manifestations. The spread of public opinion waves is the embryonic form of emotional resonance, which influences the entire society through the flow of such waves. Zhou Jun [4, p. 88] argued that emotional resonance is analogous to the emergence of public opinion: public opinion is formed when individual opinions converge into a consensus, while emotional resonance develops into "social emotional resonance" when a certain type of emotion evolves into a prevalent social emotion. Some other scholars also noted that social

emotional resonance refers to the process where social emotions are gradually recognized within different groups, and the emotional empathy between these groups intertwines, reinforces, and intensifies with each other in time and space [17, pp.108-115].

The definition of "emotional resonance" can be developed on the basis of clarifying two core concepts: "emotion" and "resonance".

First, the concept of "emotion" has been defined in the previous section. Additionally, it is worth noting that "emotion" and "affect" are easily confused in usage. In fact, emotion and affect are two aspects of the same process: emotion focuses more on short-term, intense, and situational affective responses, while affect refers to the feeling and experience of the affective process [18,12-15]—it is the continuation and deepening of the experiential and perceptual state of emotion, and represents a stable, long-lasting affective experience with profound connotations [19,157].

Second, "resonance" is a key concept in physics, referring to a phenomenon in which, when an object undergoes periodic motion, if an external driving force is applied and its frequency matches the object's natural frequency, the object will vibrate with the maximum amplitude and the system will reach the highest energy state [20, p.170]. The first scholars to introduce the concept of resonance into journalism and communication studies were Spanish scholar Tyson and American scholar Torra [21, p.194] They pointed out that under the resonant influence of factors such as public opinion and advertising, the opinions and attitudes of different individuals towards social events gradually tend to be consistent.

Based on the above, this paper attempts to interpret the connotation of social emotional resonance: In a broad sense, social emotional resonance refers to the tendency of different individuals in society to exhibit consistent emotions towards a specific event. In a narrow sense, social emotional resonance refers to a public opinion phenomenon in the process of public communication: a specific event awakens individual emotions, which then achieve group identification through emotional infection, and further spread rapidly among different groups to realize the superposition and reinforcement of emotions.

4 Analysis of Hot Topics in Social Emotional Resonance Research

4.1 Visualization Analysis Results of Keyword Co-occurrence and Keyword Clustering

First, analysis of keyword co-occurrence knowledge graph. Keywords are the core terms in academic research: the higher the frequency of keyword co-occurrence, the greater the importance of the keyword in the relevant research field; the higher the network density of keyword co-occurrence, the closer the relationship between the keyword and other keywords. Keyword knowledge graph analysis was conducted separately on the 2014–2024 literatures from CNKI and Web of Science. Specifically, in the field of Chinese-language social emotional resonance research, there are 252 keywords, 417 network connections, and a network density of 0.0132 (see Figure 2 below); in the field of English-language social emotional resonance research, there are 272 keywords, 1,741 network connections, and a network density of 0.0472 (Figure 3).

After counting the frequency of keywords in Figure 2, it is found that the node of "affective communication" is the largest and has the highest frequency. Other high-frequency keywords in domestic relevant research include "emotional communication", "affective resonance", "short videos", "communication strategies", "social media", "emergency events", "interaction ritual", "sentiment analysis", "public opinion guidance", "communication mechanism", and "artificial intelligence". The remaining high-frequency keywords are multi-

dimensionally scattered and have relatively close connections with each other. After counting the frequency of keywords in Figure 3, it is found that the central keywords with the highest centrality include "attitude", "aggression", "exposure", "social media", "media violence", "communication", "participation", and "Facebook".

Figure 2. Keyword Co-occurrence Knowledge Graph of Chinese-Language Emotional Resonance Research.

Figure 3. Keyword Co-occurrence Knowledge Graph of English-Language Emotional Resonance Research.

Second, analysis of keyword clustering knowledge graph. Clustering analysis refers to generating a clustering label graph based on keywords with similar characteristics on the basis of keyword analysis; through clustering groups, the core topic areas of social emotional resonance can be grasped. In CiteSpace, it is generally believed that a clustering modularity value (Q-value) greater than 0.3 indicates a significant clustering structure, greater than 0.5 indicates a reasonable clustering, and greater than 0.7 indicates a convincing clustering [22, pp.62-70]. A keyword clustering graph was generated based on Chinese-language literatures (see Figure 4 below). After excluding labels with low relevance, a total of 9 clustering labels were generated, which are #0 Affective Communication, #1 Communication, #2 Emotional Communication, #3 Short Videos, #4 Affect, #5 International Communication, #6 Affective

Resonance, #7 Social Media, and #8 Emotional Empathy. Among them, the Q-value is approximately 0.6445 and the S-value is approximately 0.8794, which means the clustering structure is prominent, and the clustering results are reliable and effective.

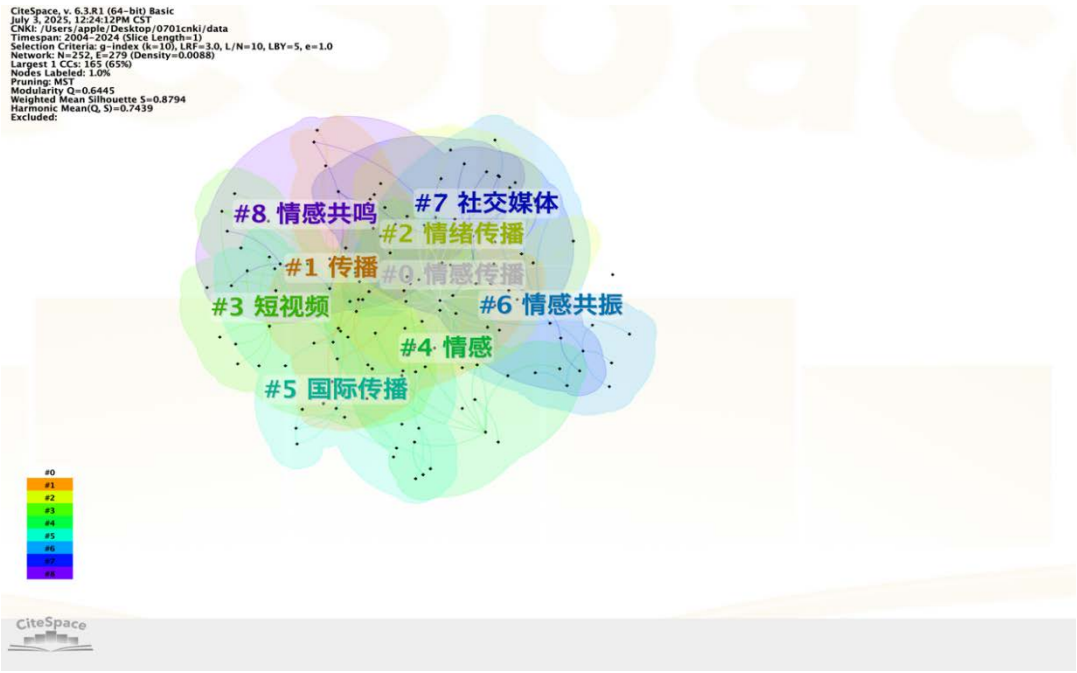

Figure 4. Keyword Clustering Knowledge Graph of Chinese-Language Emotional Resonance Research.

The keyword clustering graph of English-language literatures is shown in Figure 5 below, with a total of 6 clustering labels generated, namely #0 social support, #1 aggression, #2 crisis communication, #3 social media, #4 virtual reality, and #5 mental health. Among these, the Q-value is approximately 0.3088 and the S-value is approximately 0.6478, indicating a significant and reasonable clustering structure.

Figure 5. Keyword Clustering Knowledge Graph of English-Language Emotional Resonance Research.

4.2 Analysis of Hot Topics in Social Emotional Resonance Research

Based on the above analysis of keyword co-occurrence and keyword clustering knowledge graph, the hot topics in social emotional resonance research mainly focus on the following four aspects: Research on the causes of social emotional resonance: It covers keywords such as "emotional communication", "emotional contagion", "emotional identification", "motivation", and "behavior"; involves Chinese clusters #0, #2, #6, and #8; and includes English cluster #0. Research on the classification of social emotional resonance: It covers keywords such as "sentiment analysis", "public sentiment", "emotional energy", "emotions", "self esteem", and "stress"; involves Chinese clusters #4 and #8; and includes English cluster #5. Research on social media and social emotional resonance: It covers keywords such as "social media", "interaction ritual", "social network", "short video", "Weibo", "social media", "Facebook", and "Twitter"; involves Chinese clusters #1, #3, and #7; and includes English cluster #3. Research on public opinion guidance of social emotional resonance: It covers keywords such as "public opinion guidance", "emotional governance", "negative emotions", "online rumors", "communication effect", "media violence", "risk", and "impact"; involves Chinese clusters #0, #6, and #8; and includes English clusters #0, #1, #2, and #5.

4.2.1 Research on the Causes of Social Emotional Resonance

"The social scenario forms the mysterious foundation of the framework for our language expression and behavior patterns"[23, 28-30]. A specific scenario provides a contextual basis for the occurrence of emotional resonance, while different scenario rules also determine the transmission form of emotional resonance.

Firstly, from the perspective of micro-individuals, emotional contagion is a major inducement for the formation of emotional resonance. Hatfield [24, pp.96-99] proposed that when an individual interacts with others, he or she will unconsciously capture others' facial expressions and body language and imitate them, and this process is called emotional contagion. Crawford [25, pp.116-156] pointed out that when an individual is confronted with others' emotions, he or she will automatically form representations of others' attitudes and experiences, achieve emotional synchronization, and feel others' emotions; based on normative emotional empathy, institutionalized emotional resonance will be formed. The occurrence of emotional contagion also requires a specific context to facilitate the imitation of emotional feelings and behaviors. Scholar Zhang Qiyong [26, pp.1596-1604] proposed that even if there are physical behaviors, emotional experience may not occur without a context. Luo Dameng [27, pp.72-83] put forward the network combustion-aiding theory, holding that the emotional resonance caused by the dissemination of online information triggers online public opinion.

Secondly, from the perspective of macro-social groups, foreign scholars have carried out relevant research around keywords such as "perspective-taking", "prosocial behavior", and "political participation". Wojciesza [28, pp.241-260] analyzed that emotional communication triggered by news reports is an important intermediary factor between American citizens' reception of partisan news and their political participation. Shorck [29, pp.61-81] et al. pointed out that emotional resonance is the main representation of social ideology, potential group emotions, and collective practice. Mercer [30, pp.515-535] pointed out that when individuals in different regions and countries are faced with the same emotions, cross-border emotional resonance will also occur, and the derived emotional beliefs will be connected

with emotional memories to complete the construction of collective memory. Wang Junxiu [16, pp.55-63] pointed out that emotional resonance and emotional energy in social group polarization affect social operation and even form the offline phenomenon of "group polarization". Moreover, online hot public opinion events are not characterized by individual independence, but by "homogeneous replication" and "mass production", which makes online public opinion hotspots and emotional contagion present in a "serialized form"[31, pp.1-5].

4.2.2 Research on the Classification of Social Emotional Resonance

In Emotions Revealed, American psychologist Paul Ekman [32, pp.45-60] classified emotions into five categories: sadness, anger, fear, disgust, and joy. He believed that neutral emotions include sadness, negative emotions include anger, fear, and disgust, and positive emotions include joy. Basically consistent with the classification of emotions, research on the theme of emotional resonance mainly divides it into two types—positive resonance and negative resonance—and discusses them separately. Among them, the number of studies on negative emotions accounts for a higher proportion, mainly focusing on the response to and governance of negative emotions.

On the one hand, in the research on positive emotional resonance, Tim et al. [33, pp.197-232], based on their study of the Thailand floods, pointed out that online emotional expression can make the other party feel supported, enable the subjects involved in communication to establish online social relationships, provide emotional assistance during disasters, alleviate anxiety and unease, and promote the construction of positive forces. Zhang Chengying [34] believes that positive emotional experiences will help form high-density and unified collective rituals, and the transmission condition of positive emotions is based on the threshold of identity recognition, thereby establishing an empathetic context and conducting further empathetic communication. Generally speaking, the formation of the two types of emotional resonance (positive and negative) is caused by the nature of the event itself and the public's cognition and understanding of it. When the public attributes the cause of a disaster to "natural disaster", people are willing to accept external help and feel grateful, which promotes the formation of positive social emotions [17, pp.108-115]. Positive emotional resonance is accompanied by the spread of positive public opinion and the transmission of positive cognition, which is conducive to social stability and government governance.

On the other hand, in the research on negative emotional resonance, Walker, I [35, pp. 10-42] linked the "relative deprivation" mechanism with social emotions. He believed that when an individual compares himself/herself with others and finds that he/she is in a relatively low position, he/she will experience relative deprivation, which triggers a series of negative social emotional reactions. Negative emotional resonance in online media is often accompanied by group attacks and violence. Scholars such as Heram [36, pp. 103-113] found that the media crisis caused by media violence and fear in the public's discussion around public events has already exceeded the problem of the public events themselves. Vaish et al. [37, pp. 383-403] pointed out that compared with positive and neutral emotions, negative emotions have stronger characteristics such as diffusibility and infectivity. Negative effects such as increased social pressure, accumulated social emotions, and chaotic social order are brought about by bad and negative "resonance", which may produce negative chain reactions and form derivative problems from local to global [38]. Coombs et al. [39, pp. 263-280] pointed out that negative emotional expressions can also become a catalyst for the spread

of crisis information, thereby affecting the reputation and image of the organization. When negative emotional resonance occurs, it is urgent for official, authoritative, and rational external forces to control and resolve it in a timely manner. Negative emotions are highly infectious; when the public's negative emotions trigger group emotional communication, they are usually mobilized unconsciously. Under group emotional infection, very few rational voices are drowned by the tide of emotional remarks, and netizens are unconsciously incited [40, pp. 33-40]. After the occurrence of negative emotional resonance, all relevant subjects should promptly alleviate the public's negative emotions; otherwise, it is easy to make the public's emotions more extreme, and even lead to the phenomena of emotional polarization and group polarization.

4.2.3 Research on Social Media and Social Emotional Resonance

Thomas Friedman [41,98-100] once stated that a major change in the way of media engagement in the information age is "from a static, passive way to an active, participatory way". In the new media era, the obvious boundary between information senders and receivers has been eliminated, promoting the diversification of communication subjects, and the mechanism for reaching social consensus is also gradually dissolving [42, pp. 36-41]. The Internet has become the main platform for the public to release information, obtain information, and conduct interpersonal communication. Characteristics of social networks such as convenience, speed, and anonymity have intensified netizens' discussions and complaints in the public opinion field, making it extremely easy to trigger emotional resonance while causing online public opinion [43].

