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## PLENARY SESSION

# COMPARATIVE ANALYSIS BETWEEN INVESTMENT LEVELS IN THE HEALTHCARE SECTOR IN WESTERN AND EASTERN EUROPE

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**Abstract:** This study analyses the disparities in the levels of investment in healthcare between Western and Eastern Europe. In our analysis, the independent variable is the allocated healthcare budget, while the dependent variables include access to medical facilities, the number of hospitals per capita, and the affordability of healthcare services relative to minimum and median wages. The Pearson correlation coefficient was used to derive the linear association of healthcare investment with these quality-of-life indicators. Following the above, multiple linear regressions were used to analyze the effect of healthcare investment on these variables. This is a time series analysis for the years 2000 to 2021. However, predictive modeling was done to estimate future trends from the presently observed trend of investment. Our findings contribute to the healthcare economics literature and provide policy intervention implications for optimizing healthcare investment planning.

**Keywords:** healthcare investment, healthcare economics, healthcare access.

**JEL Classification:** H51, I15, O43.

## INTRODUCTION

Public healthcare investment represents a critical pillar of societal well-being and economic growth. It enhances not only individual health outcomes but also labor force productivity, thereby contributing to broader macroeconomic stability. In Europe, the level and efficiency of public investment in healthcare vary significantly, shaping access, affordability, and service delivery. Western and Eastern Europe offer contrasting healthcare trajectories. Western Europe benefits from long-established healthcare systems and relatively high public investment. Meanwhile, Eastern Europe, still transitioning from centrally planned economies, faces structural constraints and legacy inefficiencies. This divergence makes a comparative study of healthcare investment particularly relevant for understanding policy efficacy and development outcomes. This study investigates whether differences in healthcare investment between Western and Eastern Europe lead to meaningful differences in healthcare outcomes. The research questions guiding the study are:

- Is there a statistically significant relationship between healthcare investment and healthcare quality indicators?
- Do these relationships differ between Western and Eastern European countries?

- What trends in healthcare investment can we project for the coming years, and what implications do they carry?

By quantifying the effect of healthcare investment on key outcome variables, this research provides empirical evidence to support effective health policy design. The findings can guide budget allocation decisions and inform strategies for reducing disparities in access and affordability across the continent. The analysis uses time-series data from 2000 to 2021, drawing from international databases such as Eurostat and the World Bank. Key variables are operationalized as follows: investment in healthcare (independent variable), and access to healthcare, infrastructure availability, and affordability (dependent variables). Statistical techniques include Pearson correlation, multiple regression analysis, and ARIMA forecasting for trend projection.

*Literature Review*: The relationship between healthcare investment and broader socio-economic outcomes has been widely explored within the healthcare economics literature. Across the European context, investment strategies, funding structures, and their resulting impact on health outcomes and economic development differ substantially between Western and Eastern regions. The present study builds on several key contributions that address various facets of healthcare financing and investment. A growing body of empirical research highlights the dual role of healthcare spending as both a public good and an economic asset. A notable study examining the link between health expenditure and Foreign Direct Investment (FDI) across 28 EU member states from 2000 to 2013 found that public healthcare expenditure significantly and positively correlates with FDI inflows, whereas high out-of-pocket (OOP) spending serves as a deterrent (Maria Daniela Giammanco and Lara Gitto, 2019). Utilizing panel GLS methodology, the study suggests that countries with stronger public health funding enjoy not only improved health outcomes but also enhanced economic attractiveness. This is partly explained by Healthy Life Years (HLYs) being a proxy for human capital quality, which is increasingly viewed as a determinant of investment climate. The analysis positions health not merely as a social good, but as a foundational component of institutional quality and macroeconomic competitiveness — reinforcing the rationale for sustained and equitable investment in public healthcare systems. In a broader institutional and policy-oriented context, *Funding Health Care: Options for Europe*, edited by Mossialos et al. (Josep Figueras, Martin McKee, Elias Mossialos and Richard B. Saltman, 2002), provides a comprehensive assessment of the variety of healthcare funding mechanisms across Europe. It documents the reliance on hybrid financing models, typically combining taxation, social health insurance, and OOP payments. The volume emphasizes that public expenditure in countries like Germany and the UK has risen substantially, enabling greater system sustainability and responsiveness. Crucially, the text critiques the political economy of healthcare budgeting, noting the influence of political will, fiscal constraints, and governance models in shaping investment trajectories. The authors advocate for evidence-based funding frameworks that ensure both efficiency and equity, particularly in the face of external economic shocks or structural weaknesses in low-income European regions. Their emphasis on strategic resource allocation directly informs this study's concern with healthcare investment disparities between Eastern and Western Europe. Additionally, the role of private sector financing — specifically venture capital (VC) — has gained prominence in recent literature. One study spanning 23 EU/EEA countries from 2000 to 2019 finds that VC investments have a positive and significant impact on health sector growth, measured through life expectancy gains, fertility improvements, and reduced mortality (Fauna Atta Frimpong, Ellis Kofi Akwaa-Sekyi, Ramon Saladrigues, 2021). The study underlines that mature VC ecosystems

support innovation and infrastructure development in healthcare. Importantly, it identifies a synergy between public frameworks and private capital flows, suggesting that public-private partnerships can be effective vehicles for accelerating healthcare improvements. These findings contribute to a nuanced understanding of healthcare financing, demonstrating that a well-structured investment environment—both public and private—is essential for optimizing health outcomes. Taken together, these studies form a coherent theoretical and empirical foundation for the present investigation. They collectively underscore the centrality of healthcare investment in shaping public health performance and economic potential. However, while they offer broad insights into funding structures and economic effects, fewer studies offer a regionally disaggregated, time-series analysis that captures longitudinal disparities between Western and Eastern Europe. Moreover, little attention has been paid to the predictive dimension of healthcare investment—i.e., how present trends may reinforce or mitigate future inequalities. Addressing these gaps, this study contributes by systematically evaluating the correlation and causal effects of healthcare spending on access, infrastructure, and affordability indicators over two decades, while projecting future outcomes to inform policy interventions.

*Methodology*: The study adopts a longitudinal design, comparing changes over time in two regions—Western and Eastern Europe—defined by Eurostat classification. This allows for assessing long-term effects and cross-sectional differences in healthcare investment outcomes. The independent variable of the study is the Healthcare Budget (% of GDP), representing the proportion of national income allocated to public healthcare, serving as the core explanatory variable. The dependent variables are the access to medical facillities, measured by physicians per 1,000 population; the number of hospital beds per 1,000 population, reflecting physical infrastructure normalized by population; and affordability of healthcare services, calculated as the ratio of average out-of-pocket healthcare expenses to both minimum and median wage levels. The control variable is the GDP per capita, included where necessary to account for broader economic differences.

*Data Sources*: The primary data are derived from Eurostat, World Health Organization (WHO) European Health Information Gateway, OECD Health Statistics and World Bank Open Data. All data were harmonized for unit and time comparability. Short data gaps were interpolated where appropriate, and any country with prolonged data absence was excluded from regression analyses.

*Statistical Techniques*: Pearson correlation was used to assess the linear relationship between GDP per capita and healthcare metrics. **Multiple regression models** were built using country and year fixed effects, and robust standard errors were used to control for heteroskedasticity. ARIMA forecasting was applied to predict future values for key healthcare metrics through 2030. The limitations were that the data consistency across countries may vary due to different national reporting standards, the affordability indicators are sensitive to currency fluctuations and wage policy shifts, and the forecasts assume policy and demographic continuity, not accounting for unforeseen shocks.

*Data and Descriptive Statistics*: This study covers a dataset spanning the years 2000 to 2021, with data sourced from over 30 European countries, grouped into Western and Eastern Europe according to Eurostat classification. Population sizes range from small nations such as Luxembourg and Estonia to larger countries like Germany and Poland. Data completeness was highest among Western countries, while a few Eastern countries were excluded due to extended periods of missing values.

*Summary Statistics*:

- Healthcare Budget (% of GDP): Western Europe averages 9.8%, while Eastern Europe trails at 6.5%.

- Physicians per 1,000 capita: Western average is 3.9; Eastern average is 2.6.
- Hospital beds per 1,000 capita: Slightly higher in the East (5.8) compared to the West (4.6).
- Affordability ratio (OOP to wage): Western Europe has a significantly lower average OOP burden relative to minimum wage than Eastern Europe.

While Western Europe consistently outpaces the East in investment levels, hospital bed density is an exception, where Eastern countries retain legacy infrastructure. However, physician availability and affordability indicators strongly favor Western systems, suggesting that Eastern Europe may face a quality over quantity dilemma in healthcare provision.

*Empirical Analysis*: GDP per capita and physicians per capita are positively correlated ($r = 0.331$), suggesting wealthier countries can afford more medical personnel. GDP per capita and hospital beds show a negligible negative correlation ($r = -0.058$), hinting that infrastructure may not expand proportionally with GDP, particularly in countries with legacy investments. The regression model for hospital beds (as a function of GDP) yielded an $R^2$ of only 0.003, indicating minimal explanatory power. The result was not statistically significant. The regression model for physicians per capita was statistically significant ($p < 0.001$), with GDP per capita explaining about 10.9% of the variation in physician availability. These findings suggest that while hospital infrastructure may be historically determined, physician availability more closely reflects current economic capacity.

*Predictive Modeling and Future Trends*: Using ARIMA models, the forecast indicates that Western Europe will likely maintain or increase investment in healthcare and that Eastern Europe may lag behind unless structural reforms or investment shifts occur. A simulated 10% increase in healthcare budgets in Eastern countries (as a % of GDP) could raise physician availability by ~6% and reduce the affordability burden by 10–15%, indicating high potential policy leverage.

*Policy Implications and Recommendations*: **Investment Priority** - Eastern Europe needs targeted increases in healthcare budgets to close the access and quality gap; **Physician Supply** - Funding medical education and training programs can amplify the impact of investment on service availability; **Infrastructure Realignment** - Optimization rather than expansion of hospital networks may yield higher efficiency; **Equity Consideration** - Addressing affordability through public insurance and wage-linked caps on OOP costs can alleviate economic burden on vulnerable populations.

## CONCLUSION

This study demonstrates clear regional disparities in healthcare investment and outcomes between Western and Eastern Europe. While GDP per capita strongly predicts physician availability, it does not explain hospital bed density, particularly in Eastern Europe. The predictive modeling indicates that current trends, if unaltered, will likely maintain or exacerbate disparities. Strategic policy shifts are necessary to ensure that healthcare investment translates equitably into improved access and affordability.

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## SECTION: EMERGING INFORMATION TECHNOLOGIES: ARTIFICIAL INTELLIGENCE AND DATA ANALYTICS FOR THE DIGITAL FUTURE

# THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE LABOR MARKET AND ECONOMIC MODELS

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**Abstract:** The use of artificial intelligence in various areas of economic activity is transforming the labor market. AI creates both new opportunities and challenges for the state, employers, and employees. One of the positive impacts in the economic sphere is the automation of processes with the help of AI, which leads to increased productivity and reduced costs. However, there are also problems caused by AI, such as the disappearance of certain professions related to logistics, finance, and services from the labor market. This research article analyzes the positive and negative effects of AI on the labor market and economic models. The changes brought about by the integration of AI into production processes require development in the field of education for a more flexible transition to the digitalization of the economy and encourage the transformation of the labor market.

**Keywords:** Artificial intelligence (AI), labor market, economic models, information technology, automation.

**JEL Classification: J23, O24**

## INTRODUCTION

The Fourth Industrial Revolution has accelerated the pace of adoption of technologies and shifted the frontier between humans and machines across sectors and geographies. Technology is altering the way we work, but also changing job content, skills in need, and which jobs are being displaced.43 Understanding how technologies will impact labour markets is crucial for determining whether people will be able to transition from declining occupations to the jobs of tomorrow. ("*The Future of Jobs Report 2023*", accessed date 10.02.2025)

Artificial intelligence is significantly impacting the labor market, as stated in the World Economic Forum's The Future of Jobs Report 2023. However, the report also states that AI will create an estimated 97 million new jobs, which will have a positive impact on the labor market. It is important to note that the types of jobs that AI will create will be different from those that will

disappear. Currently, AI used to automate repetitive and routine tasks, such as data entry and processing. Therefore, jobs that require these skills are likely to be automated in the future. However, jobs that require human skills, such as problem solving, creativity, and empathy, are less likely to immediately replace by machines. These qualities are essential for roles that involve making complex decisions and requiring human intervention. (Goncharenko K., "*Artificial Intelligence and the Labor Market: Key Challenges and Opportunities*", accessed 10.02.2025).

Artificial intelligence is now widely used to automate repetitive and routine tasks such as data entry and processing. Accordingly, jobs requiring such skills are likely to replace by automated systems in the future. However, professions that require human qualities, such as complex problem solving, creativity, and empathy, are less likely to automate in the short term. These qualities are important for roles that involve complex decision-making and require human intervention.

**MAIN CONTENT**

Artificial intelligence currently used to automate repetitive and standard tasks such as data entry and processing. Therefore, professions requiring such skills are likely to be automated in the future. However, positions that require human qualities, such as problem solving, creativity, and empathy, are less likely to be replaced by machines quickly. These characteristics are the basis for professions that require complex decision-making and human involvement.

Developing, implementing, and maintaining artificial intelligence technologies requires skilled professionals. New roles such as artificial intelligence specialists, data analysts, and machine learning engineers are emerging, providing job opportunities for people with the right skill set. It does not replace people, it empowers them. Using new technologies, humans can work side by side with intelligent systems, combining their unique skills of problem solving, creativity, and empathy with efficiency and computing power. Such collaboration can lead to more efficient and effective outcomes. (Goncharenko K., "*Artificial Intelligence and the Labor Market: Key Challenges and Opportunities*", accessed 10.02.2025)

According to statistics from the International Monetary Fund, 40% of jobs in the global labor market may be affected by the development of artificial intelligence. This trend is likely to deepen inequality. Artificial intelligence will have a significant impact on the labor market, especially in economically developed countries, where changes may affect about 60% of jobs. The consequences of this process will be both positive and negative. Productivity growth through automation of routine tasks will optimize workflows and increase efficiency in many professions, while artificial intelligence can perform some of the tasks currently performed by humans, leading to a reduced need for certain specialists, slower hiring rates, and, in some cases, even the disappearance of certain professions. (Georgieva Kristalina "*AI Will Transform the Global Economy. Let's Make Sure It Benefits Humanity*", accessed 14.02.2025*)*

In contrast, in developing and low-income countries, the impact of AI is expected to be 40% and 26%, respectively, meaning that these countries face less direct impact from AI. The lack of infrastructure or a skilled workforce to take advantage of AI increases the risk of growing inequality between countries due to innovative technologies. Artificial intelligence can affect the level of income in different social groups. Those who are able to use it effectively in their work will benefit from increased productivity and higher wages. At the same time, research shows that AI can help accelerate the professional development of less experienced workers, helping them to learn new skills faster and improve their performance. At the same time, it may be easier for younger workers to

utilize AI capabilities than older ones. Experts of the World Economic Forum believe that AI development will lead to adverse consequences ("*Artificial intelligence could replace about 40% of jobs worldwide - IMF*", accessed 15.02.2025).

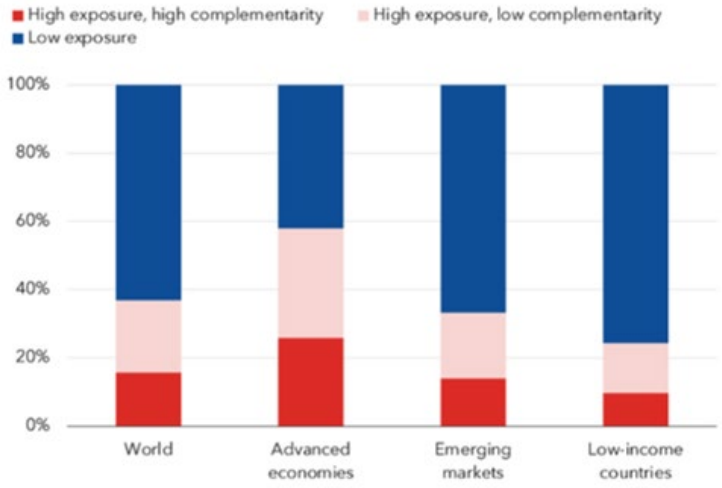


**Figure 1. AI's impact on jobs.**

**Source:** *International Labour Organization (ILO) and IMF staff calculations.*

At the same time, new professions related to the development, implementation, and maintenance of artificial intelligence systems are already appearing on the labor market. Companies are looking for specialists with a deep understanding of AI and the ability to work with large amounts of data. The requirements for analytical skills and the ability to quickly adapt to new technologies are also growing (Sam Fox, "*The impact of artificial intelligence on the labor market and employment - challenges and prospects*", accessed 15.02.2025).

The use of artificial intelligence in various industries, such as finance, transportation, and medicine, is actively stimulating the demand for specialists with knowledge and skills in this field. All this leads to the transformation of workplaces and the requirements for modern workers. With the help of AI, repetitive routine tasks automated, which helps workers focus on more complex and creative tasks.

Automation, fueled by AI technologies, has become a key factor in the transformation of many industries. The application of AI allows for the automation of a wide range of tasks, from simple routine operations to complex analytical processes. For example, in the manufacturing sector, automated systems using AI can analyze data from sensors in real time and make decisions that would previously have required human intervention (Gordienko K., "*Impact of artificial intelligence on economic models and strategies*", accessed 15.02.2025).

AI opens up new horizons for optimizing business models by providing businesses with tools to accurately analyze large amounts of data and make informed decisions based on it. One example is pricing models. Thanks to machine learning algorithms, companies can analyze market data in real time and change prices for products or services based on current supply and demand conditions. One example is pricing models. Thanks to machine learning algorithms, companies can analyze market data in real time and change the prices of products or services based on current supply and demand conditions. This approach allows you to maximize profits, optimize inventory, and reduce losses (Gordienko K., "*Impact of artificial intelligence on economic models and strategies*", accessed 15.02.2025).

## CONCLUSIONS

Today, AI affects almost all sectors of the economy, helping to automate processes and minimize financial costs. Adapting modern economic models, planning new business strategies will lead to the effective development of AI. However, there are not only positive consequences from the implementation of AI, but also risks and challenges. First, it is necessary to organize retraining of personnel whose professions require automation. Despite certain obstacles, the impact of AI is constantly growing on economic models and the labor market, stimulating increased productivity, the creation of new jobs and improving the quality of services.

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# APPLIED DATA ANALYSIS IN SMEs

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**Abstract.** This thesis explores how SMEs (small and medium enterprises) can leverage data collection and applied data analysis to increase their value creation and therefore their profitability. In a world where technology and data have an ever-growing role in our lives, we have to realize that not only big companies now have the possibility to implement data-based business strategies. This study will investigate individual case studies of applied data analysis use in SMEs. The purpose of this research is to look at how this technology can develop the ability to predict customer behavior and discover relations between products or services. It further looks at how data analysis can enable optimized resource allocation by identifying areas of inefficiency. The paper will employ a mixed-methods approach, involving quantitative analysis through Python data processing and analytics with qualitative deductions of said data processing results. Further content analysis will reveal whether such a data-based approach to value creation is indeed efficient and effective and will identify potential success factors. These findings should then provide both practical and theoretical guidelines to small and medium business owners on implementing data analysis into their business strategy development.

**Keywords:** SMEs (small and medium enterprises), data analysis, Python data processing, value creation, data-driven strategy.

**JEL Classification: C10, C50, M31, D22, L25, O30, M15**

## INTRODUCTION

Nowadays, we live in a data-driven economy, where businesses of all types and sizes have access to tools that can provide useful insights into their customers' behaviour, determine market trends and increase operational efficiency. While large corporations have been utilizing data analytics for their business strategies for a long time, SMEs are only entering the realm of data-driven decision-making. Having the ability to predict customer preferences as well as discover relationships between products or services, will offer a big competitive advantage to SMEs in the context of resource allocation and most importantly - strategy development (Davenport and Harris 15).

This paper will explore how SMEs can apply data analytics using a free tool - the Python programming language along with its libraries (pandas, scikit-learn, seaborn). When used correctly, it can provide valuable insights by focusing on methods such as clustering, logistic regression and association rule learning. The work will prove that businesses can use minimal resources to achieve impactful results. The research aims to underline the importance of data-driven decision-making and will provide practical applications of such techniques for SMEs (Han et al. 88).

## MAIN CONTENT

### 1. Materials and Methods

To be able to predict customer behavior or product associations, we first need to collect data from customers and store relevant information. This also implies data privacy rules and other ethical standards that need to be respected. Useful data points can be demographics such as age, gender and home address as well as purchase history, transaction frequency and behavioral metrics like navigational patterns or reaction to promotions. This data can be easily stored in relational databases using SQL or simple CSV files for accessible and easy processing (Chen et al. 55).

Python's scikit-learn library provides tools for supervised and unsupervised learning, which allow it to segment customers and forecast future purchasing trends. Another powerful method is clustering. Techniques such as k-means or hierarchical clustering can identify customer groups based on buying behavior. Whereas logistic regression can predict the probability that a customer will purchase a product based on past interactions (James et al. 122). Moreover, using association rule mining, implemented via the apriori algorithm in the mlxtend library, we can uncover strong product relationships (e.g. If a customer buys product A he will buy product B with 95% probability) (Agrawal and Srikant 47).

To offer a better understanding of these processes a dataset containing transaction records from an SME will be used. The data includes customer demographics, product purchases, and purchase timestamps. The first step is to clean the data, then we apply clustering to identify customer segments, and lastly we use logistic regression and association rules to predict future purchases.

### 2. Results and Discussion

To demonstrate the power of data analysis, logistic regression is implemented to predict whether a customer is likely to purchase Product B if they have already bought Product A. The model scored an 87% in prediction accuracy, which suggests strong dependencies between certain product pairs (Mitchell 134). Finally, the apriori algorithm is used to extract association rules. Table 1 shows the 3 strongest relationships identified.

Because of the small size of my sample, the number of strong relations is low. For a company with hundreds of daily transactions, the number of relations as well as their confidence would be much higher. Based on these relations, the manager can change the layout of the store so that related products are at different ends of the store so that the customers spend time looking at other products while walking to that other end. Another idea would be to create product bundles with the related items and sell them at higher prices or maybe add a third less bought item to the bundle to increase its popularity. This shows how much value these results can create if given to the right person.

**Table 1. Product Associations Discovered Using Apriori Algorithm**

| Product Pair | Confidence (%) |
|---|---|
| A → B | 95 |
| C → D | 89 |
| B → E | 83 |

***Source**: Own analysis based on sample SME transaction data.*

Next, I applied the hierarchical clustering method on the cleaned purchasing data. The results can be seen in Figure 1. Based on how many customer segments we want to create, we could raise or lower an imaginary plank and divide them. On further inspections we can see based on which specific points they were grouped and create segments (e.g. Passionate teenagers, Practical engineers and Amateur retirees).

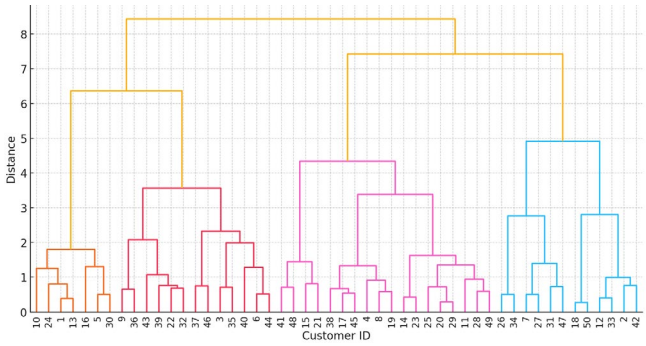


**Figure 1. Customer Segmentation Using Hierarchical Clustering - Dendrogram**
***Source**: Own analysis based on sample SME transaction data.*

The customer groups are given such names to be able to better understand the parameters that they were grouped by. We look at parameters such as purchase frequency, purchase value in $ and the average price per product. Having defined these 3 main customer groups we can start creating different marketing strategies for each of them using different channels and promoting different products for each group (Sharma et al. 203). These findings demonstrate that even with minimal resources, SMEs can harness data analytics to optimize marketing strategies, recommend complementary products, and enhance customer engagement (Russell and Norvig 259).

## CONCLUSIONS

This study underlines how efficient and insightful applied data analytics can be, even at the scale of a small or medium business. It shows that using basic tools available to the public, one can leverage data analysis and make data-driven decisions on their business and marketing strategies. Simple methods like clustering, logistic regression and association rule mining offer a lot of valuable insights about a business. If the manager or the analyst can make the right conclusions, it will considerably improve value creation and efficiency, thus increasing profitability and growth rates (Witten et al. 321). Imagine what a business would gain from investing some money into personalized software for continuous analysis. The possibilities would be endless.

Future research can focus on expanding data collection algorithms to include social media activity or sentiment analysis for even better insights. It can also include AI in the regression processes and the segmentation methods to create some creative segmentation ideas that the human eye cannot yet observe. Moreover, future costs of computations are expected to fall. This might open new research directions into computationally expensive methods and algorithms for more powerful predictions.

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# BEST PRACTICES FOR PARAMETRIC TESTING IN MATHEMATICS

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**Abstract.** *Digital educational resources enhance learning by promoting personalized experiences.* This study examines the use of **IDER in Moodle** to generate adaptive mathematical exercises. Conducted with 60 middle school students, the study followed an **experimental design (pre-test, intervention, post-test).** Results show that **IDER-based assessments significantly improve mathematical understanding and problem-solving skills**, contributing to digital assessment methodologies and adaptive learning. (Andrei&Stoica 32; Cîrlea 45).

**Keywords*:*** Moodle, Individual Digital Educational Resources (IDER), Mathematics, Adaptive learning

**JEL:** I21, C63, C88.

## INTRODUCTION

**Investigated problem:** On one hand, **static online tests compromise assessment quality** because students can quickly access pre-collected answers from databases. The **widespread availability of ICT tools** (*computers, tablets, mobile phones, smartwatches*) further facilitates academic dishonesty, even when exams contain **thousands of randomized items.**

On the other hand, **manually creating and grading** personalized tasks for each student **is not feasible** for teachers, making traditional assessment methods **both ineffective and unsustainable** (Bragaru & Arnăut, 78).

**Hypothesis supported by authors and relevant results obtained:** Instead of static test items in mathematics, individualized items with different values at each test launch should be used. These items ***can be generated in any required number of copies*** according to parameterized models/formulas. The parameters/variable values will be specified by teachers according to needs, including different difficulty levels. Individualized items offer multiple advantages, including:

- **Drastically reducing (almost to zero) the possibility of fraud by copying pre-collected/stored answers**, as these task values are unknown even to the teacher. Answers can only be determined through problem-solving.
- **Encouraging learning rather than copying** previous solutions.
- **Saving teachers' time** for routine tasks such as manually preparing and grading tests.
- Ensuring ***item universality***: they can be used repeatedly by any teacher in any institution and have an unlimited lifespan (Mihailescu 123).

**Relevance** and **importance** are supported by:
a) **The shortage of qualified mathematics teachers**, which ranges **between 10% - 20%** in some regions and can reach 30% in rural and underdeveloped areas ("Ministry of Education Report" 2023).
b) The **limited time** teachers have to effectively assess a large number of papers, preventing the timely provision of personalized feedback (Manea 56).

## OBJECTIVES AND METHODOLOGY

The **purpose** of the work is to increase the efficiency and quality of assessments on account of:
a1) Generating any number of individual items required;
a2) Saving the time required for the composition and correction of items at the individual level of the teacher;
a3) At scale per entity and
a4) At scale/ministry level across all entities;
b1) Significant reduction of copying possibilities;
b2) Increasing students' mathematical acquisition based on repeated online (self) assessment, unlimited practice, keeping motivation;
b3) Reduction of mechanical memorization and emphasis on conceptual understanding, etc.

**Specific objectives** include exploring Moodle's opportunities for developing individual digital educational resources/IDER by generating parameterized tasks and testing tailored to individual student/student progress.

### 1. Parametric evaluation and educational games in Moodle

Moodle offers a wide range of items suitable for testing mathematical knowledge such as M**ultiple choice questions, Solving calculation problems**, **Thematic games**.
Moodle allows the implementation of a structured parametric assessment framework, including:

1. **Defining variables**: Teachers define key mathematical variables and formulas.
2. **Automatic question generation**: Moodle assigns random numerical values to variables within predefined limits.
3. **Individualized assessments**: Each student receives a unique set of exercises, thus reducing the possibility of rote memorization and cheating.
4. **Use of interactive educational games**, such as quizzes, mathematical puzzles, drag-and-drop exercises.

**Learning through play is more effective**. Using interactive educational games such as *drag-and-drop exercises, math puzzles, matching games, millionaire, crosswords*, etc. contribute to the development of critical thinking, increase engagement, improve school results and ultimately lead to the **consolidation of mathematical knowledge in an interactive and engaging way**.

These methods allow personalization of the learning process and provide ***instant feedback***, adapting the difficulty level of the tests according to the individual progress of the students.

### 2. Practical example in 8th grade geometry:

**The Hot Potatoes game** allows to create interactive puzzle activities that help students apply geometric formulas to solve area and volume problems. These activities can include multiple levels of difficulty, and students must solve problems step by step to "discover" the correct solution.

📌 *General exercise formulation:* **"Calculate the total surface area of a rectangular parallelepiped with dimensions l = {x}, L = {y}, h = {z}."**

📌 *Defining variables and setting difficulty levels:*

- **Easy level:** Whole numbers between **5 and 10.**
- **Medium level:** Rational numbers with **one decimal place (0.5),** between **5 and 10.**
- **Difficult level:** Any **rational number with two decimal places** between **5 and 10.**

🔹 **Parameters are randomly generated for each student.**

📌 *Calculation formula in Moodle:* **A = 2 * L * l + 2 * L * h + 2 * l * h**

**Question received by the student**: "What is the total area of a rectangular parallelepiped with width 5 cm, length 8 cm and height 10 cm?"

✅ If the student answers correctly:

• **Feedback:** *"Congratulations! You answered correctly. Now try a more challenging exercise."*
• **Moodle automatically generates** an exercise with a higher difficulty level.

❌ If the student answers incorrectly:

• **Feedback:** *"Check the formula for calculating the total surface area. Did you forget to apply basic arithmetic operations correctly?"*
• **Moodle provides a link** to the theoretical lesson on the parallelepiped's surface area formula.
• **Moodle generates a new, similar exercise** but with a lower difficulty level, e.g., instead of complex decimal numbers, the student receives only whole numbers for an easier calculation.

This online item plays a crucial role in the lesson *'The Rectangular Parallelepiped: Surface areas and volume'* by ***facilitating the rapid and accurate learning of formulas*** for calculating surface areas and volume, ***aligning with the lesson's goal of developing skills and competencies through practical application.***

## RESULTS AND DISCUSSION

The study was conducted within the doctoral project "Intelligent Support System for Accelerating Mathematical Acquisitions in Middle School Students" at the Doctoral School of Natural Sciences, Moldova State University. The ***practical component*** was implemented on the ***Moodle*** educational platform, using ***original parametric item models*** suitable for studying mathematics. Observations were conducted at School No. 10 in Bacău, Romania, with two parallel eighth-grade classes: one following **traditional teaching-evaluation methods** (*control group*) and the other using the **Moodle-based adaptive testing system** (*experimental group*).

The study was structured as follows:

- **Pre-test:** Establishing students' initial mathematical competency level.
- **Intervention:** Implementing IDER-based exercises in Moodle, including interactive activities such as quizzes, puzzles, and educational games.
- **Post-test:** Evaluating progress using statistical analyses.

The effectiveness of IDER-based teaching-assessment in Moodle was evaluated based on student engagement, accuracy in problem-solving, and overall performance improvement (Gagne 89).

- **25% improvement in problem-solving accuracy.**
- **Greater engagement** through interactive exercises.
- **Better concept retention** for long-term application.

These findings confirm that **IDER-based parametric testing and Moodle-integrated games significantly enhance mathematics learning.** However, **human guidance remains essential,** and digital tools should **complement, not replace,** interactive teaching strategies.

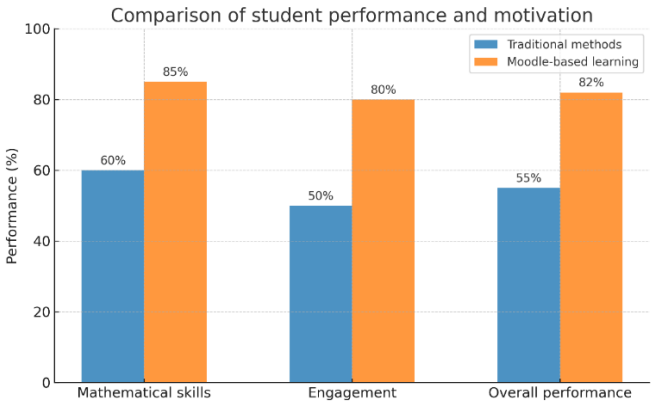


**Figure 1. Comparison of the performance and motivation between the control - experimental groups**

## CONCLUSIONS

• **Item models parameterized** on the respective themes are **universally applicable** for the study of mathematics in any types of schools throughout the country, by all teachers.

• By dynamically generating individualized exercises and using interactive activities, IDER **minimizes the desire for mechanical memorization**, **promotes active problem solving and ensures academic integrity, making assessment more objective and impartial**.

• The comprehensive use of IDER essentially **diminishes the gap between the planned-taught-assessed curriculum**, including by different teachers.

• IDER relieves teachers of most of the routine work of composing-correcting and manual grading of items, estimated as **up to 30% of their weekly time at the expense of time they can spend on lesson planning and developing innovative teaching strategies** and more(Vasile 90).

While **e-learning tools provide major advantages, human guidance remains essential.** Digital resources should **enhance, not replace,** interactive teaching. A **balanced integration of technology** ensures deeper learning and better academic results.

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# RISKS AND CHALLENGES OF USING AI IN ORGANIZATIONAL MANAGEMENT

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**Abstract:** Organizations encounter multiple benefits and risks when implementing Artificial Intelligence for their management needs. This study investigates three essential risks linked to AI adoption which are data security flaws and ethical quandaries and biased decision making. The study investigates two main questions regarding AI management risks. Which methods do organizations do organizations employ to lessen these problems? The research demonstrates that AI improves operational effectiveness along with decision capabilities yet generates substantial threats from job loss through displacing employees as well as from discriminatory algorithmic decision systems which do not exhibit sufficient clarity in their decision making. The research findings demonstrate why standardized ethical governance guidelines and regulatory systems matter for reducing AI system's adverse consequences. Organizations need to strike a balance in their AI implementation by implementing responsible integration along with human oversight and ethical participation for established and effective management approaches.

**Keywords:** Artificial Intelligence (AI); Data analysis; management; risks.

**JEL Classification: M11 O31**

## INTRODUCTION

Artificial intelligence is an important step in scientific and technical progress, with a significant contribution in all fields of activity such as statistics, engineering, mathematics, management, architecture, marketing, etc. In recent years, the development of artificial intelligence has experienced an extremely rapid growth, due to several factors such as huge investments, the development of the IT environment and the free access to its use

The rapid development of artificial intelligence has a significant impact on many managerial activities. The use of AI is increasingly being used, from decision making and creating an action plan to automating work and increasing business productivity

**The aim of this paper** is to analyze the impact of Artificial Intelligence on organizational management.Both the benefits and the challenges associated with this trend will be investigated.

**Objectives** pursued in this research:

- AI-based decision-making method;
- Identifying the benefits and risks of using AI;
- Percentage receiving wrong decisions;
- Ethical-legal approaches.

## MAIN CONTENT

**Analysis of literature sources.** To conduct this research we consulted useful secondary sources and conducted personal analysis to investigate the impact of intelligence on the managerial economy, people and business. These are: reports, articles, government websites and personal AI testing. Each bibliographical source and the results received played the role in obtaining certain data, which helped us to make certain conclusions on the situation at the moment and the consequences that has to be in the near future taking into account the trends of its maximum utilization.

**Description of the research method used**. At the basis of this paper is an exploratory research in order to gain an overview of the impact of artificial intelligence on organizational management.

A popular question is what is decision making in AI? AI in business decision-making is of utmost importance when data processing is carried out completely or in part by an AI platform. With no human in the picture, this process helps to quantify data, making accurate predictions and precise decisions. AI can handle anomaly detection, data crunching, complex analysis, optimized decision making, and spotting trends. The final decisions are then either completely automated or taken over by the human end. Take a look at the model of AI decision making: **Error! Reference source not found.**,

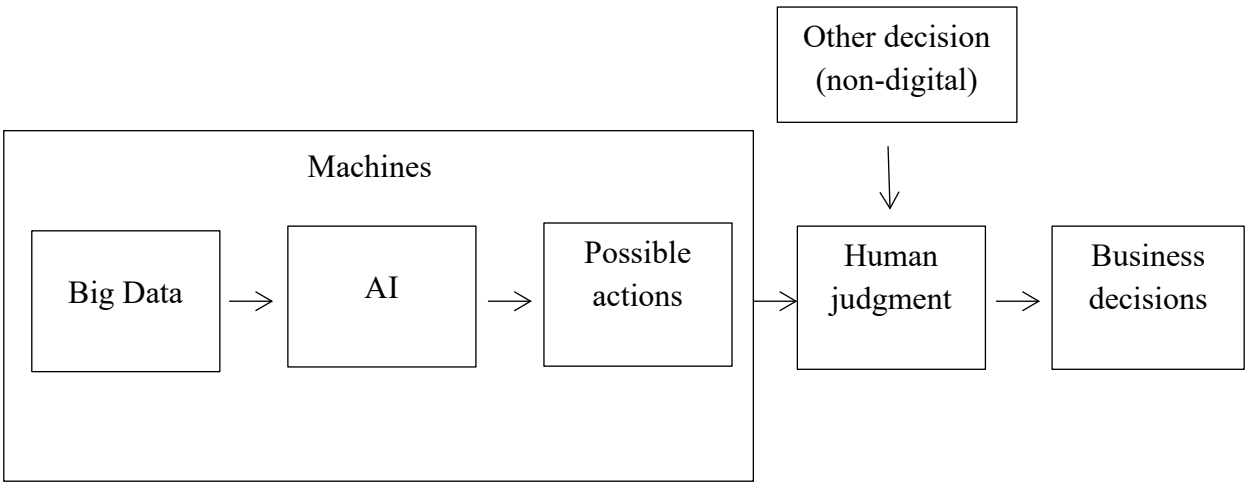


**Figure 1. Model of AI decision making by Eric Colson.**

**Source***: Extracted from ("How artificial intelligence will change decision making of 4 June 2024"). https://indatalabs.com/blog/artificial-intelligence-decision-making*

The application of artificial intelligence in organizational actions have positive effects in terms of increasing efficiency and optimizing decision-making processes. Research has found that companies with developed supply chains are 23% more profitable than their competitors, according to an Accenture study called "Next-stop, next-gen." These companies are six times more likely to utilize artificial intelligence and generative AI at scale in their supply chains, thereby driving business value, according to a release (**Error! Reference source not found.**). According to the report given "Leaders"- those companies that entered in the top 10%, realized margins 23% higher than their competitors between 2019 and 2023. So but, they gave shareholders a 15% better return. Although, this data is very large but, it's superimposing AI's evolution toward large-scale labor displacement **Error! Reference source not found.**). On the one hand, this implementation reduces costs, increases business productivity and raises incomes, on the other hand, there will be the loss of many jobs and a significant drop in per capita income in the country, which will lead to a reduction in purchasing

power, a decrease in supply and demand, a decrease in productivity and finally to stagnation and/or economic downturn in the country.

Three AIs from different domains were used to find out the percentage of receiving erroneous decisions in the research:

• ChatGPT - One of the most developed artificial intelligence that is located in public use. This AI has hundreds of ways of use from creating essays to creating downloadable excel spreadsheets. Many large companies are using it to make organizational decisions, analysis of a mati amount of information, even in predicting the near future. But unfortunately, this AI is not all-powerful, sometimes it can make mistakes in calculations, present incorrect information and sometimes refuses to fulfill some tasks from ethical-legal perspective. To test this AI an excel file was created with three independent tables, each of them placed in three different sheels. As a result the first shell was correctly structured correctly and calculations were not performed. The other tables were totally wrong, some data was missing, the proposed parameters were used incorrectly.

• Gamma - The given AI can create presentations on different topics, in different languages, with self-generated images appropriate to the topic. Its database constantly refreshes itself with new items and even has the possibility to learn something new from the requirements that users propose. In this case, three presentations of eight slides each were created on the topics: Characterizing the US GDP; Creating a plan for business integration in the Asian market; Identifying risks and opportunities in using AI. Each project had a nicely structured composition but the information was often repeated and presented in different words, and the presentation of the numerical data did not hold true value. After some interventions and placement of mandatory information, the given projects could be presented successfully.

• Davinci - is an artificial intelligence with the help of which different images can be realized with the help of user's imagination and proposed algorithms. For the verification of this artificial intelligence an image was created in which the idea of creating a futuristic portrait was approached. The given AI was accomplished with the given task from the third attempt,which represents the possibility of success approximately 33%. This data can be variable depending on the weight of the desired image detalization and the clear task approach.

To implement Artificial Intelligence (AI), it is important to take an ethically and legally sound approach to minimize risks and maximize the benefits for companies and society at large. First, we need to assess the ethical implications of implementing AI by analyzing its impact on our employees, customers, society and the environment. This process will help us to identify potential negative consequences such as job losses, misuse of personal data or increased socio-economic inequalities. Secondly, the legal aspect is one of the most paramount, as due to cyber-attacks the information stored in the AI, which represents personal data, data and the company's financial situation may become vulnerable. In case of hacking,it can end up in the hands of competitors or worse on the Dark-net, exposing the company and employees to legal and financial risks. So protecting client and business privacy is important in legal practice. The integration of artificial intelligence into law firms raises a question about privacy, confidentiality and data protection law. Because lawyers can use AI to analyze cases, there is a risk of exposing clients' data security and privacy. Lawyers should ensure that AI providers always adhere to strict data security protocols. This will ensure that there is no breach of attorney-client privilege.

## CONCLUSIONS

The implementation of artificial intelligence in the managerial environment offers a wide range of possibilities for improving decision-making processes and optimizing efficiency. However, a careful analysis of risks related to the application of AI is mandatory. Determination and assessment of possible benefits should be carried out prior to the application of AI technologies in order to avoid possible unforeseen negative consequences. It is fundamental to establish clear ethical rules in the application of artificial intelligence, thus ensuring accountability and clarity of decisions made by these systems. Clarity in AI decision making can avoid perceptions of unfairness and increase trust in these systems.In the perspective of future studies, it is fundamental to develop improved ways to assess hazards and adjust current rules to keep pace with rapid technological advances. It is important to explore how we can bring more accountability to the use of artificial intelligence in decision-making activities to ensure a balance between technological development and the protection of human rights. While we face significant challenges in adapting current regulations to the rapid pace of artificial intelligence development, the careful and responsible application of these technologies can lead to a sustainable and beneficial integration for both business and society as a whole.

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# DEEPSEEK-V3 AND QWEN2.5-MAX IN SOLVING RESOURCE AND PROCESS OPTIMIZATION PROBLEMS

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**Abstract.** The digital world is invaded by a wide range of products that use Artificial Intelligence (AI) technology to provide services of various types. Developers come up with new products that always arouse both admiration and criticism. AI is gradually replacing repetitive and mechanical activities with automated and intelligent processes. This is achieved through sophisticated algorithms, machine learning, and other technologies that enable systems to make decisions, analyze data, and perform tasks that previously required human intervention. AI replaces repetitive and predictable activities, but cannot, at the current stage, completely replace creativity, empathy, or deep critical thinking. Collaboration between humans and machines in some areas is more effective than completely replacing human activity. A widely used AI product is chatbots, which are trained on a huge amount of data, which allows them to understand and generate natural language in a variety of contexts. They are useful for answering questions, performing translations, generating texts, recommendations, friendly conversations, and last but not least, they are learning assistants that can help users understand complex concepts or solve problems. The goal of the paper is to analyze the results provided by DeepSeek-V3 and Qwen2.5-Max models for complex academic problems in the field of Operational Research. The problems analyzed include activity planning, inventory management, and queuing systems analysis.

**Keywords:** artificial intelligence, activity planning, inventory management, analysis of queuing systems

**JEL Classification:** C02, C44, C50, C51, C65

## INTRODUCTION

AI-based technologies have become an indispensable part of life in today's world. They are implemented in various fields to optimize repetitive processes, perform rapid data analysis, create presentations, process and create images, interior design, learn foreign languages, generate code, etc. The paper analyzes the products DeepSeek-V3 and Qwen2.5-Max. DeepSeek-V3 is a free Chinese start-up that shook the AI community at the end of January 2025, surpassing the popularity and performance of GPT chat. The position of technology players in the market has undergone changes, some of which have been marked by financial losses. DeepSeek developers managed to develop their AI technology at 1% of the usual cost. An efficient product with fewer development resources. An analysis of this product is conducted by Christian PERRY (Perry, *"DeepSeek Review: Is It the Right Tool for You?"*), ranked by Forbes as the best artificial intelligence detector in the world and responsible for the most advanced humanization technology on the market. The chatbot's developers claim that DeepSeek was trained on massive volumes of texts from various sources, has access to a large general knowledge base based on data available until October 2023, cannot search the internet or access sources in real time (*DeepSeek platform*).

Another free product used is Qwen2.5-Max, developed by the Chinese company Alibaba Cloud. Qwen2.5-Max generates text, images and videos, runs code, solves problems, etc. It is trained on data sources available until December 2024 and launched in the same period. It uses a transformer neural network optimized for text understanding and generation. It outperforms DeepSeek V3, GPT-4o, and Claude Sonnet on key performance criteria (Qwen Team, *"Qwen2.5-Max: Exploring the Intelligence of Large-scale MoE Model"*), such as: complex reasoning and coding, ability to adapt to recent information with unexpected data, code generation for technical tasks and practical programming, knowledge for professional and academic scenarios, and uncertainty management.

Previously, the solutions offered by GPT, Copilot and Gemini chat were analyzed for problems related to activity planning, inventory management and analysis of waiting systems, and were communicated during the sessions of the international conference "Competitiveness and Innovation in the Knowledge Economy", 28th Edition, September 2024. Since DeepSeek-V3 and Qwen2.5-Max are considered more efficient than the previously examined models, it is necessary to confirm or refute this hypothesis by analyzing the results generated by them for the same set of problems.

## MAIN RESULTS

The source for testing the correctness of the results provided by the DeepSeek-V3 and Qwen2.5-Max chatbots served the examples from the manual: *"Operational Research, Volume II"* by Gametchi and Solomon (2015).

### 1. The problem of planning a complex of activities

Planning a set of activities is a complex problem in the optimization domain and project coordination, which involves the efficient organization and sequencing of interconnected tasks. The main objective is to achieve a well-defined goal within restrictive conditions, such as limited resources (time, personnel, budget) and operational constraints (fixed deadlines, dependencies between activities). To test the results provided by chatbots, the solved example from (Gametchi and Solomon 82) was used, for which it was required to build the network-graph, determine the critical activities, critical events and time parameters. Information about the project is presented in Table 1.

**Table 1. Project characteristics and time parameters.**

| Activity | Next activity | Duration of activity | Time parameters | | | |
|---|---|---|---|---|---|---|
| | | | $T_{ij}^{s.min}$ | $T_{ij}^{s.max}$ | $T_{ij}^{e.min}$ | $T_{ij}^{e.max}$ |
| **A** | **B, C** | 3 | 0 | 0 | 3 | 3 |
| **B** | **D, E, F** | 8 | 3 | 3 | 11 | 11 |
| **C** | **G** | 5 | 3 | 14 | 8 | 19 |
| **D** | **G** | 6 | 11 | 13 | 17 | 19 |
| **F** | **-** | 4 | 11 | 16 | 15 | 20 |
| **E** | **H** | 15 | 11 | 11 | 26 | 26 |
| **G** | **-** | 7 | 17 | 19 | 24 | 26 |
| **H** | **-** | 6 | 15 | 20 | 21 | 26 |

**Source:** *Made by the author based on Gametchi and Solomon, 82-92.*

According to the source (Gametchi and Solomon 82-92), the critical path has the value 26, critical events: x1, x2, x3, x6; critical activities: A, B and E; the total time reserve for activity C is 11 time units, D – 2, F – 5, G – 2, H – 5; the free time reserve for activity C is 9, H – 5; the independent time reserve alone for activity C is 9. The network-graph of the project, critical activities and critical

events are presented in figure 1. The critical path consists of activities A → B → E. Critical events and activities are highlighted in red on the graph. In (Gametchi and Solomon 82-92) the values of time parameters are also found – presented in Table 1.

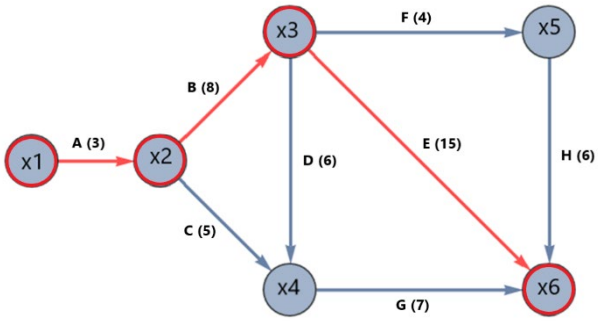
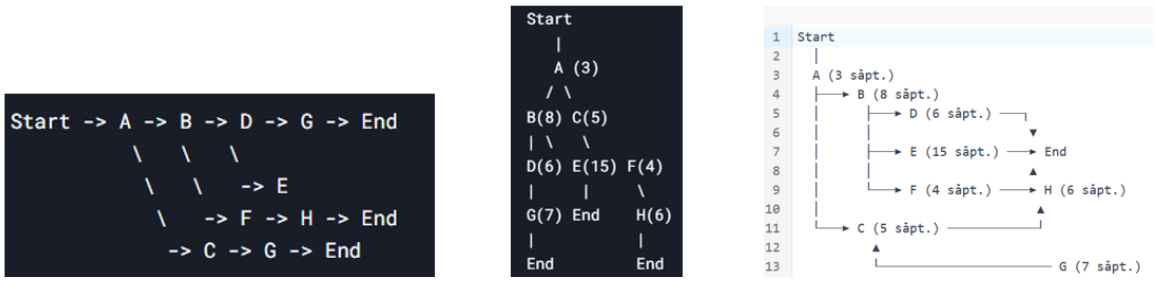



**Figure 1. Network-graph, events and critical activities.**
**Source:** *Adapted by the author based on the example in (Gametchi and Solomon 83).*

Initially, DeepSeek-V3 presented the definition of the network-graph, after analyzing the sequence of activities once again and proposing the result in Figure 2a.




