THE IMPACT OF DIGITALIZATION ON SUSTAINABLE DEVELOPMENT INDICATORS

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Abstract
One of the major objectives of the EU is digitalization. The impact of digitalization is different from one sector to another and sometimes in contradiction with sustainability. Starting from these ideas, we started the research, reporting on three sectors: entrepreneurship-trade, agriculture and justice. After establishing the sectors, we took the necessary steps to obtain the database with the specific indicators. The impact of digitalization on sustainable development indicators in the three sectors represents the central objective of the research, the period to which we reported being 2013 - 2024. The digitalization and sustainable development indicators were extracted at the level of the 27 EU member countries, the statistical processing being carried out with the JASP and Eviews programs. The analysis of the results revealed a lack of correlation between digitalization and sustainability in the agricultural sector, a significant correlation between sustainable development and sustainability in the case of large economic entities within the entrepreneurial environment, and a significant direct correlation between digitalization and the indicators defining the health and justice sectors.

Keywords
entrepreneurship, e-commerce, agriculture, labour market, e-justice, economy

JEL Classification
F43, F63, F64

Introduction

Digitalization is essential in the current economic and social context, exerting a significant influence across all areas of human activity, including healthcare, education, public administration, and entrepreneurship.
Among the major objectives of digitalization are: increasing efficiency and productivity, real-time access to information, improving the quality of services, continuous innovation and development, sustainability and environmental protection, enhancing

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competitiveness, and resilience to various types of crises, among others (Manrique S.R.C., 2025).

Researchers' interests in the field of digitalization are diverse, focusing on topics such as: the impact on employment and the labor market, digital inequality and access to technology, cybersecurity, effects on sustainability, corporate social responsibility, evolution of business models and continuous innovation, and the adoption and implementation of digitalization across different sectors.

A key driver of business digitalization, regardless of sector, is technological advancement. This advancement inevitably leads to the need for continuous employee training, making digitalization a significant challenge for the labor market. Addressing these challenges requires a deeper understanding of labor market trends and the preparation of both current and future workforces to adapt to change (Kardkovács, K., 2023).

The trend toward online work environments and improving relationships with third parties is becoming increasingly widespread among businesses. Regarding the European Union's digitalization objectives for entrepreneurs, the EU has set a primary goal of achieving the digital transformation of over 75% of European enterprises, encouraging the adoption of technologies such as cloud computing, artificial intelligence (AI), and big data analytics (European Commission, 2024).

One of the most frequently analyzed and debated sectors in the context of digitalization and sustainability is agriculture. A simple search on the Web of Science (WoS) database using the keywords digitalization, sustainability, and agriculture reveals over 90 research papers published between 2023 and 2025 on this topic.

Among the key challenges in the digitalization of agriculture is the transformation of human resources involved in the sector, to facilitate the adoption of digital technologies in rural areas. This requires a sufficient number of experts and technicians, adequate digital service providers for farmers, and a sufficiently large market to meet the demands of the agricultural and food industry (Ebrahim Navid Sadjadi & Roemi Fernández, 2023).

Research has also revealed a gap between sustainable development and actual sustainability outcomes in agriculture. Similar to non-agricultural entrepreneurial environments, sustainable development in agriculture tends to generate measurable benefits only once a critical threshold has been reached.

Given current global challenges—such as climate change, food security, and resource efficiency—the link between digitalization and sustainability in agriculture is increasingly relevant. This connection enables benefits such as: real-time data collection and analysis, waste reduction and food traceability, implementation of circular economy principles and precision farming, and assessment and reduction of ecological impact.

Beyond the domains already discussed by researchers, the link between digitalization and the justice system has also been examined. Can digitalization enhance efficiency and improve the public image of the judicial system?

Contemporary developments bring us ever closer to a digitally transformed justice system, thanks to the implementation of new technologies in judicial administration. However, this transformation must occur without compromising procedural guarantees

and, most importantly, without undermining progress in ensuring equal access to justice—a key pillar for achieving social cohesion (Yolanda De Lucchi, 2023).
The connection between digitalization and sustainability in the justice system is reflected in: improved resource efficiency, greater effectiveness of justice services, enhanced access to justice, increased transparency, accountability and public trust, as well as innovation and institutional interoperability.
In conclusion, digitalization remains a significant challenge across economic sectors, yet it serves as a powerful tool for enhancing business competitiveness. When effectively integrated with sustainability strategies, digitalization has the potential to significantly contribute to maximizing outcomes in both the private and public spheres.