On the one hand, the fast and convenient communication characteristics of social media have promoted the emergence of emotional resonance. Scholar Miller, V. [44, pp.387-400] believes that compared with traditional platforms, emotional communication and transmission in social networks are more active, leading to emotional resonance occurring on social media with a wider scope of influence. Taking social media platforms such as Weibo and WeChat as examples, differences in platform mechanisms and user interaction methods result in different ways for groups to participate in the onlooker discussion of public events. The weak-tie social network of Weibo is similar to an open "social square" in the new media public opinion field, where emotional transmission mainly ferments and brews, making it extremely easy to generate the online onlooker effect. Environmental factors such as the media literacy of Weibo users, the discourse characteristics of Weibo opinion leaders and their public opinion influence, and the impact of government public policies on new media communication jointly shape the form of emotional resonance [45, pp. 80-85]. Different from Weibo, the strong-tie social network of WeChat is an important venue for public emotional communication and emotional contagion, like a "private living room" [17, pp. 108-115], where trust and emotional resonance among friends can be quickly obtained. Huntington believes that the ability to meet expectations is far slower than the growth of expectations themselves; therefore, a gap arises between people's expectations and the possibilities of reality. Social media represented by WeChat is filled with negative feelings caused by this gap, and emotions are easily connected to form collective emotions, accelerating the resonance of public emotions.

On the other hand, online media in social media has amplified the effect of emotional transmission and promoted the emotional involvement of groups. In the post-truth era, the imagination and emotions of most people are less affected by the facts themselves in public

opinion hotspot events, while the media can use certain strategies in the identity of the parties involved and the narrative of their words to guide the direction of public opinion [5]. After the outbreak of a public opinion event, the media emotions conveyed by the information released by the media often greatly affect the public's judgment on the event itself, thereby stimulating emotional cognition to take precedence over rational cognition, and even causing the phenomenon of group polarization [46, p. 85]. Once online public opinion events are reported by the media and labeled with sensitive identity tags—such as between officials and the people, police and the people, the rich and the poor—and situational tags such as corruption, favoritism, and abuse, they are very likely to trigger a wave of public opinion and emotional resonance [47, pp. 56-69].

4.2.4 Research on Public Opinion Guidance of Social Emotional Resonance

Due to the circle communication effect of online media, social emotions are prone to form polarization under the influence of information cascades and echo chambers. Therefore, in the face of the phenomenon of social emotional resonance, orderly guidance is necessary; otherwise, it is likely to trigger superimposition and amplification effects, damage the government's credibility, and even may lead to secondary public opinion disasters.

First, at the level of the government and other functional departments, effective public opinion guidance and emotional governance need to be carried out. The government should attach importance to the issue of social emotional resonance, construct multi-channel interest expression mechanisms, and a coordinated guidance and governance system. Ye Bihua and Liu Zhiyong [48, pp. 35-38] proposed methods such as enhancing risk perception and building social trust, arguing that emotional guidance should be implemented on the basis of grasping the psychological characteristics and development laws of the public. From past cases, the inaction of relevant parties has intensified the emergence of contradictions; the government and relevant parties must take actions in response to the public's demands or conflict points. After the occurrence of emotional resonance, various subjects (such as the government) should play their roles in guiding the public's emotions at different stages of emotional evolution, use the public crisis emotional guidance system for reasonable pre-event prediction, and build the public crisis emotional guidance system for post-event management [49]. Generally speaking, it is essential to provide the public with diverse channels for expressing opinions to reduce the occurrence of malicious public events; once an event breaks out, efforts should be made to accelerate problem-solving, avoid the escalation of the problem, and thereby reduce the frequency of negative emotional resonance.

Second, it is necessary to be good at leveraging the media to conduct effective emotional guidance. Information jointly released by various mass media is often regarded by the public as correct and authoritative, and the public will follow the direction of media reports in their thinking. The media should maintain a neutral attitude towards events, appropriately expose events, effectively reduce the degree of group polarization through correct reports, and guide netizens to develop in a positive and constructive direction; when necessary, mandatory measures can also be adopted to effectively curb extreme trends. In addition, it is necessary to improve relevant laws and regulations to ensure that netizens speak in a civilized manner, create a clean and upright online space, and use legal means to curb lawbreakers who attempt to "attract traffic" by grandstanding and inciting group confrontation, so as to reduce the spread of negative emotions at the source [46, p. 87].

Furthermore, scientific and effective monitoring, early warning, and response mechanism should be established to reduce and resolve the effects of negative emotions [50, pp. 107-113].

5 Analysis of the Trend Direction of Social Emotional Resonance Research

5.1 Research Trend: Development and Evolution of Hot Topics in Social Emotional Resonance Research

To better grasp the development and evolution trends of domestic and international research on social emotional resonance, this paper further draws timeline views, as shown in Figure 6 and Figure 7 below. The timeline map can clearly show the start and end time, time span, time zone distribution, and hotspots of keywords, which can help us understand the connection and differentiation of research topics, as well as their evolutionary relationships at different times.

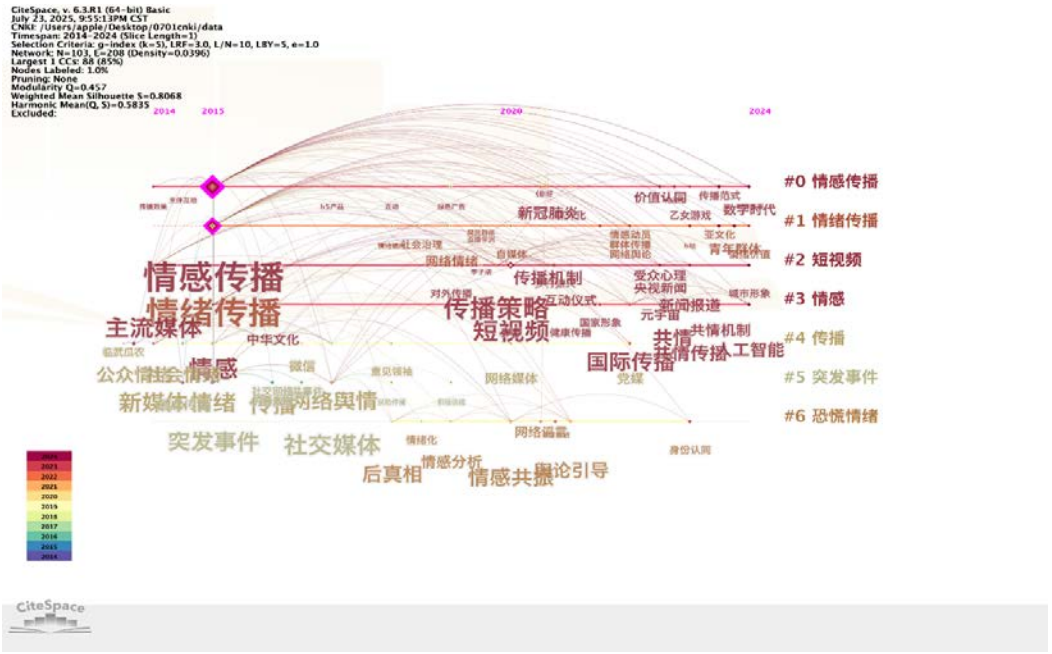

Figure 6. Timeline Map of Keywords in Domestic Emotional Resonance Research.

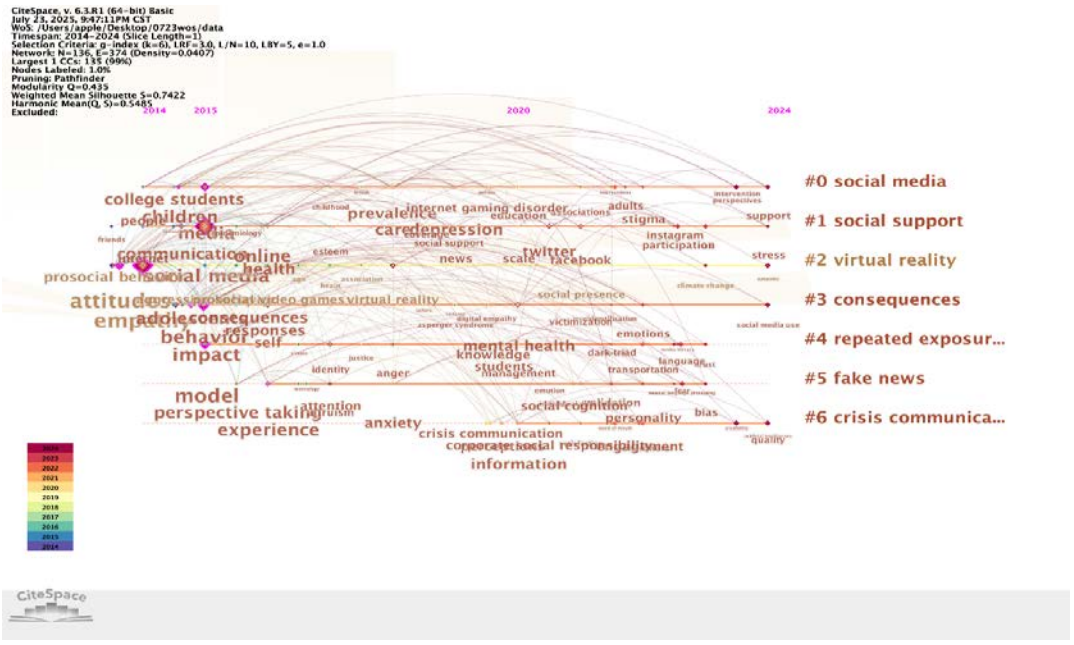

Figure 7. Timeline Map of Keywords in International Emotional Resonance Research.

In the timeline map of Figure 6, the early research keywords on the left include "emotional communication", "public sentiment", "mainstream media", and "emergency events"; while the early keywords in the timeline map of Figure 7 include "attitude", "empathy", "communication", and other terms. Early research on emotional resonance focused on the group and social characteristics of emotional resonance in media communication, as well as the impact of media on emotional resonance. For example, Sui Yan [51, pp. 10-15] proposed that the Internet era has become a "group communication era" in the true sense, and group communication is the fundamental driving force for individual emotions to achieve socialization through emotional resonance. The rise of online media has provided more opportunities for the expression, transmission, and aggregation of social emotions, increasing the social influence of emotional resonance [52, pp. 90-93]; at the same time, the arrival of the online communication era has also made social psychological issues such as the irrationality of emotional expression in online communication more prominent. Meanwhile, research in this stage took public emergency events as the entry point, focusing on the transmission characteristics of emotional resonance and its impact on social public opinion. For instance, in the post-truth era, the public opinion transmission triggered by emergency events has irrational characteristics, and emotions, along with the spread of public opinion, show the convergence of emotional resonance [40, pp. 33-40].

In the middle stage of the timeline, Figure 6 focuses on keywords such as "communication strategy", "short video", and "transmission mechanism", while Figure 7 focuses on keywords such as "mental health", "crisis communication", "Facebook", and "Twitter". During this stage, social media and short video media achieved rapid growth and development; scholars began to further focus on the transmission mechanism of emotional resonance and the media's response strategies. The popularization of social media and its in-depth penetration in real life further expanded the social impact of social emotional resonance. Ariel Hasell [53, pp. 1085-1102] conducted a study on social media (taking Twitter as an example) and concluded that the over-amplification of partisan and emotional news media content may have important consequences for others who rely on social media to obtain political news and information. Audio-visual communication symbols have formed a high penetration into people's daily lives; in highly interactive emotional communication, strong emotions with high infectivity will drive weak emotions and eventually form emotional convergence, thereby increasing the overall effectiveness of emotions and strengthening the irrational tendency of group psychology and social cognition [40, pp. 33-40]. Zhang Zhi'an [54, pp. 20-28] emphasized the impact of emotional communication on social public opinion, proposing that emotions can change people's cognition, thereby causing changes in the trend of social public opinion.

In the recent stage of the timeline, the domestic and international timelines focus on keywords such as "empathic communication", "artificial intelligence", "public opinion guidance", "support", "stress", and "virtual reality" respectively. With the interdisciplinary integration of social physics, psychology, and emotional resonance research, as well as the support of big data and AI analysis, emotional analysis has been promoted to a deeper level, and the importance of public opinion guidance has been recognized. Li Chunlei [55, pp. 61-66] proposed that as an important effective factor interspersed in emergency events, emotional communication not only guides the development of event public opinion but also even affects group actions; therefore, in-depth analysis and governance of the occurrence of social emotional phenomena are particularly important. From the perspective of future

development, social governance, risk perception, and social media use will still have the potential to become the focus of social emotional resonance research. Especially in the context of the rapid development of artificial intelligence and algorithm technology, the impact of intelligent media on emotional communication will be further explored.

5.2 Research Summary and Future Prospects of Social Emotional Resonance: Based on Literature Analysis (2014-2024)

This paper analyzes Chinese and English literature samples from CNKI and Web of Science in the past decade, summarizes the research methods used, defines the connotation of social emotional resonance, summarizes the hot research topics of social emotional resonance based on the analysis of keyword co-occurrence and keyword clustering knowledge graph, and analyzes the trend direction of social emotional resonance research based on the keyword timeline map. Based on the above research and analysis, it is found that the current research on social emotional resonance has solid content, rich topics and perspectives. It has carried out relatively in-depth research on the causes and classification of social emotional resonance, the transmission characteristics of social emotions from the perspective of social media, and the public opinion guidance and emotional governance of social emotional resonance, and has reached certain research consensuses, laying a solid foundation for the follow-up research on social emotional resonance. In the future, the research on emotional resonance needs to be further enriched, and can be expanded from the dimensions of theory, method and perspective.

First, at the level of research theory, it is necessary to expand and deepen the theoretical research on social emotional resonance. (1) From the perspective of the overall research framework, the existing research mainly focuses on the causes and classification of social emotional resonance, the phenomenon of emotional resonance in social media, and the public opinion guidance of social emotional resonance. However, a relatively comprehensive, systematic and in-depth research theoretical system has not yet been constructed; there is a lack of sufficient demonstration of the connotation of social emotional resonance, analysis of the characteristics of social emotional resonance, and systematic and in-depth research on the causes, mechanisms, influencing factors of social emotional resonance, as well as the early warning index system and social emotional governance. (2) From the perspective of specific research issues, the current research on social emotional classification is mainly based on the positive-negative emotional dichotomy, and has not carried out more detailed research on emotional types; it is also necessary to expand the analysis of different types of emotional resonance. In addition, the existing research mainly focuses on the analysis of typical cases, which has certain limitations; attempts can be made to conduct comparative analysis of different types of emergency public events to expand the research perspective. Furthermore, as other researchers have pointed out, in the post-truth era, the research direction should not be limited to the analysis of emotions but also need to explore the potential rational roots behind them [56]. Therefore, it is also necessary to analyze the core elements of social emotional resonance and its internal and external causes, and explore the technical causes and social background of its formation.