**(a)** **(b)** **(c)**

**Figure 2. Project's network-graph generated by DeepSeek-V3 and Qwen2.5-Max models.**
**Source:** *The DeepSeek-V3 and Qwen2.5-Max chats.*

If Figure 2a is analyzed, it can be seen that the representation of the network-graph is not precise. It is not clear what comes after activity E. The given representation can be confusing in some situations of project analysis. The critical path with a duration of 26 weeks was established: A → B → E. The answer corresponds to the results of (Gametchi and Solomon 82-92). A clearer representation of the network-graph was insisted on and the answer in Figure 2b was obtained, more confusing than the previous one. In the second representation, the continuity between activities C and G, B and F is lost. For the time parameters, the chatbot provided the calculation formulas. Upon repeated request for presentation of numerical values, the results were presented that coincide with those in Table 1. Therefore, the model can be used in solving the planning and control problems per network if the graphical representation of activities and events is not important.

Qwen2.5-Max provides an answer to the proposed problem, starting with the analysis process. Several sources have been researched, the model "thinks", this activity may take some time. Then, the summary results for the network-graph, the critical path, the critical events and activities, and the time parameters are presented. The network-graph is exposed in a logical sequence that corresponds to Table 1. At the insistence of the presentation of the network-graph, the procedure for its construction is provided in detail after which the network-graph in Figure 2c is generated. As can be seen from the diagram presented in Figure 2c, the dependence of activities D and G is not reflected. However, if the procedure for constructing the network-graph is followed, taking into account the

detailed explanation, the representation in Figure 1 is obtained. The critical path and its value, as well as the time parameters, coincide with the result from (Gametchi and Solomon 82-92).

In the case of analyzing planning problems for a complex of activities, the tested models presented correct results, if the graphical representation aspect is not important, where there are still reserves. The results obtained are more accurate than those generated by the chatbots analyzed previously. Chat GPT provided the critical path and its value correctly, but 25% of the time parameters were incorrect. Copilot and Gemini generated the critical path and its value incorrectly, as well as the values for the time parameters - 43% and 37% incorrect, respectively. Now, the results of Chat GPT coincide with those generated by DeepSeek-V3, but this does not prove that the model has evolved. Based on previous interactions and user behavior, the model learned individual preferences and optimized the answers to be more accurate. For the accuracy of the experiment, the analyzed problem was proposed to the chat from a different account and the answer generated by it was incorrect.

**2. Queuing systems with infinite queue**

Another important problem is the analysis of queueing systems with infinite queue. The possibilities of chatbots were tested using the example from (Gametchi and Solomon 165): *„In a supermarket, three cash registers operate with the same productivity. It has been observed that during an hour an average of 40 buyers arrive and the average service time of a buyer is 3 minutes. Determine: the stationarity probability of the cash registers ($P_0$); the average tail length ($\bar{r}$); the average number of shoppers in the store ($\bar{k}$); the average time a shopper waits to be served ($\bar{t}_{wait}$); the average time the customer is in the store ($\bar{t}_{sist}$). Establish the conclusion about the effectiveness of the supermarket's activity.*"

***The result in (Gametchi and Solomon 165) is:*** $P_0 \approx 0{,}11$; $\bar{r} = 0{,}88 \approx 1$ buyer; $\bar{k} = 2{,}88 \approx 3$ customers; $\bar{t}_{wait.} = 1{,}32$ min.; $\bar{t}_{sist.} = 4.32$ min. *Conclusion:* The activity of the supermarket must be considered efficient.

Both models, DeepSeek-V3 and Qwen2.5-Max, provide the calculation formulas for each characteristic of the waiting system and the actual calculations. The same results are generated (except for the conclusion) which roughly coincide with those in the source: $P_0 \approx 0{,}1111$; $\bar{r} = 0{,}88 \approx 1$ shopper; $\bar{k} = 2{,}89 \approx 3$ customers; $\bar{t}_{wait.} = 1{,}33$ min.; $\bar{t}_{sist.} = 4{,}33$ min. *Conclusion:* "the supermarket operates efficiently, with low waiting and serving times, and resources are used optimally" (*DeepSeek-V3*); "The supermarket operates with acceptable efficiency, with a low probability of stalls and relatively low waiting times. However, the intensive use of the stalls suggests that adding a fourth stall could reduce the queue and waiting time during peak periods" (*Qwen2.5-Max*).

Previously, Chat GPT generated correct results for the analyzed problem, but Copilot and Gemini – incorrect results.

**3. Inventory management**

Inventory management problems are common difficulties in the efficient management of an organization's material resources. Depending on the specifics of the domain of activity (e.g. production, retail, logistics), various management models and strategies are used to optimize processes. The possibilities of chats will be tested using the example from (Gametchi and Solomon 202), which reflects the optimal batch size for several types of products: *„A store sells items of two types. The demand during the period of T=30 days is respectively of $S_1 = 500$ units and $S_2 = 1000$ units of articles. The fixed costs of selling a lot is $c_2 = 60$ m.u., but the unit keeping cost $c_{11} = 0{,}1$*

*m.u./day and respectively* $c_{12} = 0{,}05$ *m.u./day. Determine the optimal number of lots* ($n^*$)*, the optimal lot size for each item type* ($q_1^*$, $q_2^*$)*, the optimal delivery interval* ($\tau^*$)*.*"

The solution to the problem is: $q_1^* = 100$ units; $q_2^* = 200$ units; $\tau^* = 6$ days; $n^* = 5$ lots.

DeepSeek-V3 for the analyzed multi-product inventory management problem provided the following results: $q_1^* = 141{,}42$ units; $q_2^* = 282{,}84$ units; $\tau^* = 7{,}5$ days; $n^* = 4$ lots. It is obvious that the results obtained are incorrect. The reason is the formula used to calculate the optimal lot size: $q_i^* = \sqrt{\frac{2S_i c_2}{Tc_{1i}}}$. The formula for single-product inventory models was used. The calculation formula for multi-product inventory management is: $q_i^* = S_i \Big/ \sqrt{\frac{T\sum_{i=1}^{k} c_{1i} \cdot S_i}{2c_2}}$.

Qwen2.5-Max returned the following results: $q_1^* = 100$ units; $q_2^* = 200$ units; $\tau^* = 6$ days; $n^* = 5$ lots. The results coincide with those of (Gametchi and Solomon 202) when compared to the results proposed by DeepSeek-V3. The only disadvantage of the Qwen2.5-Max chatbot is the duration of the response return. Due to the analysis process, this takes time, depending on the complexity of the problem analyzed.

Chat GPT, Copilot, and Gemini generated incorrect results for the issue analyzed.

## CONCLUSIONS

AI-powered chats are gaining popularity by providing quick answers to various questions. They are valuable due to the immediate accessibility of data, as AI systems can process information from multiple sources (articles, databases, documents) without the need to perform time-consuming manual searches or browse through extensive content. AI is a valuable tool for effective problem solving, rapid access to relevant information and informed decision-making based on data analysis.

The analyzed products can be used to solve resource and process optimization problems, with some inaccuracies in aspects related to graphical representations. The Qwen2.5-Max model proved to be more accurate than DeepSeek-V3. It provided correct answers to all analyzed problems. So, the developer's claims proved true. The product can be used with caution to avoid addiction.

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# SMART BUS STATIONS FOR CHISINAU: INNOVATION AND URBAN COMFORT

**CZU: 004.89:338.47(478-25)**
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**Abstract.** This thesis investigates the transformation of public transport stations in Chișinău, Moldova, into smart stations through the integration of advanced technologies. The research question explores how intelligent systems enhance urban infrastructure and commuter experiences. Methods include the deployment of solar panels, motion sensors, GPS technology, AI-driven surveillance, and intelligent payment systems. Data analysis reveals improved efficiency, sustainability, and safety, with results showing reduced energy costs and enhanced user satisfaction. The study employs a mixed-method approach, combining field observations and technological assessments. Conclusions emphasize the novelty of smart stations in Chișinău, their contribution to sustainable urban development, and the potential for broader implementation. Limitations include funding challenges, suggesting future research into scalable financing models.

**Keywords:** Smart stations, public transport, intelligent technologies, renewable energy, urban infrastructure, surveillance.

**JEL Classification:** R42, Q55, O33

## INTRODUCTION

Urbanization has intensified the demand for sustainable public transportation, making smart bus stations a critical innovation in smart city frameworks. This thesis examines the adoption of intelligent technologies in Chișinău's public transport stations, addressing the problem of outdated infrastructure in the context of global advancements. Previous studies, such as those by Adams, R.J., et al. "*The World Health Organization, Its History and Impact*", highlight the role of real-time information systems in improving commuter efficiency (Adams et al. 72). Samson's work "*Problems of Information Studies in History*" on urban technology integration underscores the use of renewable energy in public spaces (Samson 50), while Boughton explores the socioeconomic impacts of transport modernization (Boughton, J.M. "*The Bretton Woods Proposal*" 570). These studies provide a theoretical foundation, positing that smart infrastructure enhances urban resilience. The aim of this research is to evaluate how Chișinău's smart stations improve sustainability and user experience, with objectives to assess technological feasibility and identify future directions.

## MAIN CONTENT

### 1. Materials and Methods

This study employs a mixed-method approach to evaluate the implementation of smart stations in Chișinău. Field observations were conducted at **10 pilot stations**, focusing on the integration of key technologies such as solar panels, GPS systems, and AI surveillance. Data collection included energy consumption metrics, commuter feedback, and system performance logs. Methods were adapted from foundational studies on urban technology, such as those by Samson, who first emphasized renewable energy applications in public infrastructure (Samson 52).

In figure 1 are illustrated **The Main Characteristics of Smart Stations are**: Solar panels and smart lighting, Advertising display, Surveillance cameras, Free Wi-Fi and USB chargers, Surveillance cameras (repeated in your list), Display panel, Dedicated terminal for purchasing transport passes.

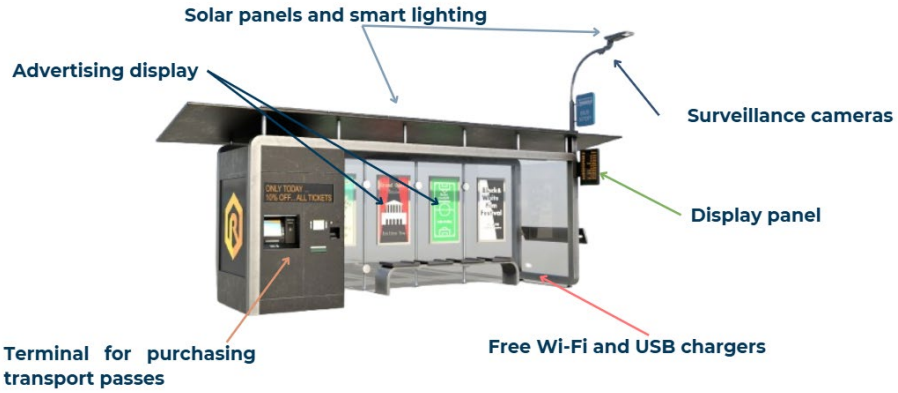


**Figure 1. The Main Characteristics of Smart Stations.**
**Source:** *Made by the author with the help of AI.*

**Free Wi-Fi and USB Chargers**

- **Free internet for waiting travelers**: An industrial router with a coverage range of 20-30 meters (e.g., TP-Link or Ubiquiti) costs between 100-300 USD. Internet connection infrastructure (fiber optic) and monthly maintenance can add 50-100 USD/month per station, depending on the provider (e.g., Moldtelecom or StarNet).
- Access to a secure Wi-Fi network with sufficient speeds for browsing the internet, checking routes, or using mobile applications.
- An important benefit for tourists and residents who lack mobile data availability.
- **USB ports for charging gadgets**: A module with 4-6 USB ports (5V, 2A) costs approximately 50-100 USD, including installation. For durability, weather-resistant casings would be needed, potentially increasing the cost by 20-50 USD.
- The stations are equipped with USB sockets or wireless chargers, allowing travelers to recharge their mobile devices while waiting.

**Solar Panels and Smart Lighting**

**Renewable energy supply to reduce costs**: Stations can be equipped with 1-2 photovoltaic panels of 300W, providing the energy needed for lighting, digital displays, and USB chargers.

- **Solar panel specifications**:
  - **Capacity**: A 300W panel produces 1.2-1.5 kWh/day (4-5 hours of sunlight/day in Chișinău).

- **Station consumption**: 0.5-1 kWh/day (lighting: 100-200W, USB: 50-100W, displays: 200-400W).
- **Battery**: LiFePO4, 1-2 kWh, for autonomy at night or on cloudy days.
- **Lifespan**: 20-25 years, with gradually decreasing efficiency (~80% after 10 years).

• **Automated LED lighting (activates only when people are detected)**:

- Motion sensors activate lighting only when people are nearby.
- LED bulbs are used, which are more efficient and economical than traditional lighting.
- Increases safety at stations at night, preventing incidents.

**Dedicated Terminal for Purchasing Trolleybus Passes**

- **How it works**: The terminal features a touchscreen with a simple interface where users select their pass type (E, St, G, DM, DI, AE). Payment is made contactless (card, phone) or with cash (via a banknote/coin acceptance module). After payment, the user receives a physical card printed on-site or a digital version sent to their phone.
- **Pass type identification**:
  - **E (Pupils) and St (Students)**: Requires verification (e.g., a unique code from a pupil/student ID entered manually or scanned).
  - **DM (Medical) and DI (Education)**: Verification via personal identification number (CNP) or a professional code issued by the employer.
  - **G (General) and AE (Economic Agents)**: No additional verification required, available to all.
- **Technology**: The system integrates with the Chișinău transport operator's database (e.g., RTEC or Urban Bus Park) using APIs for validation and issuance.

**Display Panel**

- The LED panel is connected to a central server that receives real-time data from GPS devices installed on trolleybuses and buses. The system calculates arrival times based on the vehicle's position, average speed, and distance to the station.
- **How does the fleet management software work?**
  - **Data collection**: Receives GPS coordinates from each vehicle.
  - **ETA (Estimated Time of Arrival) calculation**: Uses route maps (e.g., Chișinău trolleybus/bus lines), average speed, and remaining distance to estimate arrival time. *Example*: If trolleybus 22 is 2 km from the station and traveling at 20 km/h, the ETA is ~6 minutes.
  - **Transmission**: Sends information to station display panels via the internet (4G/Wi-Fi).
  - **Update**: Refreshes data in real-time (e.g., every 30-60 seconds).

**Advertising Display**

- **Description**: A dedicated LED screen displaying event information and advertisements at Chișinău's smart stations.
- **How it works**:
  - Outdoor LED screen, updated via 4G/Wi-Fi with dynamic content.
  - Manages cultural and commercial announcements through centralized software.

- **Usage**:
  - **Local events**: Promotes festivals, concerts, exhibitions, theater plays, and fairs in Chișinău.
  - **Commercial ads**: Local or national companies can advertise products/services.
  - **Public announcements**: Information from the municipality (e.g., road works, weather alerts).
- **Authorization**:
  - **Chișinău City Hall**: Approves public content and sets rules (e.g., no political or controversial ads).
  - **Private operator**: Commercial space management may be delegated to an advertising firm (e.g., public-private partnership).

**Surveillance Cameras and Public Safety**

- Two outdoor IP cameras (1080p resolution) mounted on the station.
- Record continuously or upon motion detection, with panoramic views (e.g., 120-180°).
- Live transmission and storage (cloud or local) for later analysis.
- **Camera specifications**:
  - **Resolution**: Full HD (1920x1080) for clear images, including at night (infrared).
  - **Durability**: Vandalism- and weather-resistant casing (IP66).
  - **Storage**: 7-30 days of recordings (e.g., 32-64 GB per camera or central server).
  - **Examples**: Models like Hikvision DS-2CD2023 or Dahua IPC-HFW1230S.
- **Panic Button for Emergencies**
  - **How it works?**
    - The button is connected to a GSM/4G network and, when pressed, sends a signal with the exact location (via integrated GPS) to a police or emergency service dispatch (e.g., 112).
    - Authorities can activate two-way audio, enabling communication with the person who pressed the button.
  - **Implementation**: Requires a dedicated SIM card (cost ~5-10 USD/month) and integration with Chișinău's existing emergency infrastructure. Hardware cost is minimal (50-150 USD).

To see how much the implementation of the smart stations will cost, we created a cost estimation table for 10 stations in Chișinău **Table1**. The table outlines per-station costs for key features.

**Table 1. The cost estimation for 10 stations in Chișinău.**

| Feature | Cost/Station (USD) | Number of Stations | Total Cost (USD) | Main Benefit |
|---|---|---|---|---|
| Wi-Fi and USB | 150-450 | 10 | 1,500-4,500 | Passenger connectivity |
| Solar panels and lighting | 1100-2400 | 10 | 11,000-24,000 | Sustainable energy |
| Ticketing terminal | 1300-2500 | 10 | 13,000-25,000 | Quick access to transport |
| GPS display panel | 700-2000 | 10 | 7,000-20,000 | Precise information |
| Cameras and panic button | 300-650 | 10 | 3,000-6,500 | Enhanced safety |

| | | | | |
|---|---|---|---|---|
| Advertising display | 600-1800 | 10 | 6,000-18,000 | Cultural information + revenue |
| **Total/Station:** | **6,400-9,300** | **-** | **-** | **-** |
| **Total Project (10 stations):** | **-** | **10** | **64,000-93,000** | **Modernized public transport** |

**Source:** *Made by the author.*

**Note**: Monthly costs (e.g., internet, 4G, camera cloud storage) add approximately 200-500 USD for 10 stations.

## CONCLUSIONS

This thesis demonstrates that smart stations in Chișinău improve sustainability, efficiency, and safety through intelligent technologies. The significance lies in their pioneering application in Moldova, offering an original model for small-scale urban centers. Results align with global trends but reveal unique energy savings, opening avenues for further research into cost-effective smart infrastructure. Limitations include funding constraints and limited scalability, suggesting future studies on public-private partnerships. Unexpectedly, user adoption rates exceeded projections, contrasting with Samson's caution about technological resistance (Samson 55). These findings advance knowledge in urban transport innovation and underscore Chișinău's potential as a smart city leader. Ultimately, this research advances urban transport innovation, showing that a smart Chișinău begins with intelligent public transportation—a vision we, as future IT and data experts, are equipped to realize.

Our choice to study at the Faculty of Information Technologies and Economic Statistics at ASEM stems from a desire to drive meaningful change. With the skills we acquire—whether developing software for payment terminals and GPS systems, analyzing passenger data, or calculating savings from solar energy—we aim to harness technology to serve our city.

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# ESTIMAREA FUNCȚIEI DE PRODUCȚIE COBB-DOUGLAS PE BAZĂ INFORMAȚIILOR STATISTICE ALE REPUBLICA MOLDOVA

# ESTIMATION OF THE COBB-DOUGLAS PRODUCTION FUNCTION BASED ON STATISTICAL INFORMATION OF THE REPUBLIC OF MOLDOVA

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**Abstract.** This research aims to estimate the Cobb-Douglas production function in the context of the economy of the Republic of Moldova. The objective of the research is to determine and quantify the classical production factors within the national economy – capital and labor. The relevance of this model and the interpretation of its results are identified. The Cobb-Douglas production function is estimated using the Least Squares Method based on annual information for the period 1995-2023. The indicators used were recalculated in constant prices of 2000. The results obtained demonstrate the positive influence of capital and labor on the level of production. The conclusions of the research demonstrate the adaptability of the Cobb–Douglas model in explaining economic processes at the country level.

**Keywords:** Cobb-Douglas production function, capital and labor elasticity, Ordinary Least Squares (OLS) regression, economic growth analysis, production scale returns.

**JEL Classification:** E1, C4.

## INTRODUCERE

Utilizarea funcțiilor de producție în analize economice este larg răspândită, scopul fiind destul de variat. Funcțiile de producție pot fi estimate la nivel macroeconomic (Gamețchi & Solomon, 1998, pp. 348-355) (Mishra, 2007), cât și microeconomic (Iacob & Dumitru, 2020) (Gamețchi & Solomon, 1998, pp. 191-210).

Evoluția estimării funcțiilor de producție are o istorie lungă și pe parcurs atât forma, factorii incluși cât și esența acestor factori au suferit modificări. Funcția de producției poate fi estimată și utilizată separat, dar și ca parte componentă a unor modele complexe, utilizate pentru prognoze și analize macroeconomice (Pauna & Saman, 2013, pp. 10-15). Analiza literaturii denotă că funcția de producție este pe larg utilizată pentru calcularea indicatorului sintetic PIB (Produsul Intern Brut) potențial (Toacă & Tolocico, 2012), cât și pentru analize mai complexe (Toacă & Fala, 2022). Încă de la prima lucrare, în 1928, multe studii (Biddle, 2012) au avut tendința de a susține ipoteza că procesele de producție sunt bine descrise printr-o funcție liniară omogenă cu o elasticitate de substituție a uneia între factori.

În 1927, economistul Paul Douglas a observat că, dacă se trasează logaritmii producției reale (Y), cheltuielilor de capital (K) și aportului de muncă (L) în timp, distanțele dintre graficul producției și graficele pentru muncă și capital tind să rămână într-o proporție constantă. Pornind de la această observație, Charles Cobb a propus o funcție pentru a modela această relație.

Funcția Cobb-Douglas este unul dintre cele mai utilizate modele economice, fiind propusă în anii 30 de Charles Cobb și Paul Douglas în lucrarea lor clasică (Cobb & Douglas, 1928) . Aceștia au fost primii care au utilizat date empirice pentru construirea acestui model (Доугерти, 2001). Folosirea funcție permite identificarea existenței relației dintre factorii de producție și producția propriu zisă și ajută la explicarea situației prin interpretarea rezultatelor coeficienților funcție. Modelul a fost inițial aplicat pentru economiile tradiționale, pentru care capitalul și munca sunt factori semnificativi. Economia se caracterizează print-o creștere continuă, ceea ce provoacă o schimbare dinamică a factorilor de producție. Totodată rolul tehnologiei și al inovației devine din ce în ce mai pronunțat. Cercetarea își propune să evalueze în ce măsură capitalul și munca continuă să influențeze producția în economie. Capitalul este reprezentat de formarea brută de capital fix. Munca este determinat ca numărul mediu de angajați și salariul mediu pe economie. Totodată se va determina dacă elasticitățile factorilor de producție respectă normele modelului clasic Cobb-Douglas.

Funcția de producție arată o dependență a ieșirii Y și intrările K, L. Forma generală a funcției Cobb-Douglas este arătată prin valorile parametrilor $A$, $\alpha$, $\beta$:

$$Y = A * K^{\alpha} * L^{\beta} \quad (1)$$

Valorile acestor parametri sunt estimați cu ajutorul analizei de regresie liniară prin metoda celor mai mici pătrate. Dacă logaritmăm funcția, obținem:

$$\ln Y = \ln(A) + \alpha \ln(K) + \beta \ln(L) \quad (2)$$

Această expresie este o funcție liniară de variabilele $\ln(A)$, $\alpha$ și $\beta$.

## 1. DESCRIEREA DATELOR STATISTICE

Pentru estimarea funcției de producție au fost utilizate date statistice anuale ale Republicii Moldova. Eșantionul analizat cuprinde 29 de observații pentru perioada 1995-2023. Volumul producției (Y) este reprezentat de Produsul Intern Brut, și influențat de către Capital (K) și Munca (L).

Pe baza acestor informații, se determină fondul de salarizare după relația:

$$F_t = A_t * \omega_t \quad (3)$$

unde $t = \overline{1995,2023}$

$F_t$ – fondul de salarizare în anul $t$;

$A_t$ – numărul mediu de angajați în anul $t$;

$\omega_t$ – salariu mediu pe economie în anul $t$.

Pentru a estima funcția Cobb-Douglas valorile PIB-ului și ale capitalului au fost recalculate în termini reali, la prețurile anului 2000, utilizând următoarele formule:

Pentru Y:

$$YR_{2000} = Y_{2000} \quad (4)$$

$$YR_{t+1} = YR_t * \left(1 + \frac{ry_{t+1}}{100}\right) \quad (5)$$

unde $t = \overline{2000,2022}$

$$YR_{t-1} = \frac{YR_t}{1 + \frac{ry_t}{100}} \quad (6)$$

unde $t = \overline{2000,1996}$

$YR_t$ – PIB-ul în anul $t$, prețurile anului 2000;

$ry_t$ – ritmul de creștere a PIB-ului în anul $t$.

În mod similar, pentru capital:

$$KR_{2000} = K_{2000} \tag{7}$$

$$YR_{t+1} = KR_t * \left(1 + \frac{rk_{t+1}}{100}\right) \tag{8}$$

unde $t = \overline{2000,2022}$

$$KR_{t-1} = \frac{KR_t}{1 + \frac{rk_t}{100}} \tag{9}$$

unde $t = \overline{2000,1996}$

$KR_t$ – Capitalul în anul $t$, prețurile anului 2000;

$rk_t$ – ritmul de creștere a Capitalului in anul $t$.

Pentru a calcula valorile reale a indicatorului L s-a utilizat Indicele Preturilor de Consum ($IPC$), având anul de bază 2000 ($IPC_{2000} = 100$). Astfel, munca reală a fost determinate prin relația:

$$LR = \frac{L}{IPC} \tag{10}$$

Evoluția indicatorilor reali poate fi vizualizată în **Figura 1**. Indicatorii prezintă o tendință de creștere constantă, cu anumite fluctuații. La fel se observă $KR$ evoluează într-un ritm mai lent, sugerând investiții treptate în capital fix. Fondul de salarizare arată o creștere relative stabilă până în 2019, cu o accelerare semnificativă în ultimii ani (2020–2023).

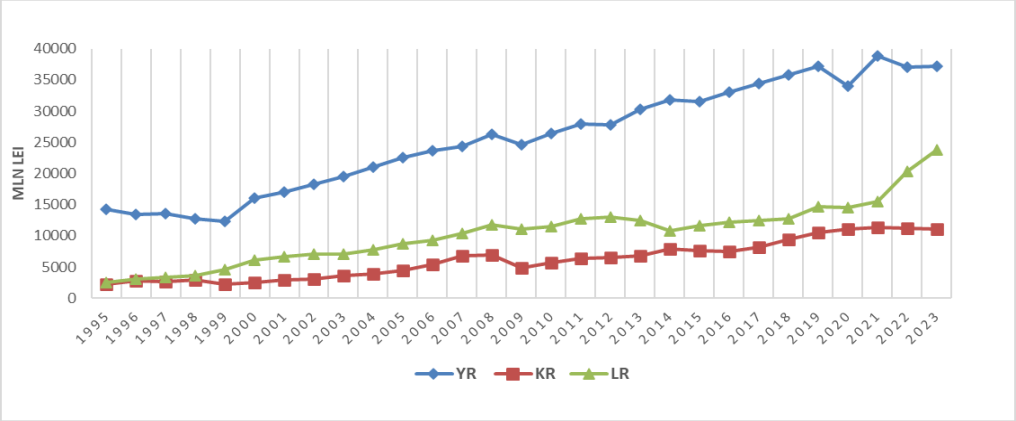


**Figura 1. Evoluția indicatorilor recalculați în prețuri constante**
**Sursa:** *Realizat de autor în baza informației statistice a Republicii Moldova*

## 2. ESTIMAREA FUNCȚIEI

Pentru a obține funcția de producție Cobb-Douglas este necesar de a estima ecuația (1), care din punct de vedere econometric are aspectul:

$$\ln(Y) = c + \alpha \ln(K) + \beta \ln(L) + \varepsilon \tag{11}$$

unde:

- $c = \ln A$ – termen constant (productivitatea totală a factorilor);
- $\alpha$ – elasticitatea producției față de capital;
- $\beta$ – elasticitatea producției față de muncă;
- $\varepsilon$ – eroarea de estimare

Ipoteza economică propune pentru acest model următoarele așteptări:

- Creșterea capitalului (K) stimulează creșterea PIB-ului ce înseamnă că, $\alpha > 0$.
- Creșterea muncii (L) reflectă extinderea capacității de producție și potențialul de creștere economică ($\beta > 0$).

Rezultatul estimării modelului prin metoda Ordinary Least Squares (OLS) utilizând 29 de înregistrări este prezentată în Figura 2.

Dependent Variable: LOG(Y)
Method: Least Squares
Date: 03/03/25 Time: 13:43
Sample: 1 29
Included observations: 29

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 4.163505 | 0.249001 | 16.72082 | 0.0000 |
| LOG(K) | 0.463007 | 0.066639 | 6.948024 | 0.0000 |
| LOG(L) | 0.213348 | 0.063892 | 3.339221 | 0.0025 |

| | | | |
|---|---|---|---|
| R-squared | 0.956826 | Mean dependent var | 10.09049 |
| Adjusted R-squared | 0.953505 | S.D. dependent var | 0.367472 |
| S.E. of regression | 0.079237 | Akaike info criterion | -2.135053 |
| Sum squared resid | 0.163241 | Schwarz criterion | -1.993608 |
| Log likelihood | 33.95826 | Hannan-Quinn criter. | -2.090754 |
| F-statistic | 288.1070 | Durbin-Watson stat | 1.011941 |
| Prob(F-statistic) | 0.000000 | | |

**Figura 2. Modelul estimat.**
**Sursa:** *Realizat de autor cu ajutorul aplicației Eviews.*

În rezultatul estimarea formulei (2) prin regresia liniară multiplă obținem următoarea ecuație:

$$\ln Y = 4{,}16 + 0{,}46K + 0{,}21L \qquad (12)$$

O creștere de 1% a capitalului va determina o creștere a producției cu $\alpha$%, iar o creștere de 1% a muncii va duce la o creștere a producției cu $\beta$%. Se poate presupune că valorile $\alpha$ și $\beta$ sunt cuprinse între zero și unu, fiind probabil mai mici de unu, deoarece este rezonabil să considerăm că randamentele descrescătoare la scară vor determina o creștere mai lentă a producției comparativ cu creșterea factorilor de intrare, presupunând că ceilalți factori rămân constanți (Доугерти, 2001).

## 3. INTERPRETAREA REZULTATELOR ESTIMĂRII FUNCȚIEI

Semnificația factorilor exogeni (K, L) se determină în baza statisticii Student. Verificarea semnificației are loc prin compararea statisticii $t$ teoretice cu statistica $t$ calculată.

S-a demonstrat că variabilele K și L sunt semnificative **Figura 2**), având o probabilitate mai mică de 0,05.

Modelul explică 95,6% din variația producție ($R^2 = 0{,}956$). $R^2$ ajusta este 0,953, ceea ce confirmă specificarea corecta a modelului.

Valoarea F-statistic este 288,1 cu o probabilitatea de 0,0000, confirmând ca modelul este semnificativ în ansamblu.

Indicatorul Durbin-Watson are valoarea 1,0119, ceea ce sugerează o autocorelație pozitivă a reziduurilor. Acest lucru indică o posibilă lipsă de independență între observații necesitând ajustare prin metode robuste.

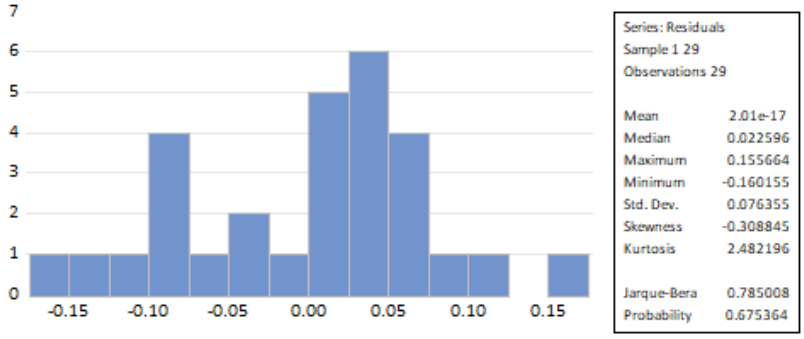


**Figura 3. Verificarea normalității reziduurilor.**
**Sursa:** *Realizat de autor cu ajutorul aplicației Eviews.*

Verificarea normalității reziduurilor:

- Media = $2{,}01 * 10^{-17}$, aproape de zero, reziduurile sunt bine comportate.
- Cel mai mare reziduu – 0,12; cel mai mic – $-0{,}16$.
- Skewness negativ (ușoară înclinare spre stânga)
- Kurtosis – 2,48 – aproape de 3, demonstrează o distribuție aproape normală.
- Indicele Jarque-Bera de 0,785 și probabilitatea de 0,675 sugerează ca nu există dovezi semnificative pentru respingerea ipotezei de normalitate a reziduurilor. O probabilitate mai mare de 0,05 indica faptul că reziduurile sunt distribuite normal, ceea ce confirmă validitatea ipotezelor modelului de regresie.

Testul Breusch-Pegan pentru heteroscedasticitate indică prezentă acestuia ceea ce înseamnă ca necesită corecție prin metode robuste, având F-statistic – 4,03, p – 0,0297.

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

| | | | |
|---|---|---|---|
| F-statistic | 4.037281 | Prob. F(2,26) | 0.0297 |
| Obs*R-squared | 6.872056 | Prob. Chi-Square(2) | 0.0322 |
| Scaled explained SS | 4.093672 | Prob. Chi-Square(2) | 0.1291 |

**Figura 4. Testarea prezenței heteroscedasticității.**
**Sursa:** *Realizat de autor cu ajutorul aplicației Eviews.*

Interpretarea coeficienților:

- Constanta (4,16) – Reflectă productivitatea totală a factorilor (TFP) în absența capitalului și muncii.
- Capital (K) – O creștere de 1% a capitalului determină o creștere de 0,46% a producției, influență semnificativă.
- Munca (L) – O creștere de 1% a muncii determină o creștere de 0,21% a producției, influență mai mică decât capitalul.

Randamentul de scară conform formule este egală cu suma coeficienților ($0{,}46 + 0{,}21 = 0{,}67$) care este subunitară, ceea ce indică randamentul descrescător la scară. Suma este mai mică decât o unitate atunci are loc micșorarea efectului de la scara proporției ( $Y$ se mărește în raport mai mic fată de $K$ și $L$.

De exemplu presupune că $K$ și $L$ se măresc. Apoi noul nivel de ieșire devine:

$$Y' = A * (2K)^{\alpha} * (2L)^{\beta} = A2^{\alpha} * K^{\alpha} * 2^{\beta} * L^{\beta} = 2^{\alpha+\beta} * A * K^{\alpha} * L^{\beta} = 2^{\alpha+\beta} * Y$$

Din cauza că $\alpha + \beta = 0{,}67$, și $2^{\alpha+\beta} = 1{,}59$, atunci $Y$ se mărește mai puțin decât de 2 ori.

Ecuația rezolvată prin aplicarea regresiei OLS (Metoda celor mai mici Pătrate Ordinare) prezintă următoarele rezultate:

Funcția Cobb-Douglas utilizată pentru analiza economiei Republicii Moldova are forma:

$$\ln Y = 64{,}07 * K^{0{,}46} * L^{0{,}21} \quad (13)$$

## CONCLUZII

Rezultatele cercetării confirmă aplicabilitatea funcției Cobb-Douglas în contextul economiei Republicii Moldova. Elasticitatea capitalului $(0{,}46)$ indică o influență semnificativa asupra producție, în timp ce elasticitatea muncii $(0{,}21)$ arată o contribuție mai redusă. Modelul explică $95{,}6\%$ din variația producției ($R^2 = 0{,}956$), ceea ce demonstrează o relație puternică între factori și producție. Noutatea cercetării constă în aplicarea funcției Cobb-Douglas pe date recente din Moldova, evidențiind influența investițiilor în tehnologie asupra PIB-ului.

Potențialul de cercetare ulterioară vizează extinderea modelului prin includerea factorilor precum progresul tehnologic și inovația. O direcție viitoare ar fi analiza impactului capitalului uman și a digitalizării asupra producției. Rezultatele obținute sunt în conformitate cu modelul Cobb-Douglas clasic.

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# GESTIONAREA ȘI OPTIMIZAREA CHELTUIELILOR PERSONALE
# MANAGING AND OPTIMIZING PERSONAL EXPENSES

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**Abstract.** Managing and optimizing personal expenses contributes to improving financial balance and reduces the risk of economic instability. However, efficiently managing one's personal budget becomes a challenge in the context of a society marked by high levels of consumption, easy access to credit, and the impact of social pressure – aspects that call for appropriate approaches and effective solutions.

The main objective of the paper is to identify categories of expenses, analyze the efficiency of strategies for managing them, and evaluate the influence of technology implementation in optimizing the spending process. The research was conducted using a methodology that combined the study of specialized literature with the application of quantitative and qualitative methods, aimed at detecting spending patterns and measuring the effects of saving strategies.

The research highlighted three major categories of expenses: fixed, variable, and periodic. Furthermore, it was found that the careful monitoring of expenses, the creation of a budget tailored to personal needs, and the implementation of modern financial technology tools have a significant impact on improving financial behavior.

**Keywords:** personal expenses, managing expenses, income, personal budget, financial behavior.

**JEL Classification:** C89, D10, D19, D50, D59, D69.

## INTRODUCERE

Gestionarea eficientă a cheltuielilor este esențială pentru menținerea echilibrului financiar și realizarea obiectivelor financiare. În societatea contemporană, caracterizată de un nivel ridicat al consumului și de acces facil la credite și împrumuturi, gestionarea prudentă a resurselor financiare reprezintă o preocupare esențială. Această abordare ajută la evitarea dezechilibrelor financiare și asigură stabilitatea economică pe termen lung.

Studiile din domeniul economic evidențiază faptul că absența unei educații financiare corespunzătoare, alături de predispoziția spre cheltuieli impulsive, duc adesea la acumularea de datorii și la instabilitate financiară. O proporție semnificativă a populației întâmpină dificultăți în administrarea eficientă a bugetului personal și în menținerea unui echilibru între cheltuielile esențiale și cele suplimentare. Pe de altă parte, utilizarea tehnologiilor financiare și a aplicațiilor mobile pentru urmărirea cheltuielilor contribuie la îmbunătățirea sănătății financiare prin educarea utilizatorilor cu privire la concepte de bază și prin consolidarea unei abordări disciplinate față de finanțele personale.

### 1. Conceptul de *cheltuieli personale*

*Cheltuielile personale* reprezintă sumele alocate pentru cumpărarea de bunuri și servicii care sunt necesare desfășurării activităților cotidiene și asigurării unui anumit standard de viață. O gestionare eficientă a acestor cheltuieli este vitală pentru păstrarea echilibrului financiar și prevenirea

acumulării de datorii. În funcție de frecvența și scopul lor, cheltuielile personale pot fi clasificate în mai multe categorii.

*Cheltuielile fixe* reprezintă costurile care apar în mod regulat, de obicei lunar, și au o valoare relativ constantă. Ele sunt, în general, legate de obligații contractuale sau legale, ceea ce le face greu de redus pe termen scurt. Printre exemplele comune de cheltuieli fixe se numără plata chiriei, a ipotecilor, a ratelor la credite, facturile pentru utilități sau abonamentele lunare. Deși ajustarea acestor cheltuieli poate fi dificilă, există posibilitatea de a renegocia contractele sau de a găsi alternative mai accesibile pentru a micșora costurile asociate.

*Cheltuielile variabile* reprezintă costurile care se modifică în funcție de nivelul de consum și de alegerile financiare personale. Acestea sunt mai greu de anticipat și gestionat, întrucât depind de obiceiurile și deciziile individuale de consum. Printre exemplele de cheltuieli variabile se numără sumele alocate pentru alimente, transport, utilități sau activități de divertisment.

*Cheltuielile periodice* apar la intervale mai mari sau neregulate, ceea ce le face mai greu de anticipat. Unele dintre acestea au o dată fixă de plată (cum ar fi taxele școlare sau înmatricularea mașinii), în timp ce altele pot să survină în mod întâmplător (precum cheltuielile pentru călătorii, activități recreative sau cadouri). Din cauza naturii lor imprevizibile, este important să le integrăm în planificarea financiară prin constituirea unui fond de rezervă menit să acopere aceste costuri ocazionale.

O analiză detaliată a noțiunilor expuse mai sus este realizată în (Reed, *The 3 Types of Expenses: Fixed, Periodic, and Variable*).

## 2. Gestionarea eficientă a cheltuielilor

Gestionarea cheltuielilor contribuie la menținerea stabilității financiare pe termen lung și sporește calitatea vieții. Prin evaluarea și gestionarea atentă a cheltuielilor, se pot preveni dezechilibrele economice, se poate evita creșterea datoriilor și se poate elabora un plan financiar sustenabil.

Importanța gestionării eficienta a cheltuielilor este menționată în (*Expense Management: How to Manage Your Expenses Effectively and Efficiently*).

Un aspect esențial al unei gestiuni financiare eficiente este monitorizarea cheltuielilor. Această practică furnizează o perspectivă clară asupra utilizării resurselor financiare și permite identificarea unor modele de consum nesustenabile, precum și descoperirea unor posibilități de economisire.

Un alt element cheie constă în organizarea cheltuielilor în categorii separate, precum locuință, transport, alimentație, divertisment și altele. Prin evidențierea categoriilor cu cheltuieli mai ridicate, se pot realiza ajustări și reduceri de costuri, facilitând astfel realizarea obiectivelor financiare.

Bugetul personal reprezintă instrumentul folosit pentru a planifica și limita cheltuielile în funcție de veniturile disponibile. Crearea unui buget realist previne cheltuielile excesive și permite distribuirea eficientă a resurselor financiare către necesitățile esențiale și economii.

Monitorizarea constantă a cheltuielilor contribuie atât la identificarea și eliminarea costurilor nejustificate, cât și la dezvoltarea unor obiceiuri financiare mai echilibrate și sustenabile. Un buget fundamentat pe date reale despre cheltuieli facilitează definirea unor obiective financiare realizabile și oferă o imagine clară asupra progresului în atingerea lor.

Adoptarea unei abordări disciplinate, împreună cu implementarea unui plan financiar bine organizat, stă la baza gestionării eficiente a cheltuielilor personale. Această practică sprijină echilibrarea bugetului, reduce stresul financiar și consolidează sănătatea economică pe termen lung.

O analiză mai detaliată a beneficiilor urmăririi cheltuielilor, împreună cu sfaturile practice pe care le oferă, poate fi consultată pe (Tamplin, *The Benefits Of Expense Tracking And How You Can Do It Effectively*) și (*3 types Of Expenses (Fixed, Periodic, Variable) & How To Budget Them*).

**3. Dificultățile asociate cu gestionarea cheltuielilor personale**

Gestionarea cheltuielilor personale implică o serie de dificultăți și provocări care pot influența negativ capacitatea de a lua decizii adecvate și de a acumula economii.

Multe persoane nu dețin cunoștințele financiare necesare pentru a lua decizii înțelepte în ceea ce privește administrarea veniturilor și cheltuielilor. Această lipsă de educație financiară poate genera decizii nechibzuite, provocări în gestionarea bugetului și incapacitatea de a elabora un plan financiar viabil.

Achizițiile făcute fără o planificare prealabilă pot afecta semnificativ bugetul personal. Cheltuielile impulsive au potențialul de a depăși fondurile disponibile, generând datorii suplimentare, cum ar fi credite sau împrumuturi. Astfel de comportamente sunt amplificate de influențele sociale și media, precum ofertele atractive și idealurile de viață promovate online, care încurajează consumul excesiv.

Persoanele cu venituri reduse sau care nu au acces la un flux constant de bani întâmpină probleme în a acoperi cheltuielile de bază, precum cele legate de locuință, hrana și utilități. Absența unui venit stabil complică planificarea financiară și îngreunează economisirea pentru obiective pe termen lung.

Identificarea și gestionarea dificultățile menționate sunt esențiale pentru atingerea unui echilibru financiar și pentru crearea unui plan de cheltuieli sustenabil.

Provocările enumerate sunt descrise pe (Bowling, *11 Budgeting Challenges Hurting Your Finances*).

**4. Crearea unui buget personal**

Un buget personal constituie o metodă esențială de gestionare în mod eficient a veniturilor și cheltuielilor. Acesta se elaborează pentru o perioadă specifică de timp și cuprinde atât planificarea fluxurilor financiare, cât și evaluarea modului în care sunt respectate prevederile bugetului. Un buget bine structurat permite distribuirea echilibrată a fondurilor acoperind nevoile esențiale și dorințele, fără a genera datorii sau dezechilibre financiare. Descrierea detaliateă a noțiunilor: bugetul, venituri și cheltuieli este realizată în (Буклемишев *и др*. 61-82).

Procesul de creare a unui buget constă din mai multe etape. Prima etapă presupune stabilirea veniturilor, identificarea tuturor surselor de venit, cum ar fi salariile, bonusurile și veniturile pasive. Urmează, identificarea cheltuielilor. Cheltuielile sunt înregistrate pentru a analiza structura lor și a identifica costurile esențiale și cele ce pot fi optimizate. Etapa de monitorizare și adaptare a bugetului presupune o analiză lunară a cheltuielilor, cu scopul de a detecta eventuale dezechilibre sau posibilități de economisire. Optimizarea cheltuielilor personale și planificarea financiară sun descrise în (*Cum ne gestionăm rațional bugetul personal*).

**5. Reducerea cheltuililor neesențiale**

Reducerea cheltuielilor neesențiale poate îmbunătăți semnificativ echilibrul financiar prin adoptarea unor strategii eficiente de gestionare a cheltuielilor. Separarea cheltuielilor esențiale (cum ar fi locuința, hrana și utilitățile) de cele opționale (cu sunt divertismentele și achizițiile de lux) sprijină o distribuire mai responsabilă a resurselor financiare.

Introducerea unei perioade de reflecție, de o zi sau două, înainte de a face o achiziție majoră ajută la evitarea cheltuielilor inutile și la luarea unor decizii mai responsabile. Această abordare contribuie la diminuarea cumpărăturilor nejustificate și la consolidarea controlului asupra finanțelor personale.

Utilizarea numerarului în locul cardurilor contribuie la o percepție mai clară a cheltuielilor, diminuând posibilitatea de a depăși bugetul stabilit. În același timp, aplicațiile financiare oferă posibilitatea de a seta limite lunare pentru cheltuieli și de a alerta utilizatorul atunci când acestea sunt depășite.

**6. Utilizarea tehnologiei în gestionarea cheltuielilor**

Tehnologia are un impact semnificativ în administrarea cheltuielilor, punând la dispoziție aplicații mobile și platforme online care simplifică urmărirea cheltuielilor, evaluarea obiceiurilor de consum și depistarea posibilităților de economisire. Folosind instrumentele digitale, gestionarea bugetului devine mai transparentă și eficientă.

Aplicațiile facilitează înregistrarea automată a cheltuielilor, oferind o perspectivă clară asupra utilizării resurselor financiare. În funcție de veniturile disponibile și de obiceiurile de consum, acestea generează un buget personalizat, contribuind la o administrare eficientă a fondurilor.

Atunci când cheltuielile depășesc limitele stabilite, aplicațiile trimit alerte prin notificări, ajutând la evitarea dezechilibrelor financiare.

## CONCLUZII

Gestionarea eficientă a cheltuielilor personale reprezintă un element esențial pentru menținerea echilibrului financiar și pentru atingerea obiectivelor economice pe termen lung. Utilizarea platformelor financiare moderne și aplicațiilor de gestionare a cheltuielilor persoanele oferă claritate asupra tiparelor de consum și pot adopta decizii financiare mai responsabile. Tehnologiile informatice din domeniul financiar facilitează gestionarea eficientă a fondurilor prin urmărirea în timp real a cheltuielilor, oferirea de alerte în cazul depășirii bugetului și generarea de recomandări personalizate pentru economisire. Aplicațiile de gestionare a cheltuielilor contribuie la conștientizarea obiceiurilor de consum. Acest aspect sugerează că, deși tehnologia oferă un sprijin important în gestionarea bugetului, succesul în optimizarea cheltuielilor depinde în mare măsură de comportamentul și disciplina individuală.

Gestionarea eficientă a cheltuielilor personale reprezintă un proces complex, dar esențial pentru menținerea stabilității financiare. Adoptarea unor strategii bine definite și utilizarea tehnologiilor moderne pot conduce la îmbunătățirea sănătății financiare și la atingerea unui echilibru economic sustenabil.

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# THE USE OF AI IN EDUCATION AND INTERNATIONAL ASSESSMENT SYSTEMS. AI-BASED EXAMS – LINGUASKILL CAMBRIDGE: FAST, SIMPLE, CONVENIENT, BUT EFFECTIVE?

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**Abstract**: The integration of Artificial Intelligence (AI) in education and international assessment systems is transforming how students are evaluated. The Linguaskill Cambridge exam, an AI-driven English proficiency test, stands out as an innovative approach to language assessment. Unlike traditional exams, Linguaskill offers flexibility, as it can be taken remotely with minimal technical requirements. The AI system evaluates results quickly and efficiently, making the test available 24/7 without human intervention. Linguaskill assesses four language skills—reading, listening, writing, and speaking—through an adaptive testing method that personalizes questions based on candidates' abilities. The automated grading system ensures immediate and unbiased evaluation, reducing the time required for results. The test is divided into General and Business modules, allowing the candidates to choose the most relevant format for their needs. Despite its advantages, Linguaskill faces challenges in widespread adoption, particularly in developing countries where accreditation remains an issue. Many institutions and employers still prefer traditional assessment methods, questioning the reliability of AI-driven evaluations. However, as technology advances, AI-based exams like Linguaskill have the potential to revolutionize international education by making assessments faster, more accessible, and highly efficient.

**Keywords**: *AI, Education, International Assessment, English Language.*

**JEL Classification:** I 26, J10, J26, M15, O32

## INTRODUCTION

In today's world more and more people tend to live in the fast lane, having their day scheduled down to the minute. Such lifestyle has made people think of the ways that can significantly improve the level of living by simplifying some of the manual processes, using Information Computer Technology. With the appearance of Artificial Intelligence many realms have been dramatically revolutionized and educational system is not the exception. In recent years, the integration of AI into educational frameworks has not only enhanced teaching methodologies, but also transformed how students are assessed. Traditional forms of assessment, which typically rely on human examiners, are increasingly being supplemented or even replaced by AI-driven systems. Among these innovations, Linguaskill Cambridge exam, an AI-based English language proficiency test, stands out as a notable example of the growing reliance on technology in international assessment systems.