1. Review of the scientific literature

1.1 The impact of digitalization on sustainability indicators in the entrepreneurial environment

Research on the impact of digitalization on business sustainability has shown that there is no direct and statistically significant relationship between business digitalization and the economic sustainability of enterprises. This relationship becomes relevant only through the mediating role of environmental sustainability. Although high levels of environmental sustainability can lead to improved economic outcomes, the strength of this relationship is considerably weaker for micro-enterprises compared to larger companies (Miranda, L., et al., 2024).
Cost savings, optimization of raw material usage, productivity gains, and waste reduction have been identified as economic benefits of digitalization in European enterprises. However, these benefits are often counterbalanced by environmental concerns, such as the increase in electronic waste and threats to natural resources, which are perceived as negative externalities associated with digitalization (Andrea T., et al., 2023).
Recognizing that business growth and alignment with market demands increasingly require a dual focus on digitalization and sustainability, companies can pursue this goal through various strategies, depending on the vision and beliefs of their owners and managers.
Based on the findings of recent business-level research, a significant gap persists between digitalization and sustainability. While digitalization tends to improve resource consumption and operational efficiency at the enterprise level, sustainability generates substantial benefits primarily for large enterprises. For small businesses, however, sustainability often poses additional burdens, potentially undermining the advantages brought by digitalization.

1.2 The impact of digitalization on sustainability indicators in the agricultural sector

The agricultural sector has been extensively analyzed from an economic perspective, with a growing emphasis on bridging the gap between digitalization and sustainability. Key research topics include the role of digitalization in sustainable agriculture and the sustainability requirements essential for the digital transformation of agriculture.

The increasing interest in agricultural digitalization is further evidenced by empirical studies conducted among farmers, who have shown a growing willingness to increase investments in digital technologies in the near future.
Recent studies have revealed the existence of a nonlinear relationship between digitalization and sustainability in the agricultural sector. Specifically, the impact of digitalization on each sustainability dimension follows a U-shaped curve, indicating that positive effects only emerge once digital development reaches a certain threshold. In other words, premature or partial digitalization may yield limited sustainability outcomes, whereas advanced digital integration can significantly enhance environmental, social, and economic sustainability in agriculture.

1.3 The impact of digitalization on sustainability indicators in justice

Digitalization in the justice sector is a global phenomenon with profound implications for the administration of justice. The transition to a digitalized legal system is perceived differently depending on the stakeholders involved. Traditionalists often remain hesitant about the move toward digitalization, despite its objectives of enhancing efficiency, accessibility, and transparency within the legal system.
Research on the digitalization of judicial systems suggests that, although digital tools have the potential to significantly improve judicial operations, their implementation is frequently impeded by practical challenges that require carefully designed strategic management.
Some of the key barriers to digitalization in the judiciary include technical limitations, the absence of centralized initiatives, and a conservative mindset among legal professionals. Overcoming these challenges necessitates a strategic plan that incorporates the development of a unified digital platform, the ensuring of information security, and comprehensive training programs for legal practitioners.
The emergence of terms such as e-justice and e-administration further underscores the urgency and relevance of digital transformation in the justice sector. Studies highlight the main benefits of e-justice, including convenience, efficiency, greater accessibility, reduced bureaucratic procedures, and a decrease in corruption risks due to minimized physical interactions.
Moreover, the functionality and efficiency of e-court platforms can be significantly enhanced through the incorporation of artificial intelligence (AI) and the integration of Blockchain technologies, offering new avenues for innovation and trust in judicial processes.

2. Research methodology

The foundation of this research paper is built upon two key concepts: digitalization and sustainability. Although these concepts are distinct, they are closely interconnected and play a critical role in the development of society and the global economy.
While digitalization refers to the integration of advanced technologies into economic activities, sustainability emphasizes the responsible use of natural resources—specifically, engaging in activities that do not deplete resources, harm the environment, or exacerbate social inequalities.