Second, at the level of research methods, expand the comprehensive method framework for social emotional resonance research. At present, most of the existing research uses a single method, such as the comparative analysis and case study of qualitative research, and the big data mining and analysis of quantitative research. To further deepen the research

on social emotional resonance, it is necessary to expand multi-methods, "integrating the traditional social science methods with the big data analysis methods in computer science"[4, pp. 87-91]. For example, integrate quantitative methods such as big data mining and analysis, questionnaire surveys with qualitative methods such as discourse analysis for effective complementarity, construct a method system that combines qualitative and quantitative methods, and comprehensively use big data analysis, content analysis, discourse analysis, and social network analysis to further explore the influencing factors, occurrence mechanisms and transformation mechanisms of social emotional resonance, and construct a comprehensive framework for emotional resonance research.

Third, at the level of research perspective, try to break disciplinary barriers and carry out interdisciplinary research. In the future, research should not only limit the study of emotional resonance to the field of communication; a single discipline cannot explain complex social phenomena, nor can it analyze intricate social relationships. Research from an interdisciplinary perspective can be promoted; for example, attempts can be made to use semiotic theory, combine mathematics, management, statistics with communication, sociology, psychology, etc., to study the generation mechanism and transmission law of emotional resonance, and integrate multi-disciplinary theories and research methods to promote more scientific, rigorous and comprehensive research.

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FACILITATING A SMOOTH TRANSITION FROM GENERAL ENGLISH TO TECHNICAL ENGLISH FOR STUDENTS

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Abstract: In the context of globalization and rapid technological advancement, English language proficiency has become a prerequisite for academic and professional success in technical fields, particularly as students often encounter difficulties when transitioning from General English (GE) to Technical English (TE). This study aims to identify the main challenges associated with this transition, analyze effective pedagogical strategies, and provide evidence-based recommendations for improving technical communication proficiency, based on the assumption that integrating structured English for Specific Purposes (ESP) modules, practical exercises, and digital tools facilitates the acquisition of TE competencies. The research employs a methodology combining curriculum analysis, student surveys, and performance assessments, with data analyzed using appropriate statistical methods to determine measurable improvements in comprehension, writing, and oral communication skills. The findings indicate that targeted ESP instruction, task-based learning, and technological integration significantly enhance both linguistic and cognitive competencies, leading to improved understanding of technical texts, greater accuracy in technical writing, and increased confidence in professional communication. The study concludes that a well-designed ESP framework bridging GE and TE, supported by curriculum adaptation, practical learning, and digital resources, effectively prepares students for modern technical professions, with practical implications for curriculum design, teaching methodology, and student employability.

Keywords: *technical english, general english, language transition, engineering education, curriculum design, digital learning, student challenges.*

Rezumat În contextul globalizării și al progresului tehnologic rapid, competența în limba engleză a devenit o condiție esențială pentru succesul academic și profesional în domeniile tehnice, în condițiile în care studenții întâmpină frecvent dificultăți în tranziția de la engleza generală (GE) la engleza tehnică (TE). Studiul își propune să identifice principalele provocări asociate acestei tranziții, să analizeze strategiile pedagogice eficiente și să ofere recomandări fundamentate pentru îmbunătățirea competențelor de comunicare tehnică, pornind de la ipoteza că integrarea modulelor structurate de Engleză pentru Scopuri Specifice (ESP), a exercițiilor practice și a instrumentelor digitale facilitează dobândirea competențelor de TE.

Cercetarea utilizează o metodologie care combină analiza curriculumului, sondaje aplicate studenților și evaluări ale performanțelor, datele fiind analizate prin metode statistice adecvate pentru a evidenția îmbunătățiri măsurabile în înțelegerea textelor, scriere și comunicare orală. Rezultatele arată că instruirea ESP țintită, învățarea bazată pe sarcini și integrarea tehnologică contribuie semnificativ la dezvoltarea competențelor lingvistice și cognitive, conducând la o mai bună înțelegere a textelor tehnice, o precizie sporită în scrierea tehnică și o încredere mai mare în comunicarea profesională. În concluzie, un cadru ESP bine proiectat, care facilitează tranziția de la GE la TE prin adaptarea curriculumului, activități practice și resurse digitale, poate pregăti eficient studenții pentru cerințele profesiilor tehnice moderne, având implicații relevante pentru dezvoltarea curriculară, metodologia didactică și creșterea angajabilității.

Cuvinte cheie: *engleză tehnică, engleză generală, tranziție lingvistică, educație inginerească, proiectarea curriculumului, învățare digitală, provocările studenților.*

1. Introduction

In an increasingly globalized and technology-driven world, English language proficiency has emerged as a critical asset across disciplines. Within technical fields such as engineering, computer science, and information technology, effective communication in English is indispensable for understanding professional documentation, participating in multinational projects, and disseminating research findings [1]. While General English (GE) provides learners with the essential grammatical structures and communicative competence required for everyday interaction, it often fails to prepare them for the specialized linguistic demands of Technical English (TE).

The transition from GE to TE involves not only acquiring new terminology but also mastering discipline-specific genres, understanding technical concepts, and applying precise communicative conventions. Students often struggle with the shift in vocabulary, variations in academic and professional writing styles, and the cognitive demands of technical discourse [2]. Addressing these difficulties requires a multifaceted approach that includes curriculum adaptation, integration of practical learning experiences, and systematic support for both students and educators. This paper discusses the key issues surrounding this transition and proposes pedagogical strategies to facilitate a smoother and more effective progression.

2. Research methodology

The study combined curriculum analysis, student surveys, and performance assessments to evaluate the effectiveness of instructional strategies in ESP. Data were analyzed using appropriate statistical methods to measure improvements in comprehension, writing, and oral communication skills.

3. Importance of English Proficiency in Technical Fields

As industries continue to expand globally, the demand for professionals who can communicate technical information effectively in English has increased dramatically [1]. For non-native speakers, particularly those studying in engineering or computer-related disciplines, limited English proficiency can impede not only academic success but also professional advancement [1,3]. Research has shown that many students encounter difficulties in understanding technical documentation, programming manuals, and research articles, as well as in collaborating on international projects.

The implementation of English for Specific Purposes (ESP) programs tailored to the linguistic and professional needs of technical students can bridge this gap [4]. Such programs

not only enhance students' command of technical vocabulary but also improve their confidence in using English as a tool for collaboration, problem-solving, and innovation [5]. Furthermore, ESP instruction contributes to the creation of an inclusive academic environment, enabling all learners—regardless of linguistic background—to participate fully in professional discourse.

4. Overview of General English and Technical English

General English focuses primarily on communicative competence in social and everyday contexts. Learners develop the ability to express opinions, engage in conversation, and understand general written and spoken texts [6]. In contrast, Technical English requires mastery of discipline-specific vocabulary, structured writing conventions, and the comprehension of complex informational content. It is used in scientific reports, manuals, technical documentation, and professional correspondence [5,7].

The integration of ESP courses into technical curricula is essential to bridge these differences. Such integration not only addresses immediate language needs but also fosters higher-order thinking skills, such as analytical reasoning and problem-solving [6]. For instance, writing technical reports or research abstracts encourages students to articulate ideas clearly and logically. Collaboration with industry professionals further enriches this learning process by offering authentic contexts in which students can apply their language skills [9]. Mentorship programs, internships, and project-based workshops are effective tools for helping students internalize technical communication practices and gain practical experience in real-world settings [7].

5. Challenges Faced by Students

The transition from General English to Technical English presents students with a multifaceted set of challenges that extend far beyond the acquisition of specialized vocabulary. Learners must navigate complex linguistic structures, discipline-specific terminology, and formal writing conventions, while simultaneously developing the cognitive skills necessary to interpret and synthesize technical information accurately. In addition, socio-professional factors—including familiarity with workplace norms, collaborative communication, and industry-specific expectations—further complicate this process [8]. If these challenges are not addressed systematically, students may experience difficulties in comprehension, production, and professional application. Moreover, learners often struggle to transfer general language skills to technical contexts, where precision and clarity are critical, and errors can have significant consequences. Motivation and confidence may also be affected, particularly when students encounter highly specialized texts or unfamiliar discourse patterns. Cultural differences in communication styles and expectations can further influence students' ability to engage effectively in international or multidisciplinary teams. Finally, the integration of digital tools and software for technical documentation or analysis introduces an additional layer of complexity, requiring both language and technological literacy. The subsequent section provides a comprehensive examination of each dimension, highlighting the core elements essential for successful transition.

5.1 Linguistic Complexity

One of the primary challenges lies in mastering the specialized vocabulary and terminologies inherent to Technical English. Unlike everyday language, technical vocabulary is precise, context-dependent, and often discipline-specific [5,9]. Misinterpretation or misuse of these terms can lead to significant misunderstandings in academic assignments, laboratory

instructions, or collaborative projects [5]. For instance, in engineering contexts, terms such as tolerance, load-bearing capacity, or modulus of elasticity carry precise meanings that general English speakers may not intuitively grasp [6,10]. Students must also navigate synonyms that exist in everyday English but have distinct technical implications, such as *stress, strain,* or *force*. Furthermore, the complexity increases when technical terms are embedded in longer sentences with dense syntactic structures, passive constructions, or nominalizations, requiring learners to decode both vocabulary and grammar simultaneously for accurate comprehension and production.

5.2 Dissimilarities in Writing Styles and Formats

Technical writing follows a highly structured, formal, and concise style that contrasts sharply with the flexibility and creativity often encouraged in General English. Students frequently struggle with producing documents such as lab reports, research papers, project specifications, and technical memos, which demand precision, clarity, and strict adherence to genre-specific conventions [13]. Errors in formatting, inappropriate use of passive or active voice, and poor organization of ideas can significantly affect the comprehensibility, reliability, and credibility of a document [10–14]. Moreover, technical documents often incorporate standardized headings, subheadings, and numbered sections, requiring students to master consistent formatting practices. Academic and industry standards frequently necessitate accurate citation methods, tables, diagrams, charts, or graphs, adding another layer of complexity. Misinterpretation of these visual elements can compromise the communication of key findings or data. Additionally, technical writing emphasizes objectivity, avoiding subjective or emotional expressions common in General English writing. Students must also learn to summarize information succinctly, avoiding unnecessary elaboration while retaining essential details. The integration of concise language, discipline-specific terminology, and formal style requires sustained practice and exposure to authentic texts. Educators play a crucial role in guiding learners through iterative drafting, feedback, and revision processes to develop competence and confidence in technical writing.

5.3 Understanding Technical Concepts and Jargon

Comprehension of technical texts requires more than general linguistic competence; it requires a foundational understanding of the relevant subject matter. Many students encounter difficulties decoding complex sentences, interpreting diagrams, or following step-by-step instructions in manuals or technical guides. Jargon, abbreviations, symbols, and acronyms are pervasive in professional texts, and learners with limited exposure may find them intimidating and confusing [7,9,12]. For instance, computer science students often struggle with pseudocode, algorithmic notation, or programming syntax, while engineering students may face challenges with circuit diagrams, CAD schematics, or stress-strain curves. Scientific and technical texts often employ dense nominalizations and compound sentences, which increase cognitive load. Misreading even a single term or step can lead to significant misunderstandings or errors in task completion. Students also need to distinguish between literal and context-specific meanings of terms, which may differ from their everyday use. Developing strategies such as note-taking, concept mapping, and glossary creation can support comprehension. Exposure to authentic texts and guided exercises helps learners connect linguistic forms to technical functions. Over time, repeated practice enhances both comprehension and confidence, enabling students to engage more effectively with discipline-specific materials.

5.4 Cognitive and Socio-Professional Challenges

Beyond linguistic skills, students must develop higher-order cognitive abilities, including critical thinking, analytical reasoning, and problem-solving, to interpret and apply technical information effectively [7,13]. Technical tasks often involve evaluating complex data, identifying patterns, and making informed decisions, which require cognitive flexibility. Collaboration is another essential skill, as many projects demand interdisciplinary teamwork and coordinated effort. Limited English proficiency can hinder communication, reduce participation, and increase anxiety during presentations, team meetings, or collaborative problem-solving sessions [7]. Students may struggle to express ideas clearly, respond to questions, or negotiate solutions in group settings. The pressure to perform in English as a non-native speaker can negatively impact motivation, self-confidence, and overall engagement. Socio-professional norms, such as expectations for formal reporting, professional etiquette, and structured discussions, further challenge learners unfamiliar with workplace conventions. Time management and task prioritization are also critical, as technical projects often involve multiple overlapping deadlines. Developing resilience, adaptability, and communication strategies is essential for overcoming these obstacles. Effective guidance, feedback, and supportive learning environments can help students navigate cognitive and socio-professional challenges successfully, ensuring both linguistic competence and professional readiness.

5.5 Integration of Soft Skills

Finally, the lack of structured opportunities to develop soft skills—such as teamwork, adaptability, and professional communication—compounds the challenges faced by students. Employers increasingly value individuals who can combine technical expertise with effective interpersonal abilities [15]. Therefore, students who have not been trained to navigate collaborative environments or communicate ideas succinctly may struggle to meet the holistic demands of the modern workplace. The ability to negotiate, provide constructive feedback, and resolve conflicts is particularly important in interdisciplinary teams, where diverse perspectives and skill sets must be coordinated effectively. Furthermore, leadership, time management, and decision-making skills complement technical knowledge, enabling students to manage complex projects efficiently. Incorporating role-plays, group projects, and simulated professional scenarios into ESP instruction provides practical experience in applying these skills. Reflection exercises and peer evaluations can further enhance self-awareness, emotional intelligence, and professional etiquette [10]. Overall, these linguistic, cognitive, and socio-professional challenges underscore the need for a carefully designed pedagogical framework that prepares students for the complexities of Technical English. Addressing these issues early and systematically facilitates both academic success and professional readiness, equipping learners with the comprehensive skill set required for modern technical and professional contexts.

6. Strategies for a Comfortable Transition

Facilitating a smooth and confident transition from General English to Technical English requires a carefully structured set of pedagogical strategies that support students both linguistically and cognitively. Effective transition planning should not only address vocabulary and grammar but also promote the development of analytical and communicative competences that mirror the real demands of professional and academic environments [8–12]. Three interrelated dimensions—curriculum design, experiential learning, and technological

enhancement—are particularly effective in this process. We tried to evaluate each aspect comprehensively, giving priority to the essential components, and the outcome of this endeavor resulted in some criteria presented in the next paragraphs.