Cambridge Examination System has been extremely popular with a great variety of test-takers over the last few decades as it is recognized by major institutions all over the world. It also provides

the world's leading range of qualifications and tests for learners and teachers of English that suit every walk of live depending on their needs. The only drawback is certainly the time that takes the results to appear. To address this issue, the department of the University of Cambridge, responsible for International Cambridge Exams has recently elaborated a brand-new testing system, fully based on AI - Linguaskill Cambridge exam [1].

This article aims to critically explore the use of AI in education, focusing particularly on the Linguaskill Cambridge exam. It will evaluate the system's effectiveness in comparison to traditional language testing methods, examining both its strengths and potential limitations.

## MAIN CONTENT

### 1. Materials and Methods

Linguaskill Cambridge exam has been developed by a dedicated team of experts. It has been trialled by speakers of over 40 languages from 50 countries to ensure the accuracy and reliability of the results. The origins of Linguaskill go back to the mid-1990s when Dr Nick Saville began working on the idea of online, automated, modular tests. The aim was to democratise testing, making it quicker and more efficient. Since then, Linguaskill has developed to provide a generic, multilevel test that serves the needs of all audience, from education to business. Linguaskill is used to measure what has been learned, as opposed to score-driven alternatives, which can measure how well the candidates have practiced for the test. Since the huge demand has appeared on receiving special qualifications in English language, nowadays the research and development team is based and conducted by five most qualified professionals in Applied Linguistics, Psychology and Technology that are constantly improving the program to meet the needs. Dr Ardeshir Geranpayeh, the Head of Automated Assessment and Learning at Cambridge English is involved at the design stage for the technical model, creating the Computer Adaptive Test (CAT) for Reading and Listening. He is also responsible for preparing the automated assessment engine for marking Linguaskill's Writing and Speaking components. Dr Geranpayeh marks, that Linguaskill exam is adaptive as each candidate receives a different set of test items, personalized to their true ability level. Also, using AI technology helps deliver immediate marking of the Writing and Speaking tests, that certainly simplifies the way of assessment in terms of the Common European Framework of Reference for Languages (CEFR). Martin Robinson, Dr Jing Xu and Dr Kevin Cheung are involved in communicating with customers, addressing threats that they can face while using the platform, giving feedback and maintaining the correct interpretation of the results [2].

Linguaskill is a modular online test which assesses all four language skills: reading, listening, writing and speaking. Linguaskill is available as two options: General and Business. It gives candidates the ability to choose the sort of language that will be tested, based on their objectives. Linguaskill General tests the language used in daily life, making it ideal for university admission or exit, and recruitment for roles in a non-business-specific environment. For example, when an employee needs strong English skills to perform their role effectively, but will not need specific business terminology. This makes the test suitable for a broad spectrum of organizations. Test topics include studying and working, making future plans, travel and technology.

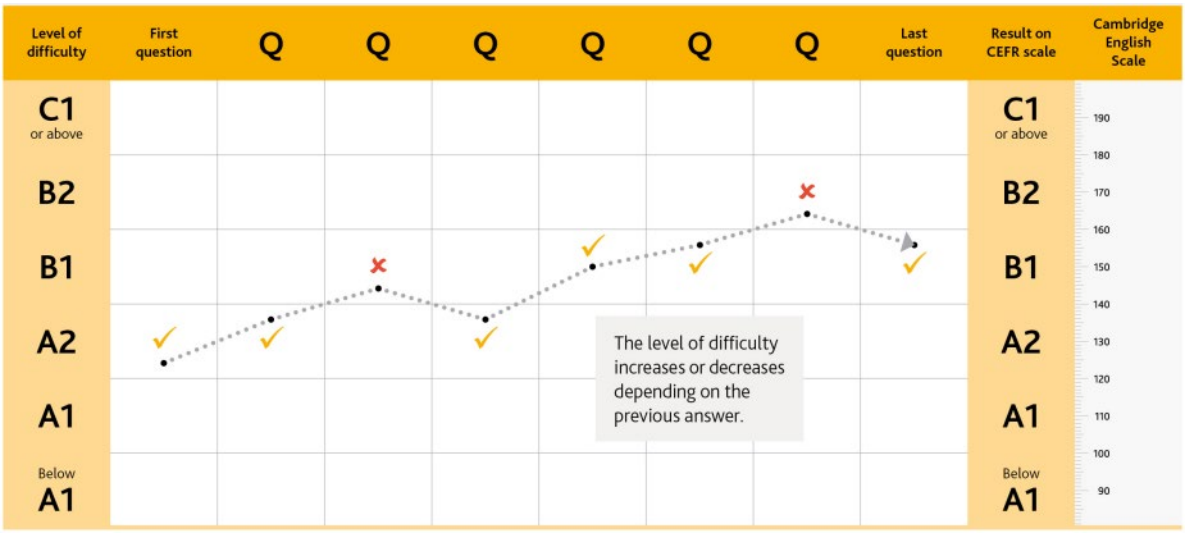
Linguaskill Business tests English used in a business and corporate setting, which is most appropriate for recruitment in organisations where employees are expected to be familiar with the language of business. It is suitable for large or small organisations, which may be operating on an

international level. Test topics include buying and selling of products or services, the office, business travel and human resources.

The Reading and Listening module is adaptive, so there is not a fixed number of questions. Each question the candidate answers helps the computer to understand their level better. The test finishes when the candidate has answered enough questions for Linguaskill to identify their level accurately. It takes approximately an hour to test the candidate's abilities to work with different types, use their critical thinking skills to manage with open-gap fill exercises and quickly find the right answers in extended reading and listening sections. The results are presented on the screen within several minutes after the test is finished and the candidate can move onto the next module. The Writing module asks candidates to input answers using a computer keyboard and consists of two parts, which do not take more than 45 minutes. In the first part the candidate is asked to write a short reply on a message, corresponded to the given task. The second part tests the ability to formulate a longer and structured text based on the presented scenario and the three bullet points. Linguaskill General candidates will write at least 180 words to a wider audience and may be asked to produce a variety of text types (e.g. review, article, web post). Linguaskill Business candidates will write a letter or report of at least 180 words, often to a manager or staff within the company or to external clients. The Speaking module is taken using a computer with a microphone and headphones. Questions are presented to the candidate through the computer screen and headphones, and their responses are recorded. There are five parts that assess a candidate's ability to express thoughts clearly, coherently, and logically, depending on the task type, either it is a long turn or some short answers. The results are assessed by market-leading auto-marking technology and are released within 12 hours together with the writing part [3].

## 2. Results and discussions

The main benefit is certainly the fact, that Linguaskill exam may be taken from home just using a laptop with headphones, a camera and a microphone. Moreover, due to the AI-based assessment system, the test is checked quickly and the results are available within 12 hours. Last, but not least, it is a flexible test in which the candidate can choose the skills they need to certify: Reading and Listening (combined), Writing or Speaking, because not all job positions require expertise in all three modules, so the testing system is adaptive on demand of each individual [4].




**Line graph 1: How adaptive testing works in Linguaskill**
**Source:** *cambridgeenglish.org*

## CONCLUSION

The integration of Information Computer Technologies and Artificial Intelligence in particular in education and international assessment systems has significantly transformed the way students are evaluated. Top-notch AI-driven exams, such as Linguaskill, demonstrate the potential of advanced technology to enhance assessment processes, making them faster, more accessible, and efficient. By introducing AI, these exams offer a more personalized and adaptive testing experience, reducing bias and improving accuracy in language proficiency evaluation comparing to human judgement. As technology continues to evolve at lightning speed, such kind of exams can revolutionize future education when such fast results are needed and expected.

This area of international assessment is quite promising due to its accessibility. Taking such an exam requires minimal technical equipment, and it can also be taken from home with the appropriate permission. The results are fully checked by AI, making the exam available 24/7/365 and independent of national holidays and weekends.

The limitation of this exam lies in obtaining accreditation by developing countries, as well as its widespread adoption. Since this is a relatively new approach, not all countries, universities, and companies recognize the reliability of its results, as they prefer to trust traditional assessment methods, believing that robots cannot yet fully replace humans.

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# EXPLORING ARTIFICIAL INTELLIGENCE AND DATA ANALYTICS FOR INNOVATION IN DIGITAL TRANSFORMATION

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**Abstract.** This study explores the ways in which data analytics and artificial intelligence (AI) foster creativity within the framework of digital transformation. The main research question is related to how much operational effectiveness and strategic decision-making are improved by the combination of these two. The study paradigm, which offers insights into organizational adoption, is based on the Diffusion of Innovation Theory and the Technology Acceptance Model (TAM). A qualitative evaluation of applications specifically suited to the operational requirements and difficulties in the manufacturing, healthcare, finance, retail, and smart city sectors is incorporated into the process. Data analysis reveals the useful advantages of AI-powered automation and predictive analytics, illustrating how they affect resource optimization, customer satisfaction, and productivity. The results support the original theory that analytics and AI are important facilitators of competitive advantage and sustained innovation. But, the study also points up important obstacles, such as issues with data privacy, integration difficulties, and moral ramifications. To properly utilize these technologies, the conclusions stress the necessity of robust governance, moral frameworks, and infrastructure adaptability. In addition to outlining future research areas for optimizing the potential of AI and data analytics in digital transformation plans, this study provides a thorough perspective on best practices.

**Keywords:** Artificial Intelligence, Data Analytics, Digital Transformation, Innovation, Predictive Analytics, AI Integration.

**JEL Classification:** O33, M15, L86.

## INTRODUCTION

In the era of accelerated digitalization, AI and Data Analytics have emerged as critical drivers of innovation, enabling organizations to gain a competitive edge through data-driven decision-making and operational optimization. As global industries face increased demands for efficiency and adaptability, the integration of intelligent technologies becomes a strategic imperative. Existing studies emphasize the transformative potential of AI beyond automation, extending into predictive capabilities, personalized user experiences, and intelligent resource allocation (Brynjolfsson and McAfee 97).

Provost and Fawcett explored how data analytics empowers businesses by delivering descriptive, predictive, and prescriptive insights, thereby improving strategic planning and execution (Provost and Fawcett 104). From a theoretical standpoint, many authors adopt the Technology Acceptance Model (TAM) and the Diffusion of Innovation Theory to explain how organizations embrace technological change. For instance, Gomber et al. examined the forces of innovation and disruption in financial services through the lens of innovation diffusion, emphasizing the impact of AI and fintech technologies on business transformation (Gomber et al. 240).

The research conducted by Topol in healthcare settings demonstrates that AI-driven diagnostics significantly enhance medical accuracy and resource utilization (Topol 56). Meanwhile, studies on smart cities have outlined the societal value of AI and analytics in urban planning, energy distribution, and traffic management (Nam and Pardo 286). While the literature acknowledges the benefits of these technologies, it also highlights unresolved challenges such as ethical concerns, algorithmic bias, and data privacy risks (Floridi and Cowls 10; Acquisti et al. 510).

Despite the growing body of research, a comprehensive cross-sectoral analysis that integrates practical outcomes with strategic insights remains limited. This study addresses that gap by exploring how AI and data analytics collectively foster innovation in digital transformation efforts across multiple industries.

The aim of this paper is to evaluate the role of AI and data analytics in enhancing operational efficiency, strategic decision-making, and long-term innovation. The core research question is: How can AI and Data Analytics effectively drive innovation within digital transformation frameworks? The central hypothesis posits that the integration of AI and data analytics significantly improves operational processes and fosters sustainable competitive advantage. By critically reviewing relevant applications and theoretical frameworks, this paper offers practical insights and guidance for organizations navigating the challenges and opportunities of digital transformation.

## 1. Materials and Methods

This research employs a qualitative analytical approach to investigate the role of AI and Data Analytics in driving innovation within digital transformation initiatives. The approach is grounded in a theoretical framework that draws from the Diffusion of Innovation Theory and the Technology Acceptance Model (TAM), two well-known theories for examining technology adoption in organizational settings. These models have been modified to evaluate how AI and analytics are integrated across a range of sectors, such as manufacturing, retail, healthcare, finance, and smart city systems.

Comparative analysis of previous case studies and industry-specific reports was part of the research, which concentrated on performance metrics like operational effectiveness, predictive capability, and enhancements to the customer experience. Industry papers and peer-reviewed literature were among the primary data sources. The cross-sectoral comparison, which attempts to find trends and difficulties in the integration of AI and analytics outside discrete industrial viewpoints, is the methodological variant introduced in this work. Additionally, the research incorporates legislative, ethical, and infrastructure aspects, reflecting current advancements in digital governance frameworks (Floridi and Cowls 10).

## 2. Results and Discussion

The results show that across industries, AI and data analytics greatly enhance operational effectiveness, prediction accuracy, and strategic adaptability. AI-powered diagnostic tools and predictive models, for instance, improve accuracy and facilitate more efficient use of resources in the healthcare industry (Topol 56). Artificial intelligence (AI) algorithms are utilized in banking for risk management, fraud detection, and consumer customization (Gomber et al. 240). While manufacturing shows improvements in quality assurance and predictive maintenance, the retail industry advantages from AI-enhanced inventory control and tailored marketing (Lee et al. 74).

Integration issues still exist in spite of these advantages. The difficulty of integrating AI systems with legacy IT infrastructure and the lack of qualified workers were regularly mentioned. Concerns about algorithmic bias and data privacy were also frequently raised across industries (Acquisti et al. 510). Table 1 summarizes these challenges and categorizes them by industry and impact level.

**Table 1. Key Integration Challenges of AI and Data Analytics by Industry.**

| Industry | Key Challenges |
|---|---|
| Healthcare | - Data privacy (HIPAA/GDPR compliance)<br>- Fragmented electronic health records (EHRs)<br>- Clinical validation and bias mitigation |
| Finance | - Regulatory constraints (e.g. AML, KYC)<br>- Legacy system integration<br>- Explainability of models (XAI) |
| Manufacturing | - Lack of standardized data formats (from IoT/PLC systems)<br>- High cost of sensor retrofitting<br>- Latency-sensitive environments (real-time inference) |
| Retail | - Data silos across sales, marketing, and logistics<br>- Handling unstructured customer data (reviews, feedback)<br>- Cold-start problem in recommender systems |
| Education | - Inconsistent or missing student data<br>- Ethical concerns over student profiling<br>- Limited AI readiness of educators |

**Source:** *Authors' synthesis from reviewed sources.*

This study contributes to existing knowledge by offering a structured cross-industry analysis, identifying both shared opportunities and context-specific challenges. In contrast to earlier research that concentrated on specific industries, this study offers an integrative perspective that improves strategic comprehension and makes it easier to create more flexible digital transformation models. This work's methodological synthesis and forward-looking examination of edge AI, AI-IoT convergence, and ethical governance mechanisms are what make it distinctive.

## CONCLUSIONS

This work's methodological synthesis and forward-looking examination of edge AI, AI-IoT convergence, and ethical governance mechanisms are what make it distinctive. The results, which are based on the Diffusion of Innovation Theory and the Technology Acceptance Model, demonstrate that AI-powered solutions, from intelligent decision systems to automation and predictive analytics, improve operational performance, resource efficiency, and strategic responsiveness in a variety of sectors, including healthcare, finance, manufacturing, retail, and smart cities.

Consistent advantages are highlighted by the study, such as enhanced decision-making, customized offerings, and streamlined procedures. But it also highlights the main obstacles, such as data silos, legacy system limitations, problems with regulatory compliance, and moral dilemmas with regard to bias, accountability, and transparency. These issues differ per industry, highlighting the necessity of specialized AI adoption plans and strong governance frameworks.

This study is innovative since it takes an integrative approach, providing technical and strategic viewpoints to guide future models of digital transformation. As responsible AI frameworks, edge AI, and AI-IoT integration develop, businesses need to match technology deployment with infrastructure and ethical preparedness.

In addition to technological developments, leadership dedication, workforce readiness, and interdisciplinary cooperation will be necessary for sustained innovation. Future studies should examine sector-specific governance models, longitudinal effects, and the creation of inclusive, transparent, and scalable AI ecosystems.

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# OPTIMIZING BUSINESS ANALYTICS AND DECISION-MAKING THROUGH THE APPLICATION OF GENERATIVE ARTIFICIAL INTELLIGENCE IN FORECASTING AND SIMULATION

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**Abstract.** This thesis investigates how generative artificial intelligence (AI) can optimize business analytics and decision-making in forecasting and simulation. Employing a qualitative synthesis of academic literature and industry reports, the study examines how AI models enhance forecasting accuracy and generate realistic simulations. Results indicate that AI-driven forecasting improves decision quality by reducing uncertainty, lowering costs, and mitigating risks, while also offering a competitive advantage. However, significant challenges remain, including algorithmic bias, data privacy concerns, high computational requirements, and regulatory hurdles. The findings underscore the need for robust governance and further research on broader applications of generative AI in strategic decision-making today.

**Keywords:** Generative AI; Forecasting; Simulation; Business Analytics; Decision-Making.

**JEL Classification:** M10, M20, C53, O33.

## INTRODUCTION

Businesses increasingly depend on data-driven analytics, but the growing complexity and scale of data have outpaced traditional forecasting methods. Generative Artificial Intelligence (AI) offers a powerful solution by using advanced machine learning to detect patterns and generate synthetic data, enabling more accurate and forward-looking insights. Its potential impact is substantial—McKinsey & Company estimates generative AI could contribute $2.6 to $4.4 trillion annually to the global economy ("The Economic Potential of Generative AI" McKinsey). This paper examines how integrating generative AI into business forecasting and simulation can improve decision-making, optimize analytics, and help organizations manage uncertainty more effectively.

## MAIN CONTENT

### 1. What is Generative AI?

Generative AI refers to algorithms that do not just analyze existing data but create new content or predictions based on learned patterns. In contrast to traditional AI systems that mainly recognize patterns or make routine predictions, generative models (such as Generative Adversarial Networks, Transformers like GPT-4, and diffusion models) can produce original outputs – from text and images to plausible future data scenarios (Understanding the Differences Between AI and GenAI). In other words, rather than simply following pre-programmed rules or forecasting from historical trends, generative AI can generate novel data that resembles real-world data. This capability enables forward-looking operational improvements and richer what-if analyses (Understanding the Differences Between AI and GenAI). For example, a generative AI model trained on time series data can simulate new plausible future data points, not just extrapolate existing patterns. These properties make

generative AI particularly powerful for business applications like forecasting and scenario planning. By leveraging vast datasets and deep learning techniques, generative AI models learn the underlying structure of data and can thus generate realistic outputs. This differs fundamentally from traditional predictive models and provides a new toolset for businesses to creatively tackle complex problems.

**2. The Role of Generative AI in Forecasting**

Forecasting in business predicts future metrics—such as sales, market trends, customer demand, or supply chain needs—using historical data. This process is vital for capacity planning, budgeting, and strategic decision-making under uncertainty. Traditional methods (e.g., ARIMA or exponential smoothing) often falter when data is complex or voluminous. Generative AI enhances forecasting by learning intricate patterns from historical data to produce adaptive, data-driven predictions that simulate multiple potential futures rather than a single trend projection. Recent studies indicate that generative AI-based forecasts can outperform classical models; for instance, Hassani and Silva (2024, Predictions from Generative Artificial Intelligence Models: Towards a New Benchmark in Forecasting Practice) found superior accuracy compared to seasonal ARIMA, suggesting these models capture complex patterns that traditional techniques might miss.

Moreover, generative AI lowers the barrier for non-experts. Advanced language-model tools (like ChatGPT or Copilot) enable users to generate forecasts via simple prompts without requiring deep statistical expertise. This democratization allows managers to rapidly obtain predictive insights and incorporate them into decision processes. For example, in retail, AI-generated demand forecasts have optimized inventory management by automatically adjusting stock levels based on factors such as social media trends and weather data. Overall, integrating generative AI into forecasting yields more reliable predictions, faster responses to change, and a nuanced understanding of future risks and opportunities.

**3. Generative AI in Business Simulations**.

Beyond point forecasts, generative AI plays a transformative role in business simulations and scenario planning. Simulations involve creating virtual models of real-world business processes or environments to test different strategies and outcomes. Traditionally, scenario planning might involve manual what-if analysis or simplistic models. Generative AI enhances this by generating realistic, data-driven scenarios that help decision-makers explore multiple potential futures. For instance, a generative model can simulate how a supply chain might behave under various conditions (surge in demand, supplier failure, geopolitical disruption, etc.), allowing companies to evaluate their contingency plans. This capability is invaluable for risk management and strategic planning in complex, volatile markets.

One practical application is in financial scenario modeling. Generative AI can be used to create numerous plausible economic or market scenarios (e.g. different interest rate trajectories or competitor behaviors) for a company's financial model. By doing so, it enables executives to test investment strategies against a wide range of conditions and identify risks that traditional models might overlook. In the realm of supply chain management, early adopters have used generative AI to run what-if simulations. For example, a chemicals manufacturer employed a GenAI tool to simulate scenarios involving delays in obtaining key raw materials; the AI not only modeled the operational impact but even suggested alternative courses of action if certain disruptions occurred (How supply chains benefit from using generative AI | EY - US). In general, today's generative AI tools can produce risk assessments and scenario simulations on-demand, helping planners proactively manage potential

problems. According to industry analysts, risk management may be one of the most promising areas for GenAI's application in operations, as these tools can rapidly output mitigation strategies for various hypothetical crises (How supply chains benefit from using generative AI | EY - US). By embracing AI-driven simulations, businesses become better prepared for uncertainty: they can visualize outcomes of decisions before committing to them, thereby optimizing strategies for resilience.

**4. Benefits of GenAI in Business Analytics**

Generative AI (GenAI) has become a powerful asset in business analytics by significantly improving decision quality and efficiency. By automating complex data analysis, organizations can ground their decision-making in robust, empirical data rather than relying on subjective intuition (Streamlining Finance Management with Generative AI). This ultimately improves decision quality and outcomes. Organizations that integrate GenAI with human expertise report more accurate insights and faster decision-making as AI-driven analysis mitigates human bias and error ("GenAI Tools and Decision-Making" Sloan Review). GenAI's rapid analysis of vast datasets helps managers uncover hidden patterns and generate synthetic scenarios, supporting evidence-based decisions in dynamic markets ("The Economic Potential of Generative AI" McKinsey).

Beyond internal efficiencies, GenAI strengthens risk management and provides a competitive advantage. Advanced generative models simulate diverse future scenarios, enabling decision-makers to anticipate potential risks and optimize inventory or hedge against market volatility ("How Generative AI is Transforming Data-Driven Decision Making in 2025" Techment). Early adopters demonstrate greater agility, innovation, and long-term competitive success ("Maximizing Organizational Value with Generative AI" Orbus Software; "Benefits, Risks, and Best Practices for Businesses" Earley Information Science).

**5. Challenges and Ethical Considerations**

Generative AI holds immense potential for business transformation but also brings significant challenges and ethical concerns. A primary issue is data privacy and security, as these models require vast amounts of sensitive information. Without robust governance and strict compliance with privacy regulations, the risk of data breaches or misuse increases, raising critical concerns about consent and confidentiality (IBM, Shedding Light on AI Bias). In addition, the high computational cost of training and deploying advanced generative models demands substantial computing power and energy, which can be prohibitive—especially for smaller firms—even with scalable cloud solutions (McKinsey, The Economic Potential of Generative AI).

Bias and misinformation present further ethical dilemmas, as these systems learn from historical data that may contain inherent biases, potentially perpetuating discrimination—for example, in lending decisions (IBM, Shedding Light on AI Bias). Moreover, generative models sometimes produce "hallucinations" or plausible but false information, misleading decision-makers. To mitigate these risks, rigorous testing, bias-detection tools, and continuous human oversight are essential (Earley Information Science, Benefits, Risks, and Best Practices for Businesses). A lack of transparency in AI decision-making compounds these challenges; many models operate as "black boxes," hindering accountability in critical industries like finance and healthcare. Advancements in explainable AI—such as interpretable architectures and confidence indicators—are crucial to ensure that AI recommendations remain clear and actionable (Techment, How Generative AI is Transforming Data-Driven Decision Making in 2025). Balancing these challenges with ethical responsibility is key as businesses increasingly integrate AI into their processes.

## CONCLUSIONS

Generative AI is poised to transform business forecasting, simulation, and decision-making by delivering efficient, accurate, and innovative analytical capabilities. Our findings reveal that integrating GenAI into forecasting allows organizations to harness complex data for more reliable predictions and robust contingency planning, shifting decision-making from reactive to proactive. This novel approach demonstrates significant operational benefits, such as optimized supply chains and enhanced financial resilience, underscoring the originality and potential of these technologies. However, the paper also highlights important limitations—ethical concerns, potential algorithmic bias, high computational requirements, and regulatory challenges—which require robust governance and human oversight. Notably, an unexpected outcome was the strong indication that real-time, continuously adapting AI-driven decision support systems will soon become standard practice, unlocking further productivity gains. Future research should quantify the economic benefits, refine methods for mitigating risks, and explore strategies for ethical AI integration. Ultimately, businesses that balance technological capabilities with ethical responsibility will be best positioned to thrive in an increasingly data-driven, AI-enhanced landscape.

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# AI DRIVEN PROJECT MANAGEMENT TOOLS

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**Abstract.** The concept of project management has significantly evolved over time, and it adapted periodically considering the needs on the market and technological advancements. In the latest years, the increased utilization of artificial intelligence (AI) tools has transformed project management by automating processes and improving efficiency. This paper explores the role of the AI tools on project planning, risk management, resource allocation, stakeholder engagement and team collaboration. The study employs a qualitative approach, analyzing existing literature and to assess the AI role in project workflow. Findings suggest that AI-driven project management solutions can improve processes, optimize workflows, accelerate tasks completion and enhance collaboration among teams. However, challenges such as data security, ethical concerns and workforce adaptation remain. The paper also discusses options for mitigating these risks in order to maximize the AI's potential in the field.

**Keywords**: Project management, artificial intelligence, risk management, resource allocation, team collaboration, automation.

**JEL Classification:** O32

## INTRODUCTION

The rapid advancements in artificial intelligence over the past three years have significantly impacted various industries, specifically reshaping the way organizations approach project management. Within the field of project management, AI has evolved and it is now widely used and accessible. This transformation is changing all phases of the project, from initiation and planning to execution, monitoring and closure. Studies indicate that approximately 70% of projects fail due to various constraints and it highlight the need for innovative solutions to increase project outcomes and success (Trienpont International).

The evolution of project management methodologies reflects the ongoing adaptation to technological changes. Traditional "waterfall" methodologies dominated project execution between the 1980s and early 2000s and then Agile methodologies gained popularity in the 2010s (Nieto-Rodriguez). Today, hybrid project management approaches are necessary to address the complexities of modern projects. Research by Gartner (2019) predicts that AI will automate 80% of a project manager's administrative tasks by 2030 and in this way, it will allow professionals to focus more on other types of tasks, for instance related to leadership and innovation. AI-powered tools are developed to help project managers with automatization of reporting, risk assessment, resource allocation and other optimization. It provided access to templates, historical data or predictive analysis that can help both new project managers and experienced professionals.

## MAIN CONTENT

### 1. AI-DRIVEN PROJECT MANAGEMENT

The adoption of AI in the project management field has led to the development of various AI tools designed to help professionals in this domain to optimize their daily tasks. These solutions are developed to facilitate communication, automatize reports, improve collaboration and help project managers allocate resources more effectively.

In the future period, the roles most likely to be taken over by artificial intelligence in project management include the project manager's assistant (52%) and project management advisor (44%). More than half of project managers expect an acceleration of digitalization in the business environment through the implementation of AI-based solutions (IPMA).

The adoption of AI can be seen as an opportunity, particularly since AI does not experience fatigue, does not require time off, and excels in processing large volumes of data quickly, and can make real-time predictions and recommendations based on historical data. Studies show that organizations investing in AI and utilizing AI tools experience an average productivity increase of 15% (Bainey, 43-55).

Utilization of AI tools can help professionals analyze faster and without many errors the historical data of other projects, identify patterns and help better forecast potential outcomes and risks or budget overruns. These details obtained faster with the help of AI tools enable project managers to be better equipped to reduce project failures. Furthermore, AI optimizes resource allocation by matching the right personnel to specific tasks based on skills, experience, and workload capacity.

An important contribution of utilization of AI is the automation of some repetitive tasks, such as reporting or document management. Considering this improvement in processes and project management time, it allows them focus on more creative or strategic tasks.

### 2. ADOPTION CHALLENGES

The use of AI has numerous advantages but also presents several challenges. Project documentation is often outdated or incomplete due to resource constraints or rapid Agile development cycles. Without accurate documentation, AI tools may produce unreliable results. Additionally, the lack of transparency in AI algorithms (Black Box Effect) raises concerns, prompting the need for Explainable AI (XAI) to improve trust and understanding (Pearce).

Challenges in AI adoption include data security or high implementation costs. Resistance to change and ethical concerns, such as biased training data, can also impact project outcomes (Institute Project Management). Ensuring fairness, transparency, and ethical compliance is important to mitigate risks. There can be different options to adapt to these challenges, where organization can set up procedures and guidelines, and provide training for better adoption.

## CONCLUSIONS

AI tools have the potential to change the processes in project management and offer improved efficiency and better risk assessment and resource allocation and more efficient collaboration. At the same time the integration needs to happen in steps and mitigate the challenges that arises.

Future research should focus on real-world AI applications in project management and explore case studies that demonstrate the impact of AI on daily operations. In addition, studies should investigate best practices for overcoming adoption challenges and ensure that AI implementation will lead to sustainable improvements in project management.

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# SECTION: CYBERSECURITY AND RISK MANAGEMENT IN THE DIGITAL AGE

## SECURING THE FUTURE

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**Abstract.** Cybersecurity is an information age chronic phenomenon, and enterprise is faced with more and more sophisticated cyber-attacks. Cybersecurity and risk management are also included since they quantify the economization of the cost of cybercrime, the value of good security mechanisms, and best practices to safeguard digital assets. Organizations can make themselves risk-proof and fortify their security position through adopting controls such as the CIA Triad and ISO 27005. Adopting an offensive security position, i.e., sophisticated technology and constant learning as a way of being one step ahead of anticipated cyber-attacks, has also been recommended in the report.

***KEY WORDS:*** *hacker, cybersecurity, threats, digital age, security measures, risks.*

## INTRODUCTION

Cyber security is safeguarding computer systems, networks, and data from any kind of malicious attacks. Opening business in the cyber world, malware attacks such as ransomware, phishing, and data stealing have been nightmare problems. Steps need to be taken for prudent steps of risk management to detect loopholes and reduce possibilities of such likely attacks before it becomes an issue.

The economic burden of cyber-crime is enormous.

The global economy lost a staggering $13.82 trillion to cybercrime up to 2028, the third-largest economy in the world behind America and China.

Increased sophistication of cyber-attacks necessitates multi-dimensional security solutions by way of technology intrusion, regulatory compliance, and compliance wherever on the web. This paper contends the evolving threat environment, cybersecurity best practice, and the degree to which developed risk models consider providing a firm cyber defense policy.

### The Changing Cyber Threat Environment

Cybercrime is on the rise day by day, day by day more complex and harmful. The hackers are exploiting the capability of emerging technologies such as AI and machine learning to automate the attack, and thus it is hard to detect and filter. The most prevalent cyber-attacks are:

- **Ransomware:** Encryption of files by malware, and the hacker will request money in exchange for its release.

- **Phishing:** Deceptive messages or emails to get the users to provide sensitive information.
- **Data Breaches:** Infringement of sensitive data, resulting in loss of finances and reputation.

More value of cybercrime is a continuous parallel with investment in greater emphasis on spending in secure cybersecurity. None of the cybersecurity companies suffer losses, business interruption, and litigation.

**Cybersecurity Best Practices and Frameworks**

Strong cybersecurity posture rests upon security fundamentals. CIA Triad is a battle-hardened veteran which guarantees:

- **Confidentiality:** Prevention of unauthorized use of confidential data through encryption and access control.
- **Integrity:** Data integrity and consistency through protection of authorized changes.
- **Availability:** Service and data availability to authorized personnel when and where required.

Organizational security posture can be strengthened by staying compliant with best practices such as the below:

- Regular vulnerability scans and security audits.
- **MFA** hardening.
- Social engineering attack simulation against employees.
- **EDR** technology deployment for real-time threat detection and response against them.

**Risk Management in Cybersecurity**

Risk management in cybersecurity is the identification, analysis, and removal of the security threats so that the damage could be minimized. It includes the following steps:

- **Risk identification:** Identification of the potential threats and vulnerabilities in the IT system of an organization.
- **Risk Estimation:** Probability and likelihood of future risk of the identified risk.
- **Risk Mitigation:** Risk mitigation controls and security policy enforcement.
- **Monitoring Continuously:** Security policy update at regular time intervals and countermeasures to imminent threats.

International standards for risk management such as **ISO 27005** and **NIST Risk Management Framework (RMF)** utilized globally provide methodological tools for detection of cybersecurity threats and cost-optimality.

## CONCLUSION

Increased intensity and sophistication of cyber-attacks require a fresh and dynamic approach to cybersecurity. Organizations require technological innovation, collaboration with regulators, and ethics in humans in order to be proof against cyberattacks. Organizations require security solutions based on AI, embrace the Zero Trust philosophy, and free the employees so that cybersecurity becomes second nature to them. Most critical to enable long-term security and resilience of digital assets will be ongoing investment in cybersecurity since the threat will persist in the digital economy. Companies can proceed to secure, de-risk, and create a future-proof digital tomorrow with best-of-breed cybersecurity architecture and best practice.

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# COLLABORATION BETWEEN EU MEMBER STATES TO DEVELOP CYBER SECURITY

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**Abstract:** Over time, technological advancements have brought significant opportunities across various fields but have also generated challenges, including the rise of cyberattacks. In an increasingly digitalized world, cybersecurity has become a top priority for individuals, public institutions, and private organizations. Cyber threats such as ransomware attacks, phishing, and data breaches can have severe consequences on critical infrastructure, the economy, and personal privacy.

The European Union and its member states are making continuous efforts to reduce vulnerabilities in IT systems by developing comprehensive cybersecurity strategies. A key example is the NIS Directive (Network and Information Security), which imposes strict measures for securing networks and information systems.

The importance of cybersecurity became even more evident during the COVID-19 pandemic when online activities significantly increased, leading to a higher risk of cyberattacks. In response, the EU adopted a recovery plan that includes substantial investments in data protection and digital infrastructure. These measures aim to safeguard privacy, enhance trust in the digital environment, and develop more secure cyber systems across Europe.

**Keywords:** Cybersecurity, digital security, European Union, data protection, cyber-attacks.

**JEL Classification:** O33

## INTRODUCTION

Cybersecurity is a particularly important area, designed to protect systems and networks against unauthorized access, theft and damage of data. Accelerated digitization and the constant interconnection of systems make technology indispensable in everyday life, influencing both professional and personal environments. The role of cybersecurity is colossal in preventing the disruption or hijacking of essential services, ensuring that digital infrastructures function properly. Most studies in this area focus on questions such as: How can EU Member States work together more effectively to prevent and combat cyber attacks? Or what policies and regulations are most effective to improve cybersecurity in the European Union.

The aim of this paper is to analyze the cooperation mechanisms between EU Member States to prevent and combat cyber threats.

The objectives pursued in this research:

- to identify the main challenges and solutions at European level;
- to identify legislative policies initiated by the EU;

- identifying collaborative initiatives and strategies implemented by Germany, France and Romania.

**BASIC CONTENT**

Analysis of bibliographical sources: In order to carry out this research we consulted the strategies and institutions of the European Union in order to analyze the importance of cybersecurity for the states. The main sources used were European legislation and reports carried out on the subject. Each of these sources helped us in our proposed approach, namely to analyze the challenges that states are currently facing in terms of cybersecurity.

Description of the research method used: At the basis of this paper is an analytical research with the aim of gaining an overview of digital infrastructure and its protection.

The European Union has adopted several measures to strengthen cybersecurity, including the EU Cybersecurity Strategy and the NIS (Network and Information Security) Directive, later replaced by NIS2. These initiatives aim to strengthen national capabilities, improve information sharing and create a single legislative framework for all Member States (BSI. *German Cybersecurity Strategy Report*, 10). The European Union Agency for Cyber Security (ENISA) also plays a key role in coordinating action at European level. ENISA supports Member States by developing guidelines and best practices, organizing security exercises and facilitating the exchange of information between national authorities. The recently established European Cyber Security Competence Center in Bucharest also contributes to research and development of innovative solutions to protect against digital threats (ENISA. *European Union Agency for Cybersecurity Annual Report*, 25). Moreover, incident reporting mechanisms such as the CERT-EU (Computer Emergency Response Team for the EU Institutions) platform help to monitor and manage risks in real time (CERT-EU. *Cybersecurity Threat Landscape Report*, 9).

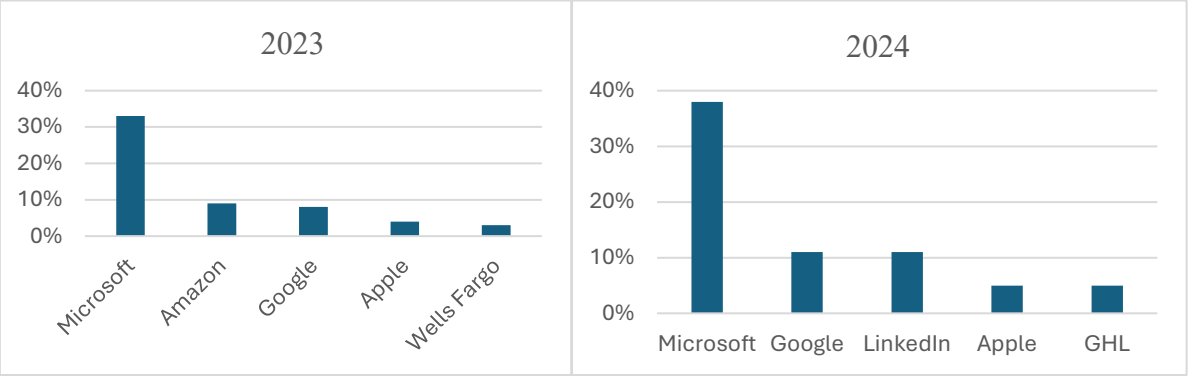


**Figure 1. Top companies with cyber attacks 2023-2024.**

***Sourcer:*** *Author based on data https://www.enisa.europa.eu/sites/default/files/2024-11/ENISA%20Threat%20Landscape%202024_0.pdf/*

According to the data presented in Figure 1, Microsoft remains the most spoofed brand in phishing attacks demonstrating the importance of its digital services in European organizations, including public institutions. In this respect, the EU, through the NIS2 Directive, imposes strict measures for the protection of critical digital infrastructures, including mandatory reporting of cyber-attacks and the implementation of enhanced security standards among public institutions and large companies. On the other hand, the emergence of LinkedIn as one of the top spoofed brands shows that cyber attacks are no longer just targeting email accounts or financial services, but also professional networks. This trend is worrying, as it may affect both the European digital economy

and the security of companies operating in the EU market (CSIRT Network. *EU Computer Security Incident Response Teams Cooperation Framework*, 5).

Cybersecurity is thus becoming a strategic priority for the European Union, essential to protect its digital infrastructure. The EU has adopted directives and regulations to increase cyber resilience and coordinate response to threats. The NIS Directive, adopted in 2016 and updated through NIS2 in 2022, imposes strict security measures for critical infrastructure and improves information sharing between Member States. NIS2 expands its scope to include more critical sectors and strict risk management requirements (European Data Protection Board. *Guidelines on Data Protection*, 17). The Cybersecurity Regulation in 2019 strengthened ENISA's role by giving it extended powers and introducing a certification framework for IT products and services (ENISA, 20). GDPR also indirectly contributes to cybersecurity by imposing strict standards for data protection and incident notification (*Guidelines on Data Protection*, 6). International cooperation plays a key role, with the EU working with NATO, the US and other organizations to exchange information and common cyber defense strategies (European External Action Service, 2).

The European Union has developed several mechanisms to strengthen cybersecurity and manage cross-border incidents. The Cyber Crisis Liaison Organization Liaison Network (CyCLONe) facilitates the coordination of response to major attacks, and the CSIRT Network brings together national teams for information exchange and mutual support. For technological development and training of specialists, the EU has set up the EU Cybersecurity Competence Network, while the NATO-supported Cooperative Cyber Defence Centre of Excellence (CCDCOE) offers training programs and attack simulations (*Cyber Diplomacy and International Cooperation*, 5). National strategies vary between Member States, with Germany emphasizing critical infrastructure protection and collaboration with the private sector through institutions such as BSI and Cyber Security Council Germany. France, on the other hand, prioritizes digital sovereignty and the protection of national infrastructures through ANSSI, taking a more restrictive approach towards foreign technologies (*International Cybersecurity Policy Analysis*, 14). Romania has strengthened its cybersecurity through national strategies and alignment with EU legislation. The adoption of NIS2 through GEO 155/2024 has extended the scope of protective measures and the DNSC has taken over the role of CERT-RO as the single point of contact for cyber incidents. (ENISA Threat Landscape, 18)

Romania also actively participates in Cyber Europe, the exercises organized by ENISA, and cooperates with Europol in the fight against cybercrime (*Cybersecurity and Risk Management*, 22). Funded through Horizon Europe and Digital Europe, the country is investing in cyber infrastructures and services. Germany therefore emphasizes critical infrastructure protection and collaboration with the private sector, France prioritizes digital sovereignty and strictly regulates the use of foreign technologies, and Romania has strengthened its strategy by aligning with EU directives and developing European partnerships. Despite these differences, a common factor remains the need for cross-border cooperation and the implementation of proactive measures to combat cyber attacks (*Octopus: Cybercrime and Electronic Evidence*, 24).

## CONCLUSIONS

In an era of rapidly advancing digitization, cybersecurity is becoming an essential pillar of the economic and social stability of the European Union. The continuous evolution of cyber threats, from ransomware attacks to phishing frauds and data breaches, requires close cooperation between Member States and constant adaptation of the legislative and operational framework.

Romania, as an integral part of this security ecosystem, has made significant progress through the transposition of the NIS2 Directive and active participation in European initiatives. The establishment of the European Cyber Security Competence Centre in Bucharest is a recognition of the country's contribution in this field and provides opportunities for research, innovation and funding for the development of advanced cyber protection solutions. At the same time, Romania's involvement in European security exercises, such as Cyber Europe organized by ENISA, demonstrates its commitment to strengthen its operational capabilities in the face of emerging cyber risks.

The study of cybersecurity in the European context is essential for understanding how digital policies influence economic and social stability.

The novelty of this research lies in the comparative analysis of legislative mechanisms and their impact on economic entities, but also in highlighting Romania's role as an emerging cybersecurity hub.

The originality of the study lies in identifying the main challenges and opportunities for international cooperation in the field of digital security. Although the current analysis provides a broad perspective on the EU legislative framework and initiatives in cybersecurity, there are certain limitations. One of the main obstacles is the lack of up-to-date data on the actual effectiveness of adopted policies. Future studies could address the impact of regulations on SMEs and the public sector, as well as assess the effectiveness of strategies to prevent cyber attacks.

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# ENSURING WEB SECURITY WITH OWASP METHODOLOGY

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**Abstract.** Currently, more and more companies, organizations, individuals (entities) operate online in the global virtual cyberspace, storing and processing enormous amounts of sensitive personal data. There are various ways to improve the security of web applications, many of which are proprietary, poorly accessible and difficult to implement. A thorough analysis suggests that the development of secure web applications using the OWASP methodology (The Open Worldwide Application Security Project) allows for the effective control and reduction of the values of all types of vulnerabilities. This paper is a review, synthesis that brings its small contribution to the specialized literature on awareness and promotion of the culture of web application protection with the OWASP methodology. The paper briefly describes the OWASP project, the approach to web application security based on the OWASP Top Ten vulnerabilities, which allows organizations not only to protect their data, but also their reputation and customer trust. OWASP provides a good understanding of how attackers can compromise an entity's web applications and sensitive user data. It also emphasizes the need to implement preventive, proactive measures to prevent web applications from compromising users and the host entity.

**Keywords:** Web applications, Web application security, OWASP, OWASP top ten vulnerabilities, Security measures, sensitive personal data.

**JEL:**L86, O33, I29

## INTRODUCTION

**The significance of web application security** has grown a lot lately and continues to grow simultaneously with the development of modern digital society and electronic business. This is because the basis of e-business and the digital economy is the Internet and the web with multiple and diverse challenges and risks. Risks persist in any web application, e-government platforms, e-finance, e-insurance, etc., affecting not only individuals and/or separate organizations, but also entire industries (e.g. banking industry, e-medicine, e-government) and society as such (e.g. social networks). And a security incident, as a result of the realization of risks can lead to the loss of user trust in online e-business platforms, can have devastating consequences, such as financial, reputational losses, sanctions.

*According* to *recent research from Verizon, web application attacks are involved in 26% of all breaches, making them the second most common attack pattern [1].* Four of the most common attacks against web applications are SQL Injection, Cross-Site Scripting (XSS), Cross-Site Request Forgery (CSRF) [11], Denial of Service & Distributed Denial of Service (DoS & DDoS).

## WEB APPLICATION SECURITY: CONCEPT, VULNERABILITIES, SOLUTIONS

### 1. What is OWASP, OWASP values and projects, basic principles of web security

The OWASP Foundation (The Open Worldwide Application Security Project) is a non-profit organization, founded in 2001 in the USA; a dedicated open collaborative community, bringing together experts, developers, testers, who focus on the security of online web applications throughout their entire life cycle. OWASP's main mission is to provide open resources, tools, standards and guidelines to help build and maintain secure web applications, to raise awareness of critical security issues faced by developers. OWASP has over 250 local chapters worldwide, tens of thousands of members, and is a leader in education and training on the security profile of trusted web applications. For more details, see [2] (*https://owasp.org/about).*

**OWASP administers** hundreds of open-source projects, including code, documentation, and standards; actively participates in the formation of standards and recommendations of ISO, COBIT, NIST, PCI DSS, etc.; contributes to improving the overall security of web applications worldwide. The projects provide members with the opportunity to freely test theories and ideas with the professional support of the OWASP community. Each project has its own web page. Most projects maintain their content on GitHub. The OWASP project inventory contains over 360 objects. For more details see [6] (*https://owasp.org/projects).*

Understanding concepts, being aware of vulnerabilities, following best practice requirements, standards and industry recommendations – are vital to creating a secure online environment with web application protection based on the resources provided by the OWASP foundation.

A proactive approach to web security with the application of basic cybersecurity principles helps prevent fraud and loss; ensures confident operation in global cyberspace for all those interacting with web applications. The basic principles of ensuring web application security refer to Implementing a Web Application Firewall (WAF) [8], Defense in Depth; Prevention, Detection and Response; Security by Design; Shewhart Cycle or Deming's (quality) wheel (PDCA=Plan-Do-Check-Act); Least Privileges, etc.

For example:

- **Privilege minimization:** Limiting user and application access to strictly necessary resources reduces security risks.
- **Risk management:** Systematic risk assessments are essential to identify and remediate vulnerabilities.
- **Security by design:** Integrating security into all stages of application development helps prevent security issues before they arise.
- **Patching:** Timely application of all security updates is essential for maintaining the security of web applications [5] etc.

Lack of training, poor integration of security into design, weak security management, and inadequate access control are among the most significant factors contributing to vulnerabilities. Addressing these challenges during the development and testing phases is crucial for reducing security risks in web applications.

### 2. Basic web application security requirements

Web application security starts with specific policies, applied throughout the entire life cycle, from design-development to operation and decommissioning. Several dozen policy templates can be found at the SANS Institute (SysAdmin, Audit, Network, Security) [9]. At the same time, web

security is based on preserving the fundamental properties of information/CIA triad: Confidentiality, Integrity and Availability. For details, see [4].

**Confidentiality** in web applications refers to protecting processed data (collected, stored, transmitted) from prying eyes, but who do not have the respective rights (by hiding = steganography; by encrypting data = cryptography) and limiting access. The mechanisms used include user authentication, the use of SSL/TLS certificates. For example, to prevent unauthorized access, data leaks, ransomware attacks, etc. in a web application that stores authentication data, sensitive data (personal, medical, banking, etc.), they must be encrypted from end to end, both in transit and at rest, in databases on servers, in archives.

**Integrity** ensures that data is not modified/altered during the use of the application. Security measures such as input validation and hashing are recommended to prevent attacks aimed at altering data, such as SQL Injection or Cross-Site Scripting/XSS.

**Availability** is crucial for web applications, as users must have access to them at any time they need them. Availability is affected by DoS or DDoS attacks, which do not alter data, but block access to it by overwhelming the server by bombarding it with an excessive number of fictitious requests. Protection measures against DoS/DDoS attacks include infrastructure redundancy, backup systems, IDS (Intrusion Detection System) or IPS (Intrusion Prevention System) [3] systems, which help prevent interruptions and ensure that the web application remains accessible even in the event of a DoS/DDoS attack or technical errors.

Based on fundamental properties, secondary aspects like non-repudiation, extended confidentiality, high availability, and accountability are ensured. Extended confidentiality secures data in storage and transit via end-to-end encryption. High availability guarantees continuous access to critical applications through disaster recovery plans and resilient architectures.

## 3. OWASP Top Ten Project and measures to counter vulnerabilities

Web application security is a vast and complex area related to network and Internet security, affected by numerous vulnerabilities, from SQL Injection and Cross-Site Scripting attacks to advanced phishing and ransomware techniques. The most critical security risks for web applications and methods to counter them, widely agreed upon by web application developers and users, see the OWASP Top Ten. For illustration, we reproduce only the first two of these in the 2021 version of the OWASP Top Ten [7]. Others, including the specifications for the first two vulnerabilities according to the 2025 version, follow the project status [10].

- A01. Broken access control (attacker can access resources or data they should not have access to). 61% of all breaches involve A01. There are many ways to achieve this, but one common method is to use a whitelist.
- A02. Cryptographic Failure. Insecure communications remain a major concern. Weak or unencrypted data transmission exposes sensitive information such as passwords and financial data to interception. In 2023, over 8 billion records were breached, with an average data breach cost of $4.54 million. Using HTTPS and strong cryptographic algorithms mitigates these risks by securing data in transit.

## 4. Results and Discussion

Ensuring the security of web applications is no longer just a technical-technological necessity of settings, usually performed once, according to the administrator's perception. It becomes a strategic responsibility, which must comply with accessible, verified and approved best practice requirements

and recommendations. In the authors' opinion, such a globally accepted and recognized practice is the OWASP Top Ten approach to web application security.

The main contribution of this bibliographic study is the review, synthesis of knowledge and recommendations of good practices for secure coding according to the OWASP Top Ten project. The main significance of web application security based on the OWASP Top Ten is the reduction of the number of reported vulnerabilities and incidents, the average severity level and the bounty payments.