The central research question guiding this study was: What impact does digitalization have on sustainability?
To address this question, we selected three relevant digitalization indicators and correlated them with key sustainability indicators, as presented in the following table:

Table no. 1. The digitalization indicators (D) and sustainability indicators (IDD)

Variable	Symbol	Domain
Enterprises with e-commerce sales of at least 1% of turnover	V1	Digitalization
Enterprises' total turnover from e-commerce sales	V2	
Internet use: selling goods or services	V3	
In work at-risk-of-poverty rate	IDD 1	IDD
Agricultural real factor income per annual work unit	IDD 2	
Government support to agricultural research and development		
Share of people with good or very good perceived health by sex	IDD 3	
Real GDP per capita	IDD 8	
Perceived independence of the justice system-Very good or fairly good	IDD 16	

Source: https://ec.europa.eu/eurostat/web/main/data/database

The selection of variables in this study was guided by the three pillars of sustainable development: economic, social, and environmental. In identifying the variables related to digitalization and e-commerce, we proceeded from the premise that sustainable development also entails adaptation to the digital economy. The connection between these variables and sustainability lies in the fact that digitalization fosters economic inclusion by expanding market access, thereby contributing to sustainable economic growth.
With regard to the agricultural sector, the variables were selected based on the availability of data for the year 2024 at the time of the research. In addition, several relevant factors were considered, such as the essential role of sustainable agriculture in ensuring food security and the responsible management of natural resources, investment in green technologies, and adaptation to current climate conditions.
As demonstrated by existing research, digitalization provides numerous benefits and supports economic development. To assess the impact of digitalization on the economy more broadly, we selected real GDP per capita, a macroeconomic indicator that reflects the overall level of economic development.
The indicators IDD 1 and IDD 3 were selected based on the idea that social sustainability encompasses inclusion, equity, and well-being. In this context, the at-risk-of-poverty rate reflects income inequality and employment quality, while health status serves as a direct indicator of quality of life and a benchmark for access to essential healthcare services.
In the justice sector, we selected the only available variable with data for 2024. The main justification for this choice is the recognition that an independent judicial system is vital for maintaining the rule of law and ensuring the coherence of public policies.
Based on the selected topic and variables, the following research hypotheses were formulated:

- H1 – There is a direct and significant correlation between the level of digitalization and a country's economic growth. Given the objectives of digitalization, its large-scale implementation is expected to increase efficiency and effectiveness in business activities, thereby significantly contributing to national economic performance.
- H2 – The financial capacity of the population is a decisive factor in the successful implementation of digitalization. Effective digitalization requires widespread access to advanced technologies and information, which entails financial costs.
- H3 – Digitalization contributes to greater objectivity in the justice system by reducing the potential for human intervention in certain legal procedures.

- H4 – All sectors, including agriculture, require digitalization; however, this must be closely aligned with sustainable development principles.

The analysis period spans from 2013 to 2024, and the study focuses on the 27 EU member states. The data used is panel data.
For the descriptive statistics and the calculation of Pearson's correlation coefficient, we employed the EViews statistical software, while network analysis was conducted using JASP.

3. Case study

The case study begins with a statistical analysis, which allows us to validate or invalidate the variables. The results obtained from the descriptive statistics are presented in the following table:

Table no. 2. The digitalization indicators (D) and sustainability indicators (IDD)