In addition, successful strategies must consider learners' individual needs, prior knowledge, and learning preferences, ensuring that instructional approaches are flexible and inclusive. Structured guidance, scaffolding techniques, and iterative feedback are crucial to help students gradually internalize technical language and conventions. Integrating authentic materials, such as industry reports, manuals, and case studies, provides learners with practical exposure to real-world tasks. Collaborative tasks and peer-learning activities further reinforce comprehension, problem-solving, and communication skills. Regular assessment aligned with professional contexts can monitor progress and identify areas for targeted intervention. Finally, fostering a reflective learning culture encourages students to self-evaluate, recognize challenges, and actively participate in their own learning journey, ultimately enhancing motivation, confidence, and long-term retention.

6.1 Curriculum Adjustments

Curriculum adaptation plays a pivotal role in ensuring that students are gradually introduced to specialized language use within their disciplinary context. Instead of treating Technical English as an isolated subject, educators should embed English for Specific Purposes (ESP) modules into existing engineering, IT, or science programs. This content-based approach allows students to engage with authentic materials—such as research articles, design specifications, or technical manuals—while simultaneously developing linguistic accuracy and critical comprehension skills [13]. Moreover, adopting a spiral curriculum structure, in which core language skills are revisited and deepened in progressively more complex contexts, ensures sustained learning and transferability of skills [13]. Collaboration between subject-matter experts and language instructors further guarantees the authenticity and relevance of course content.

6.2 Incorporating Practical Exercises

Task-based learning and experiential activities constitute the practical foundation of an effective transition program from General English to Technical English. Students should actively engage in communicative projects that replicate authentic professional tasks, including preparing technical reports, conducting oral briefings, drafting user manuals, or composing research summaries [10]. These exercises develop not only writing and speaking competencies but also essential cognitive and organizational skills, such as precision, clarity, logical structuring, and critical thinking—hallmarks of effective technical communication.

In addition to document- and presentation-based tasks, simulations of workplace interactions offer learners opportunities to practice real-world scenarios in a controlled, educational setting. Activities such as client meetings, team problem-solving sessions, technical consultations, or conference presentations help students integrate linguistic skills with professional behavior, promoting fluency, accuracy, and confidence. These exercises also foster soft skills, including teamwork, adaptability, negotiation, and decision-making, which are increasingly valued in modern technical and professional environments [13-16].

Assessment practices should be designed to reflect these practical demands. Performance-based evaluations—such as project deliverables, presentations, peer assessments, and reflective portfolios—offer a more authentic measure of a student's ability to operate effectively in professional contexts than traditional written exams. By

incorporating structured practical exercises alongside targeted feedback, educators can ensure that students develop the competence, confidence, and professionalism required for successful engagement with technical English tasks.

6.3 Utilizing Technology and Online Resources

The integration of digital technologies is another essential component of a modern transition framework. Online learning platforms, discipline-specific glossaries, and technical corpora expose students to authentic discourse and terminology in context. Interactive tools, such as AI-assisted writing platforms and corpus-based concordances, enable learners to analyze real examples of technical language use and receive personalized feedback on accuracy and style [14]. Furthermore, virtual collaboration spaces and online forums can simulate the communicative conditions of global professional environments, where English serves as a lingua franca. Blending classroom instruction with digital resources increases accessibility [14], flexibility, and learner autonomy, allowing students to take a more active role in their linguistic and professional development.

Collectively, these strategies foster a holistic learning ecosystem that bridges the gap between general linguistic competence and specialized communicative proficiency. Through curriculum innovation, hands-on engagement, and technology-driven learning, students can acquire not only the technical vocabulary and genres necessary for their field but also the confidence and versatility required to operate effectively in the global workplace [10,14].

7. Role of Educators and Institutions

The successful transition from General English to Technical English depends largely on the commitment, preparedness, and coordinated efforts of educators and academic institutions. Teachers serve as the primary mediators between linguistic theory and real-world professional communication; therefore, their expertise in both language pedagogy and the disciplinary content relevant to students' fields of study is crucial. ESP instructors must understand not only how to teach language effectively but also how technical terminology, genre conventions, and communicative norms function within specific professional communities. This dual expertise enables them to design learning tasks that are authentic, meaningful, and aligned with current industry expectations.

Institutions, on the other hand, play a central role in creating the structural and policy frameworks that support effective ESP implementation [15]. Their responsibilities include providing access to appropriate teaching resources, incorporating ESP into curricular planning, and ensuring that course objectives reflect actual labor-market demands. Administrative support is also essential for establishing cross-departmental collaboration, particularly between language educators and subject-matter experts. Such collaboration enriches course content, fosters interdisciplinary understanding, and ensures that instruction remains relevant in rapidly evolving technical fields.

Furthermore, both educators and institutions must prioritize continuous professional development. Investment in training—through workshops, joint research initiatives, peer-observation programs, and participation in professional associations—helps instructors stay informed about advances in pedagogy, technology, and disciplinary communication practices. Finally, the creation of supportive learning environments that encourage student autonomy, critical thinking, and the practical application of technical language is fundamental. When educators and institutions work synergistically, the transition to Technical English becomes

not only achievable but sustainable, ultimately enhancing students' academic performance and professional readiness.

7.1 Teacher Training and Development

Teachers of English for Specific Purposes (ESP) must possess not only advanced linguistic competence but also a nuanced understanding of the professional and technical contexts in which their students will operate. This dual competence is crucial because ESP instruction requires educators to bridge the gap between language learning and the communicative demands of specialized disciplines. Professional development programs should therefore emphasize interdisciplinary training, equipping instructors with knowledge of technical discourse conventions, specialized vocabulary, multimodal communication formats, and field-specific rhetorical strategies. Collaborative workshops involving both language teachers and subject-matter experts can significantly enrich the teaching process, ensuring that course materials reflect authentic, up-to-date industry practices [14-16]. Such collaboration also allows educators to clarify misconceptions, deepen their awareness of technical processes, and better anticipate the needs and challenges faced by learners entering specialized fields.

Furthermore, teacher training initiatives must address not only subject knowledge but also methodological flexibility. ESP teachers benefit from being able to adapt their instruction to different learner profiles, professional domains, and institutional requirements. To achieve this, educators should be encouraged to adopt reflective teaching approaches, continually assessing and adjusting their methods in response to student feedback, learning analytics, and observed performance outcomes [8]. Reflective practices—such as maintaining teaching journals, engaging in post-lesson evaluations, and conducting learner-needs assessments—enable instructors to make data-informed decisions that enhance instructional effectiveness.

Integrating innovative methodologies can further strengthen the quality of ESP instruction. Approaches such as project-based learning allow learners to engage with real-world tasks, promoting authentic language use and interdisciplinary problem-solving. Flipped classrooms provide opportunities for students to explore technical content independently before applying it through guided practice. Blended learning and digital platforms offer flexibility, access to diverse resources, and opportunities for personalized learning pathways. As technological tools continue to evolve, teacher training programs must ensure that educators are proficient in digital literacy, instructional technologies, and AI-assisted language learning platforms.

Teacher mentoring systems and peer-observation networks also contribute significantly to professional growth. Mentorship allows novice teachers to receive guidance from more experienced colleagues, fostering confidence and accelerating skill acquisition. Peer observation, when approached as a collaborative and non-judgmental practice, enables educators to exchange ideas, reflect on pedagogical choices, and identify new strategies for addressing common challenges [15]. Additionally, participation in professional associations, conferences, and research activities can promote ongoing development, keeping teachers informed about emerging trends in ESP pedagogy and global industry communication norms.

Ultimately, the effectiveness of ESP instruction depends to a large extent on the preparedness, adaptability, and professional engagement of teachers. By investing in comprehensive, interdisciplinary, and forward-looking teacher training programs, institutions

can ensure that educators are well equipped to guide learners through the increasingly complex linguistic demands of technical and professional fields. Effective teacher development is therefore not simply an institutional priority but a foundational component of high-quality ESP education.

7.2 Creating Supportive Learning Environments

Equally important is the role of institutions in cultivating supportive environments that encourage linguistic growth and confidence. Universities and technical colleges must invest in modern learning infrastructures—language laboratories, online learning platforms, and digital libraries—that facilitate exposure to authentic technical materials [16]. Additionally, establishing interdisciplinary collaboration between English departments and engineering or IT faculties can help align learning outcomes and avoid redundancy in instruction.

Institutional support should extend beyond the classroom through initiatives such as technical writing centers, tutoring programs, and language mentoring schemes. Such resources can provide students with individualized feedback and guidance, particularly in areas like report writing, research presentation, and professional correspondence. Encouraging a culture of bilingual or multilingual communication within academic institutions also reflects the realities of globalized workplaces, reinforcing students' motivation to achieve technical fluency in English [7,13,16].

Ultimately, when educators are empowered through professional training and institutions actively support integrated language learning frameworks, the transition from General to Technical English becomes more cohesive, relevant, and attainable.

8. Results

The interventions described above produced clear, measurable improvements in student performance:

Comprehension: Students demonstrated enhanced understanding of technical texts, particularly in interpreting diagrams, tables, and specialized vocabulary.

Writing: Accuracy in technical report writing improved significantly, with clearer structure, appropriate use of technical terminology, and better adherence to formal style.

Oral Communication: Students showed increased confidence in presentations and collaborative discussions in technical contexts.

Survey responses indicated that students found practical exercises and digital tools especially helpful in bridging the gap between general and technical English. The majority reported feeling better prepared for professional and academic tasks requiring TE proficiency.

9. Discussion

The results highlight that the transition from GE to TE is multifaceted, involving linguistic, cognitive, and socio-professional competencies. The findings align with prior studies emphasizing the importance of ESP modules, experiential learning, and technology-enhanced instruction.

Students' difficulties in mastering technical vocabulary, understanding professional writing conventions, and integrating visual and textual information were effectively mitigated through structured interventions. Task-based learning and authentic materials supported both comprehension and practical skill acquisition, while digital tools enhanced exposure and provided personalized feedback.

Limitations: The study focused on a single institution and a relatively short intervention period. Future research could expand to multiple institutions, longer-term interventions, and explore the integration of AI-adaptive learning systems for personalized TE development.

10. Conclusion

The transition from GE to TE represents a critical developmental phase in a student's academic and professional journey, marking the point at which learners move from everyday communicative competencies to the specialized discourse required in technical and professional settings. In an era characterized by rapid technological advancement, global collaboration, and increasingly complex information flows, mastery of TE is no longer a peripheral skill but a central prerequisite for success. Modern industries rely on precise, unambiguous communication to ensure efficiency, innovation, and safety; consequently, the ability to operate confidently within technical discourse communities is essential for students preparing to enter these fields. This article has emphasized that achieving fluency in TE extends far beyond the memorization of specialized vocabulary. Rather, it involves the integration of linguistic, cognitive, and pragmatic competencies that enable learners to access, interpret, and produce technical information within authentic disciplinary contexts.

Students navigating this transition encounter a variety of challenges. These range from decoding unfamiliar terminology to developing an understanding of discipline-specific discourse patterns, stylistic conventions, and rhetorical structures. Technical texts often require the interpretation of multimodal elements such as graphs, diagrams, models, and data tables, further increasing the cognitive load for learners accustomed only to general communicative contexts. Moreover, technical communication often demands conciseness, objectivity, and precision—qualities that may differ significantly from the narrative or conversational styles emphasized in GE instruction. If these challenges are not addressed systematically, they can inhibit comprehension, reduce learners' confidence, and limit their ability to participate effectively in professional environments.

To mitigate these difficulties, deliberate and well-structured pedagogical interventions are essential. A carefully sequenced curriculum that gradually integrates discipline-specific content allows students to develop the linguistic and conceptual foundations necessary for advanced technical communication. Task-based learning, which replicates real-world professional scenarios, enables students to practice technical functions such as describing processes, interpreting data, drafting reports, and collaborating on problem-solving tasks. These activities help bridge the gap between classroom English and the communicative demands of industry. Additionally, digital tools—ranging from terminology databases and interactive simulations to AI-driven platforms that provide personalized feedback—play an increasingly important role in fostering autonomous learning. When used strategically, such tools can support vocabulary acquisition, enhance learners' exposure to authentic texts, and provide opportunities for repeated practice and self-assessment.

At the institutional level, successful implementation requires more than curriculum design; it depends on sustained collaboration and investment. Teacher preparation is a central component, as instructors must possess not only strong language-teaching competencies but also a functional understanding of the technical fields their students are preparing to enter. Professional development initiatives, co-teaching arrangements, and

partnerships with subject specialists can enhance instructors' confidence and ensure the accuracy and relevance of instructional materials. Furthermore, institutions must demonstrate a long-term commitment to supporting English for Specific Purposes (ESP) programs through resource allocation, policy development, and mechanisms for continuous improvement. Such support structures form the backbone of effective educational ecosystems in which students can thrive.

The implications of this transition extend far beyond individual academic success. When students develop strong technical communication skills, they enhance their employability and adaptability in a competitive global labor market. Organizations benefit from employees who can articulate ideas clearly, collaborate effectively with international partners, and manage technical documentation with precision. In fields such as engineering, medicine, information technology, and environmental science, the consequences of miscommunication can be severe, potentially affecting product quality, system safety, patient outcomes, or environmental impact. Thus, technical communication should not be viewed merely as a linguistic competency but as an ethical responsibility that underpins professional practice.

Looking ahead, further research is needed to refine and optimize approaches to ESP instruction. Data-driven methodologies—such as corpus linguistics, learning analytics, and needs analysis informed by labor-market trends—can contribute to creating curricula that more accurately reflect the linguistic demands of contemporary technical professions. The long-term impact of blended and digital learning models also warrants investigation, particularly as artificial intelligence and adaptive learning systems become increasingly integrated into educational processes. These technologies hold significant potential for personalized instruction, real-time feedback, and individualized learning pathways, yet empirical studies are needed to evaluate their effectiveness and identify best practices. Equally important is the involvement of industry experts, whose insights can help ensure that teaching materials remain aligned with evolving professional expectations.

To sum it all up, we should accept that facilitating a smooth transition from General English to Technical English is an achievable and necessary goal when educational systems adopt a comprehensive, student-centered approach. Such an approach must integrate linguistic accuracy, technical awareness, critical thinking, and digital literacy, recognizing that technical communication is a multifaceted competency shaped by cognitive, disciplinary, and technological factors. By fostering sustained collaboration among educators, linguists, technologists, and industry specialists, institutions can create learning environments that empower students to engage confidently with complex technical discourse. Ultimately, when students are equipped with the skills to communicate effectively and act responsibly within globalized technical contexts, they not only advance their own professional trajectories but also contribute to the broader development, safety, and innovation of the industries they enter.