Typically, the OWASP Top Ten is updated every three to four years. However, it may be updated more frequently, depending on the emergence of new threats, changes in the security landscape, and the need for updated guidance. The penultimate update was in 2021 (https://owasp.org/Top10), a new OWASP Top Ten update from 2025 [10] is expected soon. To some extent, other previous OWASP Top Ten versions, such as those from 2017, 2013, and 2010, can also be used. However, it is best to use the latest version, which considers the changes in the security landscape.

## CONCLUSIONS

The most important measures to ensure web application security include data encryption, multifactor authentication, input data validation, implementation of WAF, IDS, IPS solutions, etc. These measures allow for essential risk reduction and proactive protection of web applications from potential attacks.

By implementing strict access policies, incident management, session management, backup and disaster recovery policies, etc., entities can ensure the continuity of their activities and the protection of sensitive data. Implementing appropriate security methods, such as intrusion detection and monitoring (IDS, IPS), periodic scans, the use of appropriate dynamic analysis tools and static analysis play a vital role in identifying and remediating vulnerabilities before they are exploited. All this allows organizations to react quickly to security incidents and minimize the impact of attacks.

**Web application security is not a static product, goal, or one-time action, but a dynamic process**, which requires constant attention and continuous adaptation to the changing threat environment. Organizations must commit to continuous improvement of web security measures, invest in staff training, and stay up to date with the latest trends and techniques in the field. A globally recognized and accepted recommendation is policy-based management and the OWASP Top Ten, with the new guidance updated in 2025 [10].

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# CYBER RESILIENCE IN THE MODERN WORLD

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**Abstract.** Cyber resilience is an essential aspect of modern cybersecurity strategies, ensuring the ability of organizations to anticipate, withstand, and recover from cyber threats. This paper explores the concept of cyber resilience in the context of increasing cyberattacks, particularly targeting financial institutions, government systems, and decentralized finance (DeFi) platforms. The research addresses key questions regarding the effectiveness of current cyber resilience frameworks and the role of emerging technologies such as artificial intelligence and blockchain in mitigating cyber risks. A mixed-method approach, combining statistical analysis of cyber incidents and expert interviews, was used to evaluate cyber resilience strategies. The results highlight the growing need for adaptive security measures, enhanced regulatory policies, and international cooperation. Data analysis suggests that organizations with proactive resilience strategies experience significantly lower financial losses and operational disruptions. The study concludes that cyber resilience should be a top priority for businesses and governments, requiring continuous improvement and investment in cybersecurity innovations.

**Keywords:** cyber resilience, cybersecurity, cyber threats, financial institutions, DeFi security, blockchain.

**JEL Classification:** L86, K24, O33

## INTRODUCTION

Modern digital technologies have seriously changed the economy and public life. But along with new opportunities, new threats have emerged. One of them is cybercrime. Previously, these were mostly individual hackers, but now organized groups using sophisticated digital tools are increasingly operating.

Cryptocurrency has become one of the main tools of such criminal groups, as it can be used to conduct financial transactions anonymously. According to Chainalysis (2024), the volume of illegal cryptocurrency transactions in 2024 amounted to $40.9 billion, and this figure continues to grow. Cryptocurrency is actively used for money laundering and financing illegal activities.

It is becoming increasingly difficult to combat such crimes, especially due to the emergence of new technologies, such as artificial intelligence, blockchain analytics and anonymous networks. One example is Huione Guarantee, an illegal structure that was used for money laundering and fraud.

A research question: how does the corporate structure of cybercrime using cryptocurrencies affect the resilience of a digital society to cyber threats?

Theoretical basis:

– Theory of the digital economy (Tapscott & Tapscott, 2016)
– Theory of organized crime (Paoli, 2014)
– theory of cyber resilience (Linkov et al., 2019)

Hypothesis: digital criminal organizations using cryptocurrency technologies make it difficult to detect financial crimes and reduce the level of cyber resilience of society.

The purpose of the study is to track the development of cryptocrime, explore ways to counteract it and propose measures to improve digital security.

## MAIN CONTENT

Modern cybercriminals are increasingly using advanced technologies to implement their schemes. The development of cryptocurrencies and anonymous networks such as Tor has given criminal groups more opportunities to hide their activities. This complicates the work of investigators and makes it more difficult to identify illegal transactions.

Cryptocurrencies such as Bitcoin and Ethereum were originally created as a means of decentralized exchange, but in practice they have become widely used in the shadow economy for money laundering, terrorist financing and other illegal purposes.

In recent years, criminals have increasingly switched to stablecoins, which are cryptocurrencies whose exchange rate is pegged to the dollar or another stable currency. This makes them less susceptible to price spikes. According to Chainalysis (2024), about 63% of illegal cryptocurrency transactions are accounted for by such stablecoins as Tether (USDT), USD Coin (USDC) and DAI. They are actively used in black markets, where it is important to reduce the risks associated with volatility.

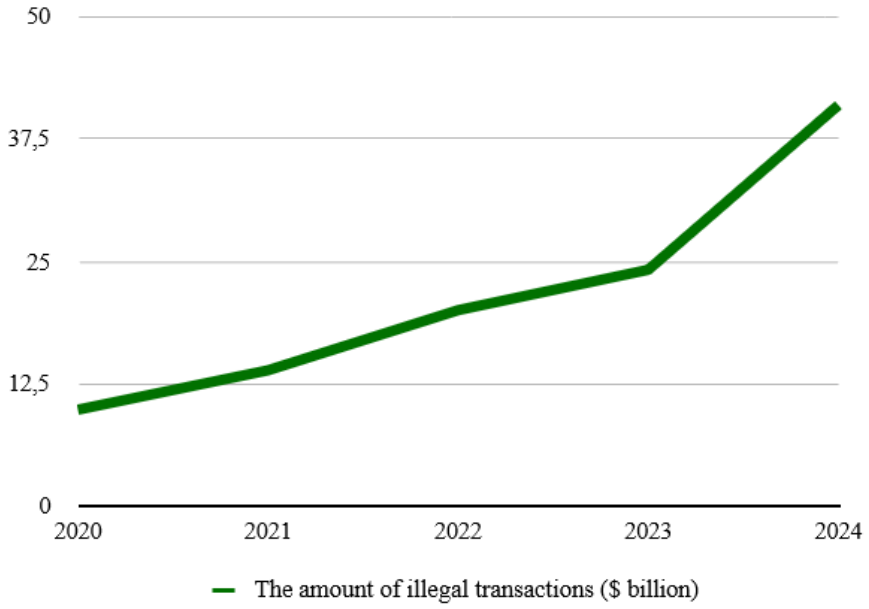


**Figure 1. Growth in the volume of illegal cryptocurrency transactions from 2020 to 2024.**
**Source:** *Chainalysis, 2024.*

In addition, the growing popularity of decentralized financial platforms (DeFi) poses a threat. Such platforms operate without control from centralized organizations, and their level of security is often low. In 2024, there were several major hacks of DeFi platforms, as a result of which more than 1.5 billion dollars were stolen. Criminals find vulnerabilities in smart contracts and withdraw funds so that they cannot be traced.

Cryptocurrency exchanges, which serve as the main source of liquidity, are also under attack. In 2024, hackers stole $2.2 billion from such platforms, which is 21% more than in the previous year.

The most commonly used method is to crack users' private keys, after which the attackers transfer funds to their wallets. Two-factor authentication and multi-signature are used for protection, but unfortunately not all users use these features, which makes them vulnerable.

In addition, artificial intelligence has also begun to be actively used in cybercrime. It creates adaptive viruses and Trojans that can change their structure depending on the protection systems. AI is also used for sophisticated phishing attacks — attackers create fake emails that look like real ones in order to lure people out of personal information. In 2024, the number of such attacks increased by 30%, which confirms the growth of digital risks.

**Measures to Improve Cyber Resilience**

To effectively combat cybercrime, a comprehensive approach is required, including international cooperation, the development of security technologies, legislative initiatives, and raising user awareness.

1. International Cooperation and Legal Measures:

Cybercrime requires global efforts. Organizations such as ENISA help countries exchange data and develop security standards. Significant steps also include international laws such as MiCA, which regulate cryptocurrency companies and prevent money laundering.

2. Security Technologies and Artificial Intelligence:

The use of machine learning and big data analytics allows for the rapid detection of transaction anomalies and fraud prevention. Blockchain technologies offer solutions to enhance transaction transparency and security. Implementing blockchain-based identification and multi-signature systems helps prevent unauthorized operations and increase trust in digital transactions.

3. Legislative Adaptation to New Threats:

It is essential to introduce laws regulating cryptocurrency operations, including mandatory transaction registration and exchange oversight. International coordination of such norms will help combat cybercrime.

4. Improving Digital Literacy and Awareness:

Educating users on online security, phishing detection, and personal data protection helps reduce attack risks. Awareness campaigns and cybersecurity training play a key role in protection.

## CONCLUSIONS

This study examined the role of cryptocurrencies in the development of cybercrime and ways to improve the cyber resilience of the digital society. The results showed that cryptocurrencies, including stablecoins, are actively used for money laundering and criminal activity financing, making them a vital tool for criminal organizations. Notably, technologies such as blockchain and artificial intelligence play a key role in both criminal schemes and countermeasures against them.

The proposed methods for enhancing cyber resilience, including international cooperation, security technology development, legislative adaptation, and user awareness, emphasize the importance of a comprehensive approach to combating cyber threats. However, several unresolved issues remain, such as the need for further improvement of cryptocurrency legislation and the search for new solutions to counter transaction anonymity.

This study opens new directions for further research, which should focus on a deeper analysis of specific cases of cryptocurrency use for criminal purposes and the assessment of the effectiveness of proposed measures. Future research should also address differences in cryptocurrency regulations across countries and explore innovative solutions for ensuring the security of digital transactions.

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# CYBER THREATS TO CREATING COST ESTIMATES IN CONSTRUCTION

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**Abstract.** Construction is one of the most important industries in achieving the goals of sustainable development of society. Digital transformation in the construction industry affects all stages of construction: planning, creation of estimate documentation, procurement of materials and construction work itself, delivery of the project to the customer. Digital technologies are used to monitor situations at the construction site, remote control of construction machines and mechanisms, the use of robotic systems and unmanned aerial vehicles. All these technologies raise certain concerns in the field of cybersecurity. The joint interaction of people and machines at construction sites increases the consequences of the implementation of cyber risks. This paper will analyze the directions of the emergence of cyber risks in the preparation of estimate documentation using new digital technologies. The limitations of the analysis are the lack of a sufficient number of publications devoted to cybersecurity in terms of such a construction business process as drawing up construction estimates.

**Keywords:** Cybersecurity, Digital Transformation, Construction Industry, Estimation Software, Risks.

**JEL Classification:** O14.

## INTRODUCTION

The results of the review of bibliographic sources showed that cybersecurity issues for the construction industry are mainly considered from the perspective of building information modeling (BIM), construction robots and prefabricated platforms, construction project management, ensuring safety at the construction site, working with confidential and commercial information (Turk, Žiga, et al. article 103988).

In the work of (Enshassi, M.S.A. et al. article 05019004), an integrated risk management framework was developed, including risk mitigation strategies, which aim to improve decision making and risk management in modular construction.

## MAIN CONTENT

Cybersecurity risks in construction estimating are difficult to identify. The volume of information to be digitized in construction projects is steadily growing. Construction companies that digitize electronic document management and design using specialized software receive clear competitive advantages.

A digital document can be worked with remotely, it is difficult to lose or destroy, and the use of an electronic digital signature ensures the authenticity of the document. However, the construction

industry has the lowest level of digitalization compared to other sectors of the economy (Regona, M. , et al. article 45).

It is especially important to pay attention to cybersecurity issues in the construction industry, since it is not only about preserving commercial and other confidential information, but also about the physical safety of users of the facility during its operation.

The cybersecurity risks in construction cost estimating are numerous and difficult to identify. The introduction of artificial intelligence (AI)-based assessment tools helps improve the accuracy and efficiency of the process, but also creates conditions for new risks that can compromise data security and calculation accuracy. Some of them include:

1) data errors: using outdated or incorrect data can lead to inaccurate estimates;

2) limited interpretation of context: AI may not consider unique aspects of a construction project (Mard, H.R.S.A. et al. 570-577).

3) integration difficulties: problems with integration with other systems can slow down the process;

4) legal risks: calculation errors can lead to legal consequences;

5) cyber threats: the threat of data leaks and attacks on cloud systems (Pinto, A. et al. 616-624).

6) ethical risks: completely trusting AI without verification can lead to serious errors and a decrease in demand for specialists.

As recommendations, we can propose to implement standards in the field of cybersecurity. Currently, many standards and guidelines have been developed: ISO/International Electrotechnical Commission (IEC) 27001:2013 (ISO/IEC 2013), identifying IT security requirements; “Framework for Improving Critical Infrastructure Cybersecurity v1.1” by the National Institute of Standards and Technology (NIST) (NIST 2018), addressing both OT and IT security; and “Guide to Industrial Control Systems (ICS) Security (NIST SP 800-82)” (Stouffer et al. 2015) by NIST, particularly addressing OT security (Sonkor Semih et al. article 04021172).

An example of the application of ISO 27001 and NIST standards in a construction company is Skanska, which has implemented an ISO 27001-compliant information security management system (ISMS), thereby ensuring the protection of project documentation through data encryption and regular internal audits, and also uses NIST recommendations to monitor and protect its cloud platforms from cyber threats.

There is a method for ranking safety risks in the construction industry using gray multi-criteria decision making. This approach allows for accurate risk assessment even with limited data and does not require the definition of membership functions, which simplifies calculations and increases its practical value for safety management on construction sites. The method can be applied when there is a small number of samples and there is uncertainty, which makes it an effective tool for risk assessment when traditional multi-criteria decision-making methods, such as statistical approaches, are not very convenient to use (Abootorabi, S.M. et al. 67-74).

An analytical hierarchy process (AHP) can also be identified for assessing safety risks in construction projects at the planning and budgeting stage, as this allows potential safety hazards to be effectively identified and mitigated at early stages (Aminbakhsh, S. et al. 99-105).

With the development of digital technologies in the construction industry, the use of specialized software for estimating is becoming more and more relevant and important. These software not only increase the accuracy of calculations, but also simplify the entire process, allowing construction companies to effectively manage resources and remain competitive. The following are some

examples of popular estimating software, as well as modern online platforms that are based on AI and are gaining popularity in the industry. Popular Software Examples:

- «GRAND-Estimate» — a comprehensive software for generating all types of estimates required for construction projects, from cost to resources;
- «Smeta.Ru» — suitable for generating and verifying construction estimates, particularly for both large companies and small contractors;
- «TURBO Estimator» — designed for creating and checking local estimates, acts, and resource statements;
- «SmetaWIZARD» — automates calculations and verification of estimate documentation;
- ABC — a system for preparing estimate and resource documentation for participants in the investment process.

In addition, modern AI-based online services are gaining traction, further simplifying the process of creating estimates. These platforms help automate routine tasks, analyze data, and offer optimal solutions. Examples include:

- Smeta.RU — an online platform for automatic calculation of construction estimates, supporting up-to-date databases;
- Grand-Smeta 2.0 — utilizes machine learning to improve calculation accuracy and cost forecasting;
- AI-Smeta — integrates with BIM to account for all parameters, providing personalized calculations tailored to specific project needs.

With the development of digital technologies in the construction industry, the use of specialized software for drawing up estimates is becoming increasingly relevant and important. These programs not only improve the accuracy of calculations, but also simplify the entire process, allowing construction companies to effectively manage resources and remain competitive. An important advantage of such programs is: 1) time-saving – programs speed up the estimation process, as most operations are automated; 2) calculation accuracy: the risk of errors is reduced due to built-in databases with current material and service prices; 3) compliance with standards –programs ensure that estimates comply with current legislation and regulatory requirements; 4) convenience of updates- quick updates of prices and regulations based on market changes; 5) versatility - support for various types of estimates, including project, resource, and local estimates; 6) documentation and archiving – programs automatically generate documentation and store it in a convenient format.

## CONCLUSIONS

The use of digital technologies and specialized software in the construction industry also influences the strategic decisions of companies. The study by (Gunhan, S. et al. 928-937) analyzes the factors that influence the choice of a construction company when entering international markets. These factors include risks, various competitive advantages and economic and political aspects, thereby helping companies choose the right market and strategy for expansion. In a globally competitive environment, the effective use of technologies such as automatic estimating systems or AI-based platforms plays a key role in strengthening a company's position in the international arena.

This paper examines some of the features of digital technology application in construction from the perspective of cybersecurity. The construction industry has one of the lowest rates of digitalization. At the same time, cyber risks are growing much faster than new technologies are being implemented.

In our opinion, it is necessary to further consider cybersecurity issues in the construction industry in the context of technologies being implemented for various business processes.

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# INTEGRATION OF AI ALGORITHMS IN THE VULNERABILITY TESTING PROCESS

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**Abstract.** Artificial intelligence's rapid development is changing cybersecurity, particularly in the areas of vulnerability assessment and detection. Scalability and accuracy issues plague traditional vulnerability testing techniques, which is why AI-powered solutions are starting to look like a desirable substitute. This paper examines the integration of AI algorithms into vulnerability assessment, focusing how they can improve mitigation techniques, highlight risks, and improve threat detection. We investigate how AI-driven methods can improve system vulnerability detection, lower false positives, and expedite reaction times using a real-world case study. The findings demonstrate how AI could transform risk assessment and improve the intelligence, speed, and adaptability of security solutions.

**Keywords:** Artificial intelligence, Vulnerability scan, Risk analysis, Threat detection, Cybersecurity.

**JEL Classification: C63, D81, L86, O33.**

## INTRODUCTION

The accelerated evolution of artificial intelligence (AI) is transforming cybersecurity, especially in identifying and assessing vulnerabilities. With the surge in cyber threats, organizations demand more robust and scalable security measures. Conventional vulnerability scanning techniques struggle with scalability and precision, driving interest in AI-powered solutions. Machine learning (ML) and deep learning models can refine risk analysis, streamline remediation efforts, and enhance the precision of threat identification. This study investigates AI's role in vulnerability discovery through a real-world example, demonstrating its effectiveness in minimizing false alarms and speeding up incident resolution.

## MAIN RESULT

This research aims to explore the integration of Artificial Intelligence (AI) into vulnerability detection and assessment processes within cybersecurity. The rapid advancement of AI technologies has introduced new potential solutions to address long-standing challenges in the field of cybersecurity, such as scalability, accuracy, and efficiency of traditional vulnerability testing methods.

The primary objective is to analyze the most prevalent vulnerabilities, particularly those highlighted in the OWASP Top 10, to identify patterns that AI models can detect more accurately and efficiently than traditional methods. The research also seeks to evaluate the performance of various AI algorithms, specifically those based on Large Language Models (LLMs), such as GPT and Claude, in real-world environments. These models will be tested for their ability to identify and assess vulnerabilities in software systems, providing insights into their capacity to reduce false positives and expedite the vulnerability detection process.

Furthermore, the study aims to propose an optimized approach for implementing AI-driven models into cybersecurity workflows. This includes a comprehensive evaluation of the different AI models tested, considering factors like execution time, detection accuracy, and contextual analysis. By doing so, the research will demonstrate how AI can enhance the efficiency and reliability of vulnerability assessment processes, ultimately improving the overall cybersecurity resilience of organizations.

**1. Case Study: AI-Powered Vulnerability Assessment**

**1.1. Analysis of Cybersecurity Vulnerabilities.** Cybersecurity threats are continuously evolving, with attackers exploiting weaknesses in software systems. According to OWASP (Open Web Application Security Project), the most prevalent vulnerabilities include:

- **Injection Attacks (SQLi, Command Injection, XXE)**: Exploiting unvalidated input to manipulate application logic.
- **Cross-Site Scripting (XSS)**: Injecting malicious scripts into web applications.
- **Insecure Direct Object Reference (IDOR)**: Unauthorized access to protected resources.
- **Server-Side Request Forgery (SSRF)**: Exploiting server-side misconfigurations to access internal resources.
- **Broken Authentication & Security Misconfiguration**: Weak access controls leading to unauthorized access.

Understanding these vulnerabilities is essential for designing AI-driven security solutions.

**1.2. AI Model Implementation: Vulnhuntr** Vulnhuntr, an advanced static analysis tool, was utilized to test AI algorithms in vulnerability detection. This application integrates Large Language Models (LLMs) such as GPT, Claude, and Ollama to analyze source code, identify security weaknesses, and generate Proof-of-Concept (PoC) exploits.

The AI-driven testing process involved:

1. **Project Initialization:** Vulnhuntr analyzed repositories to identify critical files containing potential vulnerabilities.
2. **Primary Analysis:** AI models examined entry points for user input, detecting insecure patterns.
3. **Iterative Evaluation:** Context-aware processing refined initial findings, ensuring accurate identification of security threats.
4. **Report Generation:** A structured JSON report outlined detected vulnerabilities, PoCs, and recommended mitigations.

**2. Evaluating Performance in Real Conditions**

**2.1. AI Model Comparison.** To evaluate AI effectiveness, multiple models were tested under real-world conditions. The study examined their accuracy, false-positive rate, and execution speed.

**Table 1. Comparative Analysis of AI Models for Vulnerability Detection**

| Model | Execution Time | Confidence Score | Key Observations |
|---|---|---|---|
| **GPT-3.5** | **9-11s** | **8-9** | **Fast, but limited contextual analysis** |
| **GPT-4o** | **20-40s** | **9-10** | **High precision, detailed assessments** |
| **GPT-4o-mini** | **15-25s** | **8-9** | **Balanced speed and accuracy** |
| **Claude Sonnet** | **25-50s** | **9-10** | **Best in-depth analysis, slowest execution** |

**Source:** *Made by the author based on results after testing AI models*.

### 2.2. AI Performance in Vulnerability Detection

The comparative testing of AI models revealed nuanced differences in their ability to detect specific types of vulnerabilities. For example, in the case of Cross-Site Scripting (XSS), all models demonstrated strong detection capabilities. However, GPT-4o stood out by offering a more comprehensive assessment of the associated risks and mitigation measures. Its detailed contextual analysis enabled a better understanding of how such vulnerabilities could be exploited in different environments.

When examining SQL Injection vulnerabilities, again all models successfully identified the issue, but Claude Sonnet offered the most detailed and technically robust remediation strategies. It provided structured suggestions for sanitizing inputs, enhancing query logic, and introducing layered protection mechanisms—an indication of its deep contextual capabilities.

As the analysis extended to more complex vulnerabilities like Server-Side Request Forgery (SSRF) and Insecure Direct Object Reference (IDOR), the strengths of advanced models became even more apparent. While GPT-3.5 and GPT-4o-mini flagged potential issues, they lacked the depth of explanation required to fully understand the exploitation path. In contrast, GPT-4o and Claude Sonnet not only pinpointed the vulnerabilities but also contextualized their potential impact, highlighting relevant attack scenarios and proposing practical mitigation actions.

This multi-model testing approach underlined a key finding: while lighter models can effectively identify basic security flaws, high-stakes vulnerabilities benefit significantly from the analytical depth of more advanced AI. This insight supports a tiered deployment of AI models depending on the complexity and severity of the target vulnerabilities.

## 3. Recommendations

Based on the research and findings, integrating AI into the vulnerability detection process can significantly enhance the speed and accuracy of identifying security threats. However, to ensure the effectiveness of AI-driven solutions, certain strategic approaches should be adopted by organizations.

First, it is recommended to **adopt a tiered approach** to vulnerability detection. Early scans can be quickly performed using AI models like GPT-3.5. This model excels at providing rapid analysis, making it ideal for identifying high-priority issues early in the process. However, for more complex vulnerabilities or cases requiring deeper analysis, advanced models like GPT-4o or Claude Sonnet should be used. These models are better equipped to handle intricate attack vectors, providing more detailed insights and mitigation strategies.

Next, organizations should consider **parallel processing** to optimize the detection process. Running multiple AI models simultaneously, especially using faster models for preliminary scans alongside more advanced models for detailed analysis, can help reduce total processing time. This method allows security teams to identify vulnerabilities rapidly while still benefiting from in-depth analysis where necessary. This parallel approach balances both speed and precision, ensuring that critical vulnerabilities are addressed quickly while maintaining high-quality results.

Another important recommendation is to implement **conditional escalation** of AI models based on the complexity and severity of the vulnerability. For routine, straightforward threats like XSS or SQL injections, simpler models like GPT-3.5 are sufficient. However, for more sophisticated vulnerabilities, such as SSRF or IDOR, advanced models like GPT-4o or Claude Sonnet should be triggered. This approach allows organizations to economize resources while ensuring that higher-risk vulnerabilities receive the attention they deserve.

Furthermore, the implementation of AI in cybersecurity should always be **complemented by expert human oversight**. While AI can identify vulnerabilities and suggest potential solutions, the interpretation of these findings and the decision-making process must remain in the hands of experienced security professionals. AI-generated insights are powerful tools, but human expertise is essential in understanding the broader context and in applying the most effective remediation strategies.

Finally, to continually improve the effectiveness of AI in cybersecurity, it is crucial to **invest in model updates and data quality**. The AI models used in vulnerability detection must be trained on high-quality, up-to-date datasets to ensure that they remain effective against emerging threats. Regular updates, combined with the use of real-world test cases, will help ensure that AI systems continue to evolve and improve, staying ahead of evolving cyber threats.

By following these recommendations, organizations can maximize the potential of AI in vulnerability detection, improving their overall cybersecurity posture while ensuring that the technology is used effectively, responsibly, and efficiently.

## CONCLUSIONS

The integration of Artificial Intelligence (AI) into cybersecurity practices is revolutionizing the field of vulnerability detection and assessment. The AI algorithms tested in this study demonstrate significant improvements in detecting complex vulnerabilities faster and with greater accuracy compared to traditional methods. AI's ability to process large volumes of data, recognize complex patterns, and predict potential risks has proven crucial in enhancing the overall security of information systems.

The research confirms that AI-driven solutions, like the models tested in this study, are invaluable for detecting vulnerabilities such as Cross-Site Scripting (XSS), SQL Injection (SQLi), Server-Side Request Forgery (SSRF), and Insecure Direct Object Reference (IDOR). These models not only improve the accuracy of detection but also reduce the time required for threat identification, allowing organizations to respond more swiftly to potential cyberattacks.

In conclusion, AI's potential to transform cybersecurity is undeniable. However, its effective integration into existing systems requires continuous refinement of AI algorithms, the development of high-quality datasets for training, and regular validation by human experts. As AI evolves, its role in vulnerability detection will become even more essential in fortifying digital infrastructure against increasingly sophisticated cyber threats.

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## SECTION: DEVELOPMENT TRENDS OF THE DIGITAL ECONOMY

# CONTROLUL FISCAL DIGITAL: O METODĂ DE STIMULARE A NIVELULUI DE CONFORMARE VOLUNTARĂ A CONTRIBUABILILOR

# DIGITAL TAX CONTROL: A METHOD OF STIMULATING THE LEVEL OF VOLUNTARY COMPLIANCE OF TAXPAYERS

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**Abstract.** The digitalization of tax processes represents a global trend aimed at enhancing revenue collection efficiency, reducing tax evasion, and increasing transparency in economic activities. In the Republic of Moldova, the State Tax Service (SFS) has implemented several initiatives for the digitalization of tax control, facilitating taxpayers' access to electronic services and optimizing the tax compliance process.

Digital tax control has emerged as an objective necessity in the context of global economic and technological transformations, also aiming to adapt inspection methods to new economic realities. The digitalization of financial transactions and economic activities has led to substantial changes in tax control mechanisms, requiring the use of modern tools for data collection, analysis, and verification.

**Keywords:** Fiscal digitalization, digital tax control, tax compliance, administrative efficiency, tax transparency.

**JEL Classification:** H20, H26, H83, H32, K34

## INTRODUCERE

În vederea satisfacerii scopului de creștere a transparenței dintre contribuabili și administrația fiscală, implementarea controlului fiscal digital poate deveni drept unul dintre cele mai mari obiective urmărite de către autoritatea fiscală din Republica Moldova. Întrucât autoritățile fiscale urmăresc încontinuu gradele de risc ale contribuabililor elaborând ulterior un plan de controale fiscale anuale, trimestriale sau lunare, digitalizarea acestui proces poate permite vizualizarea în timp real a acestor riscuri de către fiecare administrator sau persoană cu funcție de răspundere a unei entități, ceea ce va putea permite minimizarea de sine stătător a riscurilor și evitarea unui ulterior control fiscal, care se poate solda cu recalculări majore a impozitelor și taxelor. Controlul fiscal digital urmărește, în principal, două scopuri: pe de o parte obținerea gradului înalt de conformare voluntară a contribuabililor, ceea ce ar putea duce la creșterea încasărilor din impozite și taxe la buget, iar pe de altă parte oferă posibilitatea evitării efectuării unui eventual control fiscal total la întreprinderi.

## CONȚINUT DE BAZĂ

### 1. Controlul fiscal

În scopul desfășurării unei bune activități de întreprinzător, la 24.04.1997, Parlamentul Republicii Moldova a adoptat Legea nr. 1163-XIII, privind Codul fiscal, care stabilește principiile generale ale impozitării în Republica Moldova, dar totodată Codul fiscal conține prevederi în partea ce se referă la verificarea modului în care contribuabilul respectă legislația fiscală într-un anumit interval de timp, denumit în continuare control fiscal.

Controlul fiscal poate fi efectuat în mai multe moduri, după cum urmează:

1) verificare faptică; 2) verificare documentară; 3) verificare totală; 4) verificare parțială;
5) verificare tematică; 6) verificare operativă; 7) verificare prin contrapunere.

Toate aceste tipuri de efectuare a controalelor fiscale pot stabili abateri de la legislația fiscală națională și în consecință pot duce atragerea la răspundere penală, contravențională și/sau civilă.

### 2. Digitalizarea controlului fiscal

În contextul în care unul dintre obiectivele strategice urmărite de autoritatea fiscală este obținerea gradului înalt de conformare voluntară a contribuabililor, oferind servicii calitative, soluții optime și competente ce corespund ultimelor realizări din domeniul tehnologiilor informaționale, introducerea controlului fiscal digital devine o necesitate.

Digitalizarea controlului fiscal nu doar îmbunătățește eficiența administrării fiscale, dar contribuie și la creșterea conformării benevole a contribuabililor. Prin implementarea unor soluții digitale avansate, contribuabilii au acces mai facil la informații, iar procesele fiscale devin mai transparente și mai ușor de gestionat.

Unul dintre principalii factori care au condus la implementarea controlului fiscal digital este digitalizarea economiei și creșterea ponderii tranzacțiilor realizate în format electronic. Utilizarea pe scară largă a facturilor electronice, plăților digitale și comerțului online a determinat necesitatea adaptării metodelor de inspecție fiscală la mediul digital. În același timp, dezvoltarea economiei digitale, inclusiv fenomenul gig economy, a condus la apariția unor noi forme de activități economice, pentru care metodele tradiționale de control au devenit ineficiente.

Un alt element determinant este reprezentat de progresele tehnologice în domeniul colectării și analizei datelor fiscale. Implementarea unor soluții avansate, precum Big Data, Inteligența Artificială (AI) și blockchain, a permis o monitorizare mai eficientă a fluxurilor financiare și o identificare rapidă a riscurilor fiscale. Utilizarea acestor tehnologii contribuie la creșterea gradului de transparență fiscală și la automatizarea unor procese esențiale pentru administrațiile fiscale.

Totodată, necesitatea eficientizării administrațiilor fiscale a impus digitalizarea controalelor, permițând realizarea unor verificări mai rapide și mai precise, cu un consum redus de resurse. Controlul fiscal digital facilitează analiza automată a raportărilor fiscale și permite identificarea rapidă a discrepanțelor, fără a fi necesară o inspecție la fața locului. Astfel, se creează premisele pentru un sistem fiscal mai predictibil și mai bine structurat, în care contribuabilii beneficiază de o interacțiune digitalizată cu autoritățile fiscale.

Dintre tipurile de control, enumerate anterior, ce se aplică pe moment conform prevederilor Titlului V a Codului Fiscal al RM, controalele care pot fi executate și atribuite cu ajutorul și prin mecanisme digitale sunt: verificarea documentară**,** verificarea tematică**,** verificarea prin contrapunere și, parțial, verificarea totală și verificarea parțială, în funcție de natura documentelor analizate.

Astfel ***verificarea documentară*** se bazează pe analiza documentelor contabile și fiscale furnizate de contribuabil în format electronic (facturi electronice, declarații fiscale online, registre contabile digitale etc.). Aceasta se încadrează perfect în conceptul de control fiscal digital, deoarece implică utilizarea tehnologiilor digitale pentru colectarea, verificarea și analizarea datelor.

La rândul său și ***verificarea tematică*** se poate realiza prin instrumente digitale dacă este orientată către aspecte specifice ale activității contribuabilului, cum ar fi conformitatea declarațiilor electronice cu registrele digitale sau respectarea regimului TVA prin raportarea online.

***Verificarea prin contrapunere***, implică compararea și corelarea datelor din surse electronice diferite, cum ar fi: informațiile din sistemele de evidență contabilă ale contribuabilului cu cele raportate către autoritățile fiscale, facturile electronice raportate prin sistemele naționale (e.g., e-Factura) cu datele partenerilor comerciali, datele bancare (extrase electronice) cu evidențele fiscale.

În ceea ce ține de ***verificarea totală și parțială***, acestea pot include elemente digitale în măsura în care se analizează date din sistemele contabile și financiare electronice, însă pot necesita și controale fizice, ceea ce limitează aplicabilitatea lor exclusiv digitală.

Celelalte tipuri de control (***verificarea faptică, operativă***) necesită prezență la fața locului , cu constatări directe asupra activității economice.

Implementarea soluțiilor digitale pentru creșterea conformării fiscale în Republica Moldova a început în mod semnificativ în anul 2008, odată cu lansarea Serviciului Guvernamental de Plăți Electronice (MPay) și a primelor sisteme informatice fiscale. Ulterior, au fost introduse diverse platforme pentru digitalizarea proceselor fiscale, printre care: „Cabinetul personal electronic al contribuabilului” – platformă online pentru gestionarea obligațiilor fiscale, e-Factura – sistem de facturare electronică, e-Invoice – soluție digitală pentru raportarea tranzacțiilor comerciale. Aceste inițiative au condus la o creștere a transparenței fiscale, dar și la provocări legate de adoptarea lor de către contribuabili, SIA MEV – asigură recepționarea informației despre tranzacțiile efectuate prin intermediul echipamentelor de casă și de control, de monitorizare a vânzărilor și analiză a riscurilor.

Controlul fiscal digitalizat presupune utilizarea tehnologiilor moderne pentru a monitoriza și verifica respectarea obligațiilor fiscale ale contribuabililor urmărind următoarele obiective:

- monitorizarea și evaluarea conformării fiscale în timp real;
- reducerea riscurilor de fraudă și evaziune fiscală;
- reducerea erorilor și a neconformităților prin contrapunerea automatizată a datelor declarate de către contribuabil în dările de seamă cu datele înregistrate prin SIA MEV;
- interacțiune mai transparentă cu autoritățile fiscale, prin reducerea interacțiunii dintre contribuabil și inspectori în vederea creșterea încrederii contribuabililor în autoritatea fiscală;

În vederea îndeplinirii acestor scopuri este necesar de a înțelege că totuși principalul obiectiv este stimularea nivelului de conformare benevolă a contribuabililor și nu sancționarea acestora.

### 3. Evaluarea riscurilor de neconformare fiscală și legătura dintre reducerea acestuia în raport cu apariția și aplicarea controlului fiscal digital

La baza planificării controalelor fiscale stă procesul de management al riscurilor de neconformare fiscală, definit ca un proces sistematic, în care SFS decide asupra instrumentelor de tratament, bazate pe cunoașterea comportamentului fiecărui contribuabil în parte, ce ar putea fi utilizate pentru a stimula în mod eficient respectarea legislației în vigoare și pentru a preveni evaziunea și frauda fiscală.

În baza analizei criteriilor de risc de neconformare, în perioada anilor 2020-2024, au fost aprobate spre executare controale fiscale, conform Figurii 1:

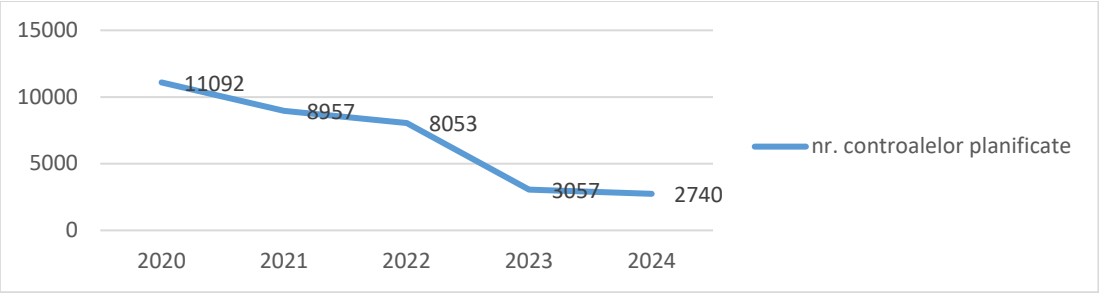


**Figura 1. Evoluția controalelor fiscale planificate în baza criteriilor de risc.**
**Sursa:** *Elaborat de autor în baza raporturilor anuale ale activităților de control.*

Potrivit Figurii 1, în perioada analizată, se atestă descreșterea a numărului de controale fiscale planificate conform riscurilor. Subsidiar constatăm că Serviciul Fiscal de Stat tinde spre conformarea fiscală benevolă a contribuabililor, minimizând numărul controalelor planificate în baza riscurilor. În acest sens, monitorizarea în timp real a riscurilor, efectuată de către persoanele cu funcții de răspundere ale întreprinderilor va permite atingerea acestui scop.

Codul fiscal stipulează exhaustiv aspectul în partea ce se referă la atribuțiile Serviciului Fiscal de Stat, în realizarea funcțiilor sale. Prin urmare, art. 133 alin. (2) pct. 11) din Codul fiscal prevede expres că autoritatea fiscală gestionează riscurile de neconformare fiscală și selectează contribuabilii cu risc sporit de neconformare fiscală. Reieșind din acest aspect, în contextul digitalizării și automatizării proceselor, introducerea controlului fiscal digital va permite contribuabililor să-și urmărească de sine stătător și în timp real, prin intermediul „Cabinetului electronic al contribuabilului", riscurile entității, având posibilitatea minimalizării acestora. În acest sens este cert faptul că nimeni nu-și dorește sancțiuni atunci când are posibilitatea evitării acestora prin prisma monitorizării individuale a riscurilor. Subsidiar, controlul fiscal digital poate permite acest lucru satisfăcând pe de o parte acest „vis" al contribuabililor, iar pe de altă parte oferind autorităților fiscale control permanent asupra întreprinderilor și prin urmare: venituri constante în Bugetul de Stat.

Pe lângă reducerea nivelului de neconformare, digitalizarea controlului fiscal a determinat o scădere semnificativă a costurilor de conformare pentru contribuabili. Automatizarea calculelor fiscale, simplificarea depunerii declarațiilor și digitalizarea raportărilor au contribuit la diminuarea riscului de erori umane și la reducerea nevoii de rectificare a declarațiilor fiscale. Prin urmare, contribuabilii au fost stimulați să respecte regulile fiscale nu doar din cauza măsurilor de descurajare a evaziunii, ci și datorită eficienței și accesibilității sporite a sistemului fiscal.

## CONCLUZII

În final, implementarea controlului fiscal digital poate avea un impact direct asupra creșterii conformării fiscale, atât prin creșterea capacității administrațiilor fiscale de a monitoriza și sancționa neregulile, cât și prin simplificarea procesului de raportare fiscală. Contribuabilii vor fi mai predispuși să respecte obligațiile fiscale datorită transparenței crescute a sistemului, a reducerii economiei tenebre și a creșterii încrederii în mecanismele fiscale. Astfel, controlul fiscal digital s-a dovedit a fi un instrument esențial pentru îmbunătățirea colectării veniturilor bugetare și consolidarea sustenabilității sistemului fiscal modern. Digitalizarea controlului fiscal reprezintă un pas esențial pentru modernizarea sistemului fiscal din Republica Moldova, care ar putea consolida relațiile dintre administrația fiscală și domeniile private de activitate.

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# THE EVOLVING LANDSCAPE OF E-COMMERCE AND EMERGING MARKET TRENDS

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**Abstract:** Currently, the e-commerce sector plays an essential role in global trade due to digital transformation, expanding technological innovations, and shifting consumer behaviors. Its fast evolution requires businesses to adapt, using AI, automation, and data to improve efficiency, customer experience, and global reach. This article explores the key trends that shape currently mobile commerce, having the main aim to investigate via analyzing secondary sources, how e-commerce is evolving, what are the causes behind and which are the future trends. Furthermore, free cross-border trade and new payment options improve global connectedness and, as digital commerce grows, firms must adapt to new trends in order to stay competitive.

**Keywords**: E-commerce, Trends, Digital transformation, Supply chain innovation.

**JEL CLASIFICATION:** L81, B17, F43

## INTRODUCTION

Many areas of human life and business activities underwent crucial changes in the last years, these changes being catalyzed by technological advancements, globalization, and new preferences of consumers that shifted their traditional habits of buying to a faster and more flexible manner. Undeniably, this switch has various consequences, especially on electronic commerce (e-commerce) development and its future trends. This paper aims to analyses the last said aspects, spotlighting that Information and Communications Technology is definitely a vital factor for global economic flourishment and businesses accomplishment.

The term “e-commerce” is defined in many different ways, but all giving similar meaning of commercial transactions conducted electronically on the internet. The statistical office of the European Union, Eurostat, is defining e-commerce as the sale or purchase of goods and services, whether between businesses, households, individuals or private organizations, through electronic transactions conducted via the internet or other computer-mediated networks. Also, it is specified as the placing of orders for goods and services via the internet including buying financial investments, confirming reservations for accommodation and travel, paying for information services, buying via online auctions [2].

E-commerce is divided into some forms, including business-to-business (B2B), where transactions happen between companies, such as retailers and wholesalers. Business-to-consumer (B2C) refers to businesses selling directly to customers, common on platforms like Amazon. Consumer-to-consumer (C2C) involves individuals selling to each other through marketplaces such

as Etsy or eBay. Another model, consumer-to-business (C2B), allows individuals to offer products or services to companies, such as freelancers on Upwork or influencers collaborating with brands.

## MAIN CONTENT

In this framework, there is a clear distinction of e-commerce based on the types of transactions and objects involved, spotlighted in an OECD workshop by [1], where is presented various types of e-commerce and its segmentation. Figure 1 illustrates this division of electronic commerce based on the types of transactions and objects involved, distinguishing between customer types and transaction categorie). Within B-to-B, a further distinction is made between end-use products and services versus process-related intermediate goods. The "object" column clarifies about the nature of goods exchanged, varying from final products for consumers to raw materials or components for businesses. This segmentation helps to understand the diverse nature of e-commerce, calling attention to the different needs and characteristics of non-identical market players.

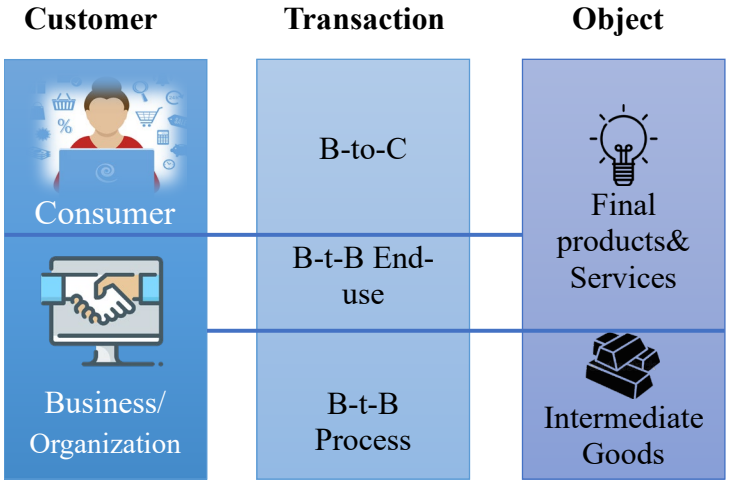


**Figure 1. Segmentation in e-commerce.**
**Source:** *Adapted by the author based on [1].*

Undeniably, the digital world of all segmentations of e-commerce is continuously outplacing traditional shopping, being mainly catalyzed by some factors all over the world. The rapid growth is primarily driven by technological development, fast, secure and accessible online transactions. Widespread internet connection and the increasing use of digital devices facilitated consumers (both customers and businesses/organizations) to shop conveniently from anywhere at any time. Changing consumer preferences, particularly the demand for quick delivery and easy ordering, have further accelerated the shift to digital shopping.

Additionally, the lockdown of COVID-19 pandemic significantly boosted e-commerce adoption as safety issues forced costumers to opt for online platforms. In addition, competitive prices and the broader variety of products offered by e-commerce platforms continue to attract more customers, making traditional retail less dominant.

This shift can be observed in the tendency of retail e-commerce revenue worldwide, by segment, being represented in table 1 where it is shown how retail e-commerce revenue is growing across different product categories from 2019 to 2024 and its prognosis for 2029 [6]. The total revenue increased from $2.19 trillion in 2019 to $4.12 trillion in 2024. Food, fashion, and hardware are the fastest-growing segments, with food prognosis rising from $0.23 trillion to $1.23 trillion. Electronics and media are also expanding, being able to reach $0.40 trillion and $0.64 trillion by 2029. Smaller

categories like beverages, beauty, and household items are also growing stead and the *others* segment (where is included eyewear, pharmaceuticals, toys and hobby, households' essentials) is also suffering a rapid growth of 50% in the period of 2019-2024. Totally, the retail e-commerce revenue worldwide managed to approximately double in 5 years period, reaching in 2024 the value of 4.12 trillion U.S. dollars.

**Table 1: Retail e-commerce revenue worldwide, by segment (in trillion U.S. dollars)**

| Segment / Year | Food | Fashion | Hardware | Media | Furniture | Electronics | Beverages | Beauty | Household | Tobacco | Others | *Total* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *2019* | 0.23 | 0.52 | 0.22 | 0.28 | 0.19 | 0.19 | 0.08 | 0.13 | 0.09 | 0.09 | 0.17 | ***2.19*** |
| *2024* | 0.68 | 0.77 | 0.49 | 0.44 | 0.28 | 0.27 | 0.24 | 0.23 | 0.20 | 0.17 | 0.35 | ***4.12*** |
| *2029* | 1.23 | 1.18 | 0.72 | 0.64 | 0.44 | 0.40 | 0.38 | 0.34 | 0.32 | 0.28 | 0.56 | ***6.49*** |

**Source:** *Elaborated by the author based on [6]*

Correspondingly, the main trends of e-commerce drive from the customers' needs for accessibility and coziness, but also from the businesses desire to stay competitive and maintain, or even expand, their revenues. Hence, the main trends and innovations that shape the future world of electronic commerce could be considered as following:

- Large expanding of voice commerce;
- Development of augmented reality and virtual reality;
- Personalization of shopping experience;
- Growing awareness of sustainable e-commerce.

Customers are more and more becoming familiar with voice assistants, such as Google Assistant and Amazon Alexa, and this leads to gaining popularity for made online shopping. Voice commerce is predicted to develop even more in the upcoming years since it is hands-free way to purchase. Artificial intelligence and data are being used by e-commerce companies to customize each customer's purchasing experience. This involves making product recommendations based on demographic information, browsing patterns, and previous purchases. Businesses may boost consumer satisfaction and conversion rates by offering personalized shopping experiences.

Moreover, e-commerce is utilizing to a larger extent now the AR and VR to make buying more captivating and immersive. While VR applications may be used to build interactive virtual showrooms, AR apps can be used to let clients virtually try on furniture or clothing. Also, in the framework of increase consciousness of sustainability importance, consumers are seeking more sustainable goods and services as they grow more ecologically responsible. In response to this trend, e-commerce companies are utilizing sustainable packaging, providing eco-friendly items, and offsetting their carbon footprints.

However, online transactions in the majority of cases involve sharing of financial and personal data, and in this way privacy could suffer. Hence, according to ethical concerns, the unauthorized data collection and storage lead to the exploitation of consumer privacy and spoil their trust in e-commerce. Nowadays, counterfeit goods represent about 10% of global trade [5]. The online nature of electronic commerce facilitates to counterfeit products and increase the number of threats the intellectual property. As a result, e-commerce will undeniably continue to face this challenge, but it

is crucial to invest in secure practices for protecting their customers data and insure them with a pleasurable process of purchasing.

## CONCLUSIONS & RECOMMENDATIONS

The shift in customers purchase behavior is more than obvious now and they (customers or business) are more comfortable with online shopping, preferring convenience, time and energy saving, competitive pricing, and personalized experiences. Digital wallets and buy-now-pay-later possibilities are also more popular in recent years, being able to offer consumers flexibility and accessibility, especially in regions where traditional banking services are limited.

The emerging market trends in the landscape of e-commerce are important to be taken into consideration by businesses and organizations in order to remain competitive and maintain their supply correspondingly to the demand. In order to do this, they should pay attention at some key aspects such as the protection of customers' data, the current trends in e-commerce and the rapid advancements in technology. According to past tendencies, we may spotlight that the potential of e-commerce is limitless, and sellers can not only assure the expectations of todays' buyers, but also can predict via different channels the possible trends and help the customers to have a proper online purchase experience in the current very dynamic and competitive market.

In the framework of embanking innovation and social responsibility, e-commerce companies can turn challenges into opportunities for growth, development, and a robust market presence.

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# THE GREEN SHIFT: ECONOMIC TOOLS FOR SUSTAINABLE GROWTH IN THE DIGITAL AGE

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**Abstract:** As environmental challenges such as climate change, resource depletion, and pollution escalate, embedding sustainability into economic models has become an urgent necessity. This paper examines the role of environmental economics in addressing these issues by critically evaluating traditional economic frameworks and their shortcomings in accounting for environmental costs. It explores alternative sustainability-oriented economic indicators and policy mechanisms, including ecological efficiency, taxation strategies, and the IPAT equation. Furthermore, the study investigates the intersection of the digital economy and sustainable development, illustrating how technological advancements and data-driven solutions can not only strengthen environmental resilience but also foster a more conscious and responsible society. Through an analysis of global and local policy initiatives, this research underscores the pivotal role of regulatory frameworks in promoting sustainable economic growth. The findings indicate that while significant progress has been made, a more holistic and widespread integration of sustainability principles across both economic and digital domains is essential to cultivating a resilient and environmentally aware society.