To make the conclusion even more resounding, we should reiterate, that the transition from General English to Technical English represents a crucial phase in students' academic and professional development. By implementing structured ESP modules, practical exercises, and digital learning resources, educators can significantly improve student readiness for technical communication.

Successful implementation depends on coordinated efforts between instructors and institutions, including curriculum planning, professional development, and supportive

learning environments. Students who master TE gain not only language proficiency but also critical cognitive and professional skills, contributing to employability and effectiveness in global technical contexts.

Conflicts of Interest:

The authors declare no conflict of interest.

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CHILDREN'S NATURAL RIGHTS IN THE LAW ON MOTHER AND CHILD WELFARE ACCORDING TO MONTESQUIEU

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Abstract. This study focuses on Article 12 paragraph (1) letter g of Law No. 4-2024, Indonesia. This article states that "every mother and father has the obligation to instill religious values, faith in God Almighty, and good character in their children." The essence of the obligation of every mother and father, while a natural obligation, is not part of the state's obligation to regulate because it would violate the natural rights of children. This study uses normative research but in its elaboration it still relies on the belief in what is right. Normative research asks questions that are relevant to the development and implementation of legislation. The natural rights in Article 12 paragraph (1) letter g are not in accordance with the teachings of Montesquieu because the state has made them a norm and they are not in line with the origins of their formation. The state was formed because society was unable to fulfill its natural desires due to a lack of facilities. Even if there were no facilities, mothers and fathers would refer to Article 12 paragraph (1) letter g of Law No. 4-2024 and would try to instill religious values, faith in God, and good character in their children.

Keywords: *children; natural rights; mothers and fathers.*

Rezumat. Prezentul studiu se concentrează pe articolul 12 alineatul (1) litera g din Legea nr. 4-2024, Indonezia. Acest articol prevede că „fiecare mamă și tată are obligația de a insufla valori religioase, credința în Dumnezeu Atotputernicul și un caracter bun copiilor lor”. Esența obligației fiecărei mame și a fiecărui tată, deși este o obligație naturală, nu face parte din obligația statului de a reglementa, deoarece ar încălca drepturile naturale ale copiilor. Acest studiu utilizează cercetarea normativă, dar în elaborarea sa se bazează totuși pe credința în ceea ce este corect. Cercetarea normativă pune întrebări relevante pentru dezvoltarea și implementarea legislației. Drepturile naturale din articolul 12 alineatul (1) litera g nu sunt în conformitate cu învățăturile lui Montesquieu, deoarece statul le-a făcut o normă și nu sunt în concordanță cu originile formării lor. Statul a fost format deoarece societatea nu a putut să-și îndeplinească dorințele naturale din cauza lipsei de facilități. Chiar dacă nu ar exista facilități, mamele și tații s-ar referi la articolul 12 alineatul (1) litera g din Legea nr. 4-2024 și ar încerca să insufle copiilor lor valori religioase, credința în Dumnezeu și un caracter bun.

Cuvinte cheie: *copii; drepturi naturale; mame și tați.*

1. Introduction

In universal legal literature, children are legal subjects who need legal protection. The legitimacy of a child is determined based on a valid, void, or voidable marriage. Children born from a valid marriage are considered legitimate, while children born from a void or voidable marriage are considered illegitimate. The actions of both parties determine the status of children in society. If both parties enter into a valid marriage, the child resulting from that marriage is considered legitimate. If not, and they live together and conceive a child, then the child is labeled as illegitimate, suffering greatly even though they are innocent and have done nothing wrong [1]. This cycle does not make the child wrong in legal terms, but rather provides more adequate protection. In human resource development, the population group that needs attention is children. Based on the results of the 2020 Population Census, there are 79.71 million children among the total population of Indonesia. These children will grow up and contribute to the economy in the future. Therefore, providing welfare for children today is tantamount to preparing for the welfare of society in the future. In the context of sustainable development, children are agents of change and successors, so investing in children is very important to achieve sustainable development targets [2]. Finally, in 2024, there was Law of the Republic of Indonesia Number 4 of 2024 concerning the Welfare of Mothers and Children in the First Thousand Days of Life (Law No. 4-2024), but the articles tended to regulate the protection of children. Referring to the positive law of Charles-Louis de Secondat, Baron de La Brède et de Montesquieu, there is a contradiction because, naturally, what is desired for children is the obligation of parents. There are legal peculiarities regarding differences in beliefs in various societies, but for Montesquieu, these differences usually lead to 'prejudice' or 'superstition', which are prone to being eliminated as interaction between societies and individuals increases, whether through trade, immigration, or mixed marriages, so that children remain part of their parents [3].

This study focuses on Article 12 paragraph (1) letter g of Law No. 4-2024, which states that "every mother and father has the obligation to instill religious values, faith in God Almighty, and good character in their children." The essence of the obligation of every mother and father, while a natural obligation, is not part of the state's obligation to regulate because it would violate the natural rights of children. To support the originality of this paper, the first comparison is with the work of Januar Akbar Wibisono, who states that when a mother brings her child into a correctional institution as a prisoner, this must be supported by "standards and principles of children's best interests and special protection for women" [4]. This shows that there are children's needs that cannot be replaced by anything else and that a mother's support is a natural right. The second comparison by Elisabeth Anderson shows that the impact of a mother's retirement changes the behavior of child workers. This means that a mother's retirement means that children do not need to work, resulting in a reduction in child labor. This has a positive impact on children's development [5]. The third comparison is by Ratna Kartika Wati, Ani Kusbandiah, and Indriati Amarini, who found that online loans have become an increasingly common phenomenon among students, especially in today's digital era. However, the decision to take out such loans often involves complex moral considerations. The factors that influence students' decisions to borrow from online loans are financial needs, social pressure, and a lack of understanding of the risks [6]. From the third comparison of the studies, there is no state involvement in realizing children's wishes. In the originality search, no similarities were found that discuss child welfare from a natural rights perspective. The tendency for law-based research only leads to rights and obligations, so that

the end result is the fulfillment of rights that have implications for sanctions on what mothers and fathers do to their children. Based on the above arguments, this study raises the question of whether children's natural rights in Law No. 4-2024 are in accordance with Montesquieu's teachings.

2. Materials and Methods

This study uses normative research but in its elaboration still relies on the belief in what is right. Normative research asks questions that are relevant to the development and application of legislation [7]. In this case, the legislation in question is Law No. 4-2024, where social order is also part of legal science. Normative research in the traditional sense is based only on applicable legislation but must be adjusted to current empirical conditions.

Legal theory, as a continuation of general legal doctrine, definitively occupies a place between legal dogmatics on the one hand and legal philosophy on the other. As with general legal doctrine, legal theory is, at least by most people, viewed as a value-free and non-normative science. This distinguishes legal theory from legal philosophy and legal dogmatics [8]. This assertion is very important because when absolute normative research is used, it will not answer "whether" based research questions. The two cases were synthesized and analyzed based on relevant principles and rules obtained mainly from relevant statutes and legal doctrines [9]. The main approach is legal interpretation so that readers also share the researcher's belief that natural rights are biased in legal science.

3. Results and Discussion

Arguments Using Montesquieu's Teachings

Montesquieu was born on January 18, 1689, and died on February 10, 1755. He was a French philosopher who lived during the Renaissance. Montesquieu had a very unique personality. He spent much of his time not only observing the political and legal systems in France but also comparing them with those in other regions. His restless soul, seeing the reality of injustice suffered by the people and the arbitrariness of the rulers, led him to visit the centers of Western civilization such as Vienna, Venice, Florence, Rome, and Naples. He also traveled extensively to England, the Netherlands, and Germany. In these places, he studied and investigated local political institutions. These experiences led him to understand the causes of injustice and how justice is present in society. Montesquieu believed that human nature is inherently fair, but due to certain social situations, people begin to choose to be fair or unfair. His most popular work is *The Spirit of Laws*, and his famous teachings are related to the separation of powers. In this line of thinking, society is synonymous with freedom that stems from its own natural will. Book VIII states that "it is in the nature of a republic that it must have a small territory; without it, it is almost impossible for it to exist. In a large republic, there is great wealth, and as a result, there is little moderation of spirit. In a large republic, the public interest is sacrificed for a thousand considerations; the public interest is subordinated to various exceptions; the public interest depends on chance. In a small republic, the public interest is more strongly felt, better known, and closer to every citizen." The natural will of the state is not the same as the will of the state. The state cannot escape its monopolistic, coercive, and both natures. There is a polarization of needs so that the state also sometimes acts as if it is fulfilling the desires of the people. Ola Olsson argues that the size of a state has two main effects: First, a large territory means less dependence on foreign trade and a greater absolute value of expected rental income from land and mines. Second, that the strong concentration of power in a country's capital and core regions implies that

public goods such as the rule of law spread according to a spatial decay function, so that the level felt in the interior is much weaker than in the capital [11]. This supports the state in being able to act according to its will. The separation of powers does not necessarily provide a sense of moral justice for society, but the separation of powers was originally intended to break away from the absolute power of the king.

Ultimately, the natural will of society is limited by state power. This limitation is not a form of reduction, but rather the state's attitude of protecting the human rights of other communities. There cannot be true freedom, lest the natural will that actually arises from the desires of the people emerge, but it is very difficult to determine whether this is natural or influenced by the surrounding environment.

The Desired Behavior of the State in Law No. 4-2024

Law No. 4-2024 raises its own legal issues, namely the ambiguity of the meaning of "the first thousand days of life" in the formulation. Normatively, the first thousand days of life is the phase that occurs in a child from the formation of the fetus in the womb until the age of 2 (two) years. Merriam-Webster defines a year as a *cycle in the Gregorian calendar of 365 or 366 days divided into 12 months beginning with January and ending with December; a period of time equal to one year of the Gregorian calendar but beginning at a different time*. There is an inconsistency between the understanding of the first thousand days in Law No. 4-2024 and the global calculation. If adjusted, the wording of Article 1 point 2 would become a person whose life begins from the formation of the fetus in the womb until the child is 3 (three) years old. The ambiguity of this formulation makes the legal norms within it difficult to understand, which ultimately does not provide legal certainty.

In general, it is known that the family, as the smallest unit of society, plays an important role in sustainable development for future generations. One of the main efforts in shaping a quality generation is carried out by improving the welfare of mothers and children. The condition of mothers before pregnancy, during pregnancy, childbirth, and postpartum, breastfeeding children, or mothers who adopt, care for, educate, and/or nurture children is a special concern so that children can live, grow, and develop optimally. Law No. 4-2024 does not require the state to immediately implement its provisions because there is a maximum period of 2 (two) years from the date of its enactment before its implementing regulations are stipulated. This means that the state is passive and does not make the welfare of mothers and children a national priority. State behavior can be examined using a natural state approach. Philosophically, the existence of the state is to protect its people. Ibn Khaldun's thinking is divided into two parts. The first is the theory that views imamah and the formation of the state as an obligation and pillar of religion, as stated by the Shi'ah. According to them, an imam may be chosen by the people, but the process of his appointment must be based on religious texts. Second, there is a theory that views imamah and the state as neither an obligation nor a religious prohibition. It is not a religious duty, but a social issue concerning human relations. And third is a middle theory that positions itself between the two theories above. This theory states that imamate is obligatory, but it must be based on an election process, not on religious texts. There are levels of importance regulated by the state, but it must also pay attention to human relations. Specifically, humans tend to be influenced by the things they do. Humans are children of their habits, not of their ancestors [14]. This idea emerged because he was raised in a culture of Asabiyyah, which would attack and destroy smaller groups. In addition, the next generation enjoyed a luxurious lifestyle, neglecting their

valuable reputation and moral ideals. Thus, there was a decline after the fall of Asabiyyah. Natural rights driven by habit also cause a person to forget their ancestral entity.

Researchers have linked Ibn Khaldun's thinking as a comparison in finding state behavior because it refers to Article 1 paragraph 1 of Law No. 4-2024, a condition of fulfilling the basic rights and needs of mothers and children, which include physical, psychological, social, economic, spiritual, and religious aspects, enabling them to develop themselves and participate optimally in accordance with their social functions in the development of community life as state behavior that negates its obligations to society. Such contradictions ultimately result in the state only being able to provide assistance when mothers and fathers are unable to do so.

Reading Article 1 paragraph (1) of the 1945 Constitution of the Republic of Indonesia (UUD NRI 1945) that the State of Indonesia is a Unitary State, which is a Republic. Here, there is glorification of society because a republic does whatever it takes to meet the needs of society. However, there are restrictions where fulfillment cannot be done absolutely by society. This is clarified in Article 33 paragraph (3) of the 1945 Constitution, which states that the land, water, and natural resources contained therein are controlled by the state and used for the greatest prosperity of the people. In line with Montesquieu's thinking, the state as intended in Law No. 4-2024 is in accordance with the will of the rulers and is part of the realization of Article 12 paragraph (1) letter g of Law No. 4-2024. However, there is a contradiction when the public reads this article, as it does not correspond with the state's interpretation. This is in line with Hans-Georg Gadamer's thinking to combine the fusion of the contemporary horizon in understanding the text of the law. Prejudice is a prerequisite for understanding; prejudice "represents the initial position from which an understanding originates". Our prejudices greatly influence our interpretation. Hans-Georg Gadamer frames prejudice as "initial or anticipatory understanding," and this meaning "should not be equated with its connotation as irrational or wrong thinking"[15]. Here, we need understanding in interpreting the state's behavior in Law No. 4-2024.

Natural Rights of Children

In the beginning, humans only used their minds to solve various problems. Using their minds did not mean negating the "powers" that existed outside of themselves, but rather optimizing what they believed in. Aristotle defined natural science as the study of "change," with kinematics at its core. This is a concept that encompasses not only change in place but also change in quantity (creation and destruction) and quality. If the existence of an individual entity is determined by a broader horizon that encompasses its boundaries, and if the expansion of that horizon is unlimited and retrospective in nature without a conclusive limit that prohibits further expansion, then the absence of boundaries complicates the discussion of the non-existence of the universe as a whole [16]. This means that the emergence of natural law influences humans to behave and defend their natural rights. Natural law is a law agreed upon by society, but there is a binding force even though there are no written sanctions.

The existence of sanctions is based solely on the beliefs of society. For example, if someone makes a mistake, there will be retribution in another form. This process makes it better for the state to be led by a philosopher, because he is able to resolve all problems with consideration. The definition of resolving all problems actually indicates the existence of

authority within a person, so that when there is recognition of what is believed, the state becomes better even though no one provides validation.

Humans participate in God's wisdom and goodness, which gives them control over their actions and the ability to regulate themselves for the sake of goodness and truth. Natural law reveals the original moral meaning that allows humans to distinguish between good and evil, truth and falsehood with reason. This law is universal because it is a set of general principles related to humans, which are not influenced by living conditions, culture, or circumstances. This law, in principle, is also immutable and remains valid throughout human history, because it is part of human nature [17]. Legal rights can guarantee these rights and thus promote these values. Such rights demonstrate their own existence so that fulfillment occurs [18].

By nature, children are the fruit of God's love. Not only do mothers and fathers have an obligation to provide the best, but because of the legal relationship between humans and the authorities, the state also has the same obligation. This obligation must be interpreted from a constitutional law perspective because of the role of power in it. The powers referred to are the executive, legislative, and judicial branches. The role of power in relation to children is important in Indonesia, as evidenced by the legal basis for child protection. Article 52 of Law No. 39 of 1999 on Human Rights (Law No. 39-1999) stipulates that every child has the right to protection by their parents, family, community, and the state. Children's rights are human rights, and for their sake, these rights are recognized and protected by law even from the womb. The state is obliged to fulfill these needs. These are the natural rights of children, meaning that regardless of whether they know they need them or not, their mother and father are obliged to fulfill them. Human goodness must be protected and enhanced, and must not be deliberately destroyed, in the person of all beings perfected by these goods, and entities are within the scope of this perfection precisely to the extent that they have dignity as human persons. "Human" in "human person" is essential because these goods are human goods; "person" is essential because it has the special advantage of being a free and rational being—again, at least in its essential capacity—all human beings are radically equal in status and thus entitled, justly and as a right, to be respected, enhanced, and not deliberately harmed [19]. In the section on the rights of citizens, the principle of "neminem laedere, suum cuique tribuere" can be applied. Almost all natural law thinkers acknowledge that these reciprocal individual rights must be respected even in a civil state after the social contract. Citizens under the law are only considered not to be allowed to use violence to defend themselves because the state will maintain their security and the courts will protect their rights. However, some of these thinkers will express this belief in terms of "permission in law" which is an unwritten part of an agreement.

The understanding of the natural rights of children begins with Article 12 paragraph (1) letter a of Law No. 4-2024, which states that mothers and fathers are obliged to prepare for, check, and maintain their health from before pregnancy, during pregnancy, during childbirth, and after childbirth. The natural attitude of mothers and fathers is to behave appropriately without further regulation so that their basic obligations are fulfilled. From an individual perspective, security is characterized as a basic human need that requires fulfillment. Individuals strive to obtain security in order to maintain their ability to act and minimize the risk of being unable to act [21]. In the process of maintaining preparation from before pregnancy to postpartum, this fulfillment cannot be left entirely to the mother and father. Their natural ability is the ability to survive, but there must be agreement on the

alienation of rights owned by the state. Referring to Article 1 paragraph 2 of the Regulation of the Minister of Health of the Republic of Indonesia Number 2 of 2025 concerning the Implementation of Reproductive Health Efforts, it is stated that all forms of activities and/or a series of activities carried out in an integrated and continuous manner to maintain and improve the health status of the community in the form of promotive, preventive, curative, rehabilitative, and/or palliative measures by the central government, local governments, and/or the community. This means that continuous legal protection will enable children to truly experience their natural rights as children, not as legal objects receiving affection due to normalization.

Then, referring to Article 12 paragraph (1) letters b, c, d, e and f of Law No. 4-2024, it is stated that maintaining the survival and growth and development of children; providing exclusive breastfeeding from birth until the child is 6 (six) months old, followed by breastfeeding and complementary foods until the child is 2 (two) years old, unless there are medical indications; providing adequate and balanced nutrition for children and appropriate stimulation according to the child's age and condition, to optimize the child's growth and development; monitoring the child's growth and development and having the child's health checked regularly at a health care facility; caring for, nurturing, educating, and protecting the child with love and affection. These articles are also the natural rights of mothers and fathers.

These basic principles and norms of natural law may seem far removed from questions about the proper political order of society, but in fact, they provide the foundation for answering those questions. The fundamental point is the moral imperative to act in a manner consistent with the fulfillment of human needs in an integral way—combined with the obvious fact that humans can only thrive in communities, and that subpolitical communities such as families and civil associations are not self-sufficient in achieving their goals and fulfilling all human needs. Children's needs have become the political authority that the state uses to counter the natural will of society. Christopher Tollefsen divides the needs that the state can fulfill without negating the natural will of society into (1) the provision of public goods and services, such as utilities and infrastructure; (2) defense against external threats; (3) protection from internal threats and judicial administration; and (4) providing for members of society who are needy and dependent and have no one else to care for them.[23] Thus, the state's authority is fulfilled while still providing facilities for the fulfillment of the natural will of society.

4. Conclusions

The natural rights in Article 12 paragraph (1) letter g of Law No. 4-2024 are not in accordance with Montesquieu's teachings because the state has made them a norm and they are not in line with the origins of their formation. The state was formed because society was unable to fulfill its natural desires due to a lack of facilities. Even if there were no facilities, mothers and fathers would refer to Article 12 paragraph (1) letter g of Law No. 4-2024 and would try to instill religious values, faith in God, and good character in their children. This article can only be implemented when obligations are not interpreted as having sanctions, so that obligations do not arise naturally but rather from external factors imposed by the state. Ultimately, mothers and fathers will do whatever it takes to fulfill Article 12 paragraph 91) letter g of Law No. 4-2024.

A suggestion that can be given is that in the formulation of legislation, natural desires should not be included so that what should already be known to the community is not

normalized. The state should strengthen the continuity of natural rights with more adequate facilities. Thus, good legal certainty will be created.

Research Data Availability Statement: JSS encourages all article authors to make their research data available. In this section, indicate where the data supporting your findings can be accessed, including links to publicly archived datasets used or created in the study. If no new data were generated, or if access is restricted due to ethical or privacy reasons, you must still provide a statement. During peer review and editorial assessment, authors may be asked to share the datasets or raw data analyzed in the manuscript and clarify whether they will be accessible to other researchers after publication. Authors should also specify details of any previously existing datasets that were analyzed in the study.

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THE ESSENCE, TASKS AND PURPOSE OF IDENTIFICATION PROCEEDINGS IN CRIMINAL PROCEDURE

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Abstract. This article examines the essence, tasks, and purpose of identification proceedings as a distinct evidentiary procedure in criminal procedure law. Employing doctrinal, comparative, and logical-analytical methods, the study investigates the legal nature of identification proceedings, their structural elements, and their role in establishing evidentiary truth. Special attention is given to procedural safeguards designed to prevent miscarriages of justice caused by erroneous identifications. The article identifies key deficiencies in the legal regulation and judicial application of this investigative action and proposes concrete recommendations for strengthening procedural guarantees in accordance with the principles of legality, adversariality, and the protection of participants' rights. The findings contribute to clarifying the theoretical framework governing identification proceedings and offer practical guidance for criminal investigation bodies and courts. The study advances scholarship in criminal procedural law by providing a systematic analysis of an underexplored evidentiary mechanism with significant implications for fair trial standards.

Keywords: *identification proceedings, evidentiary procedure, investigative action, criminal investigation body, hearing, person, object, circumstances, witness, victim, suspect, accused, distinctive features, characteristics, official record.*

Rezumat. Prezentul articol examinează esența, sarcinile și scopul prezentării spre recunoaștere ca procedeu probatoriu distinct în dreptul procesual penal. Prin utilizarea metodelor doctrinare, comparative și logico-analitice, studiul investighează natura juridică a prezentării spre recunoaștere, elementele sale structurale și rolul acesteia în stabilirea adevărului judiciar. O atenție deosebită este acordată garanțiilor procedurale menite să prevină erorile judiciare cauzate de identificările eronate. Articolul identifică deficiențele esențiale în reglementarea juridică și aplicarea judiciară a acestei acțiuni de urmărire penală și propune recomandări concrete pentru consolidarea garanțiilor procedurale, în conformitate cu principiile legalității, contradictorialității și protecției drepturilor participanților la procesul penal. Rezultatele cercetării contribuie la clarificarea cadrului teoretic care guvernează prezentarea spre recunoaștere și oferă îndrumări practice pentru organele de urmărire penală și instanțele judecătorești. Studiul avansează cercetarea în domeniul

dreptului procesual penal printr-o analiză sistematică a unui mecanism probatoriu insuficient explorat, cu implicații semnificative pentru standardele dreptului la un proces echitabil.

Cuvinte-cheie: *prezentare spre recunoaștere, procedeu probatoriu, acțiune de urmărire penală, organ de urmărire penală, audiere, persoană, obiect, circumstanțe, martor, parte vătămată, bănuit, învinuit, semne distinctive, particularități, proces-verbal.*

1. Introducere

Acțiunile legate de procedura prezentării pentru recunoaștere pot fi urmărite de-a lungul întregii istorii a luptei împotriva criminalității. Aceasta se explică prin caracterul relativ simplu al modului de obținere a probei: partea vătămată (martorul) a reținut semnalmentele persoanei care a săvârșit infracțiunea și o poate recunoaște. Totuși, apariția și dezvoltarea procesului penal a determinat treptat transformarea procedurii prezentării pentru recunoaștere dintr-o formă „spontană" într-un mijloc sigur de obținere a probelor, fundamentat științific și caracterizat printr-un grad sporit de credibilitate. Prin această acțiune, atât anterior, cât și în prezent, se înțelege faptul că partea vătămată (sau un alt participant la procesul penal) recunoaște sau nu, în persoana care îi este prezentată, individul ce are legătură cu evenimentul infracțional. S-a subliniat că prezentarea pentru recunoaștere, în calitate de categorie criminalistică, a apărut cu mult înainte de a dobândi statutul de acțiune procesuală. Problema definirii noțiunii de „prezentare pentru recunoaștere" a apărut ulterior, odată cu aplicarea acesteia în practica judiciară. Criminaliștii nu doar că au definit în mod diferit esența acestei acțiuni de urmărire penală, ci au și interpretat neuniform însuși conceptul de „recunoaștere".

Primele încercări de definire a acestei acțiuni de urmărire penală au fost întreprinse cu mai bine de o sută de ani în urmă. De-a lungul acestui interval, cercetătorii au ajustat definiția prezentării pentru recunoaștere, au perfecționat sistematizarea metodelor, tipurilor, formelor, procedeelor, subiecților și obiectelor acesteia, precum și au elaborat recomandări privind organizarea desfășurării sale. În consecință, acest domeniu al dreptului procesual penal și al criminalisticii este unul profund și amplu elaborat. Cu toate acestea, continuă să se mențină o tendință ce confirmă lipsa unor concepții unitare asupra mai multor aspecte ale acestei acțiuni procesuale, în special în ceea ce privește scopul și esența sa. Într-o accepțiune generală, prezentarea pentru recunoaștere poate fi definită ca o acțiune procesuală (de urmărire penală) efectuată în vederea identificării (recunoașterii) unui obiect care are legătură cu evenimentul infracțional[1, p. 43].

După natura sa, prezentarea spre recunoaștere este o acțiune procesuală pe parcursul căreia, unei persoane i se prezintă alte persoane sau obiecte cu scopul constatării asemănărilor sau deosebirilor cu persoanele sau obiectele observate anterior, în împrejurări care au legătură cu fapta examinată[2, p. 213]. Esența prezentării spre recunoaștere este un mecanism psihologic ce constă în compararea, prin metoda suprapunerii, imaginii (caracteristicile individuale), obiectului memorat anterior cu imaginea obiectului prezentat [3, p. 261].

2. Materiale și metode

Baza teoretico-metodologică a cercetării privind esența, sarcinile și scopul prezentării spre recunoaștere în procesul penal este constituită din ansamblul conceptelor, principiilor și teoriilor fundamentale dezvoltate în doctrina dreptului procesual penal, coroborate cu

reglementările legale în vigoare și cu practica judiciară relevantă în această materie. Cercetarea se înscrie într-un demers științific riguros, structurat pe două componente esențiale și complementare: fundamentul teoretic și instrumentarul metodologic.

I. Fundamentul teoretic

Fundamentul teoretic al cercetării este constituit din:

a) Teoriile generale ale probei și ale mijloacelor de probă, în special cele referitoare la procedeele probatorii, la funcțiile acestora în mecanismul de administrare a probelor și la rolul lor determinant în aflarea adevărului în procesul penal. Aceste teorii au fost analizate din perspectiva contribuției lor la configurarea cadrului conceptual al prezentării spre recunoaștere ca procedeu probatoriu distinct, cu natură juridică proprie și funcții specifice în economia procesului penal.

b) Doctrina dreptului procesual penal — atât cea națională, cât și cea comparată —, valorificată în scopul identificării și sistematizării principalelor abordări teoretice privind esența juridică, sarcinile funcționale și finalitatea procesuală a prezentării spre recunoaștere. Au fost integrate contribuțiile reprezentative ale autorilor din domeniul dreptului procesual penal care au tratat această instituție din perspectiva teoriei probelor, a garanțiilor procesuale și a principiilor fundamentale ale procesului penal echitabil.

c) Reglementările legale naționale și internaționale aplicabile în materia administrării probelor, inclusiv normele procesual-penale care guvernează efectuarea prezentării spre recunoaștere, interpretate în lumina principiilor legalității, contradictorialității și aflării adevărului. Aceste reglementări au constituit suportul normativ indispensabil pentru evaluarea conformității practicii judiciare cu exigențele procedurale și cu standardele dreptului la un proces echitabil.

d) Practica judiciară relevantă, valorificată ca sursă complementară de cunoaștere și ca instrument de verificare a eficienței aplicative a normelor procesual-penale. Jurisprudența în materie a permis identificarea disfuncționalităților procedurale, a erorilor de identificare și a riscurilor de viciere a probelor obținute prin intermediul prezentării spre recunoaștere, oferind astfel un suport empiric cercetării teoretice.