**Keywords:** Sustainability, Environmental Economics, Digital Economy, Technological Innovation, Regulatory Frameworks

**JEL Classification:** Q01, Q5, O44

## INTRODUCTION

Environmental and resource issues such as species extinction, toxic spills, climate change, and pollution have increasingly captured public attention in recent decades. As these challenges grow in complexity and urgency, policymakers and businesses must develop strategies that balance economic growth with environmental sustainability. Traditional economic models, which often externalize environmental costs, have proven insufficient in addressing the scale of contemporary environmental degradation. In response, environmental economics provides critical insights and tools to integrate sustainability within resource-constrained economic systems.

This paper, The Green Shift: Economic Tools for Sustainable Growth in the Digital Age, examines how economic instruments can mitigate environmental risks and promote sustainable development. First, it critically reviews global economic models, assessing both mainstream approaches and alternative frameworks such as ecological and degrowth economics. Second, it evaluates methods for quantifying environmental risks, exploring environmental valuation techniques and emerging digital tools like AI-driven climate modeling. Finally, it analyzes the role of market-

based mechanisms—including carbon pricing, tradable permits, and green subsidies—at both global and local levels, with special attention to digital finance and circular economy models.

By synthesizing these perspectives, this paper aims to contribute to the ongoing discourse on sustainable economic transformation. Through rigorous analysis of theoretical and empirical developments, we seek to offer insights into how economic tools can drive both environmental protection and long-term prosperity.

**MAIN CONTENT**

This study employs a multi-method research approach, integrating content analysis, comparative analysis, and advanced text analysis techniques to provide a comprehensive examination of the intersection between environmental economics and sustainability policy. By drawing on an extensive review of scholarly literature and policy-based research, the study ensures a thorough exploration of the subject within both academic and practical contexts.

A foundational model in environmental economics, the IPAT equation (Impact = Population × Affluence × Technology), developed by Ehrlich and Holdren (1215), illustrates how human activity drives environmental change. However, a notable limitation is the static treatment of technology, which does not account for innovations that mitigate environmental harm (Chertow 22). To address this shortcoming, the Kaya Identity (Kaya and Yokobori 53) refines the IPAT framework by incorporating carbon emissions, thereby emphasizing energy intensity and consumption patterns as key determinants of climate change (Tol 13). This refined approach underscores the potential to decouple economic growth from environmental degradation through technological advancement and efficiency improvements.

Ecological efficiency, which aims to minimize resource depletion and pollution, is crucial for sustainable economic systems. Enhanced production processes, as advocated by Mickwitz et al. (1609), contribute significantly to this goal. Quantitative tools such as the Ecological Footprint measure human consumption against Earth's biocapacity, revealing that current global consumption exceeds sustainable thresholds, requiring approximately 1.6 Earths to sustain present demand (Global Footprint Network 22). Furthermore, economic valuation techniques, such as those utilized in the Millennium Ecosystem Assessment (2005), assign monetary value to ecosystem services, strengthening the economic case for conservation. These methodologies highlight the necessity of integrating environmental costs into economic decision-making processes (Condrea and Bostan 845).

The Environmental Kuznets Curve (EKC) suggests that economic development initially exacerbates environmental degradation but, over time, leads to greater environmental protection as societies become wealthier and prioritize sustainability (Stern, Common and Barbier 1158). While this hypothesis supports the idea that wealthier nations have the capacity to implement environmental protections, critics argue that it oversimplifies the transition to sustainability and overlooks global inequalities. The EKC does not fully account for the complexities of environmental degradation in developing nations, where economic expansion often intensifies ecological harm. Additionally, the model fails to consider the transboundary nature of environmental issues such as climate change, which necessitate international cooperation and coordinated policy responses.

International policy frameworks, such as those established through UN Earth Summits (eg. Stockholm 1972, Rio 1992, Paris 2015), have played a pivotal role in advancing global sustainability efforts. The Rio+20 Summit (2012) led to the formulation of the Sustainable Development Goals (SDGs), expanding upon the Millennium Development Goals (MDGs). However, critics have

highlighted the lack of enforceable mechanisms, which has limited the effectiveness of these initiatives (House of Commons 16). Similarly, the OECD's Green Growth Strategy (85) has encountered implementation challenges across diverse economic landscapes, underscoring the tension between sustainability objectives and economic growth imperatives (OECD 94).

Market-based policy instruments, including green taxation and emissions trading schemes, have emerged as critical tools in environmental governance (Dahlström and Ekins 180). Green taxes function by internalizing environmental externalities, thereby influencing consumer and producer behavior through financial incentives. A prominent example is the EU Emissions Trading Scheme (ETS), established in 2005, which encompasses over 11,000 industrial facilities. The ETS employs a cap-and-trade system to incentivize emission reductions, promoting sustainable industrial practices. Despite its successes, challenges persist in scaling this model globally and ensuring that carbon pricing mechanisms accurately reflect the full cost of emissions (Ash 34).

## CONCLUSION

Effectively addressing environmental challenges necessitates a paradigm shift in economic frameworks and policy strategies. Traditional economic models have historically prioritized growth at the expense of sustainability (Dipietro and Anoruo 700), but this study highlights the potential of alternative economic indicators, ecological efficiency, and regulatory mechanisms as viable pathways toward sustainable development. The integration of data-driven innovations, particularly in the digital economy, emerges as a promising avenue for enhancing sustainability practices and optimizing resource management (Yadong 180).

Nonetheless, the findings underscore the need for stronger international commitments alongside localized policy adaptations to maximize the effectiveness of these strategies. While this research identifies promising approaches to sustainability, it also reveals significant gaps in current regulatory frameworks and the need for more nuanced, context-specific policy interventions.

Future research should examine the interplay between digital innovation and sustainability across various industries, as well as the long-term impacts of implementing these emerging economic models at a global scale. The observed discrepancies between ecological efficiency measures and conventional growth indicators highlight the necessity of recalibrating existing economic metrics. Additionally, further investigation is required to effectively integrate local sustainability initiatives into broader global frameworks, ensuring the development of robust, regionally tailored environmental policies.

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# DEVELOPMENT OF FRANCHISING IN TERMS OF DIGITALIZATION

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**Abstract**: The emergence of new business models in franchising, driven by digitalization, is undeniably reshaping our conventional understanding of business processes. While new technologies are intended to simplify and optimize operations, it's crucial to consider the potential challenges that both franchisors and franchisees may encounter. This article examines the concept of digitalization within the context of franchising's evolution, highlighting both the positive impacts of this process – such as digital tools that can enhance communication and collaboration between franchisors and franchisees, the utilization of smart contracts, website creation, and enhanced analytics through big data – as well as the challenges that arise from the adoption of new technologies. These challenges include: the legal and regulatory frameworks required for new franchising models, the readiness of companies to implement new digital tools, the need for new infrastructure and skilled personnel, the impact of new technologies on companies' competitiveness, and the potential limitations on franchise growth in the digital economy.

**Keywords**: digitalization, franchising, e-commerce, risks of digitalization, new business models.

**JEL Classification:** O33; M21; F10

## INTRODUCTION

The digitalization of the economy has a significant impact on all areas of business, including franchising. Traditional franchising models based on personal interaction and standardized processes are gradually being transformed under the influence of new technologies. The introduction of digital tools offers great opportunities for optimizing business processes, increasing the efficiency of communications between franchisors and franchisees, and improving analytical capabilities through the use of big data.

However, along with this, new challenges arise related to legal, organizational and technological aspects of implementing digital solutions.

The purpose of this article is to analyze the impact of digitalization on franchising development, highlight key advantages and challenges, and suggest ways to address them. The research is based on the analysis of scientific publications, statistical data and practical examples of the introduction of digital technologies into franchise models.

## MATERIALS AND METHODS

The research was conducted using qualitative and quantitative methods of analysis. A literature review was conducted, including academic articles, books and reports on the topic of digitalization of franchising. The main sources include works by Zhao (2022), Cedrola and Memmo (2013), and Mazepova's (2021) research on the legal regulation of franchising in the digital economy.

To analyze the current state of the franchising market, statistical data from open sources, such as reports from the International Franchise Association (IA) and Statista research, were used. In

addition, practical cases of companies that have implemented digital technologies in their franchise networks were considered.

## RESULTS AND DISCUSSION

Advantages of digitalization of franchising include optimization of communications. One of the key benefits of digitalization is improved communication between franchisors and franchisees. Modern platforms such as CRM-systems and cloud services, allowing for rapid information exchange, tracking of standards and co-ordination of actions network participants (Cedrola & Memmo, 2013). For example, the use of Chabots and automated support systems can reduce time spent on routine issues. Smart contracts, Blockchain-based smart contracts are becoming an important tool in franchising. They provide transparency and automation of settlements between parties, which reduces the risk of conflicts and litigation (Mazepov, 2021). According to Ye-Sho Chen's research, the use of smart contracts can reduce administrative costs by 20-30%. Big data analytics. Big data allows franchisors to better understand customer behavior, forecast demand and optimize marketing campaigns. For example, analyzing purchase data helps to identify the most popular products and tailor the assortment to the needs of the target audience (Zhao, 2022). E-commerce. The development of e-commerce expands the opportunities of franchise networks. Franchisees can use online platforms to sell goods and services, which is especially important in the context of globalization and the growing number of Internet users.

However, it also creates new legal issues related to territorial exclusivity (Branellec & Perrigot, 2013).

Challenges of digitalization of franchising; legal and regulatory issues. The introduction of new technologies requires updating the legal framework. For example, the use of smart contracts and blockchain requires a clear definition of the legal status of these instruments. In, the issues of personal data protection and cybersecurity are becoming particularly relevant (Mazepov, 2021). Technological readiness of companies - not all companies are ready to implement complex digital solutions. Small and medium-sized franchise networks often face limited resources and a lack of skilled professionals (Cuffe, 2021). Competition and constraints to growth. Digitalization can both strengthen the competitiveness of franchise networks and create barriers to their growth. For example, the high costs of technology adoption can limit new entrants' access to the market (Chen, 2023).

## STATISTICS AND DATA VISUALIZATION

Based on Statista (2023) data, the following trends can be identified:

- The global franchising market size was valued at $3.7 trillion in 2022.
- The share of online sales in total franchise revenues increased from 15 per cent in 2018 to 25 per cent in 2022.
- 67% of franchisees have implemented at least one digital tool to optimize business processes.

**Table 1. Dynamics of online sales growth in franchising**

| Year | Share of online sales (%) | Growth compared to previous year (%) |
|---|---|---|
| 2018 | 15 | - |
| 2019 | 17 | 13.3 |
| 2020 | 20 | 17.6 |
| 2021 | 23 | 15.0 |
| 2022 | 25 | 8.7 |

***Source:*** *Statista. (2023). Global Franchise Market Report.*

Studies by the IF (International Franchise Association) and other analytical companies confirm that online sales are taking an increasing share in the revenues of franchise networks. For example, the 2020 pandemic has significantly accelerated the shift to e-commerce, which explains the high growth in 2020 (17.6%).

Growth Rate Calculation:

$$Growth\ rate = \frac{New\ value - Previous\ Value}{Previous\ value} * 100\%$$

We will use the growth rate formula to calculate the data for 2023, 2024, 2025 and 2026.

Inverse formula to calculate a new value (online sales share) based on a known growth rate:

$$New\ value = previous\ meaning \times \left(1 + \frac{growth\ rate}{100}\right)$$

Initial data:

- Share of online sales in 2022: 25%
- Growth rate in 2022: 8.7%

To forecast future values, we assume that the growth rate will decline gradually as the franchising market approaches saturation. This is a realistic assumption given that the growth rate has already slowed from 17.6% in 2020 to 8.7% in 2022.

Projected growth rate:

- 2023: 7.0% (1.7 percentage points slower growth)
- 2024: 5.5% (1.5 percentage points deceleration)
- 2025: 4.0% (1.5 percentage points slower growth)
- 2026: 2.5% (1.5 percentage points slower growth)

Summary table:

**Table 2. The trend towards online sales growth in franchising**

| Year | Share of online sales (%) | Growth compared to previous year (%) |
|---|---|---|
| 2022 | 25 | 8.7 |
| 2023 | 26.75 | 7.0 |
| 2024 | 28.22 | 5.5 |
| 2025 | 29.35 | 4.0 |
| 2026 | 30.09 | 2.5 |

***Source:*** *calculated by the author*

Based on these calculations, it can be concluded that the share of online sales in franchising will continue to grow, but the growth rate will gradually decrease. By 2026, the share of online sales will reach approximately 30.09%, which reflects the trend towards market stabilization.

## CONCLUSIONS

The digitalization of franchising is a two-way process that combines significant advantages and serious challenges. On the one hand, the introduction of digital technologies allows optimizing business processes, improving communications and increasing the competitiveness of companies. On the other hand, franchise networks face challenges related to legal regulation, technological readiness and economic constraints.

To successfully implement digital solutions, companies need to develop a strategy that takes into account both internal capabilities and external factors. This includes investments in staff training, infrastructure upgrades and co-operation with technology partners. Only an integrated approach will allow franchise networks to maximize the potential of the digital economy.

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# DIGITALIZAREA PROCESELOR DE ADMINISTRARE FISCALĂ ÎN REPUBLICA MOLDOVA: EFICIENȚĂ, TRANSPARENȚĂ ȘI ADAPTAREA AUTORITĂȚILOR FISCALE LA PROVOCĂRILE ECONOMIEI DIGITALE

# DIGITALIZATION OF TAX ADMINISTRATION PROCESSES IN THE REPUBLIC OF MOLDOVA: EFFICIENCY, TRANSPARENCY, AND THE ADAPTATION OF TAX AUTHORITIES TO THE CHALLENGES OF THE DIGITAL ECONOMY

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**Abstract.** The digital transformation of tax administration in the Republic of Moldova is a key step toward modernizing the tax system, increasing efficiency, and ensuring high tax compliance. This study examines the impact of digitalization on tax processes, highlighting the main implemented tools, such as SIA "e-Declaration", "e-Invoice", and "Electronic Sales Monitoring" (MEV), which have simplified taxpayer interactions and improved transparency. Despite these advancements, several challenges persist, including unequal access to technology, low digital competencies among taxpayers and tax officials, and cybersecurity risks. Addressing these barriers is crucial for the full adoption of digital solutions. The study also explores future development prospects, emphasizing the integration of emerging technologies like artificial intelligence, blockchain, and Big Data analytics. These innovations could enhance tax collection efficiency, reduce tax fraud, and increase transparency. Additionally, the research underscores the need for updating tax legislation, promoting digital education, and strengthening international partnerships to support digital transformation. By analyzing the current state of tax digitalization and its challenges, this study provides insights and recommendations for developing a modern, fair, and sustainable tax system in the digital economy.

**Keywords:** Tax digitalization, fiscal administration, efficiency, transparency, digital economy.

**JEL Classification:** H20, H21, H26, H30, O33, K34, L84

## INTRODUCERE

Digitalizarea administrației fiscale în Republica Moldova constituie un element esențial în procesul de modernizare a sistemului fiscal, având drept obiectiv principal creșterea eficienței administrative și asigurarea unui grad ridicat de conformare fiscală. În contextul economiei digitale și al complexității tot mai mari a tranzacțiilor economice, această cercetare examinează impactul digitalizării asupra proceselor fiscale, evidențiind atât beneficiile, cât și provocările asociate. Analiza se concentrează asupra stadiului actual al digitalizării fiscale în Republica Moldova, care au contribuit la simplificarea interacțiunilor contribuabililor cu administrația fiscală și la sporirea transparenței proceselor.

## CONȚINUT DE BAZĂ

### 1. Infrastructura, sistemele digitale existente și evoluții recente în domeniul digitalizării

În ultimii ani, Republica Moldova a implementat o serie de inițiative menite să modernizeze sistemul fiscal prin digitalizare, având ca obiectiv principal reducerea sarcinii administrative și îmbunătățirea eficienței proceselor fiscale. Printre soluțiile adoptate se numără „Raportarea electronică unică", care simplifică procedurile fiscale prin consolidarea multiplelor raportări într-un format digital unic, facilitând conformarea contribuabililor și reducând volumul documentației administrative. De asemenea, portalul „MCabinet" oferă acces la o gamă extinsă de servicii publice electronice, inclusiv cele fiscale, consolidând digitalizarea interacțiunii dintre contribuabili și instituțiile statului.

Un alt progres semnificativ îl reprezintă digitalizarea controalelor fiscale, care permite utilizarea datelor digitale pentru analiza riscurilor și identificarea contribuabililor cu un potențial ridicat de evaziune fiscală, sporind astfel eficiența inspecțiilor și optimizând alocarea resurselor administrative. Totodată, automatizarea unor procese, precum calcularea automată a penalităților pentru întârzierea plăților, contribuie la simplificarea administrării fiscale și la asigurarea unei gestionări mai riguroase a obligațiilor fiscale.

Digitalizarea administrației fiscale din Republica Moldova a avut un impact considerabil asupra eficienței administrative, conformării fiscale și transparenței proceselor. Implementarea soluțiilor digitale a eliminat barierele birocratice și a facilitat interacțiunea contribuabililor cu autoritățile fiscale, reducând semnificativ timpul necesar pentru îndeplinirea obligațiilor fiscale. Prin intermediul platformelor electronice, contribuabilii pot depune declarațiile și efectua plăți online, eliminând necesitatea prezenței fizice la ghișee și simplificând procesele administrative. Aceste transformări au condus la creșterea conformării voluntare, întrucât accesibilitatea și eficiența proceselor digitale au înlesnit îndeplinirea obligațiilor fiscale.

Un aspect esențial al digitalizării este automatizarea proceselor, prin utilizarea unor platforme precum **SIA „e-Declarație"** și **„Cabinetul Personal al Contribuabilului"**, care permit depunerea declarațiilor fiscale online. Această automatizare a redus complexitatea procedurilor și a diminuat sarcina administrativă asupra contribuabililor. Totodată, utilizarea sistemelor digitale pentru calcularea automată a obligațiilor fiscale a minimizat erorile umane, eliminând riscul unor raportări incorecte și asigurând o determinare mai precisă a sumelor datorate.

Digitalizarea a îmbunătățit considerabil accesibilitatea serviciilor fiscale prin eliminarea necesității prezenței fizice la ghișee și prin digitalizarea principalelor interacțiuni dintre contribuabili și administrația fiscală. Acest progres a facilitat respectarea termenelor-limită și a redus timpul alocat de contribuabili pentru îndeplinirea obligațiilor fiscale. De asemenea, transparența administrativă a fost consolidată prin publicarea de către Serviciul Fiscal de Stat a rapoartelor digitale privind veniturile colectate și cheltuielile publice, ceea ce a contribuit la sporirea încrederii contribuabililor în sistemul fiscal.

Digitalizarea proceselor fiscale a dus la un sistem mai performant, actualizat și transparent, unde conformarea voluntară este stimulată prin simplificarea procedurilor administrative și eficientizarea relației dintre contribuabili și autoritățile fiscale. Aceste progrese reprezintă un pas semnificativ spre un sistem fiscal adaptat economiei digitale, capabil să răspundă eficient cerințelor contribuabililor și obiectivelor administrației fiscale.

Un avantaj major al digitalizării este sporirea transparenței în gestionarea finanțelor publice. Serviciul Fiscal de Stat publică rapoarte digitale detaliate privind veniturile colectate și utilizarea fondurilor, oferind contribuabililor o perspectivă clară asupra modului în care sunt administrate

resursele statului. Această inițiativă a întărit încrederea publicului în instituțiile fiscale și a îmbunătățit controlul asupra finanțelor publice.

Prin creșterea transparenței și simplificarea interacțiunilor cu administrația fiscală, digitalizarea a contribuit la îmbunătățirea conformării fiscale, reducerea sarcinii administrative și optimizarea sistemului fiscal. De asemenea, accesul rapid la informații și posibilitatea de a monitoriza utilizarea resurselor publice au consolidat încrederea contribuabililor în integritatea și eficiența autorităților fiscale. Astfel, digitalizarea nu doar că a optimizat procesele administrative, ci a sprijinit dezvoltarea unui sistem fiscal modern și orientat către contribuabili.

**2. Măsuri strategice pentru îmbunătățirea digitalizării fiscale**

Pentru a optimiza sistemul fiscal digital și a depăși provocările existente, Republica Moldova trebuie să adopte o serie de măsuri menite să consolideze infrastructura digitală, să îmbunătățească accesibilitatea platformelor fiscale și să beneficieze de expertiză internațională.

O direcție prioritară este ***investiția în infrastructura digitală***, vizând dezvoltarea rețelelor IT în zonele rurale pentru a asigura acces egal la serviciile fiscale electronice. De asemenea, integrarea unor tehnologii avansate, precum blockchain și inteligența artificială, ar putea îmbunătăți securitatea datelor, monitorizarea tranzacțiilor și automatizarea proceselor administrative, contribuind la creșterea eficienței colectării veniturilor fiscale.

De asemenea, este esențială ***simplificarea și optimizarea platformelor digitale existente***, astfel încât acestea să fie mai intuitive și ușor de utilizat de către contribuabili. Extinderea funcționalităților sistemelor fiscale electronice și crearea unor interfețe mai accesibile vor facilita conformarea voluntară și vor reduce dificultățile administrative întâmpinate de utilizatori.

Un alt aspect crucial îl reprezintă ***dezvoltarea parteneriatelor internaționale***, prin colaborarea cu organizații precum Uniunea Europeană, Fondul Monetar Internațional și Banca Mondială. Aceste instituții pot furniza asistență tehnică și financiară pentru modernizarea sistemului fiscal, sprijinind adoptarea celor mai bune practici internaționale și integrarea unor soluții inovatoare.

Prin aplicarea acestor măsuri, Republica Moldova poate accelera procesul de digitalizare fiscală, îmbunătățind eficiența administrativă, sporind conformarea voluntară și consolidând transparența sistemului fiscal.

**3. Comparație cu alte state din regiune**

Comparativ cu alte state din regiune, Republica Moldova înregistrează progrese semnificative în digitalizarea sistemului fiscal, însă mai are pași importanți de parcurs pentru a atinge nivelul de eficiență și integrare digitală observat în economii mai avansate din Europa Centrală și de Est.

**România** a implementat ***SAF-T (Standard Audit File for Taxation)***, un standard internațional de raportare electronică ce facilitează schimbul de date fiscale între contribuabili și autorități, sporind transparența și reducând riscul de evaziune fiscală. De asemenea, România extinde utilizarea ***e-Factura*** pentru mai multe categorii de contribuabili, accelerând procesul de digitalizare și reducând sarcina administrativă a agenților economici.

**Estonia** este considerată un model de excelență în digitalizarea administrației fiscale, oferind ***declarații fiscale complet automatizate*** și utilizând ***inteligența artificială*** pentru analiza și monitorizarea conformării fiscale. Acest sistem avansat permite contribuabililor să interacționeze eficient cu autoritățile fiscale, optimizând colectarea veniturilor și reducând semnificativ birocrația.

**Ucraina** a lansat aplicația ***„Diia”***, o platformă digitală inovatoare ce integrează servicii fiscale și alte interacțiuni guvernamentale, facilitând accesul cetățenilor la serviciile publice. Aceasta permite depunerea declarațiilor, efectuarea plăților și accesarea documentelor oficiale într-un mediu digital securizat, reducând timpul și costurile administrative.

În acest context, Republica Moldova trebuie să își accelereze eforturile de digitalizare, adoptând practici internaționale de succes și investind în infrastructura IT**,** automatizarea proceselor fiscale și dezvoltarea de platforme intuitive. Implementarea acestor măsuri va facilita conformarea voluntară a contribuabililor, va crește eficiența administrativă și va contribui la consolidarea unui sistem fiscal modern, transparent și eficient.

**4. Utilizarea instrumentelor digitale în administrația fiscală din Republica Moldova**

Republica Moldova a implementat o serie de instrumente digitale pentru modernizarea administrației fiscale, vizând simplificarea proceselor, reducerea birocrației și îmbunătățirea conformării fiscale. Aceste soluții au eficientizat colectarea veniturilor publice, au sporit transparența și au facilitat interacțiunea contribuabililor cu autoritățile fiscale.

Printre cele mai importante instrumente se numără **SIA „Cabinetul Personal al Contribuabilului”**, care oferă acces personalizat la informațiile fiscale și reduce necesitatea deplasărilor fizice, și **SIA „e-Declarație”**, care permite depunerea online a declarațiilor fiscale, reducând erorile și accelerând procesarea acestora. De asemenea, **SIA „e-Factura”** facilitează generarea facturilor electronice, contribuind la combaterea fraudei fiscale și la transparentizarea tranzacțiilor comerciale.

Pentru îmbunătățirea controalelor fiscale, **SIA „Monitorizarea Electronică a Vânzărilor” (MEV)** permite monitorizarea în timp real a tranzacțiilor comerciale, prevenind evaziunea fiscală. În plus, administrația fiscală utilizează sisteme avansate de analiză a riscurilor pentru a identifica contribuabilii cu potențial ridicat de neconformare, optimizând astfel inspecțiile fiscale și colectarea impozitelor. Integrarea bazelor de date guvernamentale a consolidat schimbul de informații între instituții, contribuind la o raportare fiscală mai precisă și la reducerea fraudei.

Un alt progres major este *automatizarea plăților și notificărilor fiscale*, care permite efectuarea plăților online și notificarea automată a contribuabililor cu privire la obligațiile fiscale, reducând întârzierile și îmbunătățind relația cu administrația fiscală. Digitalizarea arhivelor fiscale și dezvoltarea aplicațiilor mobile au crescut accesibilitatea serviciilor fiscale și au facilitat utilizarea soluțiilor digitale.

Un factor esențial în digitalizarea fiscală este *colaborarea internațională*, Republica Moldova beneficiind de asistență tehnică din partea Uniunii Europene și a altor organizații pentru extinderea facturării electronice și integrarea tehnologiilor emergente, precum blockchain.

În ansamblu, digitalizarea administrației fiscale a avut un impact semnificativ asupra eficienței proceselor, îmbunătățind conformarea voluntară, reducând frauda și facilitând interacțiunea dintre contribuabili și autorități. Pentru a continua acest progres, sunt necesare investiții în infrastructura IT, dezvoltarea competențelor tehnologice și consolidarea parteneriatelor internaționale, asigurând astfel un sistem fiscal modern, eficient și adaptat economiei digitale

**5. Provocările adaptării la economia digitală în Republica Moldova: Identificarea barierelor tehnologice, legislative și instituționale.**

În ciuda progreselor semnificative, Republica Moldova se confruntă cu o serie de provocări care limitează adoptarea și eficiența soluțiilor digitale în administrația fiscală. Aceste dificultăți sunt generate de bariere tehnologice, legislative și instituționale ce afectează implementarea eficientă a tehnologiilor moderne. Printre barierele tehnologice, infrastructura digitală insuficient dezvoltată, în special în zonele rurale, restricționează accesul contribuabililor la serviciile fiscale electronice, afectând conformarea fiscală. De asemenea, vulnerabilitățile în securitatea cibernetică reduc încrederea utilizatorilor în platformele digitale. Barierele legislative constau în reglementări care nu țin pasul cu noile tehnologii, creând incertitudine pentru contribuabili și investitori, în timp ce lipsa standardelor de interoperabilitate menține procesele administrative fragmentate. La nivel instituțional, deficitul de personal specializat și

rezistența la schimbare limitează adoptarea tehnologiilor moderne, în timp ce lipsa coordonării între instituțiile publice generează întârzieri și ineficiență.

Pentru a facilita tranziția către un sistem fiscal digital eficient, Republica Moldova trebuie să investească în infrastructura digitală, extinzând rețelele de internet de mare viteză, în special în zonele rurale. Totodată, este esențială actualizarea legislației pentru a reglementa economia digitală și a integra noi tehnologii, precum blockchain și inteligența artificială. Dezvoltarea competențelor digitale în rândul funcționarilor și contribuabililor va facilita utilizarea soluțiilor digitale, iar securizarea sistemelor informatice va spori încrederea în digitalizare. În plus, promovarea parteneriatelor public-private va sprijini dezvoltarea și implementarea unor soluții inovatoare pentru eficientizarea administrației fiscale.

## CONCLUZII

Adaptarea la economia digitală în Republica Moldova necesită o abordare integrată, bazată pe investiții în tehnologie, reforme legislative și consolidarea capacităților instituționale. Strategiile bine coordonate și implicarea tuturor actorilor relevanți vor transforma digitalizarea într-un motor de progres economic și social. Crearea unui sistem fiscal modern, accesibil și securizat va spori transparența, eficiența administrativă și conformarea fiscală, facilitând tranziția Republicii Moldova către o economie digitală competitivă.

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# DIGITAL TECHNOLOGIES IN BANKING: APPLICATIONS FOR INVESTMENT PROJECTS

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**Abstract.** Digitalization of investment lending and project financing processes is an important factor for increasing economic potential on a global scale. The specifics of the mechanisms of the investment projects consist of extraordinarily financing structures, the scale of projects and its demand by economic entities. The prospects for the development of new technologies, including digitalization, are considered in order to increase investment financing in the global market. Methods of comparative analysis, expert assessments and a systematic approach were applied in the research. It is noted that, with the development of the economy, using digital platform and technologies, it is possible to ensure more transparent and timely communication and structuring of transactions between participants in project financing, investment lending, including application of econometric models and artificial intelligence.

**Keywords:** digitalization, investment lending, project financing, credit risk management.

**JEL Classification:** G20, G21, O33

## INTRODUCTION

Digitalization is a transformation aimed to optimize business processes, increase company's productivity and improve customer relationship. The targets of digitalization are: product (or service) improvement: its quality, attractiveness, usability; automatization of production and other internal processes of the company; simplification of internal and external communications.

With the introduction of the digital economy, new mechanisms using platform and digital technologies are emerging. In this regard, stimulating innovation and creating favorable business conditions are important factors for increasing economic potential on a global scale, including through the digitalization of investment processes (Matkovskaya 22).

One of the main challenges that can be solved with the help of digital services is to increase the efficiency and acceleration of processing loan applications. Currently, the process of project financing transactions can take a long time and requires significant costs for analyzing documents and data. However, using digital technologies and data analytics, it is possible to automate most of the process and speed up decision-making. In addition, digital services can help ensure the security and confidentiality of data and protect against fraud. They can also help to simplify the management of a project finance transaction. Using digital tools, you can track the progress of a project and respond to changes in the situation in a timely manner.

Digitalization processes can provide more transparent and timely communication between project finance participants in syndicated lending transactions, speed up the decision-making process and reduce the time spent on resolving controversial issues.

The purpose of this scientific study is to analyze the opportunities of applying digitalization processes in financing investment projects by banks and reducing the overall level of credit risk on transactions. Taking into account the analysis, the main tasks are the possibilities of blockchain and decentralized finance mechanisms, the introduction of modern mathematical methods into credit risk assessment processes in order to increase efficiency when working with investment projects.

## MAIN CONTENT

### 1. Materials and Methods

Nowadays, blockchain is gaining relevance for online users as the implementation option for a distributed leger network. Used in the blockchain distributes registries technology allows to store, process and update media. It's being adopted for transfer of valuables as property rights, securities, debt, obligations, property assets, cryptocurrencies. Large banks and some governments have implemented blockchain technology. However, their goal is related to the acceleration of information processing, low cost of services, and system security: fewer failures and the absence of a main server as an attractive target for hackers (Tapscott et al. 48).

Blockchain and smart contracts have created a new paradigm of financial cooperation without intermediaries. Decentralized finance is a combination of specialized services based on smart contracts and decentralized applications (Dapps) that make up a financial ecosystem and provide users with access to a variety of financial services such as investing, lending, trading on exchanges, etc. (Volodina et al. 32).

These financial services are provided without restrictions to everyone for 24 hours a day due to the active development of blockchain technology in general and, in particular, Ethereum platform. The Ethereum was originally created not so much as a payment system, but as a base for the affordable implementation of blockchain technology in third-party projects. Not only new startups project to express interest to that platform but also large developers, including Banks: Grupo Santander, UBS, Deutsche Bank, Credit Agricole, BNP Paribas, Intesa Sanpaolo, as well as payment systems (Visa, Mastercard, PayPal), auditing companies (Deloitte, Ernst & Young).

The development of credit risk management in recent years has been driven by the use of modern mathematical methods: probabilistic and statistical modeling, mathematical programming, game theory, etc. When developing credit risk assessment models, banks typically use econometric models based on linear, regression, and multidimensional discriminant analysis to obtain estimates of the likelihood of events such as the probability of default. In addition, banks use neural models as computer algorithms that simulate the work of the human brain, while using the same data as in econometric models. In optimized models based on mathematical forecasting methods, it is possible to minimize the lender's errors in terms of forming the terms of the loan product. At the same time, expert models are also used that simulate the risk assessment process carried out by experienced analysts when making credit decisions based on a set of logical rules. Hybrid models using statistical data and simulation can be based on causal relationships. The sequence of model construction as a whole is based on identifying the relationship between variables in the choice of methods for estimating input parameters (David et al. 131).

## 2. Results and Discussion

The use of digital services can significantly improve the organization of project financing, increase its efficiency and speed up the decision-making process. Automatization platform can provide the following opportunities:

- Processing of loan applications: the borrower submits an application through an online form and downloads the documentation in electronic form for the project. The application will be automatically analyzed using machine learning algorithms and data analytics, while simultaneously verifying them with data from tax authorities and credit bureaus. In addition, the financial model will be analyzed for the correctness of filling out formulas, comparing model data, including the CAPEX of the project with average market data. That will reduce the time for processing applications, standardize the financial model and calculations based on it, and speed up the decision-making process for granting a loan.
- Credit risk assessment: The platform has used machine learning algorithms and uploaded data analytics, including a PD model to assess a borrower's credit risk. Based on the analysis of various factors, such as project risk assessment, financial state, cash flow, the platform will issue recommendations on the loan and its terms, such as the need to extend the financing period, issue additional collateral, increase the loan rate, and calculate the reserve for the transaction.
- Project monitoring: The platform will enable surveyors, shareholders, and creditors to monitor project execution in real time. The platform will host all the necessary documents related to the project, including contracts, plans and reports on the performance of work, as monitor the fulfillment of projected financial indicators. Thanks to this, participants will be able to easily monitor the implementation of the project and respond in a timely manner to changes in the situation.

If a syndicated lending scheme is involved in the process, all information will be promptly available to investors and ensure real-time coordination processes.

Today, views across risk/return outcomes and asset allocation are table stakes. Institutions want to unlock value and scale, while uncovering insights across horizontal functions, strategies, geographies and everything in between. BlackRock Aladdin is a platform that uses artificial intelligence and machine learning to analyze financial data and provide real–time risk management solutions. Aladdin® is a tech platform that unifies the investment management process through a common data language. Aladdin® Risk combines sophisticated risk analytics with quality-controlled data and highly scalable processing capabilities, allowing clients to know what they own across their portfolio, identify opportunities and make more informed decisions (Alladin® by BlackRock 16.02.2025).

Alladin technology based on:

- Stable Foundation: Built by and for the industry—with stability as the prime directive to achieve target operating models and scale.
- Open Innovation: Empowering unique outcomes from our API-first approach across shared services and data.
- Built for Change: Ensuring ongoing investment in both R&D and input from experienced technologists, with a rigorous release schedule/

**Table 1. Stakes of Alladin in U.S banks, 2023**

| Name | Sector | Asset Class | Market Value | Weight (%) | Notional Value |
|---|---|---|---|---|---|
| CITIGROUP INC | Financials | Equity | USD 41,075,376 | 7.22 | 41,075,376.15 |
| WELLS FARGO | Financials | Equity | USD 41,028,988 | 7.21 | 41,028,988.35 |
| BANK OF AMERICA CORP | Financials | Equity | USD 38,441,497 | 6.75 | 38,441,496.50 |
| US BANCORP | Financials | Equity | USD 36,690,721 | 6.45 | 36,690,720.75 |
| JPMORGAN CHASE & CO | Financials | Equity | USD 36,418,760 | 6.40 | 36,418,759.75 |
| FIRST REPUBLIC BANK | Financials | Equity | USD 24,916,970 | 4.38 | 24,916,970.05 |
| TRUIST FINANCIAL CORP | Financials | Equity | USD 23,549,511 | 4.14 | 23,549,510.75 |
| M&T BANK CORP | Financials | Equity | USD 23,511,562 | 4.13 | 23,511,562.34 |
| PNC FINANCIAL SERVICES GROUP INC | Financials | Equity | USD 22,810,575 | 4.01 | 22,810,575.20 |
| FIFTH THIRD BANCORP | Financials | Equity | USD 21,023,966 | 3.69 | 21,023,965.83 |

**Source:** *"Stocks & Futures Trading Magazine, 2023"*

The company is so influential that its assets under management are larger than the GDP of almost every country in the world. With over nine trillion dollars Blackrock services and holdings include several Sovereign Wealth Funds, Central Banks, Retirement accounts for everyday average folk in the form of Pension Funds, Fortune 500 companies and millions of individual investors.

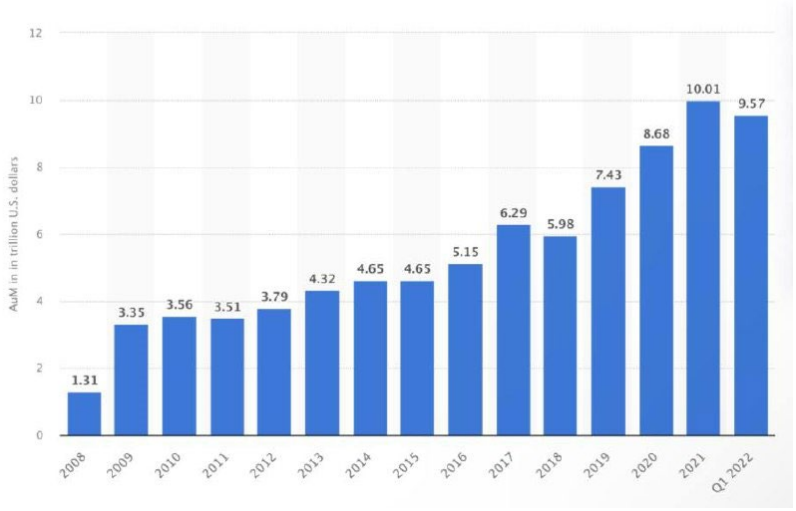


**Figure 1. Trends in Assets under management Growth.**
**Source:** *Statista, 2022.*

## CONCLUSIONS

It is noted that, with the development of the economy, using digital platform and technologies, it is possible to ensure more transparent and timely communication and structuring of transactions between participants in project financing, investment lending, including application of econometric models and artificial intelligence.

According to forecasts of the research company Autonomous Next, by 2030, the use of artificial intelligence technologies will allow banks all around the world to reduce costs of $1 billions, which is 22% more profitable (Morris 16.02.2025). In view of the foregoing, the use of digitalization in the implementation of investment financing is an additional incentive for development, innovation and macroeconomic growth.

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# ASPECTS OF THE DIGITAL ECONOMY DEVELOPMENT IN THE REPUBLIC OF MOLDOVA

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**Abstract.** This article shows the changes in the global digital economy, as well as their impact on the development of the world economy. The most promising development strategy is the introduction of the latest technologies into all types of business activities, providing their goods and services through online platforms and maintaining contact with customers remotely, which indicates a change in the field of business. The digital economy at this stage is developing rapidly, which requires fast adaptation of specialists to maintain competitiveness. The article presents some aspects of the development of the digital economy at the global and national levels, in particular analysing the indicators of e-commerce. It reveals the statistical indicators of buyers' actions on online platforms and draws conclusions regarding the development of the digital economy at global and national levels, outlining the directions of development of the digital economy in the Republic of Moldova.

**Keywords:** digital economy, economic development, digital era, digital infrastructure, digital skills, digital strategies.

**JEL Classification:** O33.

## INTRODUCTION

The development of the digital economy and the introduction of digital technologies in different sectors of the economy have a strong influence on the definition of the term digital economy. Initially, the digital economy was considered as activities related to information technology (Tapscott 8), the Internet and e-commerce, but later the digital economy was defined as an economy based on digital technologies (Gagauz 10). Digitalisation has become a top priority for many countries, including the Republic of Moldova. The process of digital transformation implies the implementation of new technologies in all fields of activity, as it contributes to increasing their efficiency and innovativeness.

The transition to a digital economy allows people to access services and goods more quickly and easily. As for businesses, digital transformation promotes greater optimisation and accuracy and enables companies to move to electronic platforms. In industry, the digitisation of companies is bringing a number of processes to a new qualitative level. Digitalisation contributes to economic growth by introducing new business models, increasing productivity and creating promising jobs in

technologically advanced areas. The introduction of digital technologies is a success factor in the modern economy, increasing competitiveness in the global market through innovation.

The aim of the study was to analyse some aspects of the development of the digital economy at the global and national level, in particular the performance of e-commerce in recent years. In the process of the study, development prospects were identified and some conclusions were drawn about the necessity and importance of the digital economy not only now, but also in the future. The findings can be used to develop strategies for digital transformation and adapt economic standards to modern technological realities.

## ANALYSIS AND INTEPRETATION OF RESULTS

### 1. Online commerce – an important part of the digital economy

Online commerce is considered an essential part of the digital economy because it is developing at a rapid pace. All those involved in this process are impressed by the growth of this sector of the economy. More than 33% of the world's population shop online, e-commerce is currently estimated at $6 trillion and is forecast to reach $8 trillion by 2027.

As of 2024, 2.71 billion people are shopping online worldwide. In 2025, the number of online shoppers will increase to 2.77 billion. China leads the world in online shopping with 915.1 million online shoppers (eCommerce Statistics in 2025 2).

By 2027, 22.6% of retail purchases are expected to be made online. Since 2021, the share of online retail purchases has increased by an average of 0.32% per year. There are more than 26.6 million e-commerce stores worldwide (eCommerce Statistics in 2025 2).

There are currently 26.6 million eCommerce sites worldwide, which is an increase in 2024 by 3.83% compared to 2023. The majority of online stores operate on the Shopify and Wix platforms, each accounting for 19.07% and 11.84% stores respectively.

A good 41% of shoppers shop directly from online retailers such as Amazon or company websites.

An analysis of global online sales shows an average annual growth of 7.8% between 2024 and 2027, reaching $8 trillion by 2027. The increase in online sales shows that e-commerce is becoming one of the most profitable choices for businesses around the world.

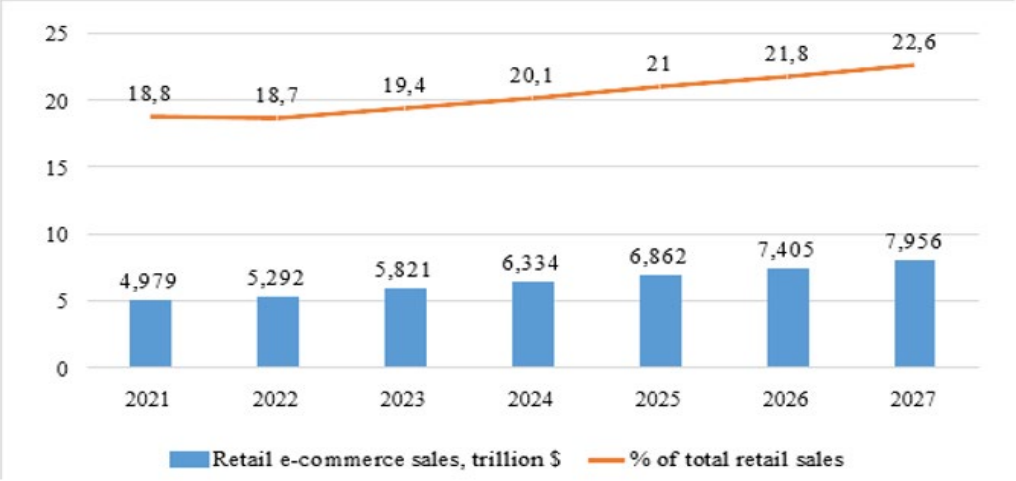


**Figure 1. Global retail e-commerce sales, 2021-2027.**
**Source:** *eCommerce Statistics in 2025, January11, 2025.*
*https://www.sellerscommerce.com/blog/ecommerce-statistics*

One of the directions of development of the digital economy in all countries, including the Republic of Moldova, is the use of online space. Internet sales of commercial goods and services in Moldova reached € 358.6 million [excluding VAT] in 2023, which is 15.2% more than in 2022 (Figure 2) (Piața comerțului electronic din Republica Moldova 12). The e-commerce market in the country is growing faster than offline retail. The value share of goods in the country's online sales has increased to 63.9% in 2023, but the share of commercial goods and services has been stable over the last six years (Piața comerțului electronic din Republica Moldova 12).

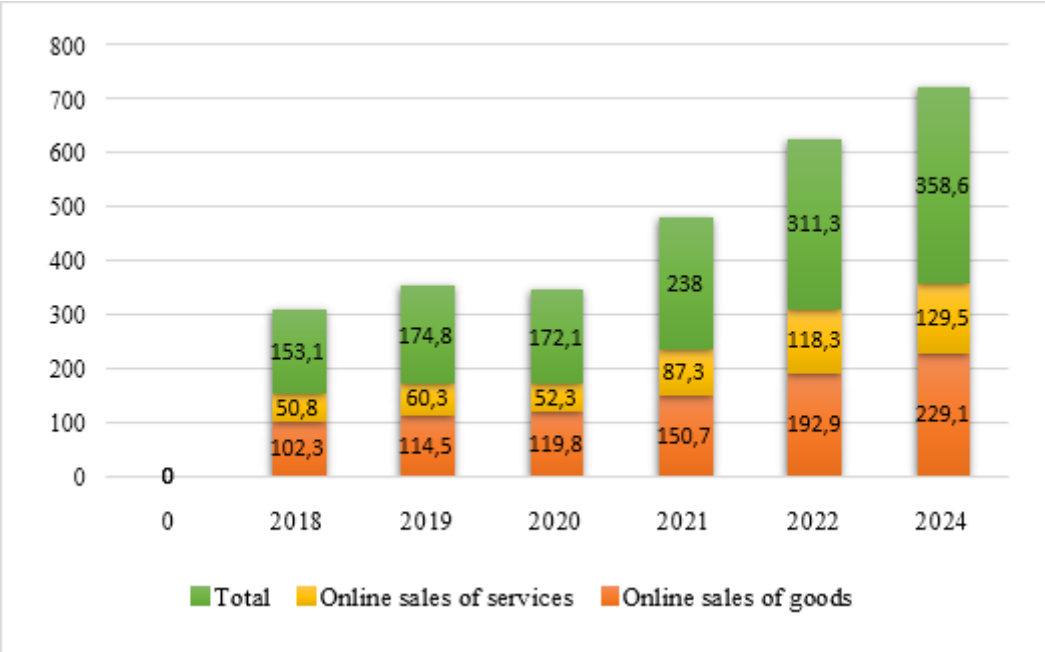


**Figure 2. Estimated value (EUR million, excluding VAT) of the e-commerce market in Moldova, 2018-2023**

**Source:** *Piața comerțului electronic din Republica Moldova. https://www.amcham.md/st_files/2024/07/15*

Currently, online sales do not play a significant role in the retail market, accounting for only 5.6% of the total sales of commercial goods and services in Moldova.

## 2. Development directions of the digital economy in the Republic of Moldova

The development of the digital economy varies from country to country. The Republic of Moldova has most of the conditions in place to develop the digital economy.

In 2022, two three-year programs related to digital transformation were approved*: the Program for digital transformation of small and medium-sized enterprises* and *the Program for supporting digital innovations and technology Startups* and subsequently implemented by the Entrepreneurship Development Organization.

*The program for digital transformation of small and medium-sized enterprises* has the following objectives: „to develop entrepreneurs' skills on the implementation of digital transformation-friendly business practices; to provide financial support for the implementation of digital transformation plans for at least 150 SMEs; to increase the competitive advantage and customer portfolio of SMEs by at least 20%; to develop e-commerce, facilitate the process of reducing the circulation of physical currency and develop courier services for at least 20% of the beneficiary companies" (Programul de transformare digitală a întreprinderilor mici și mijlocii 2).

*The Program to Support Digital Innovation and Technology Startups* includes four thematic components: „digital innovation, technological innovation, green technology, sustainable

production and has the following objectives: to promote the development of high value-added industries; to accelerate the implementation of the digital, circular and green economy through technological progress; to attract investment for start-ups with growth potential in the targeted sectors and industries and their export; to establish an alternative innovation and business development financing mechanism for high potential start-ups in the field of digital innovation, information and communication technologies, green technologies and sustainable production" (Programul de Susținere a Inovațiilor Digitale și Startup-urilor Tehnologice 2).

„The government's vision for the development of the digital economy and e-commerce is set out in *the Digital Transformation Strategy of the Republic of Moldova for 2023-2030*, which aims to create an innovative and resilient digital economy through the following initiatives:

- developing and promoting digital public services, ensuring their 100% availability by the end of 2030;
- digital transformation of businesses;
- stimulating the market for electronic payment services;
- creating a favorable business environment for digital start-ups;
- developing national e-commerce platforms and attracting international participants to the Moldovan market" (Republic of Moldova Digital Transformation Strategy 2023-2030 17).

## CONCLUSION

The digital economy plays a crucial role in global economic development and is a key determinant of market competitiveness. The adoption of digital technologies in all sectors of the economy is necessary to increase productivity and business efficiency.

One of the central aspects of the digital economy is e-commerce, with sales growing steadily worldwide. At a national level, growth in online sales is more modest. This trend emphasises the need for businesses to adapt to new technological realities by investing in online platforms and innovative digital solutions.

As for as the Republic of Moldova is concerned, the development of the digital economy depends on creating adequate infrastructure, supporting technological start-ups and stimulating the market for electronic payment services. *The Digital Transformation Strategy of the Republic of Moldova for 2023-2030* aims to strengthen this sector through specific measures such as digitisation of public services and attraction of international investors.

In conclusion, digital transformation is inevitable to ensure a modern and sustainable economy. It is important to stress the need to implement effective policies to support digitization, so that all stakeholders can benefit from the opportunities offered by the digital economy.

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# DIGITAL TRANSFORMATION IN THE FINANCIAL SECTOR: NEW TRENDS AND TECHNOLOGICAL INNOVATIONS

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**Abstract.** Recent years have seen the financial sector undergo a dramatic transformation, largely thanks to rapid technological breakthroughs and the relentless digitalisation of many business processes. This transformation—almost as if the traditional rules of finance are being rewritten by tools like artificial intelligence, blockchain, big data, and a host of fintech solutions—has sparked a kind of metamorphosis in what were once considered conventional financial services. At times, these shifts present both intriguing opportunities and significant challenges; for instance, while financial institutions are harnessing new digital tools to streamline operations, they also encounter unexpected hurdles that can, paradoxically, seem to undermine their very progress, which is quite a conundrum... The exploration here takes an in-depth look at how these technologies not only reshape institutions but also subtly alter regulatory frameworks, consumer behaviour, and even the broader economic landscape. Furthermore, by scrutinising current trends and venturing into speculative forecasts, valuable insights emerge regarding the continuously evolving terrain of finance in our digital era—a scenario that, while occasionally marred by minor contradictions, still offers a rich, albeit imperfect, tapestry of progress and potential.