II. Instrumentarul metodologic

Din punct de vedere metodologic, cercetarea se întemeiază pe o combinație de metode științifice specifice științelor juridice, selectate și aplicate în funcție de natura obiectului de studiu:

e) Metoda analizei și sintezei, utilizată pentru examinarea detaliată a componentelor structurale ale prezentării spre recunoaștere — condiții de admisibilitate, procedură de desfășurare, valoare probatorie — și pentru integrarea acestora într-o viziune unitară și coerentă asupra instituției.

f) Metoda logico-juridică, prin intermediul căreia au fost examinate relațiile de cauzalitate, conexiune și condiționare dintre normele procesual-penale aplicabile și efectele lor practice în cadrul urmăririi penale și al judecății.

g) Metoda comparativă, aplicată în scopul identificării similitudinilor și diferențelor existente între reglementările și practicile judiciare din diferite sisteme de drept procesual penal în materia prezentării spre recunoaștere, cu accent pe garanțiile procesuale și pe standardele de fiabilitate a identificării.

h) Metoda interpretării sistematice și teleologice a normelor de drept procesual penal, utilizată pentru înțelegerea sensului și finalității reglementărilor aplicabile prezentării spre recunoaștere în contextul mai larg al sistemului probator și al principiilor fundamentale care guvernează procesul penal.

3. Discuții și rezultate obținute

Analiza definițiilor acestui act procesual, existente în literatura de specialitate permite să concluzionăm că autorii includ în conținutul său atât temeiurile juridice, cât și scopul, precum și modul de desfășurare, indicând totodată cercul obiectelor care pot fi prezentate pentru recunoaștere. În mare parte, aceste definiții coincid și nu conțin deosebiri esențiale. Se impune, însă, să ne oprim asupra unor poziții și aspecte de principiu. Or, se menționează că scopul prezentării pentru recunoaștere poate consta în: recunoaștere; identificare vizuală; identificare; echivalare (asociere); stabilirea asemănării sau a deosebirii; determinarea apartenenței de grup ori de gen. Pentru a clarifica care dintre aceste categorii reflectă scopul real al acestei acțiuni procesuale, ele trebuie analizate atât din perspectiva sensului general acceptat, cât și a statutului lor categorial în cadrul criminalisticii.

În primul rând, termenii „recunoaștere", „identificare vizuală", „identificare" și „echivalare (asociere)" pot desemna atât un anumit proces (în calitate de sistem de acțiuni realizate într-o anumită succesiune), cât și rezultatul acestuia („obiectul a fost identificat")[4, p. 415, 582, 1192].

Recunoașterea reprezintă procesul și rezultatul raportării, atribuirii obiectului prezentat la o imagine psihică determinată, formată anterior[5, p. 510]. Autorul M. S. Șehter definește procesul recunoașterii ca „o activitate a raportării obiectului prezentat la o anumită clasă (categorie) cunoscută, fixată în memorie"[6, p. 6]. Identificarea reprezintă recunoașterea a ceva sau a cuiva; echivalarea (asocierea) cu cineva ori cu ceva anume[7, p. 129]. În literatura de specialitate din România, se menționează despre identificarea persoanelor și a obiectelor (*procedeu probatoriu, similar cu prezentarea spre recunoaștere, reglementată la art. 116 și 117 din Codul de procedură penală al Republicii Moldova – n.n.*), aceasta fiind un procedeu probatoriu prin care se urmărește clarificarea împrejurărilor cauzei și care constă în recunoașterea persoanelor sau obiectelor de către diverși subiecți procesuali (martori, subiecți procesuali principali, părți în proces)[8, p. 527]. În acest sens, în opinia lui M. Udroiu, „Identificarea persoanelor sau obiectelor constituie un procedeu probatoriu fundamental al procesului penal, fiind deseori utilizat de către organele de urmărire penală în stadiile incipiente ale urmăririi penale și având ulterior un rol hotărâtor în soluționarea definitivă a acțiunii penale"[9, p. 417].

Identificarea judiciară constituie o activitate indisolubil legată de împlinirea actului de justiție și de prevenire a fenomenelor antisociale. Descoperirea infractorilor, probarea comiterii unor fapte penale și a vinovăției, determinarea împrejurărilor în care s-a produs, precum și a altor situații, reclamă în mod necesar stabilirea identității persoanelor și obiectelor[10, p. 1].

Recunoașterea reprezintă o formă de identificare bazată pe imagini mentale. Asemănarea nu echivalează cu identitatea și nici cu coincidența; asemănarea reprezintă o similitudine aproximativă, chiar îndepărtată, bazată pe caracteristici superficiale. În dreptul procesual penal și în criminalistică sunt necesare definiții precise, exprimate prin concepte neechivoce: coincidență, egalitate, identitate, uniformitate. Se evidențiază astfel legătura dintre definițiile prezentate, care arată că recunoașterea – identificarea vizuală –

identificarea – echivalarea (asocierea) au același înțeles, fiind folosite ca termeni sinonimi, la fel cum sunt sinonime și cuvintele „grup” – „gen”.

Se evidențiază definiții ale căror autori consideră că scopul prezentării pentru recunoaștere poate fi stabilirea identității sau a diferenței obiectului prezentat față de cel perceput anterior de către persoana care recunoaște. Această poziție este împărtășită de numeroși autori[11, p. 269]. De asemenea, autorii numeroaselor comentarii științifico-practice la legea procesuală penală subliniază că prezentarea pentru recunoaștere se efectuează pentru a stabili identitatea sau diferența față de o persoană sau obiect observat anterior[12, p. 539; 13, p. 411; 14, p. 374].

Din punctul nostru de vedere, includerea în definiția prezentării pentru recunoaștere a stabilirii diferenței dintre obiecte ca scop independent nu este justificată. În primul rând, un astfel de scop contrazice esența procesului de recunoaștere (a recunoaște înseamnă a stabili că obiectul prezentat este același cu cel observat anterior de persoana care recunoaște). Specificitatea cercetării judiciare constă tocmai în faptul că aceasta urmărește determinarea individualității obiectului, și nu stabilirea unei alternative.

În al doilea rând, stabilirea identității obiectului implică de la început, în mod necesar, diferențierea acestuia față de toate celelalte obiecte. În cadrul prezentării pentru recunoaștere ca acțiune procesuală, nu se pune niciodată sarcina de a stabili diferența obiectului, adică de a recunoaște că nu este același obiect. Dacă s-ar admite că o astfel de situație este posibilă, atunci sarcina diferențierii s-ar transforma într-o acțiune experimentală, o formă de experiment judiciar, de exemplu, pentru verificarea capacității de a distinge semnalele semaforului. Prin urmare, stabilirea diferențelor între obiectele prezentate pentru recunoaștere ca scop separat este inutilă.

Următorul grup de definiții este unit de faptul că, în calitate de scop al acestei acțiuni procesuale, este stabilirea identității, a asemănării (determinarea apartenenței la un grup) sau a diferenței obiectului prezentat față de cel perceput anterior de persoana care recunoaște[15, p. 73; 16, p. 404; 17, p. 299; 18, p. 110].

Surprinde punctul de vedere conform căruia prezentarea pentru recunoaștere s-ar efectua în general doar pentru stabilirea „asemănărilor și diferențelor”[19, p. 189]. O asemenea opinie nu este compatibilă nici cu principiile științifice ale teoriei identificării, nici cu obiectivul probatoriului în procesul penal, care, după definiția inspirată a lui V. Ia. Koldin, „constă în stabilirea obiectului căutat – a unui obiect material unic, legat de evenimentul infracțional”[20, p. 24].

Cercetătorul N. A. Moiseev subliniază că „obiectul prezentat pentru recunoaștere trebuie să posedă anumite semne caracteristice sau trăsături proprii, specifice numai lui și nu întregii specii sau tipurilor de obiecte. Aceste semne și trăsături permit diferențierea sa dintre obiectele similare și, în consecință, identificarea lui. Atunci când, din materialele dosarului, rezultă că recunoașterea este imposibilă din cauza lipsei trăsăturilor distinctive ale obiectului, efectuarea acestei acțiuni de urmărire penală nu are sens. De exemplu, nu se poate recunoaște făina furată dintr-un depozit fără ambalaj sau un lichid incolor”[1, p. 49].

În opinia profesorului I. Dolea, „La prezentarea spre recunoaștere a obiectelor trebuie ținut cont de faptul că sunt omogene nu numai obiectele care au aceeași denumire și destinație, dar și aceleași dimensiuni, forme, modele, culori, tipuri”. Același autor susține că „nu este rațional a se efectua o prezentare spre recunoaștere dacă lipsesc anumite calități distinctive ale obiectului (de exemplu, prezentarea cerealelor sustrase fără un anumit ambalaj”[2, p. 216].

Se consideră că lista acestor obiecte este destul de extinsă, incluzând cazurile în care, ca probe materiale, apar obiecte de producție în serie, care practic nu prezintă urme de utilizare, reparații sau depozitare. Nu este recomandat să se prezinte pentru recunoaștere, de exemplu, aparatură casnică sau electronică, deoarece recunoașterea, adică identificarea, acesteia este practic imposibilă. Persoana care recunoaște poate doar să confirme că obiectul sustras este exact același model sau tip. În schimb, dacă partea vătămată indică existența unor defecțiuni sau urme de reparații pe asemenea obiecte, ofițerul de urmărire penală poate și trebuie să le descopere și să le înregistreze, dar nu în cadrul prezentării spre recunoaștere, ci în timpul desfășurării unei alte acțiuni de urmărire penal (de exemplu, cercetare la fața locului sau audiere)[1, pp. 49-50].

A. Ia. Dubinski subliniază că „...nu trebuie prezentat spre recunoaștere, de exemplu, un costum complet nou, fabricat în serie"[21, p. 64]. O poziție similară este susținută de A. A. Levi: „nu este oportun să se prezinte obiecte de același model sau marcă, care nu prezintă niciun fel de trăsături distinctive; în astfel de cazuri, recunoașterea este imposibilă"[22, p. 63]. În această privință, B. T. Bezlepkin se exprimă categoric, afirmând că „nu poate fi vorba despre recunoașterea obiectelor furate dacă acestea fac parte dintr-un lot mare de marfă"[23, p. 270].

Regulile procesuale privind prezentarea spre recunoaștere, în special cerința de selecție a obiectelor pentru recunoaștere, nu permit punerea persoanei care recunoaște sarcina de a determina apartenența la un grup (gen, specie, tip) a obiectului, deoarece acesta trebuie să fie prezentat printre obiecte omogene, iar persoana supusă recunoașterii – printre persoane asemănătoare ca aspect (art. 116 alin. 3 și art. 117, alin. 3 din Codul de procedură penală al Republicii Moldova)[24]. Cu alte cuvinte, ofițerul de urmărire penală este cel care trebuie să rezolve sarcina de creare a unui grup omogen de obiecte, adică să stabilească apartenența la un anumit grup a obiectelor prezentate.

Prezentarea pentru recunoaștere a unui obiect în scopul stabilirii apartenenței sale la un grup (ca obiectiv final) nu este, din punctul nostru de vedere, justificată. Trebuie avut în vedere că normele procesual-penale definesc raționalitatea și eficiența aplicării anumitor mijloace și metode din perspectiva consumului timpului de muncă în soluționarea sarcinilor procesului penal. Eficiența în investigare se realizează printr-un sistem diversificat de măsuri și este asigurată prin alegerea și aplicarea celor mai adecvate proceduri, mijloace și metode, corespunzătoare situației de urmărire penală, care permit îndeplinirea sarcinilor concrete ale cercetării faptei în mod optim. Aceasta poate fi realizată, în primul rând, prin efectuarea celei mai eficiente acțiunii de urmărire penală în situația dată și, în al doilea rând, prin utilizarea cât mai corespunzătoare a timpului, eforturilor și resurselor.

Ce observăm, însă, în cazul rezolvării sarcinii de stabilire a apartenenței la grup a obiectului în cadrul prezentării spre recunoaștere: concluzia obținută nu are o valoare probatorie independentă, iar cheltuielile (de timp și materiale) pentru organizarea desfășurării acestei acțiuni procesuale sunt considerabile. Din perspectiva economiei procesuale, poate fi considerat acest demers rațional? Probabil că nu. În cele din urmă, informațiile privind trăsăturile de grup ale obiectului observat pot fi obținute în cadrul audierii, adică prin acțiuni textuale, și nu prin prezentarea efectivă și nemijlocită a obiectului.

Astfel, discuțiile din literatura de specialitate privind definirea scopului prezentării pentru recunoaștere sunt artificiale, deoarece poziția susținătorilor unei interpretări extinse este pur teoretică, fără a contribui la clarificarea teoriei criminalisticii și a procesului penal, precum și a activității practice a organelor de urmărire penală. Din perspectiva logicii și a abordării metodologice, au dreptate acei cercetători care consideră că scopul prezentării spre

recunoaștere constă în stabilirea identității[25, p. 373]. Deci, termenul „apartenență la grup" nu este potrivit pentru definirea scopului prezentării spre recunoaștere, deoarece direcția sa procesuală vizează exclusiv stabilirea identității. Persoanei care recunoaște i se pune întotdeauna sarcina de recunoaștere, iar eventualele concluzii negative sau intermediare nu modifică conținutul acestei sarcini. La baza acestei acțiuni procesuale stă utilizarea capacității psihice de recunoaștere, inerentă omului, iar reglementarea sa procesuală are scopul de a asigura credibilitatea actului de recunoaștere.

Să ne referim la un alt aspect, care reflectă esența prezentării spre recunoaștere. Legiuitorul, definind pentru prima dată esența prezentării spre recunoaștere, dispunea de dezvoltări științifice destul de ample ale criminaliștilor privind premisele și temeiurile psihologice ale actului de recunoaștere, precum și despre cadrul (spectrul) obiectelor supuse recunoașterii. Cu toate acestea, a fost aleasă o cerință nu tocmai precisă și neechivocă față de obiectul recunoașterii – persoana care recunoaște trebuia să fi văzut anterior obiectul.

Este evident că utilizarea termenului „a vedea, a observa" nu cuprinde toate tipurile posibile de percepție a realității obiective de către om. Persoana poate vedea (observa) obiectul de interes pentru investigație și să rețină trăsăturile și caracteristicile sale distinctive. Totuși, ea poate să nu vadă direct o persoană, dar să audă cu atenție vocea sau vorbirea acesteia, remarcând caracteristicile care ulterior îi vor permite să recunoască persoana respectivă.

Dezvoltarea ulterioară a acestei chestiuni nu a avut succes: în art. 116 alin. 1 și art. 117 alin. 1 din Codul de procedură penală al Republicii Moldova, legiuitorul continuă să se refere la prezentarea spre recunoaștere a unei persoane, a unui obiect, pe care persoana care recunoaște le-a văzut anterior. O astfel de poziție creează anumite coliziuni în probatoriu, care, din perspectiva logicii formale, ar trebui excluse din categoria probelor admisibile.

Practica de urmărire penală este bogată în exemple în care partea vătămată (sau martorul) nu a reținut trăsăturile fizice ale infractorului, ci vocea și modul de exprimare verbală ale acestuia. În astfel de cazuri, dacă sunt respectate condițiile și cerințele legii, ofițerii de urmărire penală au efectuat prezentarea spre recunoaștere a persoanei pe baza trăsăturilor vocii și ale vorbirii. Acest lucru nu contravine normei legale, deoarece legiuitorul nu definește trăsăturile concrete după care o persoană poate fi recunoscută, și nici principiilor științifice ale procesului psihofiziologic de recunoaștere, al cărui fundament în reprezintă capacitatea firească a omului de a percepe diverse semne și caracteristici ale obiectelor și fenomenelor lumii materiale.

Astfel, considerăm justificat să insistăm asupra propunerii anterior formulate de numeroși cercetători, și anume de a aduce o modificare în redactarea alin. (1) al art. 116 și alin. (1) art. 117 din Codul de procedură penală al Republicii Moldova, prin înlocuirea cuvântului „*văzut*" cu „*perceput*", astfel încât textul articolelor vizate urmează să aibă următorul conținut: „Persoanele care recunosc sunt audiate în prealabil cu privire la circumstanțele în care au perceput persoana sau obiectul prezentat spre recunoaștere, precum și cu privire la semnele și trăsăturile în baza cărora pot efectua recunoașterea." Această corectare va permite reflectarea mai completă a practicii reale de prezentare a persoanelor spre recunoaștere în procesul penal, atât pe baza trăsăturilor anatomice, cât și a celor dinamice.

Problema precizării obiectelor prezentate spre recunoaștere este direct legată de înțelegerea esenței obiectului identificabil (de identificat) în criminalistică. Din acest motiv, cercetătorii care studiază teoria și practica prezentării pentru recunoaștere raportează

obiectele supuse recunoașterii în trei aspecte: 1) orice obiecte accesibile percepției senzoriale și cunoașterii raționale a omului; 2) obiecte ale identificării criminalistice; 3) obiecte ale prezentării spre recunoaștere ca formă de identificare și acțiune de urmărire penală.

Trebuie menționat că, până în prezent, în știința juridică nu există un consens între cercetători privind posibilitatea și acceptabilitatea cercetării unui obiect în diferitele sale forme de reprezentare (fixat material, mental, descris) în cadrul identificării în procesul investigației judiciare (la urmărirea penală, în procesul efectuării expertizelor judiciare și la examinarea cauzelor penale în instanța de judecată). Totuși, prevalează tendința de extindere a cercului acestor obiecte, inclusiv a obiectelor prezentate spre recunoaștere. Această tendință se explică, în mare parte, prin lipsa cunoașterii specificului cercetării mai multor obiecte, particularităților, proprietăților și trăsăturilor lor, precum și a mecanismului formării urmelor, precum și a altor factori[1, p. 57].

Nivelul contemporan al cunoștințelor criminalistice permite o reconsiderare critică a pozițiilor formulate acum mai bine de 70 de ani, conform cărora „se poate identifica orice, sau cel puțin: evenimente, fenomene, animale, persoane, obiecte cu determinare exterioară, precum și substanțe lichide sau gazoase, pulberi, ale căror proprietăți sunt studiate prin reprezentările lor material-fixate sau ideale”[26, p. 199].

Așa cum se știe, omul este capabil să perceapă orice obiecte materiale și fenomene ale lumii înconjurătoare, precum și genurile și tipurile acestora, cantitățile și calitățile, segmentele de spațiu și perioadele de timp, ființa umană în ansamblu și anumite trăsături ale acesteia, acțiuni exterioare și acte psihice interne ale persoanei, formulând raționamente și concluzii corespunzătoare. În cadrul probatoriului, aceste procese sunt denumite, din perspectiva criminalisticii, diagnostică și identificare. Cu alte cuvinte, obiectele menționate se regăsesc în cadrul diagnosticii, iar doar o parte mai mică dintre ele reprezintă obiecte implicate în procesul de identificare.

Ca obiect care poate fi identificat nu poate fi considerat oricare obiect material, ci doar cel cu o formă exterioară stabilă. Prin urmare, nu pot fi identificate (prin nici o formă de identificare) materialele și substanțele în diferitele lor stări de agregare (cu excepția substanțelor de origine biologică), deoarece, de regulă, este vorba doar despre separarea unui anumit volum sau masă a materialului.

În acest context, recunoașterea unei persoane nu este posibilă pe baza pielii unor părți ale corpului său, a proprietăților părului, a mirosului emanat de haine, lenjerie sau încălțăminte, deoarece persoana care recunoaște poate doar constata existența anumitor trăsături (calități) ale individului, cum ar fi, de exemplu: păr lung, moale, creț; pielea mâinilor uscată, aspră; miros de tutun, parfum, cremă pentru încălțăminte etc. Însă chiar și o asemenea combinație relativ largă de trăsături nu poate fi caracteristică numai unui singur individ, ceea ce înseamnă că nu poate fi vorba despre identificare. Din punctul de vede a mai multor autori (Panfilov P. B., Serghievschii D. A., Starovoitov V. I.), „trebuie respinsă categoric posibilitatea de a prezenta spre recunoaștere o persoană pe baza trăsăturilor olfactive. Totuși, dacă o astfel de identificare se realizează sub forma unei expertize odorologice cu utilizarea unui câine-biodetector (câine), aceasta este științific justificată și legală, utilizându-se criterii obiective și diferite pentru selectarea trăsăturilor identificatoare ale obiectelor comparate”[27, p. 238].

Pe de o parte, se poate afirma că obiectele supuse identificării, în ambele sale forme, sunt aceleași, însă, pe de altă parte, sunt diferite. În majoritatea cazurilor, obiectul poate fi identificat doar prin efectuarea unei expertize judiciare. De exemplu, pentru stabilirea autorului unui manuscris este necesară doar cercetarea prin prisma expertizei, chiar dacă

trăsăturile scrisului de mână sunt percepute vizual. Totuși, identificarea și evaluarea trăsăturilor care individualizează scrisul de mână, în mod calificat, corect și obiectiv, poate fi realizată doar de o persoană competentă – un specialist în acest domeniu al cunoștințelor științifice, adică de un expert.

Astfel, ambele forme de identificare, atât pe baza reprezentărilor material-fixate, cât și pe baza imaginilor mentale, urmăresc același algoritm al procesului de cercetare și al operațiilor logice și sunt echivalente din punctul de vedere al importanței concluziei obținute. Totuși, trebuie avut în vedere că a doua formă are un caracter subiectiv.

Împărtășind poziția lui M. Ia. Segai privind posibilitățile limitate ale conștiinței de a reflecta proprietățile obiectelor materiale ale lumii, considerăm de asemenea că trebuie limitat cercul obiectelor supuse identificării în forma recunoașterii la proprietăți percepute direct de organele de simț, adică obiecte unice, precum persoane, cadavre, obiecte[28, p. 130].

Legiuitorul, soluționând problema obiectelor prezentate pentru recunoaștere, a manifestat mai multă prudență decât criminaliștii, recunoscând ca atare doar persoanele și obiectele. Această listă este, în mare parte, recunoscută unanim ca fiind neconformă cu posibilitățile reale ale capacității de recunoaștere umane. Totuși, definirea cercului obiectelor prezentate spre recunoaștere exclusiv pe baza a ceea ce poate fi perceput de om conduce la extinderea și universalizarea acestei acțiuni, contrar posibilităților reale ale procedurii vizate. Aceasta, la rândul său, duce la neglijarea modului și ordinii stricte de desfășurare a prezentării spre recunoaștere, stabilite prin lege pentru a asigura obiectivitatea și credibilitatea actului de recunoaștere. Poziția multor criminaliști privind obiectele și persoanele prezentate spre recunoaștere se bazează pe posibilitatea procesului psihic de recunoaștere în sine, fără a ține cont de cerințele procesuale privind modul de prezentare a obiectelor și persoanelor, prevăzute în art. 116 și 117 din Codul de procedură penală al Republicii Moldova.

Astfel, terenul sau încăperile propuse ca obiecte pentru prezentarea spre recunoaștere nu corespund regulilor procesuale care reglementează această acțiune procesuală. Cu alte cuvinte, proprietățile unui astfel de obiect împiedică efectuarea prezentării spre recunoaștere în condițiile prevăzute de lege, adică printre obiecte omogene. De exemplu, imobilitatea obiectului nu permite realizarea recunoașterii conform metodei prevăzute de lege. Încălcarea modului de prezentare pentru recunoaștere (de exemplu, prezentarea obiectelor în momente diferite) duce la recunoașterea rezultatelor ca fiind inadmisibile.

Proprietățile menționate mai sus sunt interdependente, dar nu de neînlocuit și nu pot avea semnificație independentă: anumite obiecte unice pot fi prezentate spre recunoaștere, dar nu există obiecte omogene pentru ele; clădirile tipice nu pot fi prezentate simultan, deși cerința de omogenitate ar putea fi respectată. Aceste observații nu înseamnă că obiectele cu astfel de proprietăți nu pot fi obiecte ale recunoașterii. Pot fi, dar în alte forme procesuale. Deoarece prezentarea pentru recunoaștere reprezintă o formă specială, dar nu singura, de echivalare procesuală, se recomandă să se facă o distincție între obiectele prezentate spre recunoaștere și obiectele supuse altor forme de identificare în cadrul urmăririi penale.

Prezentarea spre recunoaștere nu este singura formă de recunoaștere. Este evident că aceasta este potrivită doar în situațiile în care pot fi respectate cerințele procesual-penale privind obiectele și condițiile de prezentare spre recunoaștere. Diversitatea situațiilor de urmărire penală și a datelor inițiale impune îmbinarea proceselor de recunoaștere cu alte acțiuni procesuale. De exemplu: anumite obiecte sau documente pot fi prezentate unei persoane în cadrul audierii; ofițerul de urmărire penală are dreptul să invite partea vătămată sau proprietarul obiectelor să participe la percheziția efectuată la bănuit/învinuit, pentru

recunoașterea obiectelor sau bunurilor sustrase. În timpul efectuării percheziției, ofițerul de urmărire penală, în căutarea probelor materiale, trebuie să compare trăsăturile obiectelor descoperite cu cele menționate în descrierea obiectului sustras (în procesul-verbal al audierii părții vătămate sau martorului, în fișa de evidență a obiectului sustras). În aceste cazuri, recunoașterea reprezintă un element integrant al unei alte acțiuni procesuale efectuate.

În anumite cazuri, acțiunea de identificare poate fi realizată prin cercetarea la fața locului. De exemplu, identitatea victimei poate fi stabilită prin compararea imaginii de pe fotografia din actul de identitate găsit asupra sa cu fața cadavrului descoperit. Concluzia privind identitatea poate fi trasă numai dacă ofițerul de urmărire penală descrie în procesul-verbal al acțiunii procesuale, în detaliu, prin metoda portretului verbal, trăsăturile fizice ale cadavrului descoperit și trăsăturile feței din fotografia respectivă și le compară între ele. În aceste cazuri, rezultatele obținute sunt evaluate, apreciate împreună cu alte circumstanțe stabilite în cadrul desfășurării acțiunii principale de urmărire penală[1, pp. 67-68].

Astfel, decizia ofițerului de urmărire penală de a efectua o anumită acțiune procesuală, inclusiv prezentarea spre recunoaștere, trebuie să fie dictată de obiectivele urmărite, de conținutul datelor inițiale disponibile, de absența oricăror impedimente în desfășurarea acțiunii (interdicții legale, obstacole de fapt, considerente de oportunitate tactică) și de posibilitatea reală de efectuare a acesteia.

Se știe că același fapt poate fi stabilit prin efectuarea diferitelor acțiuni de urmărire penală, iar în unele cazuri realizarea uneia dintre ele împiedică desfășurarea alteia (de exemplu, efectuarea unei confruntări între bănuit și martor exclude ulterior prezentarea bănuitului pentru recunoaștere acelui martor) sau o face inutilă, adică neavantajoasă și din perspectiva economiei de timp. Specificitatea recunoașterii ca proces psihic obligă ofițerul de urmărire penală, atunci când alege prezentarea spre recunoaștere și stabilește forma procesuală a acesteia, să țină cont de numeroși alți factori. De exemplu, este foarte important să se clarifice natura, caracterul interacțiunii anterioare dintre persoana care recunoaște și obiectul recunoașterii, deoarece aceasta determină, în mare măsură, forma procesului de recunoaștere.

Analiza legii și studiul esenței recunoașterii ca mecanism și proces de identificare, adică a ansamblului de procese psihice succesive, conduc la concluzia că acțiunea procesuală (de urmărire penală) reglementată de lege – prezentarea spre recunoaștere – reprezintă doar una dintre modalitățile posibile de utilizare a capacității de recunoaștere a omului pentru identificarea obiectelor în scopul obținerii probelor judiciare[1, p. 68].

4. Concluzii și recomandări

Scopul prezentării spre recunoaștere constă în stabilirea identității între imaginea mentală reținută în memoria persoanei care recunoaște și unul dintre obiectele prezentate pentru a fi recunoscute. Prezentarea unui obiect pentru recunoaștere cu scopul stabilirii apartenenței sale la un grup (similarității) nu este justificată. Persoanei care recunoaște i se pune sarcina de recunoaștere, iar eventualele concluzii negative sau intermediare nu modifică conținutul acestei sarcini. La baza acestei acțiuni de urmărire penală stă utilizarea capacității psihice de recunoaștere, inerentă omului, iar reglementarea sa procesuală are scopul de a asigura credibilitatea actului de recunoaștere.

Urmează a fi efectuate modificări în textul alin. (1) al art. 116 și în alin. (1) al art. 117 din Codul de procedură penală al Republicii Moldova, aici urmând să se regăsească următoarea formulare: „Persoanele care recunosc sunt audiate în prealabil cu privire la

circumstanțele în care au perceput persoana sau obiectul prezentat spre recunoaștere, precum și cu privire la semnele și trăsăturile în baza cărora care pot efectua recunoașterea".

Cercul obiectelor prezentate spre recunoaștere trebuie stabilit nu doar pe baza capacității firești a omului de a recunoaște obiectele materiale, ci și în conformitate cu modul și ordinea strict prevăzute de lege pentru desfășurarea acestei acțiuni de urmărire penală, care asigură obiectivitatea și credibilitatea actului de recunoaștere.

Prezentarea pentru recunoaștere nu este singura formă de recunoaștere. La acțiunile procesuale de identificare pot fi incluse și alte acțiuni precum cercetarea la fața locului, examinarea corporală, percheziția, ridicarea de obiecte, verificarea declarațiilor la locul infracțiunii, experimentul judiciar. În aceste cazuri, recunoașterea reprezintă un element integrant al acțiunii procesuale efectuate.

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