**Keywords:** FinTech, Blockchain, Artificial Intelligence (AI), Digital Banking, RegTech, Cybersecurity.

**JEL Classification:** G20, G21, O33

## INTRODUCTION

The digital makeover of the financial arena is completely upending age-old banking, investment, and payment paradigms by weaving in state-of-the-art technologies like AI, blockchain, and massive data analysis; this evolution is all about boosting efficiency, trimming down operational costs, and, arguably, enhancing the overall customer experience. Financial institutions are increasingly driven to cater to the surging appetite for digital services, which means that cybersecurity and keeping up with regulatory hoops now stand as critical hurdles even though sometimes it feels like these very challenges are the fuel for further innovation.

Amidst the rapid expansion of FinTech and RegTech tools, the need for staying ahead in a fast-paced global market is more obvious than ever—an ever-changing digital landscape that, in a minor contradiction, sometimes seems to promote both transparency and opacity simultaneously... Studying these trends, therefore, is absolutely vital for ensuring sustainable growth and resilience in this brave new era of digital finance.

A core objective of the present analysis is to dissect the ongoing digital revolution within finance, putting a spotlight on the trends and tech breakthroughs that are redrawing the industry's future map. The exploration delves into how AI, blockchain, and big data are reshaping financial services and looks at how institutions are merging these technologies to ramp up efficiency, tighten security, and deliver more tailored customer experiences, even as the digital shift introduces its own set of risks like cybersecurity breaches and the constant pressure of regulatory compliance (curiously enough, security measures sometimes hinder progress, but that's the paradox of innovation).

The financial realm is witnessing a deep-rooted transformation propelled by relentless digitalisation and technological leaps. Traditional banking is morphing as digital banking platforms, mobile payment ecosystems, and automated services become the norm—these modern tools not only widen accessibility and streamline processes but also reframe risk management in ways that were previously unimaginable; however, the transition from face-to-face banking to a predominantly online and mobile-first experience (a shift that, for some, might feel abrupt and jarring) comes with its own learning curve. Digital wallets, person-to-person payment networks, and AI-driven advisory systems are collectively redefining customer interactions by offering faster, more personalized, and data-fuelled solutions (*Digital Transformation in Financial Services*).

In another twist, blockchain technology is not just a buzzword but a practical tool that bolsters transaction security and transparency, trims down fraud risks, and optimizes international payments; RegTech solutions, meanwhile, ease the burden of complex regulatory demands by automating compliance tasks and refining risk management strategies. And yet, even as these digital advances pave the way for innovative financial services, the pressure to constantly update technology and fend off cybersecurity threats lingers as an ever-present challenge—a reminder that progress sometimes comes with a price tag that is both ironic and inevitable

There are undeniable benefits to digitalisation, but it also brings a jumble of issues such as ambiguous regulatory landscapes, ever-evolving cybersecurity threats, and the necessity for non-stop technological upgrades; all of which make it a mixed bag—one that, despite its challenges, promises a future where finance is not only digital and data-centric but also increasingly customer-focused and innovative, even if, at times, that innovation seems to contradict the old ways just enough to leave a slight sense of unresolved tension.

## MAIN CONTENT

### Key Trends in Financial Digitalization

The financial realm is undergoing a remarkable overhaul, courtesy of the surge in FinTech innovations and the swift rise of digital banking, which is, admittedly, reshaping the age-old systems of banking, investments, and payments; emerging technologies like AI, blockchain, and big data analytics are now being woven into the fabric of these services—enhancing efficiency, boosting accessibility, and reinforcing security in ways that were once unimaginable.

At the heart of this metamorphosis lies a growing consumer appetite for convenient, speedy, and bespoke financial services—think mobile banking apps, digital wallets, and P2P payment platforms that have become indispensable for today’s transactions; these tools enable real-time fund transfers, automated investment management, and even AI-driven advisory systems, making banking not only more accessible but also remarkably cost-effective for both individuals and businesses.

FinTech startups, with their alternative lending platforms, crypto exchanges, and blockchain-based payment systems, have thrown a wrench into conventional banking models by offering more

agile, flexible solutions often accompanied by lower fees and a surprising degree of transparency (an irony not lost in the age of digital innovation, since these advancements sometimes both simplify and complicate matters simultaneously).

A separate thread in this digital tapestry is the influence of artificial intelligence (AI) and machine learning (ML) on financial operations; these technologies now drive everything from fraud detection and risk management—where machine learning sifts through enormous datasets in real time to flag suspicious activities—to customer service enhancements via chatbots and virtual assistants, which provide instantaneous support and tailored financial advice. Sometimes, AI's role in algorithmic trading and portfolio management is so profound that it executes high-frequency trades with a precision that traditional models struggle to match, even as robo-advisors democratize wealth management for the everyday investor.

Curiously, even the processes of loan underwriting and credit risk assessment have been transformed by AI-driven models that look well beyond conventional credit scores—taking into account factors like social behavior and alternative data sources—which paradoxically extends credit to a wider, sometimes underbanked, demographic while simultaneously raising questions about data privacy and algorithmic bias (*Emerging Technologies and Digital Transformation in Finance*).

Yet another twist is introduced by RegTech innovations which aim to simplify compliance by automating complex regulatory processes and mitigating risks associated with financial crimes. Still, as the digital banking phenomenon expands its reach, challenges such as cybersecurity vulnerabilities, evolving legal standards, and digital fraud persist, necessitating continual technological upgrades and robust data protection measures.

For reasons that may seem a bit contradictory, the very digital leap that promises a more secure and efficient financial future also brings with it an array of hurdles—cybersecurity risks, regulatory uncertainties, and the occasional need to retool legacy systems, which is both a sign of progress and a reminder of the costs that change can incur.

In a final twist of fate, as AI and ML further embed themselves into the core of financial services, it is anticipated that this intelligent automation and real-time decision-making will continue to reshape the industry, cultivating a more data-driven, customer-centric ecosystem—even if, at times, the pace of innovation leaves behind a trail of regulatory and ethical conundrums that are as puzzling as they are progressive.

**Future Prospects of Financial Digitalization**

In the past few years, the world of finance—thanks to digitalization—has been completely upturned, with global financial landscapes morphing at breakneck speed; as fresh tech emerges, financial bodies are, somewhat unsurprisingly, focusing more on refining their internal workings, boosting customer satisfaction, and reinventing the services they offer.

**Emerging Technologies & Their Uncertain Potential**

New-age tools like AI, blockchain, and machine learning are poised to rewrite the rules of the financial sector. AI, for instance, paves the way for automated decision-making, fancy predictive analytics, and risk management improvements, all of which are meant to boost both efficiency and accuracy; meanwhile, blockchain is shaking up payment systems, making transactions not only speedier and more secure but also trimming down the role of middlemen (although, oddly enough, sometimes the removal of intermediaries creates its own set of complications) and machine learning

is busy sharpening fraud detection systems to spot questionable activities practically in real time (*Blockchain and the Future of Financial Services*).

**Customer Experience Reimagined**

Digitalization has turned the customer-bank relationship on its head—traditional in-person banking is being steadily edged out by mobile apps, online platforms, and even chatbots; this change gives users almost instant access to services. The clever integration of AI now permits institutions to dish out personalized advice based on heaps of customer data, thereby ramping up both satisfaction and loyalty (curiously, these high-tech solutions sometimes feel as impersonal as they are customized) and digital wallets alongside innovative payment systems are making transactions smoother and (with the rise of biometrics, ensuring security in a somewhat unpredictable fashion) more secure

The move towards mobile-first services, not to mention contactless payments, has made financial interactions far more accessible especially in emerging markets, which means that digital solutions are in a way democratizing access to financial services—opening up participation in the global economy to a far wider spectrum of people.

**Some Strategic Considerations**

Investing in Innovation & R&D is key; financial institutions must keep pushing the envelope by continuously channeling funds into emerging tech. By forming specialized R&D teams, institutions can explore untapped potentials in AI, blockchain, and machine learning to further optimize operations and enhance services (*Digital Transformation in Banking and Financial Services* ).

Cybersecurity cannot be taken lightly either. As digital services mushroom, so does the need for state-of-the-art security measures—multi-factor authentication, encryption, biometric verifications, you name it—so as to guard sensitive customer data and cement trust in these digital channels

Also, adopting a customer-centric mindset is crucial. Placing the customer at the very heart of any digital transformation strategy (although at times the focus on technology seems to overshadow the human element) allows financial bodies to leverage data insights and deliver tailored, one-off experiences that can elevate service quality significantly

There's also merit in partnering with FinTechs; collaborating with these agile innovators can bring forth fresh ideas and new revenue streams that benefit all parties, even if sometimes such partnerships seem to blur the lines between traditional and modern financial practices

Lastly, a focus on financial inclusion is non-negotiable. Digitalization shouldn't just cater to the tech-savvy elite but must extend to those historically underserved—be it rural areas or low-income segments—thus fostering a more inclusive financial ecosystem that, ironically, sometimes leaves behind some traditional practices.

All in all, while these technological leaps promise a future where financial services are faster, more secure, and highly personalized, it remains a bit contradictory that the same innovations introducing efficiency also usher in complexities and vulnerabilities that call for constant vigilance and, well, further innovation.

## CONCLUSIONS

This article examines the swift metamorphosis of digital finance and its deep-seated effects on the financial sector; emerging technologies like AI, blockchain, and machine learnin' (yes, even if sometimes they seem a bit overhyped) are redrawing the industry map, allowing institutions to streamline operations, boost security, and deliver richer customer experiences—a series of findings that underscore the pressing need to adopt digital tools in finance.

Adoption of these digital innovations has not only smoothed operational workflows but also bolstered safety measures while opening uncharted avenues for creativity in finance; AI and machine learning have upended traditional decision-making methods, whereas blockchain holds the promise—if not the certainty—to unsettle old-school financial systems by providing secure, transparent, and, dare it be said, decentralized alternatives. Meanwhile, customer interactions have been reimagined with personalized services and frictionless digital interfaces that widen access to financial resources (*PWC. The Future of Finance: Digital Transformation and Innovation*).

Furthermore, the shift toward mobile-first services—enhanced by biometric checks and contactless payments—has rendered transactions more accessible than ever before, which is not merely a matter of convenience but also an effort to extend financial inclusion to groups that were once left out.

The implications of this ongoing digital revolution are substantial. Financial institutions must, by necessity, pour investments into technological innovation to stay competitive in this ever-changing market, especially as nimble fintech startups enter the arena, forcing established banks to adopt avant-garde technologies and forge strategic alliances (a paradoxical situation where legacy systems are both challenged and, at times, inadvertently preserved).

Cybersecurity and data privacy, now more than ever, have become paramount as reliance on digital platforms grows—institutions are compelled to build robust defense mechanisms to protect customer data and maintain trust in their digital offerings, all while navigating a maze of regulatory challenges as lawmakers and regulators attempt to craft frameworks for digital finance.

Looking forward, the horizon of digital finance appears brimming with potential for growth and innovation, yet there remains a delicate balance between embracing this promise and ensuring that security, privacy, and accessibility are not sacrificed at the altar of rapid advancement. The future is, undeniably, digital, and those institutions that manage to harmonize innovation with responsible practices are poised to lead the way towards a more efficient, inclusive, and sustainable global economy.

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# DIGITAL PAYMENT SYSTEMS AND THEIR IMPACT ON INFLATION

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**Abstract**: Due to the rapid expansion of digital payment systems, global financial transactions have been revolutionized, reducing reliance on physical cash and increasing transaction efficiency. This paper aims to critically explore the impact of digital payment systems on inflation and analyze both their advantages and potential risks. The widespread adoption of credit and debit cards, mobile payment applications, and cryptocurrencies has led to increased money circulation, its velocity and cased inflationary pressures. Moreover, the integration of digital transactions helped government reveal shadow economy and follow up the transparency of transactions. Moreover, digital payments strengthen monetary policy and give the possibility to central banks to respond swiftly to economic fluctuations. However, this system has its disadvantages as cryptocurrencies create volatility on the market and the transition to a fully digital economy is now impossible.

**Keywords**: *digital payment systems, monetary policy, inflation, impact*

**JEL Classification**: E31, E42

## INTRODUCTION

Nowadays, when the world is developing at a light speed and people's days are meticulously planned to the minute, many are seeking ways to significantly enhance their quality of life. With the appearance of the top-notch technology many realms have been dramatically improved and payment system is not the exception. In recent years, the integration of Computer Technologies into economical frameworks has not only enhanced transactions, making them more accessible but also transformed the global financial market. Thus, payment systems changed greatly and turned into a host of digital platforms that have become widespread all around the world.

Digital payment systems have experienced great diversification through last decade and refer to various electronic methods of transferring money. They include: credit and debit cards, mobile payment apps (e.g., PayPal, Apple Pay, Google Pay), cryptocurrencies, Central Bank Digital Currencies (CBDCs), online banking and wire transfers. These led to increased transaction speed and accessibility to any walk of life.

Advanced technology has replaced the role of cash with cashless transactions, such as credit and debit cards, electronic checks, and online and offline digital wallets. (Andrieu 2). A cashless economy has a positive effect through the financial transparency and reduced transaction costs (Kumari & Khanna 4).

This article aims to critically explore the use of digital payment systems, mainly focusing on their impact on global economy and inflation rate in particular. It will evaluate the system’s effectiveness in comparison to traditional methods of payment, examining both its strengths and potential limitations.

## MAIN CONTENT

### 1. Materials and methods

Although money still plays an essential role in all purchases, it now does not operate in a physical way and is usually replaced by digital ways of transferring money. Their origins date back to the era of steam engine railroads, in the 1870s, when Western Union debuted its electronic funds transfer which was operated via telegraph on copper wires and initiated a new way of payment. In 1910, the Federal Reserve first used the telegraph to transfer money. Fast-forward to the 1950s, when American Express introduced the first credit card, transactions became instantaneous, including deferring payments and accumulating debt. Electronic payments in the late 1960s through the 1970s saw a significant leap forward. Barclays Bank introduced the first automated teller machines (ATMs) in the UK in 1967, soon to be followed by Chemical Bank in the U.S. in 1969. The Automated Clearing House (ACH) was officially established in 1972. The Society for Worldwide Interbank Financial Telecommunication (SWIFT) for cross-border payments established in Belgium went live in 1977. These technologies were further developed throughout the 1980s, but with the advent of the Internet and digital technology in the 1990s, electronic payments evolved at light speed. This is where today's e-commerce, mobile banking, contactless payments, cryptocurrencies, and central bank digital currencies all have found their point of genesis (Montevirgen M. 2).

First and foremost, digital payment systems, such as credit cards, mobile money transfers and e-wallets provide the possibility for individuals to perform instant transactions. As a result, money moves faster from one user to another, increasing its velocity. Due to the fact, that the ability to purchase any items has become more accessible, the demand has as well experienced a dramatic increase. It may contribute to inflationary pressures, if supply does not expand proportionally (Payments statistics 3). Another point to mention is the fact that payments made by different digital appliances are monitored with greater ease by governmental institutions, such as Tax Authority or Finance Police. It reduces the risk of shadow economy and helps identify suspicious patterns of payment such as money laundering or tax evasion.

Last, but not least, digital methods of payment improve the efficiency of monetary policy by enabling quicker responses to interest rate changes as Central Banks receive information about relevant data and current financial situation when deciding on the volume of loans. Credits and capital investments become more accessible to a wider range of people due to its speed while processing transactions.

### 2. Results and discussions

The usage of digital payment systems has made the transactions easier and more accessible. Digital payment systems has both advantages and disadvantages. The advantages of digital payment include the following:

1. High liquidity within the country.
2. Ease of use.
3. Increased purchases of goods and payment for services.
4. Impossibility of counterfeiting.
5. No physical wear and tear.
6. Possibility of payment by QR.
7. Possibility of interstate exchange within individuals and legal entities.
8. High level of transaction traceability.

9. Possibility of receiving cashback from purchases.
10. Possibility of paying large amounts.

The disadvantages of digital payment include the following:

1. Susceptibility to inflation.
2. Low transaction speed, bank transfers can take 1-3 days.
3. Possibility of government influence on the exchange rate, which leads to "acceleration of inflation".
4. Centralization of account data within banks, which creates the possibility of data hacking and loss of funds.
5. The possibility of blocking an account by the bank owner for any reason.

Based on data published by European Central Bank, the use of electronic money continued to increase. This phenomenon can be seen in figure 1. Figure 1 shows the number of digital transactions in billions in EU for the period 2000-2024.

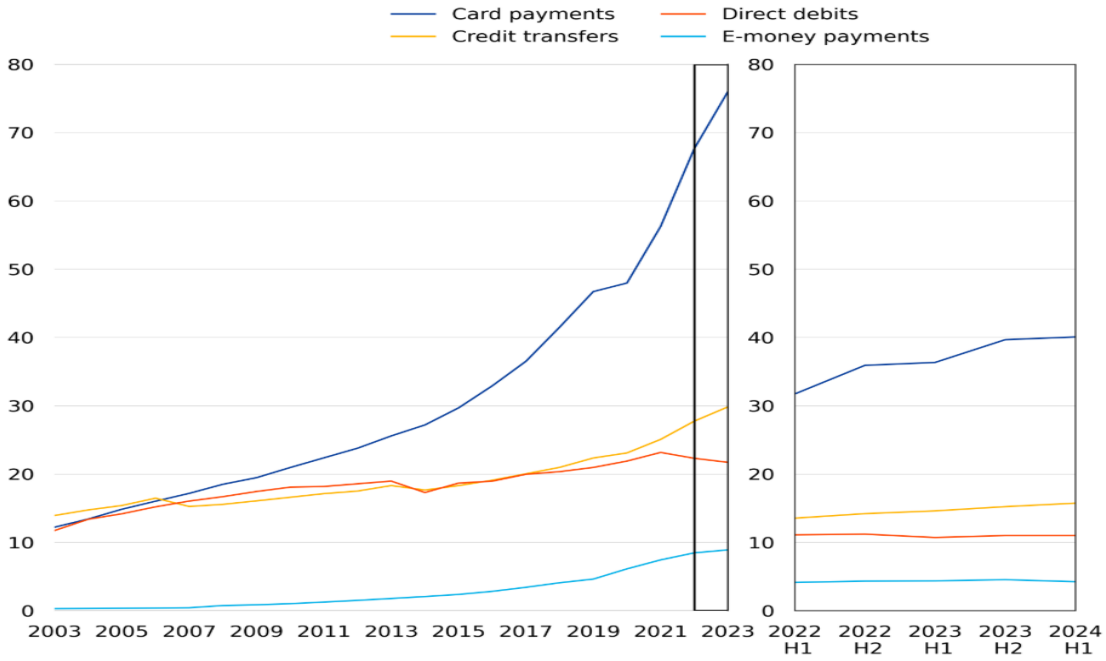


**Figure 1: Number of digital transactions in billions in EU 2000-2024 (graph on the right-hand-side refers to half-yearly data)**

**Source**: *www.ecb.europa.eu*

As you can see from the figure 1, the use of non-cash payment instruments increased yearly. Digital payments showed very significant developments. The number of digital transactions increased throughout the analyzed period, but it was mostly through credit cards, reaching about 75% in 2023.

Countries such as Sweden, the Netherlands, Finland, and the United Kingdom show the potential to make their countries cash-free in the next few years.

One of the disadvantages of digital payment is the fact that, this may cause a dramatic increase in prices and as a result, an inflation pressure. Though, other factors, like low interest rates, increase in governmental subsidiaries, currency shock, should also be taken into consideration.

If the power of money circulation is high, it is feared that it will cause inflationary effects. Low and stable inflation leads to the welfare of society, and uncontrolled inflation leads to poor socio-economic indicators. Therefore, inflation control is very important for sustainable economic growth. Figure 2 shows the results of inflation changes in the EU countries for the period 2016-2023.

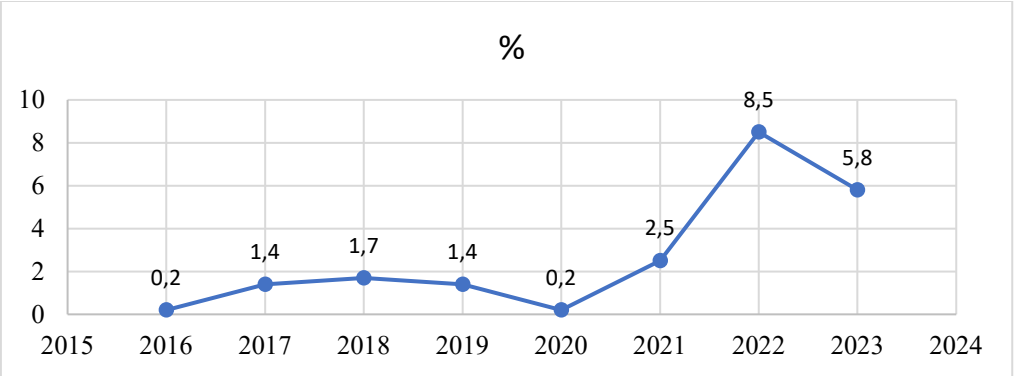


**Figure 2: Inflation, consumer price % EU (2016-2023)**

**Source**: *www.worldbank.org*

As can be seen from the figure 2, the inflation rate has increased significantly since 2020, from 0.2 in 2020 to 8.5% in 2022, followed by a slight decrease to 5.8% in 2023.

## CONCLUSION

The integration of digital payment systems has significantly transformed world economy and the way of purchasing any items or service. Top-notch appliances such as credit cards, mobile banking and cryptocurrencies demonstrate the potential of technology to ameliorate payment process making it easier to access. By introducing them in mass, government is able to control transactions, find out suspicious actions and reduce phishing or illegal money circulation. Digital payment systems also influence inflation through multiple channels, including money velocity, monetary policy effectiveness, cost efficiency, and financial inclusion. Though, the rise of digital money, such as cryptocurrencies, introduces volatility in financial markets. If widely adopted, they could influence inflation expectations, destabilizing national currencies until the regulatory police is stable.

The constant development of technology creates a great opportunity for the development of comprehensive digital paying systems. Developed countries widely implement Central Bank Digital Currencies to react faster to changes in economic situation, adjusting interest rates and bank liquidity. Cashless transactions can also be of interest to government, as they increase payment transparency helping reveal and tackle shadow economy. Nevertheless, there are some constrains in this realm, as inappropriate regulatory policy may cause new challenges to Central Banks by decrease in deposit amount and interest rate fluctuation.

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# THE IMPACT OF SHARING ECONOMY PLATFORMS ON THE TOURISM INDUSTRY: AIRBNB AND UBER

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**Abstract.** This study examines the impact of sharing economy platforms, in particular Airbnb and Uber, on the tourism industry. It examines how these platforms influence tourist behavior, market structure and associated economic and social challenges. The research uses international data, case studies and local economic analysis to explore the transformations brought about by these platforms. The findings show that Airbnb has made accommodation more affordable, but has also contributed to rising real estate prices and stricter regulations in big cities. Uber has simplified transportation for tourists but has led to conflicts with traditional taxi services and raised concerns about drivers' rights. Despite the benefits, these platforms highlight the need for tighter regulation and adjustments to local policies to balance economic benefits with the protection of local communities. Further research is recommended to better understand the role of these platforms in promoting responsible tourism. The study provides valuable insights for policy makers who want to maximize the benefits of sharing economy platforms while minimizing negative impacts on local communities.

**Keywords:** Sharing Economy; Tourism; Economic impact; Economic challenges.

**JEL Classification**: O33, F63, Z32

## INTRODUCTION

The collaborative (sharing) economy is a model of economic base for the participation of a resources, goods and services provider, the objectives of which are to facilitate the access and use of this mod, which can be effective and more accessible. This is a fundamental departure from traditional economic models, where companies own goods and services, and consumers pay for their use. The platform basic model of the world, including Airbnb and Uber, have had a significant impact on the tourism industry, changing the structure of the transportation market and accommodation.

The importance of this topic lies in analyzing the economic and social changes these platforms have brought to the tourism industry. Airbnb, for example, allowing the owner homeowners to rent out their spaces, creating an alternative to hotels and hostels, while Uber as a support module for customer service, offering a more flexible and often cheaper option than traditional taxis. However, these platforms have sparked controversy, as they have been associated with insufficient regulation

and challenges related to unfair competition to the traditional accommodation and transportation industries (Consiliul Concurenței, Direcția Cercetare 2020).

This article is an analysis of the impact of platforms on the economy and collaboration in tourism, focusing on the special services of Airbnb and Uber. We will examine both the economic advantages generated by these platforms, as well as the challenges and risks they pose to the local economy, competition and legal regulation. This analysis is based on prior research and official reports that have addressed these issues.

Key research questions focus on understanding the impact of Airbnb and Uber on the travel market's structure. What are the economic and social implications for the hotel and transportation industries? The hypothesis of this study is that while these platforms have contributed significantly to democratizing access to travel services, they have also generated considerable tensions regarding market regulation and equitable competition.

## MAIN CONTENT

### 1. Materials and Methods.

To conduct this research, we used a documentary method of analysis based on academic sources and official reports. Core sources include case studies, academic articles and institutional reports on the impact of the collaborative economy on tourism, with a particular focus on Airbnb and Uber. The document analysis includes a qualitative approach, focusing on interpreting the results obtained from published research and extracting the most relevant information for the topic under study. Key sources include studies published in the Economic Amphitheater and AISNet (Cristian Bogdan Onete, Doru Pleşea, Sonia Budz 2018), official reports by the Competition Council (Consoliu Concurenței România 2021) and research presented on journalist resource platforms such as Journalists Resource (Uber, Airbnb and consequences of the sharing economy: Research roundup 2016). The research method includes a detailed analysis of the economic benefits, changes in tourist consumption behaviors, and regulations that influence these platforms. (Uber, Airbnb and consequences of the sharing economy: Research roundup 2016)

### 2. Results and Discussion.

The impact of sharing economy platforms on the tourism industry has been significant. Airbnb has democratized access to accommodation by allowing people around the world to rent out their homes, leading to an increase in the supply of accommodation in areas that previously had no access to mass tourism. According to a study published in Economic Amphitheater, this platform has been responsible for a drop in prices in traditional accommodation markets and a diversification of supply (Cristian Bogdan Onete, Doru Pleşea, Sonia Budz 2018).

Case studies conducted by AISNet (Park 2020) show that Airbnb has contributed to the growth of local tourism in smaller towns and rural areas, boosting the local economy by increasing demand for transportation and other services adjacent to tourism. However, there are also negative effects, such as rising prices in urban areas where demand for rental housing is high. Some cities have started to regulate Airbnb activity more strictly to protect the local real estate market and prevent mass tourism that can affect the quality of life for permanent residents (Researching the impacts of Airbnb on the NSW North Coast .).

As for Uber, the ride-hailing platform has revolutionized the transportation sector. According to a report by the Competition Council, Uber has provided a more flexible and affordable alternative to traditional taxis, leading to lower prices in some cities and greater affordability for consumers

(Consoliu Concurenței România 2021). However, there are a number of criticisms of unfair competition to traditional taxi drivers, who are more strictly regulated in terms of safety and fares.

Also, a study by Journalists Resource (Uber, Airbnb and consequences of the sharing economy: Research roundup 2016) points out that ride-hailing platforms, including Uber, have led to economic volatility in some cities, where prices and availability of transportation services vary widely depending on the demand and supply on the platform. This can negatively affect the stability of the transportation market and lead to economic losses for traditional taxi drivers.

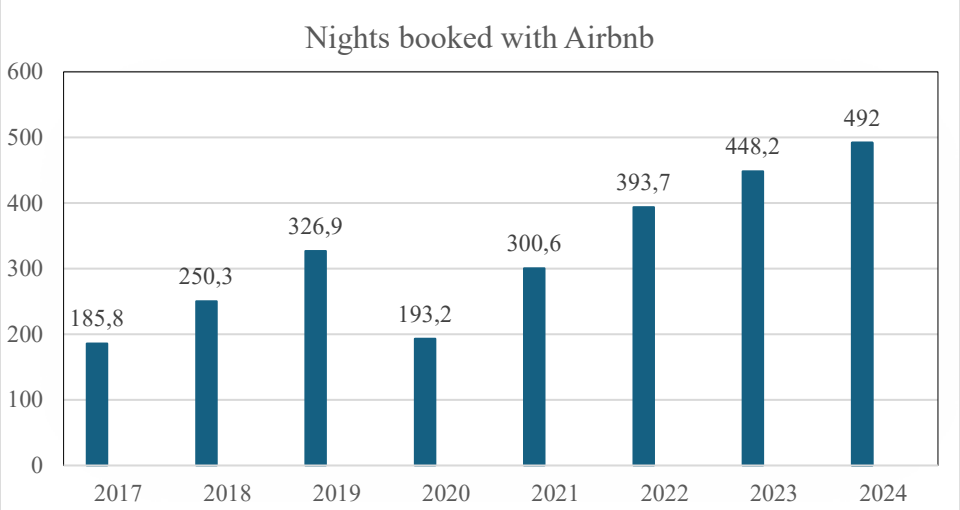


**Figure 1.** Nights booked with Airbnb from 2017 to 2024 (mil.)
**Source:** *Statista.com*

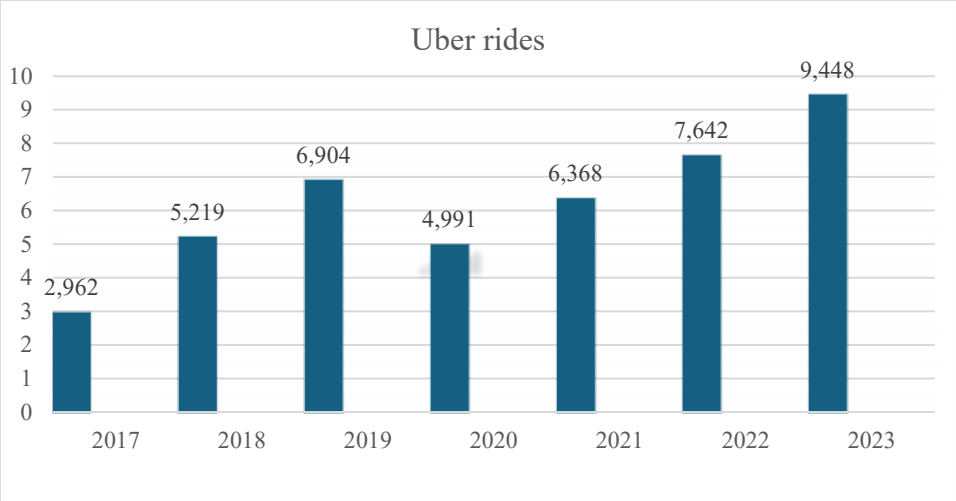


**Figure 2**. Uber rides per year (bil.)
**Source:** *Wallstreetzen.com*

Figure 1 shows the growth in nights booked through Airbnb from 2017 to 2024, with a dip in 2020 due to the pandemic, followed by a strong rebound. Figure 2 shows Uber rides increasing steadily, peaking in 2023, with no significant drop during the pandemic period. Both graphs reflect growth trends in the collaborative economy, with Airbnb temporarily affected by travel restrictions, unlike Uber.

## FINDINGS

The research results show that sharing economy platforms such as Airbnb and Uber have had a considerable impact on the tourism industry. These platforms have made accommodation and transportation services accessible to a wide range of consumers, thereby contributing to the growth of tourism and boosting local economies. However, there have also been significant challenges related to insufficient regulation and unfair competition to traditional industries. The study findings underline the need for clearer regulation to protect both consumers and traditional economic actors.

Moreover, future studies should focus on analyzing the long-term impact of these platforms on local economic structures and consumer behavior. In this context, it will be essential to develop policies that ensure a level playing field between new platforms and traditional companies, while protecting the economic interests of local communities.

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# MODERN ECO-TRENDS IN THE TOURISM BUSINESS USING INNOVATIVE TECHNOLOGIES

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**Abstract:** The integration of innovative technologies into the tourism sector contributes to the development of sustainable environmental practices. The urgency of environmental sustainability and the need to inform the public about the preservation and responsible use of natural resources due to environmental challenges is one of the most important issues in the context of globalization. Today, eco-trends are becoming increasingly important in the development of the tourism industry. This research paper identifies and analyzes the main eco-trends that implemented in the tourism industry based on innovative technologies and contribute to global sustainable development. It is eco-trends that provide new prospects for the development of new specialized types of tourism that will contribute to the conservation of natural resources and environmental sustainability. Innovative technologies in the field of sustainable tourism are important tools aimed at efficient use of natural resources, preservation of a clean environment and raising environmental awareness and will contribute to its development.

**Keywords:** eco-trends, eco-tourism, sustainable development, environmental certification, innovations

**JEL Classification:** Q01, Q56, Z32

## INTRODUCTION

The tourism industry is one of the leading sectors of the global economy, which has a significant impact on sustainable development both in Ukraine and globally. The implementation of environmental initiatives and the latest trends will contribute to the conservation and efficient use of natural resources, an environmentally friendly environment, and increase the environmental awareness of society. One of the leading areas among specialized types of tourism today is ecological, natural, rural green tourism, which enhances the introduction of innovative tools such as eco-trends that enable the development and popularization of sustainable forms of recreation.

The concept of ecotourism implies a responsible journey through protected areas. Its goals are to be acquainted with different natural ecosystems, admire the surrounding nature without harming it. An ecotour may include organized walks along eco-trails and routes laid out on the territory of places where the natural conditions preserved to the maximum extent possible and have not been interfered with by humans (nature reserves, natural parks). Such recreation not only introduces the

richness of nature, but also inspires the conservation of natural resources and a more careful attitude towards them ("*Ecological tourism in Ukraine*", accessed 09.02.2025).

**MAIN CONTENT**

Travel that minimizes the negative impact on nature and supports local communities is becoming increasingly popular. Tourists are increasingly choosing natural parks, nature reserves, and eco-trails. According to a report by the World Travel and Tourism Council, greenhouse gas emissions from the industry accounted for 6.5% of global emissions in 2023, a significant reduction from 7.8% in 2019, showing a 10.2% drop in emissions intensity. This shows significant progress in reducing the environmental impact of tourism while supporting its development. According to Booking.com, 74% of travelers now believe that urgent action is needed to make greener choices, compared to 66% in 2022, and 65% of travelers prefer accommodation with sustainability certificates, highlighting the growing appeal of environmentally conscious hospitality ("*Tourism industry trends for 2025 - AI, sustainability, and emerging travel norms*", accessed 09.02.2025).

The tourism industry is actively integrating environmental certification standards, introducing the concept of carbon-neutral housing, and developing community-based tourism models to meet the growing demand for sustainable travel. Digital technologies, such as e-tickets, mobile apps, and interactive audio guides, help optimize resource use and minimize environmental impact by reducing paper waste. The implementation of such strategies not only aligns with consumers' environmental preferences, but also ensures transparency of companies' environmental positioning, which helps to build trust and loyalty among environmentally conscious tourists.

Environmental certification of tourist facilities is an important mechanism for reducing negative environmental impact and encouraging responsible consumer behavior. It contributes to the development of sustainable tourism and the formation of environmental awareness among both industry enterprises and tourists. The certificate confirms that a travel company adheres to the principles of environmental management, implements environmentally responsible practices, and promotes the optimization of natural resources, pollution reduction, and harmonious coexistence with the environment.

Businesses that join the environmental certification system declare their responsibility for preserving the environment and gain additional advantages in the tourism market. From an economic point of view, environmental management systems allow for a significant reduction in the resources consumed and, consequently, in costs. From a marketing perspective, such companies emphasize their environmental image ("*Environmental certification for the tourism business*", accessed 12.02.2025).

Tourism is one of the most public sectors of business and is able to influence the consciousness of the general population, transmit knowledge, and raise public awareness, primarily by setting an example of sustainable consumption of resources, production of goods and services ("*Tourism industry trends for 2025 - AI, sustainability, and emerging travel norms*", accessed 09.02.2025).

Many hotels and tourist facilities receive environmental certificates confirming their compliance with the principles of sustainable development:

Green Key is an international certificate of environmental responsibility for hotels, restaurants and tourist facilities. It confirms compliance with high standards in the field of sustainable tourism. To receive this certificate, you must meet a number of environmental criteria, such as efficient use of resources, waste reduction, and implementation of environmental practices. Green Key holders are subject to regular inspections and must constantly improve their environmental strategies. Among the

facilities that have already received this certificate are hotels, campsites, restaurants and other tourist facilities around the world ("*Green Key*", accessed 14.02.2025).

EarthCheck is an international sustainability certification program for the travel industry that helps organizations minimize their negative impact on the environment. The program evaluates businesses on criteria such as energy and water management, waste reduction, social responsibility, and biodiversity protection. To receive the EarthCheck certificate, companies undergo an audit that assesses their environmental performance. Among the facilities that have already received this certificate are well-known hotels, resorts and tourist destinations around the world ("*EarthCheck Certified*", accessed 14.02.2025).

LEED "Leadership in Energy and Environmental Design" is one of the most widespread types of voluntary certification of green buildings or construction. The non-profit organization U.S. Green Building Council developed this LEED certification system in 1998 to create an assessment system for the design, construction, operation and maintenance of green buildings, homes and their environments. LEED certification designed to inspire developers to seek innovations in the field of environmental and social protection. In other words, LEED is primarily about a viable and thriving environment that less affected by human activity by reducing air emissions, increasing energy efficiency and efficient use of natural resources ("*What is green building? Certification according to the LEED standard"* accessed 14.02.2025).

Transportation is a major source of carbon emissions, and the travel industry is addressing this with innovative solutions. Electric vehicles (EVs) are becoming more affordable and widespread not only for local travel, but for rental services. Companies such as Tesla and Rivian are collaborating with car rental agencies to provide electric options, making it easier for tourists to choose environmentally friendly transportation ("*Revolutionising Travel: The Latest Trends in Sustainable Tourism for 2024*" accessed 17.02.2025).

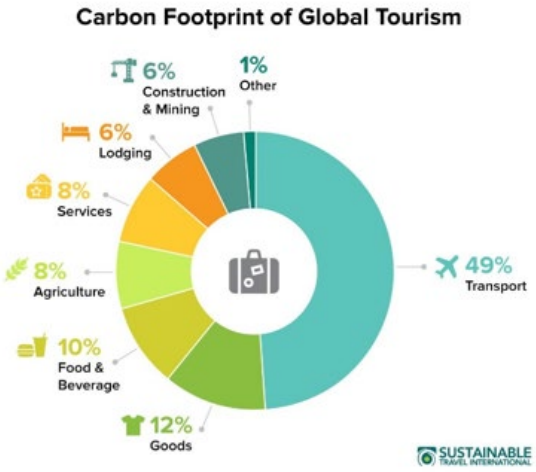


**Figure 1. Carbon Footprint of Global Tourism.**

***Source:*** *Sustainable Travel International https://sustainabletravel.org/issues/carbon-footprint-tourism/*

One of the important tasks in the tourism industry is to reduce the negative impact of transport on the environment. The following environmental solutions are proposed to address this problem: increasing the number of travel arrangements via transport modes such as ferries, buses and trains; the use of electric vehicles, the development of cycle paths and bicycle transport.

One of the most significant trends in sustainable tourism for 2024 is the rise of eco-friendly accommodations. From luxury resorts to budget hostels, more properties are adopting eco-friendly practices. This includes using renewable energy sources, implementing water conservation methods, and reducing waste. Modern travelers are increasingly thinking about the environmental impact of their travels, including the level of their carbon footprint, and are actively implementing measures to reduce and offset it. Airlines, tour operators and travel agencies offer carbon offset programs that allow tourists to offset their travel emissions by investing in environmental projects such as reforestation and renewable energy initiatives. In 2024, the transparency and effectiveness of these programs increased significantly, with companies providing detailed reports on how offsetting funds are used. In addition, responsible travel practices such as reducing single-use plastic, minimizing waste and respecting wildlife and natural habitats are becoming a standard expectation for environmentally conscious travelers ("*Revolutionising Travel: The Latest Trends in Sustainable Tourism for 2024*" accessed 17.02.2025).

The use of digital platforms that offer options for eco-friendly hotels and eco-friendly transport leads to the popularization of ecological and rural green routes reduces the traffic in certain regions and develops the environmental awareness of tourists, which is an important component of its sustainable development.

## CONCLUSIONS

The use of innovative technologies in the form of eco-trends to promote sustainable tourism development contributes to its transformation and popularization of new types of tourism. Due to the introduction of environmental initiatives at the level of globalization changes, eco-trends are increasingly becoming tools for raising awareness of tourists about the conservation and efficient use of natural and recreational resources, raising environmental awareness and promoting tourism development in the future.

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# BLOCKCHAIN AND THE DIGITALIZATION OF TRADITIONAL INDUSTRIES: NEW TRENDS AND CHALLENGES FOR THE FUTURE OF THE ECONOMY

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**Abstract.** The article examines the transformational trends determining the digitalization of traditional sectors of the economy, with a special focus on the integration of blockchain technologies. As industries such as finance, logistics, and manufacturing increasingly embrace these innovations, blockchain plays a key role in increasing transparency and security. The paper analyzes how digital technologies are designed to revolutionize processes, from accelerating supply chain management to optimizing smart contracts and asset management. However, this path is not without difficulties. The problems of introducing these technologies into established business models are also discussed and, based on a detailed analysis of various statistical data, a forecast is made regarding the role of blockchain in the future of the digital economy.

**Keywords**: blockchain technology, digital transformation, financial technology, cryptocurrency, supply chains

**JEL Classification**: O33, D82, L86, O25

## INTRODUCTION

Blockchain technology appeared a few years ago and immediately opened up new perspectives for data exchange. Blockchain technology has led to the emergence of new methods for securing data transactions and increasing transparency in digital systems. The decentralized structure of blockchain ensures that data is protected from external changes, which makes it particularly attractive for various industries. As digitalization continues to transform traditional business processes, blockchain serves as a key enabler of this transition, especially in the fields of finance, logistics, and healthcare. However, blockchain remains an experimental technology — many problems of its use have not yet been solved.

The study examines the digital transformation driven by blockchain, its adoption in various industries, and the challenges and opportunities it presents. Existing literature highlights the essential role of blockchain in reducing transaction costs, increasing operational transparency, and improving data security. However, widespread adoption remains difficult due to technical integration issues, security concerns, and regulatory uncertainty.

The research addresses key questions such as: How does blockchain technology reduce operational costs and stimulate innovation? What barriers do traditional industries face in adopting blockchain and how can these issues be addressed? The study also reflects on the impact of emerging technologies, such as artificial intelligence (AI) and the Internet of Things (IoT), on complementing

blockchain to facilitate further digital transformation. Through a critical analysis of relevant literature, this study makes a new contribution to the transformative role of blockchain in various fields.

## MAIN CONTENT

### 1. Materials and Methods

1. This study used qualitative and quantitative research methodologies to explore the role of blockchain in digital transformations. Primary data was collected through market analyses, industry reports, and case studies from sources such as Statista, PwC, and Deloitte. Interviews were conducted with experts from various sectors, including finance, healthcare, and logistics, to gain insights into real-world blockchain applications.

Secondary data sources included academic articles, government reports, and industry publications from various sectors. The study examines how blockchain is integrated into existing systems and assesses both the challenges and successes encountered during this integration process. The collected data is analyzed using a comparative approach to establish connections between blockchain adoption and the operational efficiencies it provides.

### 2. Results and Discussion

**2.1 Blockchain Adoption Trends.** Blockchain adoption has seen significant growth across various industries, particularly in finance, logistics, and healthcare.

The table below highlights the trends in blockchain adoption in the financial sector and demonstrates the reduction in transaction costs over the years.

**Table 1: Blockchain Adoption in Financial Transactions**

| Year | Adoption Rate (%) | Transaction Cost Reduction (%) |
|---|---|---|
| 2020 | 45% | 30% |
| 2021 | 50% | 35% |
| 2022 | 60% | 40% |
| 2023 | 70% | 50% |

**Source:** *PwC Blockchain Adoption Survey 2023*

This table shows the year-over-year adoption rate and transaction cost reduction in the financial sector due to blockchain implementation. In the financial sector, blockchain is transforming the way transactions are processed by reducing costs and increasing efficiency.

In logistics, blockchain is used to enhance supply chain transparency, streamline operations, and ensure the security of product data. In 2020, only 19% of companies utilized blockchain for supply chain tracking, but by 2023, this figure had increased to 55%. The figure below illustrates this rapid adoption trend in logistics.

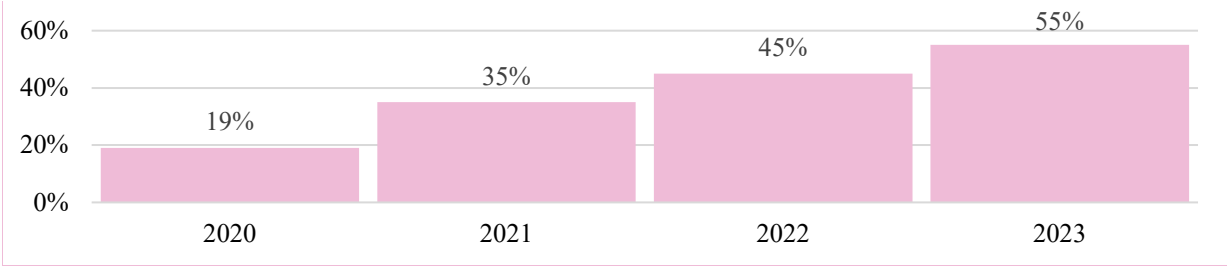


**Figure 1: Blockchain Adoption in Supply Chain Management**

**Source:** *Deloitte Supply Chain Survey 2023*

**2.2 Advantages of Blockchain Technology.** The main advantage of blockchain is its ability to provide decentralized and immutable data storage. In the financial sector, blockchain has significantly reduced transaction costs, which has led to substantial savings for large organizations. By 2025, 95% of financial organizations will use blockchain in their processes.

In the healthcare sector, blockchain has been increasingly implemented for storing patient data. By 2025, over 50% of healthcare institutions are expected to adopt blockchain for managing medical records. The decentralized nature of blockchain ensures that patient data is protected from unauthorized access, while allowing authorized parties to access the information.

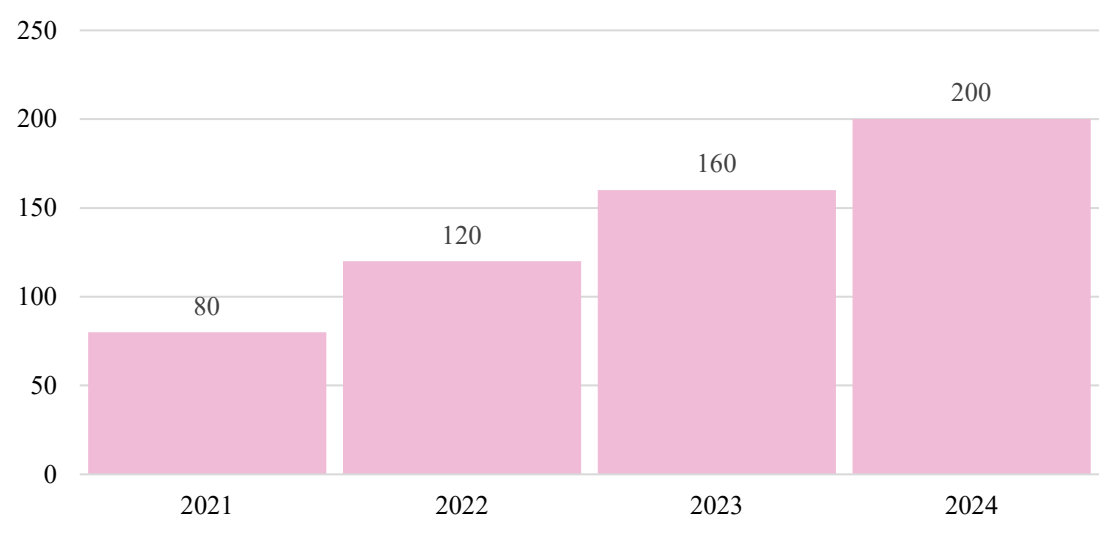


**Figure 2: Number of Cyberattacks on Blockchain Platforms (2021-2024)**
**Source:** *CipherTrace Report 2023*

Another challenge is the legal and regulatory framework surrounding blockchain. This figure tracks the increase in cyberattacks on blockchain platforms over the years, illustrating the growing concern over security. While 35% of countries had clear regulations regarding cryptocurrencies in 2021, this figure is expected to rise to 80% by 2025. However, the lack of consistent regulations across jurisdictions creates uncertainty for businesses looking to adopt blockchain technologies. Legal clarity will be essential for fostering a global blockchain ecosystem.

## CONCLUSIONS

The research findings indicate that blockchain technology significantly contributes to the digitalization of traditional sectors, especially in the fields of finance, healthcare and logistics. Blockchain technology reduces transaction costs, increases data transparency and security, thereby increasing operational efficiency. However, to ensure the successful adoption of blockchain across industries, challenges related to security risks, regulatory uncertainty and integration with existing systems need to be addressed.

The research concludes that blockchain has enormous potential to revolutionize digital economies, but its large-scale implementation will require overcoming technical, legal and security challenges. Future research should focus on developing solutions to these problems and exploring new areas where blockchain can be integrated, such as education and government services. The synergy of blockchain with other technologies such as artificial intelligence and IoT will further accelerate the digital transformation of industries.

## RECOMMENDATIONS

1. **Enhanced Security Measures**: As blockchain adoption grows, especially in the financial sector, companies must prioritize strengthening cybersecurity protocols. Given the rise in attacks on cryptocurrency platforms, businesses should invest in advanced security technologies, regular audits, and real-time monitoring to protect blockchain systems from vulnerabilities.
2. **Development of Global Regulatory Standards**: Governments and regulatory bodies should work together to establish clear and consistent regulations for blockchain and cryptocurrency use. As shown in **Table 1**, only **35% of countries** had blockchain regulations by **2021**, indicating a significant gap in legal frameworks. Creating universal guidelines would foster innovation and ensure the safe and legal application of blockchain technology.
3. **Education and Training**: As blockchain technology continues to disrupt industries, it is crucial to educate and train the workforce on its applications and security considerations. Universities and professional institutions should offer more specialized programs to build a skilled workforce capable of handling the technical, regulatory, and security challenges posed by blockchain adoption.
4. **Investment in Research and Development**: Companies, especially in the healthcare and logistics sectors, should increase investment in blockchain research and development. The potential for blockchain to improve operational efficiency, reduce costs, and enhance data security is immense. Increased investment in R&D will accelerate the adoption of blockchain solutions tailored to specific industry needs.
5. **Cross-Sector Collaboration**: It is essential for businesses in various sectors to collaborate and share best practices for blockchain integration. As blockchain technology matures, cross-industry partnerships can help address shared challenges such as security risks, regulatory uncertainties, and system integration, while maximizing the potential benefits.

In conclusion, while blockchain presents significant opportunities for various industries, strategic actions to address security concerns, regulatory gaps, and skills development are crucial. By implementing these recommendations, businesses and governments can fully leverage blockchain technology to enhance efficiency, transparency, and innovation in the coming years.

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# DIGITALIZAREA CONTROLULUI FISCAL CA MODALITATE DE CREȘTERE A VENITURILOR LA BUGETUL PUBLIC NAȚIONAL AL REPUBLICII MOLDOVA

# DIGITIZATION OF FISCAL CONTROL AS A WAY TO INCREASE REVENUES TO THE NATIONAL PUBLIC BUDGET OF THE REPUBLIC OF MOLDOVA

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**Abstract.** Tax control is one of the cornerstone elements of a sustainable economy, with a direct impact on the financial stability of a country. In the context of the Republic of Moldova, the digitalization of tax control emerges as a crucial opportunity to streamline administrative processes, reduce tax evasion, and optimize revenue collection for the national public budget. This paper offers an in-depth analysis of the role of digitalization in transforming tax control, highlighting the integration of advanced technologies such as Artificial Intelligence (AI), Big Data, and blockchain, which have the potential to revolutionize administrative processes and ensure more accurate and transparent tax collection. Furthermore, best practices and international information systems that have significantly impacted fiscal control optimization are explored, with the aim of proposing models tailored to the specific context of the Republic of Moldova. The findings underscore that the adoption of these emerging technologies not only enhances the efficiency of the collection process but also significantly contributes to increasing fiscal compliance and combating tax fraud, with a direct and profound impact on boosting budgetary revenues and strengthening the country's financial stability.

**Keywords:** Digitalization of fiscal control, fiscal information systems, emerging technologies, revenue collection optimization, fiscal transparency, public revenue growth.

**JEL Classification:** H26, H83, O33, O38, M15

## INTRODUCERE

Digitalizarea controlului fiscal este esențială pentru optimizarea colectării veniturilor publice și administrarea eficientă a fiscalității, contribuind la creșterea transparenței și reducerea evaziunii. Organizații internaționale precum OECD, FMI și Banca Mondială subliniază rolul tehnologiilor digitale în îmbunătățirea administrării fiscale și combaterea fraudei.

Acest studiu analizează impactul controlului fiscal asupra veniturilor Bugetului Public Național al Republicii Moldova, evidențiind rolul digitalizării în sporirea veniturilor publice. Soluțiile digitale avansate, precum inteligența artificială și analiza Big Data, facilitează detectarea practicilor fiscale neloiale și modernizarea sistemului fiscal, promovând eficiența și echitatea economică.

Controlul eficient realizat de SFS este crucial pentru funcționarea corectă și transparentă a sistemului fiscal al Republicii Moldova.

**Rolul controlului fiscal în creșterea gradului de încasări la Bugetul Public Național al Republicii Moldova**

Controlul fiscal influențează direct nivelul veniturilor colectate la buget, reducând pierderile cauzate de evaziunea fiscală a contribuabililor. Un sistem fiscal eficient necesită un echilibru între măsurile constrângătoare aplicate de autoritatea fiscală și cele de conformare voluntară, iar optimizarea controlului fiscal poate contribui semnificativ la acest echilibru.

Rezultatele controalelor fiscale realizate de SFS între 2020 și 2024 reflectă o imagine clară a activității fiscale din țară, subliniind atât volumul controalelor efectuate, cât și impactul acestora asupra colectării impozitelor și taxelor. Astfel, conform datelor prezentate în Figura 1, se remarcă o tendință descendentă a numărului total de controale fiscale în ultimii cinci ani. Comparativ cu 2019, numărul controalelor a scăzut cu 32% până în 2024, de la 45 594 la 30 917. În același timp, eficiența acestor controale a crescut semnificativ, de la 65% în 2020 la 75% în 2024. Aceasta indică o eficacitate crescută a controalelor în identificarea neregulilor cu caracter fiscal.

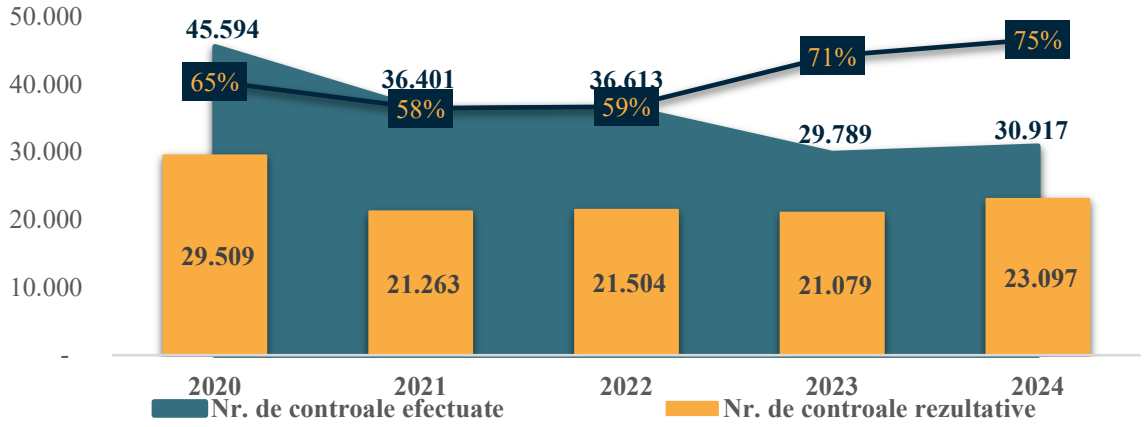


**Figura 1. Dinamica numărului controalelor fiscale efectuate în perioada 2020-2024**

**Sursa:** *elaborat de autor conform datelor de pe Portalul Guvernamental al Datelor Deschise: Date statistice privind rezultatele controalelor fiscale efectuate de către Serviciul Fiscal de Stat și Rapoartelor de activitate ale SFS pentru perioada 2020-2024*

Un aspect deosebit de important îl reprezintă veniturile efectiv încasate la BPN în urma controalelor fiscale. Datele din Figura 2 evidențiază o discrepanță semnificativă între veniturile calculate ca rezultat al controalelor fiscale și sumele efectiv achitate. Prin urmare, eficiența acestor controale rămâne relativ scăzută, înregistrând o tendință descendentă – de la 47% în 2020 la doar 22% în 2024.

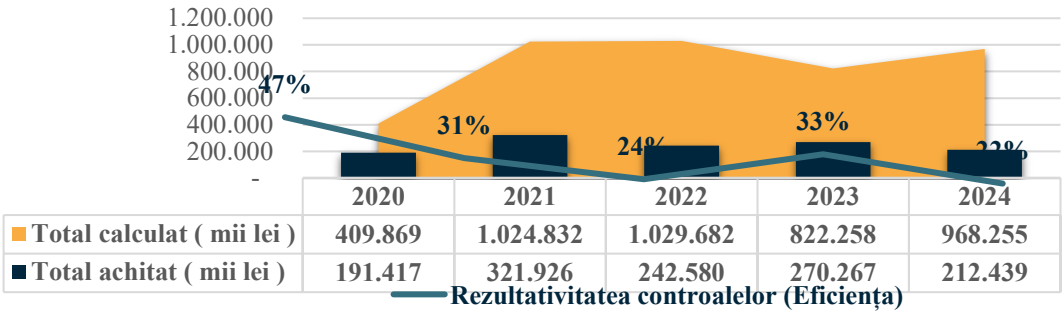


**Figura 2. Dinamica veniturilor din controalele fiscale efectuate în perioada 2020-2024**

**Sursa:** *elaborat de autor conform datelor de pe Portalul Guvernamental al Datelor Deschise: Date statistice privind rezultatele controalelor fiscale efectuate de către Serviciul Fiscal de Stat și Rapoartelor de activitate ale SFS pentru perioada 2020-2024*

Această evoluție este îngrijorătoare, având în vedere că obligațiile fiscale stabilite pentru contribuabili în urma controalelor sunt în continuă creștere, de la 409 869 mii lei în 2020 la 968 255 mii lei în 2024, ceea ce reprezintă o creștere de 136%. Aceste rezultate indică o eficiență redusă a mecanismelor de colectare a sumelor stabilite în urma controalelor fiscale, ceea ce poate fi cauzat de mai mulți factori. Printre aceștia se numără dificultățile în recuperarea creanțelor fiscale, contestațiile depuse de contribuabili, insolvența unor agenți economici sau chiar lacunele legislative care permit amânarea sau evitarea plății obligațiilor fiscale. De asemenea, o astfel de discrepanță ridică semne de întrebare cu privire la eficiența măsurilor de conformare fiscală și a sancțiunilor aplicate pentru neplata sumelor datorate.

Datele din Tabelul 1 prezintă evoluția veniturilor din amenzi și sancțiuni fiscale aplicate în urma controalelor fiscale. Aceste date arată o tendință generală de creștere, cu o majorare semnificativă de 37,1% în 2021, urmată de o ușoară scădere în 2022 (-0,51%) și o revenire pozitivă în anii următori. Creșterea accentuată din 2021 poate fi explicată prin intensificarea controalelor fiscale și înăsprirea regimului de sancționare, în timp ce scăderea din 2022 sugerează o îmbunătățire a conformării contribuabililor.

**Tabelul 1. Evoluția veniturilor încasate din amenzi și sancțiuni în urma controalelor fiscale în perioada anilor 2020 – 2024 (mln lei)**

| Anul | Venituri din amenzi și sancțiuni | | | | | |
|---|---|---|---|---|---|---|
| | BPN | +/- (%) | Inclusiv la: | | | |
| | | | BS | +/- (%) | BL | +/- (%) |
| **2020** | **264,49** | **-** | 262,18 | **-** | 2,31 | **-** |
| **2021** | **362,63** | **37,10%** | 359,94 | 37,29% | 2,69 | 16,32% |
| **2022** | **360,77** | **-0,51%** | 357,02 | -0,81% | 3,74 | 39,29% |
| **2023** | **385,39** | **6,83%** | 382,56 | 7,15% | 2,83 | -24,38% |
| **2024** | **402,9** | **4,54%** | 399,54 | 4,44% | 3,32 | 17,31% |

**Sursa:** *calculat de autor conform datelor de pe Portalul Guvernamental al Datelor Deschise: Date statistice privind rezultatele controalelor fiscale efectuate de către Serviciul Fiscal de Stat și Rapoartelor de activitate ale SFS pentru perioada 2020-2024*

În acest context, se simte necesitatea unor măsuri mai eficiente de colectare, inclusiv digitalizarea procesului de urmărire și recuperare a datoriilor fiscale, automatizarea analizelor de risc pentru identificarea contribuabililor cu grad ridicat de neconformare și întărirea mecanismelor de sancționare pentru neplata obligațiilor stabilite. În acest context, digitalizarea controlului fiscal poate contribui semnificativ la creșterea gradului de colectare a veniturilor și la reducerea pierderilor pentru Bugetul Public Național.

**Optimizarea controlului fiscal în Republica Moldova prin integrarea tehnologiilor digitale**

Pentru creșterea veniturilor publice, statul are două opțiuni principale: majorarea cotelor de impozitare sau îmbunătățirea eficienței controlului fiscal. De regulă, accentul se pune pe consolidarea mecanismelor de control, contribuind la reducerea evaziunii și creșterea conformării voluntare.

Transformarea digitală globală și emergența Industriei 4.0 marchează o schimbare majoră, integrând tehnologii precum securitatea cibernetică, cloud computing, inteligența artificială (AI), analiza Big Data, Blockchain, Internetul Lucrurilor și automatizarea proceselor. Aceste tehnologii pot optimiza controlul fiscal, reducând birocrația, accelerând procesarea datelor și diminuând riscurile umane.

Big Data oferă autorităților fiscale posibilitatea de a analiza date în timp real, identificând modele suspecte. Algoritmii predictivi detectează devierile fiscale și optimizează alocarea resurselor pentru inspecții. La nivel internațional, utilizarea Big Data în Mauritius a crescut conformarea voluntară prin platforme moderne și sisteme MIS.

Implementarea Blockchain în sistemul fiscal va asigură o evidență fixă și transparentă a tranzacțiilor, reducând riscul de manipulare a datelor. Un exemplu de succes este ecosistemul „TrustSQL" din China, care simplifică facturarea, reduce costurile și îmbunătățește managementul fiscal.

Inteligența artificială eficientizează controlul fiscal prin automatizare și detectarea riscurilor. În UE, sisteme precum „STIR" din Polonia identifică tranzacțiile suspecte prin analiză în timp real, facilitând schimbul de date între instituțiile financiare și autoritățile fiscale.

Conform unei analize recente, Republica Moldova a obținut 4,1 puncte din 5 în pregătirea digitală, iar 73,68% din serviciile SFS sunt digitalizate, demonstrând un potențial semnificativ pentru digitalizarea controlului fiscal.

Totuși, digitalizarea aduce provocări, cum ar fi costurile infrastructurii, securitatea cibernetică și pregătirea angajaților. Pentru a le depăși, Republica Moldova trebuie să adopte o strategie complexă, bazată pe parteneriate public-private, investiții și dezvoltarea competențelor digitale ale funcționarilor fiscali.

## CONCLUZII

În concluzie, controlul fiscal joacă un rol crucial în creșterea veniturilor la Bugetul Public Național al Republicii Moldova, având un impact semnificativ asupra eficienței colectării veniturilor fiscale. Totuși, există o discrepanță între veniturile stabilite prin controale și cele efectiv încasate, ceea ce sugerează necesitatea îmbunătățirii mecanismelor de colectare. În acest sens, integrarea tehnologiilor digitale, precum Big Data, inteligența artificială și blockchain, reprezintă soluții promițătoare pentru optimizarea procesului de control fiscal, reducerea riscurilor de fraudă și sporirea transparenței administrative. Deși implementarea acestor tehnologii implică provocări legate de infrastructura tehnologică și protecția datelor, progresele deja înregistrate în digitalizarea serviciilor fiscale indică un potențial semnificativ de îmbunătățire a eficienței și transparenței administrativ-fiscale.

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# UTILIZAREA SERVICIILOR DE RAPORTARE FISCALĂ ELECTRONICĂ DESTINATE PERSOANELOR JURIDICE

# USE OF ELECTRONIC TAX REPORTING SERVICES FOR LEGAL ENTITIES

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**Abstract.** In recent years, digitalisation has emerged as a significant catalyst in modernizing tax systems worldwide. Resilient and secure digital services are increasingly essential not only for managing tax obligations but also for enabling full participation in society. Those who miss out on the digital era, whether due to insufficient technical skills, lack of access to necessary resources, or other obstacles, risk being left behind in an interconnected world. This paper examines electronic tax reporting services intended for legal entities, highlighting how these services provide access to information, facilitate real-time data collection from taxpayers, enable the electronic submission of standardized tax forms, and ensure compliance. The main purpose of the present paper is to analyze the digital tax reporting framework provided by the State Tax Service of Moldova and its benefits. To accomplish this, a blend of approaches is employed, including the review of specialized literature, legal regulations, and the application of deductive reasoning. The findings of the study substantiate the necessity of digitalizing the existing reporting system in the Republic of Moldova.

**Keywords:** tax services, electronic declaration, legal entities, digitalization, technologies

**JEL Classification: H32, O30**

## INTRODUCERE

Progresul tehnologic rapid care a caracterizat economia digitală a condus la o serie de tendințe emergente. Una din tendințele conturate în această perioadă, este transformarea adusă de tehnologia informației și comunicațiilor, care a determinat instrumentele electronice să devină mai ieftine, mai puternice și standardizate pe scară largă, stimulând inovarea în toate sectoarele economiei.

După cum se susţine şi în lucrarea publicată de International Monetary Fund, odată cu capacitatea de a comercializa și de a vinde bunuri și servicii la distanță, a fost pus la încercare conceptul tradițional de sediu permanent, care se bazează pe o prezență fizică fixă ca o condiție prealabilă pentru ca guvernele să își exercite dreptul de a impozita (International Monetary Fund,189).

În această consecutivitate logică de idei, mai întâi evidențiem scopul cercetării, care constă în studierea cadrului de raportare fiscală electronică oferit de Serviciul Fiscal de Stat din Moldova și a beneficiilor acestuia. Studiul de față analizează serviciile electronice de raportare fiscală destinate persoanelor juridice, evidențiind modul în care aceste servicii facilitează accesul la informații, colectarea datelor în timp real de la contribuabili, transmiterea electronică a formularelor fiscale standardizate și asigurarea respectării legislației.

## CONȚINUT DE BAZĂ

Pornind de la faptul că soluțiile IT stimulează inovarea și colaborarea între instituțiile publice și entitățile private, ne propunem să analizăm modul în care digitalizarea tehnologică facilitează adoptarea celor mai bune practice în sistemul fiscal actual, privind sporirea exactității informațiilor colectate.

### 1. Materiale și metode

În procesul studiului au fost utilizate următoarele metode de investigare științifică: prioritar, analiza sistemică (analiza în ansamblu a elementelor și evenimentelor) și interpretarea logică prin aplicarea procedeelor de deducție. Suportul științific al lucrării este constituit din cadrul normativ fiscal aferent domeniului vizat, rapoartele de activitate oferite de Serviciul Fiscal de Stat al Republicii Moldova, precum și diverse surse web relevante.

### 2. Rezultate și discuții

Determinând obiectul actualei cercetări, se impun anumite clarificări noționale ale sintagmei servicii digitalizate. Potrivit Ministerului Cercetării, Inovării și Digitalizării al României, termenul de digitalizare a serviciilor se referă la furnizarea de servicii digitale către cetățeni și agenți economici, cu scopul de a reduce prezența fizică la instituțiile publice și de a diminua volumul de documente fizice generate (Ministerul Cercetării, Inovării și Digitalizării al României, 21).

În vederea sesizării modalităților de raportare fiscală disponibile pentru entitățile economice, vom examina diversitatea serviciilor electronice integrate în pagina web oficială a SFS, așa cum este prezentată în figura 1.

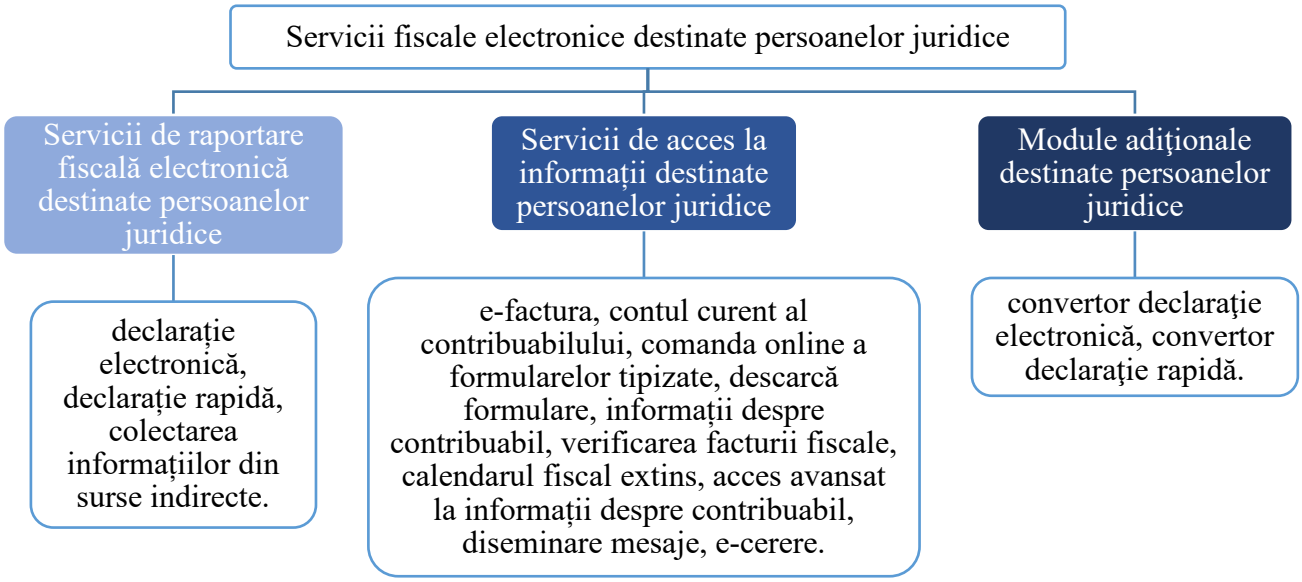


**Figura 1. Lista serviciilor fiscale electronice destinate persoanelor juridice în Republica Moldova**

**Sursa:** *elaborat de autor în baza informațiilor de pe (pagina Serviciul Fiscal de Stat al Republicii Moldova)*

Serviciul „Declarație electronică” reprezintă un instrument gratuit, disponibil 24 de ore din 24, pentru generarea, verificarea corectitudinii şi transmiterea rapoartelor fiscale prin intermediul reţelei internet de către agenţii economici, cu aplicarea semnăturilor electronice emise de către prestatorii de servicii de certificare acreditați în domeniu. Din mulţimea opţiunilor posibile utilizatorul va alege formularul necesar pentru completare, va introduce datele declaraţiei în câmpurile formularului, respectând indicaţiile sistemului informațional. De asemenea, serviciul oferă posibilitatea de a importa

declarații fiscale create preventiv folosind un sistem de contabilitate al utilizatorului. Menționăm că Serviciul de declarație electronică a fost introdus în anul 2009, inițial fiind destinat persoanelor fizice, pentru a le oferi posibilitatea de a depune online declarația cu privire la impozitul pe venit.

Serviciul „Declaraţia Rapidă" reprezintă o metodă automatizată de creare, verificare şi imprimare a declaraţiilor fiscale, prin aplicarea codului de bare bidimensional ce criptează datele introduse la etapa depunerii declaraţiilor fiscale respective, la autoritatea fiscală. Avantajele utilizării serviciului sunt multiple: nu este necesară aplicarea semnăturii electronice, completarea se realizează online, iar sumele introduse sunt verificate automat, eliminând astfel erorile de calcul.

Serviciul „Colectarea informaţiilor din sursele indirecte" asigură colectarea informaţiei de la sursele indirecte către Serviciul Fiscal de Stat. Contribuabilul va benefica de aceste servicii dacă v-a prezenta anumite documente necesare și se va conecta în baza Acordului de conectare la serviciile fiscale electronice (Bădicu *et al* 84).

În ceea ce privește modul de accesare, contribuabilii beneficiază de acces la serviciile fiscale electronice prin intermediul SIA „Cabinetul personal al contribuabilului", oferit gratuit și accesibil pe portalul Serviciului Fiscal de Stat, sau prin „Ghișeul unic de raportare", dezvoltat în vederea simplificării procedurii de raportare fiscală, financiară și statistică pentru toți membrii implicați în acest proces. La finele anului 2024, creșterea calității serviciilor destinate contribuabililor s-a evidențiat prin faptul că 73,68% din serviciile oferite de Serviciul Fiscal de Stat (SFS) au fost disponibile în format digital. Astfel, din totalul de 19 servicii publice prestate de SFS, 14 au fost accesibile online, iar 5 au fost oferite în mod tradițional. Totodată, menționăm că, conform Codului fiscal, darea de seamă fiscală a fost și continuă să fie prezentată, în mod obligatoriu, prin servicii informaționale reglementate de Serviciul Fiscal de Stat. Categoriile de persoane juridice care, de-a lungul anilor, au fost supuse modificărilor privind prezentarea cu utlizarea serviciilor automatizate a dărilor de seamă fiscală sunt reflectate în tabelul 1.

**Tabelul 1. Categorii de subiecți impozabili obligați să prezinte darea de seamă fiscală în format electronic**

| Data intrării în vigoare | Subiecții impunerii |
|---|---|
| 1 ianuarie 2013 | subiecţii înregistraţi în calitate de plătitori ai T.V.A. |
| 1 iulie 2016 | subiecţii care au, conform numărului scriptic de salariaţi înregistrat în anul precedent, mai mult de 10 persoane angajate prin contract individual de muncă ori prin alte contracte |
| 1 ianuarie 2017 | contribuabilii care la situaţia din 1 ianuarie 2016 aveau angajaţi mai mult de 5 salariaţi |
| 1 ianuarie 2017 | rezidenţii parcurilor pentru tehnologia informaţiei |
| 1 ianuarie 2019 | contribuabilii care au 5 şi mai mulţi angajaţi |
| 1 ianuarie 2023 | toți contribuabilii subiecți ai impunerii, cu excepția persoanelor fizice care nu desfășoară activitate de întreprinzător pentru care prezentarea dărilor de seamă utilizând metodele automatizate de raportare electronică nu este obligatorie. |

**Sursa:** *elaborat de autor în baza (Codul Fiscal al Republicii Moldova nr. 1163 din 24.04.1997., art. 187, alinl. 2[1])*

Asemenea altor țări, Republica Moldova a depus eforturi considerabile în ultimii ani pentru a implementa o deservire automatizată destinată persoanelor juridice de înaltă performanță. Deservirea de calitate a cetățenilor reprezintă o valoare importantă, ghidată de motto-ul „Funcționarul fiscal – în

serviciul contribuabilului". Aceste eforturi au implicat și adaptarea cadrului legal existent pentru a sprijini furnizarea eficientă a serviciilor fiscale.

În prezent, digitalizarea serviciilor fiscale a adus o serie de beneficii semnificative atât pentru autoritățile fiscale, cât și pentru contribuabili. Acestea includ:

- viteza sporită de depunere a declaraţiilor - optimizarea timpului de lucru și reducerea suportului de hartie, duplicarea documentelor;
- creșterea eficienței muncii - eliminarea erorilor și costurilor asociate cu depozitarea şi arhivarea fizică a documentelor;
- exigența de transparență - transparența, accesibilitatea și simplificarea procesului de obținere a informațiilor, comunicării şi evaluării cu contribuabilii;
- îmbunătățirea relațiilor fiscale cu contribuabilii - funcţionarul fiscal va fi eliberat de mai multe sarcini care îl suprasolicitau, ceea ce ar putea reduce riscul apariției unor situații conflictuale în urma interacțiunilor directe;
- identificarea rapidă a evaziunii fiscale - permite autorității fiscale să obțină acelaşi volum de venituri cu un nivel mai scăzut al impozitelor și taxelor sau să crească volumul încasărilor menţinând aceleași cote fiscale.

## CONCLUZII

În concluzie, vom reitera că sistemele de tehnologie a informației și comunicațiilor, din ce în ce mai sofisticate, fac dificilă prezicerea evoluțiilor viitoare ale economiei, iar acestea trebuie monitorizate atent, deoarece pot genera provocări pentru factorii de decizie în politica fiscală. Pentru îmbunătățirea serviciilor fiscale electronice, se constată necesitatea personalizării acestora, permițând utilizatorilor să salveze informațiile personale, să primească notificări relevante și să acceseze ușor serviciile preferate, alături de implementarea unui program de evaluare a satisfacției contribuabililor și dezvoltarea aplicațiilor mobile de e-guvernare. Astfel, este esențial ca autoritățile publice să continue adaptarea legislativă și tehnologică a sistemului fiscal pentru a răspunde nevoilor persoanelor juridice aferente eficienței și accesibilității serviciilor fiscale electronice.

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# DIGITAL TECHNOLOGIES IN THE PRESERVATION AND PROMOTION OF GREEK ENOGASTRONOMIC HERITAGE

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**Abstract.** The tourism industry is undergoing a digital transformation, which profoundly affects enogastronomic tourism. Implementing digital tools offers a richer tourist experience, streamlines the reservation procedure, and tailors travel packages to individual preferences. Advanced instruments, including online portals, augmented reality applications, artificial intelligence systems, and blockchain technology, are important elements in maintaining the historical value of local cuisine, fostering local economies, and enhancing the viability of food-focused itineraries. Greece provides a prime example of successfully incorporating digital strategies into culinary tourism. Interactive websites, smartphone apps, virtual tourism opportunities, and product certification services prove how innovative technologies can harmonize with established gastronomic customs. Digital projects such as Greek Wine Routes, Taste Halkidiki, and Agroknow help promote gastronomic tourism and entice fresh tourist interest.

**Keywords**: enogastronomic tourism, digital economy, online platforms, virtual tastings, blockchain in gastronomy, Big Data in tourism.

**JEL Classification:** O33, Q01, Z32

## INTRODUCTION

Amidst the ongoing digital revolution, the tourism sector is proactively embracing cutting-edge technologies, fundamentally reshaping how tourists, enterprises, and local populations interact. A particularly advantageous area, merging cultural expression, traditional practices, and financial prosperity, is enogastronomic tourism. Greece, renowned for its extensive culinary and vinicultural legacies, is aggressively leveraging digital instruments to showcase its genuine offerings and customs.

The digital realm unveils novel roads for safeguarding and amplifying enogastronomic heritage. Internet-based platforms, smartphone applications, virtual tasting sessions, blockchain systems verifying genuine recipes, and the utilization of Big Data to tailor tourist itineraries, altogether contribute to a more enhanced tourist experience. These tools don't simply make authentic Greek commodities more accessible; they also back up regional businesses and help maintain time-honored culinary traditions.

The principal objective of this research is to evaluate present-day digital technologies within the framework of Greek enogastronomic tourism, ascertain their efficacy in preserving cultural identity, and highlight potential directions for their forthcoming advancement.

## MAIN CONTENT

The digital economy is one of the most vital driving powers of global development, influencing all sectors, including tourism. The application of digital technologies in tourism promotes process automation, betters interactions between tourists and businesses, and generates fresh chances for cultural heritage promotion. This is especially pertinent for enogastronomic tourism, which combines taste experiences with the investigation of a region's culinary traditions. Enogastronomic tourism is an essential part of cultural exploration, and its digitalization allows tourists to access various services, select unique gastro-expeditions, and get familiar with local producers. The digital economy shapes new methods to organizing travel, streamlining planning, booking, and experience-sharing processes.

The main digital tools used in enogastronomic tourism for its popularization:

1. **Online platforms and booking services** enable tourists to find authentic restaurants, wineries, and gastronomic tours based on reviews, recommendations, and ratings. For instance, platforms like TripAdvisor, Airbnb Experiences, and Google Maps help select locations for tasting traditional Greek dishes or participating in wine tastings.

2. **Virtual and augmented reality** allow tourists to explore a region's cultural heritage before traveling. Virtual winery tours or Greek cooking masterclasses create an immersive experience without physical presence.

3. **Digital platforms for selling local products** (online markets and gastronomic platforms) facilitate not only tour bookings but also direct purchases of authentic products such as wines, cheeses, and olive oil.

4. **Social media and influencer marketing** significantly influence tourists' choices. Many travelers select gastronomic destinations based on recommendations from bloggers and experts on platforms like Instagram, YouTube, and TikTok.

Considering all the avenues of the digital economy in enogastronomic tourism, we can highlight the key advantages and challenges (Table 1).

**Table 1. Key advantages and challenges of the digital economy in enogastronomic tourism**

| Advantages | Challenges |
|---|---|
| accessibility of information | risk of losing authenticity |
| convenience and personalization | cybersecurity threats |
| support for local businesses | unequal access to digital technologies |
| environmental benefits | |

The digital tools previously highlighted within the sphere of Greek enogastronomic tourism offer extensive possibilities for drawing in visitors, bolstering the competitive advantage of regional producers, and safeguarding culinary traditions. A central pattern involves the expanding application of artificial intelligence coupled with personalized recommendations. Powered by machine learning systems, tourists are presented with customized suggestions for dining venues, wineries, and food-related gatherings, encompassing culinary workshops, all tailored to individual tastes and prior adventures. AI-driven applications meticulously examine reviews and ratings to identify the most suitable options for tastings or culinary adventures.

Augmented reality delivers the capability to generate interactive, 3D tours/guides for Greek gastronomic trails, wineries, and eateries. These resources are accessible to travelers before their arrival in the country, thus appealing to a new subset of tourists who prefer advanced trip preparations.

By utilizing AR glasses or smartphone applications, for instance, tourists can engage with virtual wine descriptions, uncover the history of viticulture, and join in virtual tasting sessions.

Furthermore, artificial intelligence supports vintners and restaurateurs in areas like demand prediction, production streamlining, and the development of effective promotional plans. The utilization of NFT tickets for select gastronomic events offers unique entry to tastings and culinary training sessions.

The broad use of blockchain technologies enhances transparency in product manufacturing and the authentication of Greek wines. This allows tourists to verify product origins and avoid counterfeits. Furthermore, digitalization contributes to the development of sustainable enogastronomic tourism by regulating resource consumption and promoting eco-friendly production.

**Successful Digital Initiatives in Greece.**

Greece stands as a prime example of seamlessly weaving digital advancements into enogastronomic tourism, effectively marrying age-old culinary customs with contemporary technology. Key projects and initiatives that have achieved notable success include:

1. Greek Wine Roads is interactive platform serves as a promotional tool for Greek wine regions, integrated with Google Maps, the platform empowers tourists to create custom-tailored itineraries, easily locate wineries and tasting rooms nearby, and reserve excursions. It supplies comprehensive details regarding wineries, culinary routes, and events such as tastings and wine festivals ("GREEK WINE ROADS", accessed 10.02.2025).

2. Taste Halkidiki is sait, dedicated to spotlighting the culinary heritage of the Halkidiki Peninsula and delivers information on local products, culinary traditions, event calendars, and even facilitates the delivery of genuine Greek dishes ("TASTE HALKIDIKI", accessed 10.02.2025).

3. Melitzazz Festival (held annually in Leonidio) is gastronomic and cultural festival spotlights the local Tsakoniki Melitzana eggplant, a product protected under a Protected Geographical Indication (PGI). The festival encompasses tastings, culinary workshops, musical performances, and opportunities to engage with local producers ("Melitzazz 2024", accessed 10.02.2025).

4. Virtual winery tours is utilizing augmented reality technology. Wineries like Boutari and Gerovassiliou provide virtual tours of vineyards, insights into production processes, and remote tasting experiences ("Boutari Wineries", accessed 11.02.2025), ("Gerovassiliou Wineries", accessed 11.02.2025).

5. Agroknow platform is blockchain-based solution is designed to ensure product certification and authentication for Greek wines, olive oils, and other traditional products ("Agroknow platform", accessed 11.02.2025).

6. Greece 2.0 initiative is national government initiative is focused on investing in digital infrastructure to stimulate gastronomic tourism and foster the development of novel digital solutions specifically for local producers and tour operators ("National recovery and Resilience Plan "Greece 2.0"", accessed 13.02.2025).

These successful initiatives showcase how digital technologies can be integrated within the realm of enogastronomic tourism, thereby providing ease for tourists, bolstering local enterprises, and preserving cultural heritage. Greece effectively serves as a compelling instance of how innovation can revitalize a traditional industry, rendering it contemporary, accessible, and competitive.

## CONCLUSIONS

The digital age is profoundly reshaping enogastronomic tourism, rendering it more readily available, engaging, and tailored to individual preferences. The deployment of online portals, augmented reality tools, artificial intelligence systems, and blockchain networks is streamlining workflows, amplifying the ease of travel for tourists, and providing support for local culinary creators. In the future, the convergence of all digital advancements into comprehensive tourism platforms will elevate the approachability, ease, and appeal of enogastronomic tourism within Greece, for all who visit. This evolution not only fortifies the competitive edge of the tourism sector but also aids in the protection of cultural legacies. Concurrently, the embracing of innovation will cultivate sustainable practices and elevate the worldwide acclaim of Greek cuisine, especially appealing to younger demographics who are frequent users of digital resources during their journeys.

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# NOILE MĂSURI PRIVIND SIMPLIFICAREA PROCEDURILOR VAMALE ÎN REPUBLICA MOLDOVA ÎN CONTEXTUL DEZVOLTĂRII EREI DIGITALE

# NEW MEASURES ON SIMPLIFICATION OF CUSTOMS PROCEDURES IN THE REPUBLIC OF MOLDOVA IN THE CONTEXT OF THE DEVELOPMENT OF THE DIGITAL ERA

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**Abstract:** The Customs Service supports and promotes a constant dialogue with the business environment, offering concrete solutions for the efficient application of the new customs regulations. The practical guide to the establishment and use of customs guarantees is an essential tool for economic agents, helping them to benefit from the available facilities and optimize their costs. In order to ensure the uniform application of the provisions of the Customs Code and the efficiency of customs clearance processes, the Customs Service continues to invest in the professional development of its employees. At the same time, the Customs Service remains firmly committed to the reform and modernization process, strengthening international cooperation and implementing innovative solutions to streamline customs activity and ensure the economic security of the Republic of Moldova.

**Key words:** Customs Service, import, export, Customs Code, customs facilities

**JEL Classification:** H27, H71, H72

## INTRODUCERE

**Serviciul Vamal al Republicii Moldova** este organul administraţiei publice, subordonat Ministerului Finanţelor, care contribuie la dezvoltarea Republicii Moldova prin asigurarea securității economice și fiscale a statului, facilitarea comerțului legitim și oferirea serviciilor publice calitative mediului de afaceri și cetățenilor. În acest scop, Serviciul Vamal asigură administrarea veniturilor vamale, exercită atribuțiile de control și supraveghere în baza analizei de risc și aplică tehnici moderne de vămuire în mod profesionist, transparent şi responsabil. Serviciul Vamal este o autoritate publică de specialitate care exercită conducerea efectivă a activităţii vamale în Republica Moldova prin: implementarea politicii vamale, asigurarea respectării reglementărilor vamale la trecerea mărfurilor, mijloacelor de transport şi persoanelor peste frontiera vamală a Republicii Moldova, perceperea drepturilor de import şi drepturilor de export, vămuirea, controlul şi supravegherea vamală [5].

În conformitate cu articolul 6 al Codului vamal al Republicii Moldova, **activitatea vamală** se desfăşoară în conformitate cu legislaţia care este în vigoare la data la care organul vamal a primit declaraţia vamală şi alte documente, cu excepţia cazurilor prevăzute de legislaţie [1]. Cadrul legal general al Serviciului Vamal este publicat și poate fi consultat pe pagina web a Serviciului Vamal: www.customs.gov.md [5].

## CONȚINUTUL DE BAZĂ

Legile sunt mereu într-o evoluție, fiind adaptate realităților în care se aplică. Legislația vamală națională a evoluat pe parcursul timpului, cunoscând o serie de modificări. **Primul Cod vamal a fost adoptat în anul 1993**, fiind actul legislativ de bază care reglementa principiile organizatorice și de activitate ale sistemului vamal. Codul vamal era *constituit din 112 articole*, iar prevederile acestuia erau sumare, activitatea vamală fiind una limitată. Odată cu evoluția proceselor economice și sociale atât la nivel național, cât și internațional, intensificării traficului internațional de mărfuri, a apărut necesitatea modificării și cadrului normativ din domeniul vamal. **În anul 2000 a fost adoptat noul Cod vamal**, care deja este unul mult mai vast și complex (are **325 de articole**), mai structurat și mai adaptat realităților economice, financiare și tehnice ale Republicii Moldova. Însă evoluțiile economice naționale și internaționale, concurența internațională, au determinat, și determină în continuare, necesitatea unor modificări legislative în domeniul vamal.

Ținînd cont de parcursul European al RM și Având în vedere *deosebirile majore între Codul vamal în vigoare a Republicii Moldova și Codul vamal al Uniunii Europene*, precum și ținându-se cont de dispozițiile Legii nr.780-XV din 27.12.2001 privind actele legislative, a fost constatată imposibilitatea operării modificărilor la Codul vamal în vigoare, dar și necesitatea dezvoltării și aprobării unui Cod vamal nou, fiind structurat și apropiat Codului vamal al Uniunii Europene.

**Scopurile** scontate prin elaborarea proiectului noului Cod vamal au constat în:

- Armonizarea cadrului legislativ național vamal la standardele europene ale legislației vamale;
- Modernizarea sistemului de reglementare a legislației vamale și introducerea bazei legale pentru utilizarea tehnicilor și metodelor noi de control vamal;
- Facilitarea comerțului prin implementarea procedurilor vamale simplificate și conform practicii statelor membre a Uniunii Europene;
- Liberalizarea unor reguli de vămuire a mărfurilor trecute peste frontiera vamală;
- Revizuirea conceptuală ale prevederilor ce se referă la sistemul facilităților la plata drepturilor de import, prin prisma oportunității acestora, precum și a impactului său asupra economiei naționale;
- Unificarea mai multor prevederi legale, care actualmente se conțin în mai multe acte legislative și normative, fiind simplificată semnificativ legislația vamală națională [3].

Proiectul noului Cod vamal al Republicii Moldova a fost dezvoltat pe parcursul a trei ani, în baza unei intense cooperări dintre Ministerul Finanțelor și Serviciul Vamal cu Banca Mondială, Misiunea Uniunii Europene de Asistență la Frontieră în Moldova şi Ucraina (EUBAM), misiunea experților TAIEX împreună cu Înaltul Consilier UE în domeniul vamal și fiscal, Rosario de Blasio, și Comisia Europeană [4]. La finele acestei misiuni, a fost prezentat de către experţi Raportul misiunii în care au fost reflectate constatările şi recomandările de perfecționare și ajustare a textului noului Cod vamal.

În cadrul ședinței plenare a Parlamentului din 24 august 2021, a fost aprobat proiectul de lege cu privire la Codul vamal, în cea de-a treia lectură, finală. **Noul Cod Vamal al R. Moldova urma să intre în vigoare la 1 ianuarie 2023, însă aplicarea lui a fost amânată mai întâi până la 1 iulie 2023, iar apoi - până la începutul anului 2024.** Guvernarea nu a reușit să adapteze legislația națională la cea europeană, iar companiile au cerut timp pentru a-și adapta procesele interne la noile reguli. Autoritățile susțin că extinderea termenului a fost necesară pentru „a asigura continuitatea armonizării legislației Republicii Moldova cu cea a Uniunii Europene” și, în același timp, că au „ținut cont de opinia mediului de afaceri” [2].

Astfel, noul Cod vamal a intrat în vigoare la 1 ianuarie 2024 obiectivul căruia este uniformizarea și armonizarea legislației vamale naționale cu cea a Uniunii Europene.

Implementarea noului Cod Vamal reprezintă unul dintre principalele angajamente asumate odată cu obținerea de către Republica Moldova a statutului de țară candidat pentru aderarea la UE. Noua legislație vamală racordată la acquis-ul european va oferi agenților economici mai multe facilități, servicii digitalizate și reducerea birocrației.

Printre beneficiile și inovațiile noii legislații în domeniul vamal enumerăm:

- eliminarea taxelor pentru procedurile vamale și amânarea plății taxelor vamale
- reducerea costurilor și a timpului de vămuire
- validare automată a declarațiilor vamale la export
- digitalizarea și automatizarea proceselor
- interacțiune fizică redusă cu funcționarii vamali
- posibilitatea declarării verbale pentru anumite categorii de mărfuri
- reducerea costurilor și întârzierilor legate de declararea mărfurilor
- declararea trimiterilor poștale la distanță
- declararea până la 999 de mărfuri pe o singură declarație vamală (în prezent 99)
- diminuarea riscurilor de fraudă și incidentelor de integritate, prin monitorizarea online a operațiunilor vamale [7].

Noul Cod vamal vine **să sistematizeze legislația vamală a Republicii Moldova**, încorporând în sine Legea cu privire la tariful vamal și Legea cu privire la modul de introducere şi scoatere a bunurilor de pe teritoriul Republicii Moldova de către persoane fizice.

Principalele măsuri implementate odată cu intrarea în vigoare a noului Cod vamal sunt:

- prezentarea informațiilor în format electronic necesare vămuirii;
- liberalizarea activității de reprezentant vamal;
- dreptul la replică al solicitantului asupra unei decizii vamale. Prin urmare, înainte de luarea unei decizii care ar avea consecințe nefavorabile pentru solicitant, Serviciul Vamal comunică solicitantului motivele pe baza cărora intenționează să ia decizia, acordându-i în acest sens solicitantului posibilitatea să își exprime dezacordul într-un termen de 30 de zile;
- prelungirea termenului de depunere a contestației asupra deciziilor de la 10 zile până la 30 de zile;
- modernizarea și alinierea instrumentelor de facilitare a comerțului la standardele internaționale.

Codul vamal aprobat vine și cu o serie de noi simplificări, printre care:

- Declarația simplificată – permite titularului să plaseze mărfurile sub un regim vamal pe baza unei declarații cu un set redus de date.
- Înscrierea în evidențele declarantului – permite titularului să depună declarația vamală sub forma unei înscrieri în evidențele declarantului, cu condiția ca informațiile din declarația respectivă să fie la dispoziția autorităților vamale în sistemul declarantului la momentul depunerii declarației.
- vămuirea centralizată – permite persoanei să depună la postul vamal unde este înregistrat o declarație vamală pentru mărfurile care sunt prezentate în vamă la un alt post vamal.

Simplificările menționate prezintă beneficii reale pentru operatorii economici, cum ar fi: furnizează o alternativă la procedura standard, răspund la unele nevoi specifice legate de fluxul și de tipul mărfurilor declarate, asigură acordarea rapidă a liberului de vamă, implică o reducere a costurilor.

Un beneficiu important în activitatea comercială a agenților economici este implementarea mecanismului de achitare a drepturilor de import până la acordarea liberului de vamă sau în termen de

până la 7 zile de la data notificării datoriei vamale, cu constituirea unei garanții în cuantum deplin al drepturilor de import. Astfel, plătitorul vamal beneficiază de o „vacanță" de la plata obligațiilor vamale.

Totodată, noul document stabilește condiții clare (nereglementate în Codul vamal actual) privind rambursarea drepturilor de import în cazul mărfurilor defecte sau neconforme cu clauzele contractuale [4].

Analizând activitatea Serviciului Vamal la capitolul încasări de venituri, în perioada anului 2024 **la bugetul de stat au fost încasate venituri administrate de Serviciul Vamal în valoare de 38 276 911,8 mii lei** (peste 38,28 miliarde lei), cu 3 107 618,02 mii lei mai mult decât în perioada analogică a anului 2023. Ponderea cea mai mare o are TVA cu cca 66,5%, urmată de acciza cu 26,8% și taxa vamală cu 6,4%.

| Luna | Executat 2024 (mii,lei) | Executat 2023 (mii,lei) | Diferența 2024/2023 | |
|---|---|---|---|---|
| | | | % | (+/-) |
| Ianuarie | 2 352 409,6 | 2 697 080,7 | 87,2 | -344 671,1 |
| Februarie | 2 956 258,4 | 2 626 939,1 | 112,5 | 329 319,3 |
| Martie | 3 119 134,4 | 3 118 158,3 | 100,0 | 976,1 |
| Aprilie | 3 382 888,0 | 2 513 596,2 | 134,6 | 869 291,8 |
| Mai | 2 887 471,1 | 2 740 977,4 | 105,3 | 146 493,7 |
| Iunie | 3 028 260,5 | 2 605 050,5 | 116,2 | 423 104,0 |
| Iulie | 3 382 260,1 | 2 841 875,1 | 119,0 | 540 385,1 |
| August | 3 426 398,7 | 3 116 165,1 | 110,0 | 310 233,1 |
| Septembrie | 3 302 645,6 | 3 060 701,9 | 107,9 | 241 943,7 |
| Octombrie | 3 477 057,8 | 3 179 832,3 | 109,3 | 297 225,5 |
| Noiembrie | 3 281 166,9 | 3 123 460,4 | 105,0 | 157 706,5 |
| Decembrie | 3 681 066,7 | 3 545 457,0 | 103,8 | 135 609,7 |
| **Total** | **38 276 911,8** | **35 169 293,8** | **108,8** | **3 107 618** |

**Sursa:** [8]

1) **TVA la import a constituit 25 449,74 mil lei**, ceea ce reprezintă 66,5% din totalul plăților percepute la bugetul de stat. Față de aceeași perioadă a anului 2023 (în care au fost acumulate 23 348,4 mil lei) se constată o creștere cu 2 101,35 mil lei sau cu 9% mai mult.

2) **Accize la import – 10 265,98 mil lei**, ceea ce reprezintă 26,8% din totalul plăților percepute la bugetul de stat. Comparativ cu perioada similară a anului precedent (în care au fost acumulate 9 025,78 mil lei) se constată o creștere cu 1 240,2 mil lei sau cu 13,7% mai mult.

3) **Taxa vamală – 2 466,95 mil lei**, ceea ce reprezintă 6,4% din totalul plăților percepute la bugetul de stat. Comparativ cu perioada similară a anului precedent (în care au fost acumulate 1 987,25 mil lei) se constată o creștere cu 479,69 mil lei sau cu 24,1%.

4) **Taxa pentru efectuarea procedurilor vamale – 57,87 mil lei**, ceea ce reprezintă 0,2% din totalul plăților percepute la bugetul de stat. Comparativ cu perioada similară a anului precedent (în care au fost acumulate 771,43 mil lei) se constată o descreștere cu 713,56 mil lei. De menționat, că taxa pentru efectuarea procedurilor vamale a fost eliminată o dată cu intrarea în vigoare a Codului Vamal nr. 95/2021. Actualmente această taxă se încasează doar de la rezidenții ZEL și PIL Giurgiulești care au optat pentru desfășurarea activității conform prevederilor în vigoare la data de 31 decembrie 2023 [8].

În luna ianuarie 2025, la bugetul de stat au fost încasate venituri administrate de Serviciul Vamal în valoare de 2.736.174,1 mii lei (peste 2,73 miliarde lei), ceea ce reprezintă 6,6% din sarcina bugetară anuală și cu 383.764,53 mii lei mai mult (+16,3%) decât în perioada similară a anului 2024 [10].

## CONCLUZII

În concluzie este important de menționat că implementarea noului Cod vamal implică: *aducerea în concordanță a legislației cu prevederile noului Cod vamal, elaborarea și aprobarea cadrului normativ subsidiar legii propuse și în special al Regulamentului cu privire la punerea în aplicarea Codului vamal, alocări financiare pentru dezvoltarea sistemelor informaționale din cadrul Serviciului Vamal, care urmează a fi realizate cu suportul partenerilor externi de dezvoltare.* Cu noile modificări, noul Cod Vamal al Republicii Moldova, nu doar protejează interesele economice ale țării, dar facilitează și comerțul internațional, oferind un mediu eficient pentru afaceri și contribuind la dezvoltarea economică a țării [9]. Noul Cod vamal contribuie la **perfecționarea și ajustarea legislației** la standardele europene ale legislației vamale, apropiind și mai mult Republica Moldova de Uniunea Europeană [3].

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## SECTION: DIGITAL SOLUTIONS FOR SOCIAL INCLUSION AND HEALTHY AGING

# ASOCIAȚII SENIORALE – SOLUȚIA PROBLEMEI DE ÎMBĂTRÂNIRE ACCELERATĂ A SOCIETĂȚII

# SENIOR ASSOCIATIONS – THE SOLUTION TO THE PROBLEM OF ACCELERATED AGING OF SOCIETY

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**Motto: ASEM e casa mea! Casa mea e ASEM**

**Abstract.** The Senior Association is a humane ecological community of the elderly at the Mother Enterprise, which allows and supports the continuity of the activities of the seniors at the Mother Enterprise until old age. The Senior Association is an invention of the teachers "around retirement" from the Academy of Economic Studies of Moldova (ASEM), which differs essentially from other communities of pensioners in that it operates under the mottos: "ASEM is my home" and "My house is ASEM". No known community of retirees nowadays allows BOTH the continuity of activities at the Mother Enterprise until old age AS well as the inter-generational collaboration of seniors at the "workplace" AS well AS the unity of the individual with the collegial community at the Mother Enterprise, practiced for years.

The Senior Association "ASEM Seniors" is created at the end of 2019 and fully fits into the achievement of the goal and objectives of the UN Decade 2021-2030 "Healthy Aging". We would like to share with society the latest activities of spiritual, intellectual and material production of the Association "ASEM Seniors", which encourages us to hope that the experience gained will be a good omen for the partial resolution of the crisis, in which the 800 thousand elderly people in the Republic of Moldova are currently located.

The creation of Senior Associations at Parent Enterprises (high school, college, university, village, commune, communal household, small town, etc.) with the intention of requesting the qualified and experienced contribution of each elderly person both to the consumption of goods from the Society and to the production of goods for the Society is a vital necessity of the Moldovan Society. The partnership agreements recently concluded with the Public Association "Parliament of Independence" (AO PI), which is represented today by 84 deputies, and with the Union of Pensioners of the Republic of Moldova (UPRM) with its 32 subdivisions are a real contribution to solving the crisis of the elderly in the Republic of Moldova. The first action of the ASEM-AO PI and ASEM-UPRM agreements for the computerization of the first 2 groups of elderly people in ASEM, AO PI and UPRM between December 2024 and February 2025 with the contribution of ASEM's MACIP is already "history". He attended courses in languages, entrepreneurship, rural and urban tourism, entertainment, sociology, etc.

**Keywords:** association, senior, retired, elderly, consumption, production, society

**JEL:** I13, C40, F15, I31

## INTRODUCERE

Persoana adultă e obișnuită cu formula timpului petrecut în viați: 8 – 8 – 8! Opt ore le dedică muncii creative, opt ore le dă somnului și opt ore e pentru „timpul liber". Cam așa este repartizat timpul ritmului de viață.

Ce face persoane la pensionare? Evident că somnul î-și ea timpul său. Dar celelalte două treimi de timp? Ce facem cu ele?

Cu „Timpul liber", cele opt ore rămase, ce facem cu ele? Hobby, lucrul pe lângă casă, cititul cărților dragi, răsfoitul ziarelor și revistelor, pe la biblioteca, la teatru, televizorul, copiii și nepoții, pescuitul, ciupercile, plimbatul prin parc sau pădure, turism local, muzee pe care „în sfârșit" poți să le vizitezi când dorești  și a. m. d. Este cu „ce să umpli cele opt ore". Soluția este pentru pensionar.

Vârstnicul e deprins să lucreze, să creeze, „să se ducă la serviciu". Dar dacă e pensionat atunci ce să facă? Ar dori să mai „facă ceva ce nu a izbutit să facă". Dar cum să o facă? Întreprinderea – Mamă ia oferit această posibilitate când a fost angajat, ba chiar ia „făcut și program de lucru", ia cerut să și documenteze rezultatul produsului creat, „la mai și lăudat", la mai și criticat din când în când, la avut în vizorul activităților ... Acum „e liber cazac", fă ce dorești, nimeni „nu te mână din urmă", vrei faci ceva, produci ceia ce ai produs tot timpul ... Dacă nu dorești, nu faci ... nimeni nu te obligă ... doar numai cunoștința te întreabă: ai lucrat „un veac", ai cunoștințe, ai rezultate, ai experiență și acum ce faci cu ele? Conștiința de îndeamnă să face mai departe ceia ce ai făcut tot timpul. Ea caută „ieșire din situație".

Noi, profesorii de la Academia de studii economice a Moldovei (ASEM), nu facem excepție de la ocupațiile de la alte tipuri de Întreprindere – Mamă. În anul 2019 prin martie am înființat un Comitet de inițiativă de creare a unei Comunități al vârstnicilor din ASEM, care „să se gândească" cum de organizat viața profesorilor pensionari ca „să se simtă utili" și mai departe societății, să „nu se cadă în singurătate", să „mai vadă din când în când" colegii și discipolii, să-și poată da experiența „celor rămași la plug", să trăiască o viață decentă, să „nu observe ieșirea le pensie!". E o problemă foarte mare! Necesită soluție. Profesori „din jurul pensionării" avem vreo sută și jumătate în ASEM.

**Originalitatea vs autenticitatea**

Comitetul de inițiativă a început s studieze cele vreo 30 de aziluri și case de bătrâni din Republica Moldova, comunități ale vârstnicilor din Republică, România, orășele pentru pensionari și oameni în etate din Uniunea Europeană și chiar din America cu statutele și regulamente de activitate a lor și ... nu ne-a plăcut de așa decizii „de conlucrare a societății cu vârstnicii". DAR, având o impresie foarte bună despre organizarea traiului măicuțelor de la Mănăstirea "Agapia" din România am sesizat, că o „așa conlucrare la Întreprinderea – Mamă" ar fi tare binevenită și pentru profesori „în jur de pensionare" de la ASEM. "Asta ar fi bine depus în baza Regulamentului Comunității profesorilor pensionari din ASEM", - a fost concluzia Comitetului de inițiativă de la ASEM.

A doua idee pentru o comunitate a vârstnicilor din ASEM am „cules-o„ din cartea Domnului D. Michael ABRASHOFF, căpitan de navă din SUA „It's Your Ship. Management Techniques from the Best Damn Ship in the Navy, By Captain D. Michael Abrashoff. El le-a spus marinarilor: Asta e nava Voastră! A obținut cea mai bună performanță, care ia adus și Diploma de Gradul Superior la competiția respectivă anuală din SUA. Știți care e secretul: Pe marinari „îi durea capul pentru fiecare lucru de perspectivă pe nava lor: NAVA Î-MI APARȚINE, e și a mea! Iată de unde vin și devizele Asociației „Seniorii ASEM": „ASEM e casa mea" și „Casa mea e ASEM".

Deci, noi am făcut un lucru mai puțin original, dar e făcut un lucru autentic!

Comitetul de inițiativă „și-a suflecat mânicile”, a investigat un set de chestionare pentru a face un chestionar al vârstnicilor din ASEM, a compus un Chestionar de investigare a dorințelor profesorilor ASEM din jurul de pensionare ca să „colectăm contingentul” viitoarea Comunități a profesorilor pensionari din ASEM și, în paralel, să selectăm direcțiile de activitate a viitoarei comunități. Circa 80% din profesorii din jurul de pensionare din ASEM sau expus în favoare creării „Comunității profesorilor pensionari din ASEM” în cadrul ASEM cu intenția de a activa în continuare în cadrul ASEM - Întreprinderea – Mamă, până la adânci bătrânețe.

## I. PRODUSUL ASOCIAȚIEI „SENIORII ASEM”: PRIMII 5 ANI DE ACTIVITATE.

Asociația „Seniorii ASEM” a făcut multe lucruri [1-3], chiar dacă în acești 5 ani am avut chiar de la început „3 ani de COVID”.

În fiecare din acești 5 ani a organizat TELECONFERINȚE internaționale a tinerilor cercetători cu deviza „Crearea Societății Conștiinței”. La TELE în fiecare an au participat în jur de 60 de tineri cercetător cu și fără coordonatori științifici și savanți cu renume în majoritate de la universitățile și centrele științifice din Republica Moldova, România, Italia, Grecia, Bulgaria, Ungaria, Germania, Canada și SUA.

Producția membrilor Asociației „Seniorii ASEM” și a colegilor lor este înserată pe paginile revistelor „ARA Journal of Sciences” și „ARA Journal of Arts” editate în SUA de către ARA Publishing Hause.

Asociația „Seniorii ASEM” a publicat 3 monografii în baza rezultatelor activității ei. De asemenea a participat la depunerea de 4 proiecte internaționale cu temele de ameliorarea situației migraționale din Republica Moldova, Crearea Rețelei „Cererea și Oferta” produselor authtone, Crearea Asociațiilor seniorale în spațiile rurale și urbane a Republicii Moldova și a.

„Grupele Speciale de Interese” ale Asociației „Seniorii ASEM” sunt în plină activitate.

## II. CE AVEM ÎN PREZENT?

Recent Asociația „Seniorii ASEM” a început o activitate de colaborare republicană. În 26 noiembrie 2024 a fost încheiat primul Acord de Parteneriat dintre Asociația „Seniorii ASEM” și Uniunnea Pensionarilor din Republica Moldova (UPRM) – Acordul ASEM-UPRM. În 10 decembrie 2024 a fost încheiat al doulea Acord de Parteneriat dintre Asociația „Seniorii ASEM” și Asociația Obștească „Parlamentul Independenței” (AO PI) – Acordul ASEM-AO PI.

### 2.1. Acorduri de Parteneriat

Atât Acordul ASEM-UPRM cât și Acordul ASEM-AO PI conțin compartimentele scopul și obiectivele lor, activitățile preconizare, modificarea și duratele acordurilor.

Acordurile de Parteneriat își propune realizarea activităților în domeniul protecției drepturilor, libertății și securității sociale ale oamenilor de vârsta a treia din R. Moldova. Alte directii importante, care sunt planificate de UPRM și AO PI pentru persoanele în etate sunt:

- Promovarea unui mod sanatos de viaţă, prin acordarea serviciilor medicale efective şi sustenabile pentru persoanele vulnerabile cu acordarea suportului financiar după necesitate.
- Realizarea unor programe socio - economice, comunicantive şi sustenabile.
- Realizarea unor activităţi diverse prin promovarea unui mod sănătos şi activ de viaţă, însoţit cu activităţi istorico-patriotice şi cultural-educaţionale
- Implementarea practicilor europene de susţinere a persoanelor de vârsta a treia în Republica Moldova.

**2.2. Părțile Acordurilor de Parteneriat își propun următoarele obiective:**

- Asocierea membrilor UPRM, AO PI și a Asociației „Seniorii ASEM, fără deosebire de naționalitate, afiliere politică și confesiune, în acțiuni de soluționare a problemelor cotidiene cu care se confruntă.
- Colaborarea între UPRM, AO PI și Asociația „Seniorii ASEM în vederea apărării drepturilor civice și asigurării securității sociale a oamenilor de vârsta a treia.
- Asociația „Seniorii ASEM" adera ca membru colectiv al UPRM și al AO PI cu păstrarea autonomiei depline in conformitate cu statutul organizației.
- Promovarea unei colaborări prietenoase și fructuoase între generația oamenilor de vârsta a treia, membri ai UPRM, AO PI și a Asociației „Seniorii ASEM și generația tânără.
- Colaborarea între UPRM, AO PI și Asociația „Seniorii ASEM în promovarea tradițiilor populare naționale în rândurile generației tinere.
- Încadrarea plenară a unui grup de lucru cu specialiști profesionali în elaborarea și realizarea proiectelor social-economice, istorico - patriotice, educaţionale şi etno-culturale în susţinerea oamenilor vârstnici.

**2.3. Activitățile preconizate în cadrul Acordurilor de parteneriat ASEM-UPRM și ASEM-AO PI:**

- Organizarea în comun de către Părți a unor evenimente de promovare și protejare a drepturilor și libertăților fundamentale ale omului.
- Organizarea în comun și desfășurarea de seminare, conferințe, lansări de carte, expoziții, conferințe publice etc. cu atragerea specialiștilor în domeniile respective.
- Acordarea de asistență juridică în soluționarea problemelor de ordin socio – juridic, cu care se confruntă membrii UPRM, AO PI a Asociației „Seniorii ASEM" și ai Sindicatului Educației și Științei din R. Moldova.
- Editarea de publicații elaborate în comun de către membrii ambelor Părți.
- Acordarea de asistență de orice natură persoanelor social-vulnerabile.
- Elaborarea și realizarea în comun a diferite proiecte la nivel național și local în scopul realizării obiectivelor enunțate în acorduri.

## III. SUSTENABILITATEA

Ambele acorduri au Protocoale adiționale, unde se specifică activitățile de evaluare recente a lor atât de Asociația „Seniorii ASEM" al Academiei de Studii Economice din Moldova cât și de Uniunea Pensionarilor din Republica Moldova și de Asociația Obștească "Parlamentul Independenței".

Una din activități se referă la Inițierea în informatică a seniorilor Asociațiilor Seniorale din R. Moldova, care a și fost efectuată în perioada 12 decembrie 2024 – 20 februarie 2025. Acordul de parteneriat ASEM-UPRM cu tematica „Utilizarea tehnologiilor informaționale de comunicare" a și fost pus în acțiune de către Centrul de instruire și Consultanță în Afaceri al ASEM nr. 012/24 „05" decembrie 2024: Oferta serviciilor de instruire MACIP-ASEM.

UPRM, AO PI și Asociația „Seniorii ASEM efectuează crearea și implementarea efectivă a Asociațiilor Seniorale, atât la nivel național, cât și în cadrul proiectelor transfrontaliere între Republica Moldova și România.

În următorii ani de colaborare fructuoasă între UPRM, AO PI și Asociația „Seniorii ASEM vor fi implementate: (1) Algoritmul de inițiere și creare a Asociațiilor Seniorale în spațiile rurale și urbane a Republicii Moldova, (2) Chestionarul de bază de acumulare a membrilor Asociațiilor Seniorale și

specificările lui dictate de condițiile specifice ale Asociațiilor Seniorale în spațiile rurale și urbane ale Republicii Moldova și (3) Regulamentul de bază de funcționare al Asociațiilor Seniorale și adaptările lui la condițiile specifice ale Asociațiilor Seniorale în spațiile rurale și urbane a republicii Moldova.

În activitățile susmenționate vor fi implicate și Asociațiile Seniorale „Seniorii Durlești", „Seniorii Zagarancea " și „Seniorii din Unțești", care sunt inițiatorii și primii experimentatori în spațiul rural al Republicii Moldova.

**MULȚUMIRI**

Evident, că implementarea invenției „Asociațiile Seniorale" reprezintă un lucru colectiv în primul rând al Șefilor Grupelor Speciale de Interese a Asociației „Seniorii ASEM", profesorii Vasile Bucur, Ion Bunu, Boris Chistruga, Marina Coban, Valentina Capațina și a Secretrei General al Asociației „Seniorii ASEM Elena Chicu. Un lucru imens depun și Consiliile de administrarea a Asociațiilor Seniorale „Seniorii Durlești": Dl Ion Madan și Parascovia Sava, „Seniorii Zagaranea": Dl Sebastian Andriuță și „Seniorii din Unțești": Primarul Nicolae Sorotinschi, care prin munca lor voluntară ajută la lichidarea crizei vârstnicilor din Republica Moldova.

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# NEW ERA OF PERSONALIZED EDUCATION: PROMOTING EQUITY AND SOCIAL INCLUSION

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**Abstract.** In the era of Artificial Intelligence (AI), language learning is undergoing a transformative shift, offering unprecedented opportunities for personalized education, equity, and social inclusion. AI-driven applications have redefined traditional learning paradigms by providing adaptive learning paths, real-time feedback, and interactive engagement, making language acquisition more accessible to diverse learner groups. This study explores the actuality and significance of AI in language education, emphasizing its role in bridging linguistic gaps, enhancing inclusivity, and supporting individualized learning experiences.

The primary objectives of this research are to identify the most widely used AI-powered language learning tools, assess their effectiveness in skill development, and analyse learners' perceptions of AI-driven education. The target group consists of university students enrolled in language courses, representing a varied demographic with different proficiency levels.

A quantitative and qualitative methodology is employed, integrating survey-based data collection and comparative analysis of AI-based platforms. Preliminary results indicate that AI applications such as Duolingo, Grammarly, and ChatGPT enhance learners' motivation, engagement, and linguistic accuracy while addressing educational inequalities. However, challenges such as over-reliance on technology, limited human interaction, and data privacy concerns persist. The study underscores the necessity of balancing AI integration with traditional pedagogical approaches to maximize educational benefits while ensuring ethical considerations.

**Keywords:** Artificial Intelligence (AI), EdTech Innovation, Language Learning, Equity and Social Inclusion, AI-powered Learning Tools

**JEL Classification: I2**

## INTRODUCTION

In an era defined by rapid technological advancement, Artificial Intelligence (AI) is reshaping the landscape of education, particularly in the realm of language learning. By offering personalized learning paths, instant feedback, and interactive experiences, AI tools are making language acquisition more accessible and engaging than ever before. This article explores the current impact of AI on language education, focusing on its ability to bridge linguistic gaps and promote inclusivity. We will examine the most widely used AI-powered language learning platforms, such as Duolingo, Grammarly, and ChatGPT etc., to assess their effectiveness in developing key language skills. Furthermore, we will delve into the perceptions of university students, a diverse group of language

learners, to understand their experiences with AI-driven education. This study aims to shed light on the benefits and challenges of integrating AI into language learning while ensuring a balanced approach to education.

## MAIN CONTENT

### 1. Materials and Methods

This study adopts a mixed-methods approach, combining quantitative surveys and qualitative interviews to assess the impact of AI-driven personalized education in language learning. The quantitative data, collected from university students, was analysed using statistical methods, while qualitative insights were drawn from interviews and open-ended questions.

An extensive literature review contextualises the study, examining previous research on AI-powered language learning tools, their effectiveness, and their role in promoting inclusivity and equity.

The survey, conducted with students from the Academy of Economic Studies of Moldova (ASEM), focused on their preferences, usage patterns, and perceptions of AI tools. Both statistical analysis and thematic analysis were applied to evaluate the data comprehensively.

### 2. Theoretical Framework

In the context of educational innovation, personalized learning powered by AI is emerging as a transformative approach in language education. The integration of AI in educational settings allows for the creation of adaptive learning environments that cater to individual student needs, preferences, and learning speeds. According to Hîrbu, ICT and AI enables personalized experiences by providing dynamic, context-aware learning pathways that adjust in real time to each learner's progress.

#### 2.1. Personalized Education and AI in Language Learning

Personalized learning refers to an educational model that tailors content, instruction, and assessments to the individual needs of learners. Hîrbu (*"Enhancing foreign language learning through AI"*.45-46) emphasizes that AI-based tools are reshaping how students engage with language content, offering interactive lessons that adapt to each learner's unique proficiency level. AI-driven platforms like *Duolingo*, *ChatGPT*, and *Grammarly* are capable of using machine learning algorithms to track progress and adjust the learning experience accordingly, providing tailored challenges and instant feedback. These personalized learning paths enhance learner engagement, increasing retention rates and facilitating more effective language acquisition.

As Katonane Gyonyoru (2-10) argue, AI technology enhances scaffolding in language learning by offering temporary support to novice learners, helping them complete tasks or acquire skills, and then gradually reducing that support as they become more proficient. Through adaptive systems, AI can support learners in progressively mastering new skills, ensuring that tasks and lessons build upon previous knowledge and abilities. These systems provide just-in-time feedback and additional support, contributing to the development of self-regulation and critical thinking skills.

#### 2.2. AI and Equity in Education

AI holds considerable promise for enhancing equity in education, particularly by addressing barriers related to access, cost, and resource distribution. AI-based platforms make language learning more accessible by reducing the reliance on costly private tutors and providing continuous, on-demand educational support. This opens opportunities for learners from diverse socio-economic backgrounds, including those in underserved regions, to engage with high-quality educational content at an affordable price.

AI's potential to foster social inclusion is also significant. According to Gobert et al. (252-260), AI-powered tools help eliminate geographic and economic barriers by offering flexible, self-paced learning options that are available regardless of location or economic status. This democratization of language learning contributes to a more inclusive educational landscape, enabling learners from various backgrounds to access the resources they need to succeed.

### 3. Social Interaction and AI Learning Environments

Despite the clear advantages of AI in language learning, one notable limitation is its inability to replicate the social interaction integral to language acquisition. Vygotsky's social constructivist theory (1978) posits that cognitive development is significantly influenced by social interactions. AI-powered tools, while effective in individualized learning, lack the emotional and social nuance that human instructors bring to the classroom.

To address this gap, it could be suggested integrating community engagement features into AI platforms. By incorporating live classes, peer feedback, and interactive discussion forums, AI tools can create a more social learning environment. These features allow students to collaborate with peers, engage with instructors, and practice language in a meaningful context. Not only do they enhance language skills, but they also foster motivation and build a sense of community among learners.

Additionally, Hîrbu argues that the role of computers in the classroom should be viewed from a broader perspective. He states that computers should be seen not only as teachers but also as tools that complement classroom activities and aid in language practice (Hîrbu, *"Utilizarea tehnologiilor informaționale în predare - învățare a limbilor străine"* 121). This perspective highlights the multifunctionality of technology in education, particularly in AI-powered personalized language learning, where adaptive learning systems play a crucial role in enhancing language acquisition. Therefore, combining AI's personalized approach with human interaction and community-building features can help overcome its limitations and create a more holistic language learning experience.

The shift toward personalized education marks a critical step in promoting equity and social inclusion. By embracing adaptive learning technologies, differentiated instruction, and data-driven approaches, we can ensure that every student, regardless of their background, has the opportunity to reach their full potential.

### 4. Survey Results

A survey was conducted with ASEM students to evaluate the effectiveness and impact of AI-driven language learning tools. The key results are presented below:

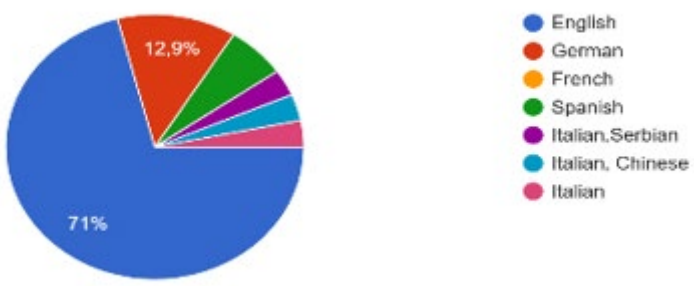


**Figure 1. Most learned languages.**
**Source:** *Data based on internal survey conducted within the study.*

A significant 71% of the students indicate English as their preferred language of study. German represents a notable 12.9% of the language preferences, making it the second most popular choice. The remaining languages (French, Spanish, Italian/Serbian, Italian/Chinese, and Italian) each represent a smaller portion of the students' preferences.

ChatGPT and Duolingo are the most popular choices, with 22 and 20 students respectively using them. Google Translate is also widely used, with 17 students. Grammarly sees moderate usage (6 students), while other apps like Babbel, Mondly, Elsa Speak, DeepL, and a combined group including Drops, LingoDeer, Falou, and Busuu have very low adoption rates, with some even showing zero usage.

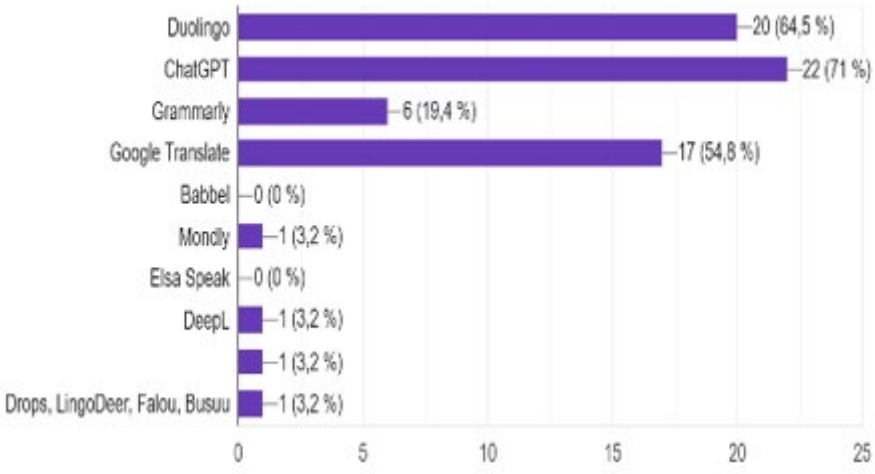


**Figure 2. Most used apps.**

**Source:** *Data based on internal survey conducted within the study.*

The most useful features in language learning applications, as preferred by the same group of ASEM students are: grammar and vocabulary suggestions: This feature is the most sought-after, with 16 students (51.6%) expressing interest, and speech recognition: which is found useful by 15 students (48.4%).

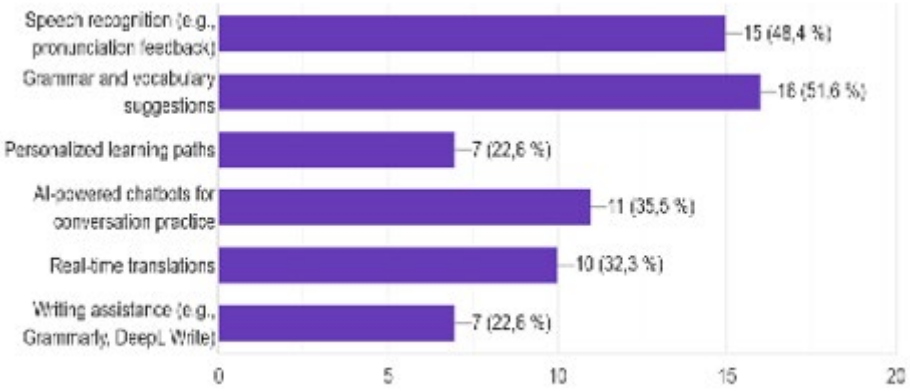


**Figure 3. Most useful features of AI-powered apps.**

**Source:** *Data based on internal survey conducted within the study.*

The most perceived drawback of using language learning applications, as reported by the ASEM students is lack of human interaction, with 14 students (45.2%) citing it as a drawback.

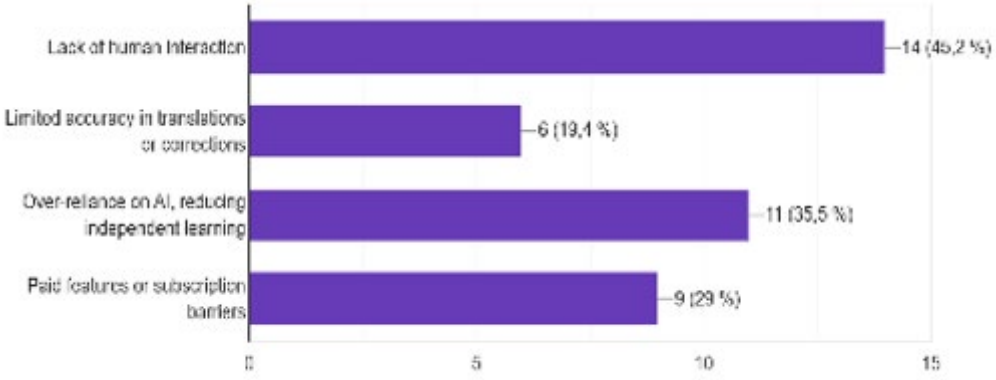


**Figure 4. Challenges of AI-powered apps.**
**Source:** *Data based on internal survey conducted within the study.*

## CONCLUZION

This study highlighted the transformative potential of AI in language education. AI tools like Duolingo, Grammarly, and ChatGPT offer significant advantages over traditional, one-size-fits-all approaches. These advantages include increased efficiency, 24/7 accessibility, and cost-effectiveness, enabling learners to focus on their specific needs and progress at their own pace. The conceptual frameworks emphasize the adaptive and multifunctional nature of AI in this context, demonstrating its capacity to act as a personalized tutor, a task development tool, and a practice resource. However, the study also acknowledges crucial challenges. The lack of nuanced human interaction and potential privacy concerns related to data collection necessitate careful consideration. While AI can enhance language acquisition, it cannot fully replace the complexities of real-life conversations and the social aspects of learning. Therefore, the successful integration of AI in language education requires a balanced approach.

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# THE ROLE OF ACTUARIAL CALCULATIONS IN ENSURING THE FINANCIAL SUSTAINABILITY OF PENSION FUNDS

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**Abstract**: Due to impetuous demographic changes that have hit our planet over the last decade, financial sustainability of pension funds becomes an actual problem of 21st century. This article is dedicated the role of actuarial calculations in ensuring balanced and trustworthy pension system. Actuarial models help forecast financial burdens and analyze potential risks of increased taxes for the workforce. The research involves thorough analysis of impact of demographic trends on pension funds and potential ways of increasing stability in government payments. In this article there were applied either theoretical or practical methods of analyses, including statistical data and current legislative norms.

**Keywords:** *pension system, actuarial calculations, demographic changes, sustainability*

**JEL Classification: C63, J26, G22, H55**

## INTRODUCTION

Nowadays, pension systems in many countries face different challenges due to impetuous demographic changes like ageing population, birth rate decrease and increased life expectancy. Financial sustainability is a milestone of today's economy due to the growth of burden on the workforce as pension payments are continuously rising. Actuarial calculations play an essential role in assurance of balanced and reliable pension systems as they allow forecasting financial burdens, analyzing potential risks and developing strategies for their minimization. Such factors as demographic trends, macroeconomy conditions, current level of income and life expectancy are taken into account while developing actuarial models.

This article aims to examine the impact of demographic chances on financial sustainability of pension funds, the role of actuarial mathematics in forecasting future pensions, and probable strategies in increasing the security of public pensions. Methodology, used while conducting this research, comprises a number of theoretical and practical aspects and is guided by corresponding elaborations in this realm, conducted either in Moldova or abroad.

## MAIN CONTENT

### 1. Materials and methods

It the last few decades, increased life expectancy and decreased birth rate have been observed in many countries. These inevitably lead to changes in population age structure. There is enlarged proportion of elderly people as well as the number of the workforce, that ensure pension payments, decreases [1]. Growing life expectancy is accompanied by not only increased number of pensioners,

but also by shifting their needs. Now, seniors are more active, maintain the ability to work longer hours and require new forms of social security, medical care and financial support.

In terms of healthy aging, national pension system has to be revolutionized as it no longer suits modern policy. Now, it is mainly focused on financial security, when pensioners are not dependent on minimal pension payments just to make both ends meet, but can lead a healthy and fulfilled life.

National pension system is currently based on PAYG (pay-as-you-go) system that means that retirement burdens fall on the shoulders of the employed nation. Such way makes pension system quite vulnerable due to constant brain drain of skilled and qualified workers that leads to increased aged dependency ratio. Another aspect worth mentioning is that "salary in an envelope" is still popular in our country, that is the main risk factor affecting transparency of pension system. Such way of payroll undoubtedly influences future pension payments as it depends on different factors. If the whole salary or its part is paid unofficially, the employer does not make tax deductions to the pension fund or makes payments from a minimum wage, that leads to a decline of total amount of future pension. That is why, such payment scheme may only seem tempting to reduce tax burdens over working years, but when it comes to the retirement, the individual may remain without a sufficient amount of money to provide themselves with all the essentials [2].

Actuarial calculations are the milestone of financial sustainability of pension funds as they allow forecasting average life expectancy and its impact on terms of pension payments. Due to the growing number of centenarians, pension system runs the risk of deficit in money, granted for them by the government. Actuarial mathematics also helps manage individual calculations for pensioners depending on their contribution period during lifetime [3].

## 2. Results and discussions

In the Republic of Moldova ageing population is constantly growing. At the beginning of 2024 the percentage of pensioners (60 years or more) was 25,2% or a quarter of all residents, that means the demographic ageing ratio is quite high (Figure 1).

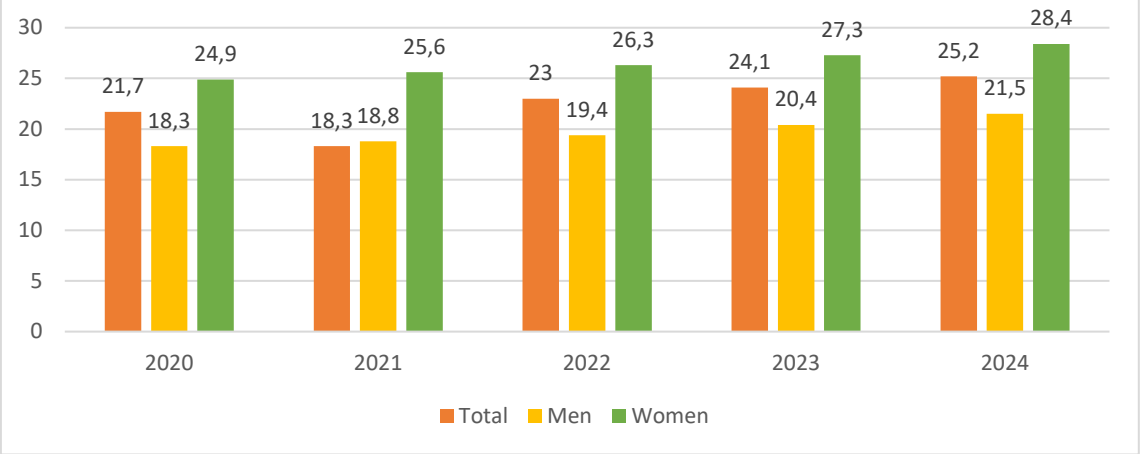


**Figure 1: Demographic ageing ratio by gender (2020-2024)**

**Source**: *National Bureau of Statistics* [4]

Average subsistence minimum for pensioners could cover all the essentials at the time of year 2023, but due to current inflation level and price increase, it is supposed not to be enough anymore. Even if the amount of received retirement payments is sufficient for covering the cost of municipal service and staple food, there can be no talk of any healthy ageing and fulfilled life (Figure 2).

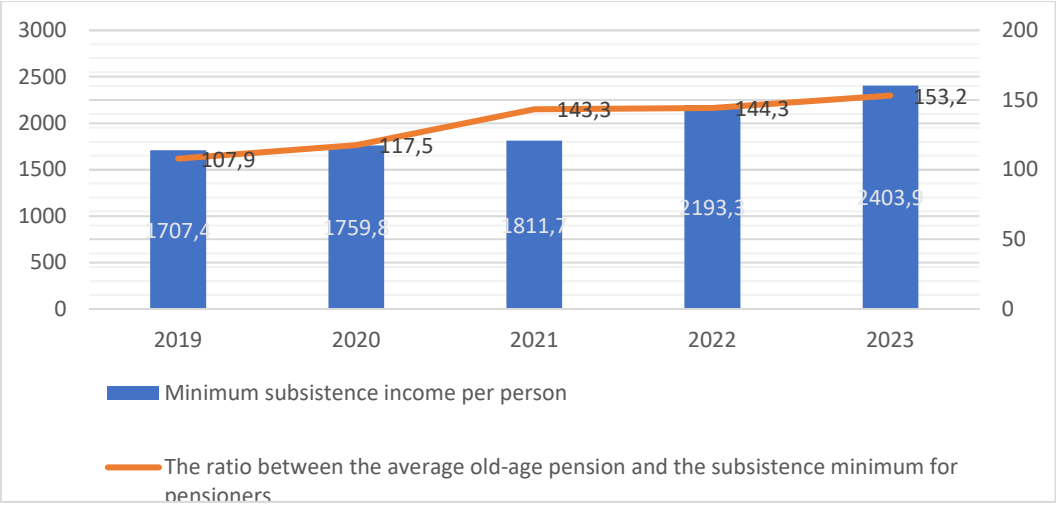


**Figure 2: Minimum subsistence income in lei and % (2019-2023)**

**Source**: *National Bureau of Statistics* [4]

The percentage of employed aged population has also increased over the last four years due to difficult economic situation and increased level of prices. Pensioners now are running the risks of becoming ill too frequent because of insufficient time for quality rest (Figure 3).

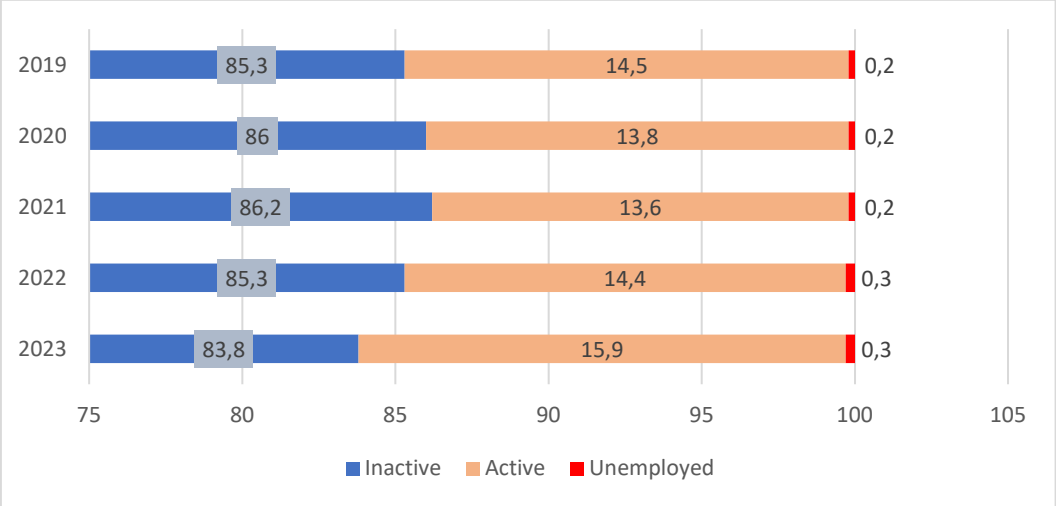


**Figure 3: Employed pensioners in % (2019-2023)**

**Source**: *National Bureau of Statistics* [4]

According to General Government Law on Pensions and Social Insurance, the average monthly insured income can be calculated individually, using formula (1). It is quite an important datum, that reflects an individual's average income used to make deductions to social funds. This indicator shows the impact on future pension payments, dole and maternity leave [5].

$$S_a = \frac{\Sigma_{i=1}^{n}({}^{con_i}/_{C_i})}{n} \quad (1)$$

$S_a$ – average monthly insured income
$con_i$ – the sum of individual contribution, paid in the i-year
$C_i$ – amount of individual contribution, established in the i-year
n – number of paid months

Another formula, worth mentioning is certainly the one, by which the full retirement pension is calculated (2) [5].

$$P = 1{,}35\% * T_t * V_{av} \quad (2)$$

P – full retirement pension

$T_t$ – full insurance period

$V_{av}$ - valorized average monthly insured income

To illustrate this formula application, full retirement pension for school teachers with full insurance period of 34 years and valorized average monthly insured income of 12 000 lei can be calculated as:

$$P = 1{,}35\% * 34 * 12\,000 = 5\,500\ lei \quad (3)$$

## CONCLUSION

In this article there was discussed the role of actuarial calculations in ensuring financial sustainability of pension funds under demographic changes. It was revealed that such factors like increased life expectancy, decreased birth rate and ageing population dramatically impact pension systems by increase in tax burdens on employees.

Main method of investigation included actuarial modeling, statistical analyses of national pension payment systems and use of mathematical formulae to calculate individual pension payments and average monthly insured income to assess full retirement pensions.

Constrains of integrating actuarial calculations are related to a number of factors, including high ratio of people, employed unofficially and receiving "salaries in an envelope", that certainly decline the amount of pension payments and undermine the reputation of governmental policy. Also, increased inflation and economic crisis can make it difficult to forecast probable changes in longer period of time.

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# ONLINE PLATFORMS FOR LEARNING PAINTING AS A MEANS OF PROMOTING HEALTHY AGING

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**Abstract.** The present study examines the influence of online learning platforms for painting on healthy aging, highlighting their cognitive, emotional, and social advantages to older adults. With increasing access to digital technology, creative activities such as painting from online tutorials offer an unique advantage to mental exercise, emotional satisfaction, and social engagement in old age. The review scrutinizes various websites, including *YouTube*, *Skillshare*, *Udemy*, and niche sites like *Art Therapy Online*, for their usability, accessibility, and quality of content. The study finds strengths and weaknesses of each site, with ease of use, structure in courses, and opportunities for social interaction being specifically emphasized. In addition, it addresses the therapeutic benefits of painting for the elderly, particularly stress relief, alleviation of anxiety and depression symptoms, and enhancement of cognitive functions. Lastly, this research provides suggestions on selecting the most appropriate platforms for the elderly who wish to engage in creative activities and enhance their overall health and well-being.

**Keywords:** online learning platforms, healthy aging, painting education, creative engagement, mental health, older adults

**JEL Classification: I2**

## INTRODUCTION

In recent years, scientists across various countries have increasingly focused on the study of the brain and psyche, with the aim of preventing mental diseases and identifying ways to achieve healthy aging. One activity that has proven effective in supporting mental well-being and promoting healthy aging is art. In this paper, we will explore the role of painting – one form of art – as a tool to enhance the mental health of older adults. We will consider not only traditional in-person lessons with instructors but also online platforms that offer similar opportunities. The significance of this research lies in the fact that modern technologies now enable elderly people from around the world to learn painting, which can contribute to their mental and psychological well-being as they age. We aim to support this hypothesis by reviewing scientific studies that highlight the benefits of painting for psycho-emotional health, with research conducted by experts in both Europe and the United States.

## MAIN CONTENT

### 1. Literature Review

Healthy aging involves maintaining cognitive ability and emotional well-being as one ages, achieved by activity, socialization, and mental health. This is significant to aging as it allows individuals to live well, remain positive about themselves, and deal with the challenges of advanced age. Art, particularly painting, plays a significant role in this endeavour. New technologies now enable older people to learn painting online, providing a new means of participating in this art form. Older people, however, tend to struggle with learning to use online spaces. It is thus essential to find easy-to-use platforms with easy-to-use interfaces that can support their learning process.

According to Rowe and Kahn (435-437), healthy aging is linked to maintaining social well-being, physical and mental health. This framework focuses on the contribution of engaging activities, such as art, in maintaining mental health in the aging process. Further, Chung and Lee (2018) assume that online learning platforms possess a unique strength in overcoming physical barriers and social isolation among the elderly. The positive impact of creative activities of creative activities in the aging process have been extensively documented. Additionally, studies by Camic and Chatterjee (67-70) demonstrate the significant role that can play in promoting emotional well-being and cognitive health among older adults. Painting, in particular, has been shown to improve cognitive flexibility and to decelerate cognitive aging. Similarly, Creech et al. (85-97) found that musical and artistic engagement among older adults is significant in cognitive development, further confirming the therapeutic value of creative expression.

Furthermore, Lee, V., et al. (2-19) point out highlight the growing role of digital channels in facilitating cognitive stimulation among older individuals. The internet allows older individuals to access creative channels such as painting at any place, developing both their emotional and cognitive well-being. Although the benefits of online learning channels are clear, older individuals find it difficult to adopt new technologies. Vaportzis et al. (30-39) highlight the challenges that elderly individuals face in accessing online sites, particularly the technological barriers that hinder them from pursuing online courses. To mitigate such barriers, sites for older adults must focus on simplicity and accessibility.

### 2. Positive Effects of Painting on Healthy Aging

Engaging in art activities such as painting has been proven to have a range of positive effects on older individuals in terms of both their cognitive and physical functions. The act of painting not only enhances brain function but also helps improve emotional well-being, and foster social connections. In the sections below, we explore the numerous benefits of painting for healthy aging, supported by scientific studies.

**Cognitive Benefits.** One of the biggest benefits of painting for older individuals is its positive effect on cognitive function. Evidence has shown that creative activities like painting can actually stimulate the mind and slow intellectual decline by enhancing memory, mental flexibility and attention. Research presented in *Frontiers in Aging Neuroscience* (2015) revealed that creative activity offers neuroplasticity – this capacity of the brain to create new connections and pathways between neural cells – which thus helps maintain cognition and delay the onset of neurodegenerative disorders. Cognitive stimulation by this activity plays an important role in slowing down the brain-deterioration effects of age and maintaining mental sharpness.

**Physical Benefits.** Besides its cognitive advantages, painting also helps to preserve physical health by improving fine motor skills and hand-eye coordination. Such physical abilities are important for older adults to ensure independence and carry out daily activities. The *Journal of Aging and Physical Activity* (2017) published research that highlighted the positive influence fine motor activities have on dexterity: painting works to retain manual ability and physical well-being. For the older adult, this improves the physical aspect needed to carry-on with daily tasks and lessen the chance of falling while increasing independence in movement.

**Emotional Health.** Painting has many advantages for mental and physical health, but it also has a big impact on emotional health. Painting is one form of creative expression that has been repeatedly shown to help older adults who struggle with stress, anxiety, and depression. For instance, a study that was published in *Art Therapy Online* showed that people who painted for just forty-five minutes saw a significant decrease in the stress hormone cortisol. According to this research, painting may be a useful technique for emotional control, assisting senior citizens in managing stress and encouraging mental calm. Furthermore, the artistic process of painting promotes self-expression, which can boost confidence and give one a feeling of achievement (Jingxuan Hu, et.al. 1-6).

**Social Engagement.** Another important component of healthy ageing is social interaction, and painting is a great way to promote social ties. Older adults can interact with people who have similar interests through online platforms that have community features like forums, live classes, and group challenges. This interaction promotes a sense of belonging and lessens feelings of isolation, which are common concerns for many seniors. Because they offer chances for emotional support, encouragement, and shared experiences, social connections are crucial for preserving mental health. Older adults can maintain their involvement and build lasting relationships by taking part in painting communities, which has a major positive impact on their general wellbeing.

## 3. Review of Existing Online Platforms

The primary benefit of online education is that users are able to connect at any time and from any location, view lessons whenever it is convenient for them, and learn at their own pace. By providing flexible access to resources and encouraging self-paced learning, digital platforms and AI tools have the potential to improve educational experiences, claims Hîrbu (46–48). Additionally, online resources are crucial in addressing loneliness, especially for older people who are less socially active. These platforms offer a different way to communicate, like chat rooms and forums, where users can engage with others who share their interests and build a sense of community.

Despite these advantages, the main disadvantage of online learning is the technological barrier. Older adults, in particular, often find it difficult to master modern technologies. As highlighted by previous author (50)**,** the unfamiliarity with digital tools can make online platforms and AI tools feel challenging and overwhelming for many. This technological gap can hinder the effective use of these platforms by older generations.

## 4. Analysis of Popular Platforms

Within our study, we analysed five well-known platforms for learning painting: Udemy, Skillshare, YouTube, Domestika, and Craftsy. Based on a comparison of several key criteria we selected the best platform for each aspect. The figure below was created within our study, summarising the findings about the five different platforms.

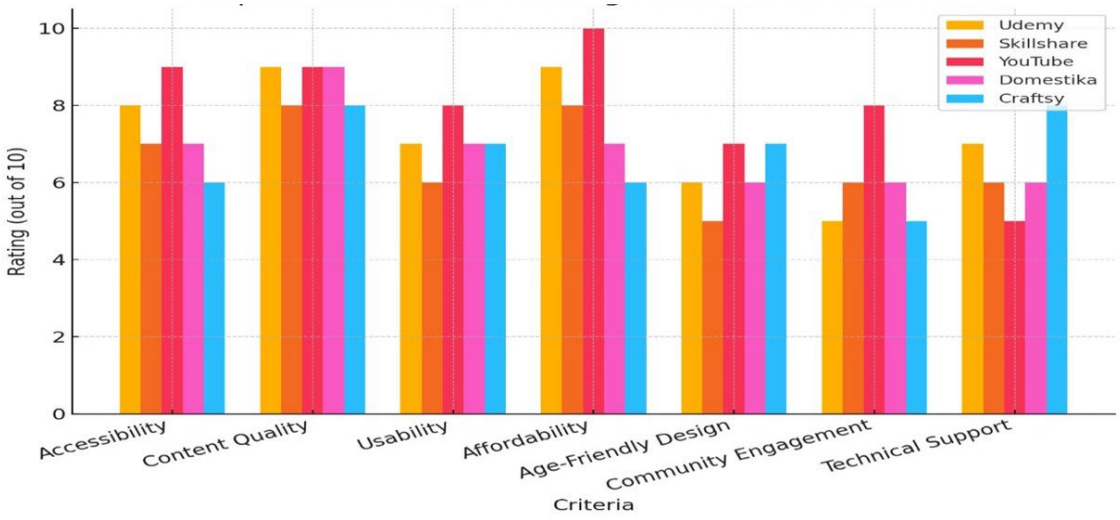


**Figure 1 Comparison of online painting platforms for older adults.**
**Source:** *Data based on internal analysis conducted within the study.*

According to the Fig. 1, *YouTube* is the best platform for *Accessibility* and *Affordability* and *Community Engagement*, offering free access, ease of use, and interactive features like forums. *Udemy and Domestika* excel in *Content Quality* and Structured Learning, providing high-quality courses that cater to various skill levels. *Skillshare* stands out for its *Community Engagement*, with interactive features and forums that foster a strong sense of community. *Craftsy* was highlighted in the comparison for the specific categories like *Technical Support*, and remains a user-friendly platform for seniors. This analysis highlights the strengths of each platform, helping users choose the best option based on their wishes and needs.

### 5. How to Choose the Best Platform

When selecting a painting learning platform, especially for older people, there are different aspects to be considered so that the platform satisfies the needs and preferences of the user. Based on the comparison of the platforms, the following are some of the key considerations:

- ✓ Search for websites with senior-friendly interfaces and easy navigation.
- ✓ Prioritize platforms with features of community that allow interaction and feedback.
- ✓ Utilize platforms that offer formal lessons and sequential learning progressions.

## CONCLUSION

Overall, new-age technologies have created new ways to learn painting, providing access to online courses, virtual workshops, and imaginative art-making resources. These online sources enhance the learning process, making it possible for older adults to master various techniques of painting. Painting is not only enhancing imagination but also relaxing, having a positive impact on emotional well-being. Furthermore, such activity continues to build the nervous system, enhances concentration, and enhances memory. Therefore, either through traditional or modern technologies, painting is an effective tool for personal development and healthy aging.

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