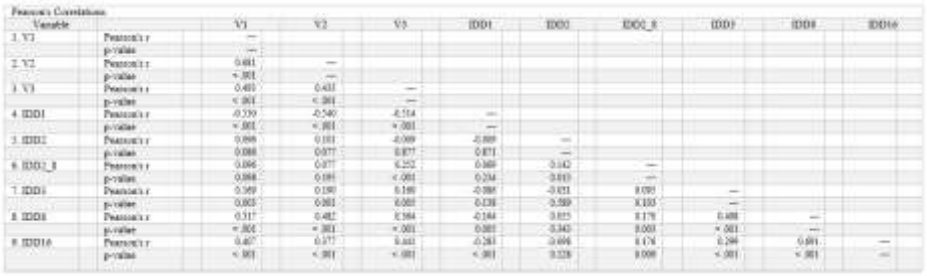
Descriptive Statistics

	V1	V2	V3	IDD1	IDD2	IDD2_8	IDD3	IDD8	IDD16
Valid	320	306	322	302	324	302	301	299	243
Missing	4	18	2	22	0	22	23	25	81
Mean	18.673	16.582	17.609	8.124	116.010	114.408	66.657	26.970	54.786
Std. Deviation	7.869	7.666	9.895	3.131	26.601	207.935	9.542	17.301	18.487
Skewness	0.460	0.514	0.375	0.782	0.927	2.982	-0.728	1.509	0.007
Std. Error of Skewness	0.136	0.139	0.136	0.140	0.135	0.140	0.140	0.141	0.156
Kurtosis	-0.567	0.172	-0.601	0.944	1.423	9.401	-0.061	2.532	-1.022
Std. Error of Kurtosis	0.272	0.278	0.271	0.280	0.270	0.280	0.280	0.281	0.311
Minimum	4.760	1.580	0.960	2.500	53.970	0.267	42.800	5.470	17.000
Maximum	38.580	43.950	47.670	19.800	225.660	1121.618	84.500	86.540	88.000

Source: Own processing using Eviews, 2025

The average values of the variables exceed the standard deviation, and the Skewness and Kurtosis levels fall within the specific range limits, which confirms their validity.
The correlation analysis between variables using Pearson's index is presented in the following table:

Table no. 3. The digitalization indicators (D) and sustainability indicators (IDD)



Variable		V1	V2	V3	IDD1	IDD2	IDD2_1	IDD3	IDD4	IDD16
1. V1	Pearson's r	—								
	p-value	—								
2. V2	Pearson's r	0.681	—							
	p-value	< .001	—							
3. V3	Pearson's r	0.401	0.431	—						
	p-value	< .001	< .001	—						
4. IDD1	Pearson's r	-0.339	-0.540	-0.514	—					
	p-value	< .001	< .001	< .001	—					
5. IDD2	Pearson's r	0.099	0.103	-0.009	—	—				
	p-value	0.088	0.077	0.877	0.871	—				
6. IDD2_1	Pearson's r	0.096	0.077	0.252	0.369	0.142	—			
	p-value	0.088	0.195	< .001	0.234	0.033	—			
7. IDD3	Pearson's r	0.369	0.190	0.180	-0.086	-0.031	0.093	—		
	p-value	0.003	0.003	0.005	0.238	0.580	0.185	—		
8. IDD4	Pearson's r	0.317	0.482	0.384	-0.164	0.055	0.179	0.408	—	
	p-value	< .001	< .001	< .001	0.005	0.343	0.003	< .001	—	
9. IDD16	Pearson's r	0.407	0.377	0.441	-0.283	0.096	0.174	0.299	0.091	—
	p-value	< .001	< .001	< .001	< .001	0.228	0.009	< .001	< .001	—

Source: Own processing using Eviews, 2025

The Pearson analysis reveals insignificant correlations between digitalization indicators and agricultural sector indicators. When considering the specific type of digitalization indicator, such as the shift to electronic sales, the correlation pattern is justified, as agricultural sales are primarily conducted physically. However, the online environment can still be effectively used for product promotion.

A significant inverse correlation was established between the population's risk of poverty and digitalization. Access to digitalization is generally dependent on the financial capacity of the population in a given region.

Direct correlations were identified between digitalization and health status. In the medical field, digitalization is becoming increasingly important, especially with the emergence of new trends such as telemedicine.

Digitalization has a direct and significant impact on economic growth in a given country or region.

Additionally, a direct and significant correlation was found between digitalization and the justice system. As digitalization expands in the judiciary, efficiency and effectiveness in this field will increase.

Possible causal relationships between the analyzed variables include:

Between digitalization and economic growth, through market expansion, cost reduction, and operational efficiency;

Between digitalization and poverty reduction, by creating new jobs, enabling work flexibility, and improving access to services;

Between increased levels of digitalization and agricultural income, through the adoption of precision farming, access to digital markets, and optimization of agricultural processes;

Between GDP growth and the reduction of poverty risk, as well as the improvement of public health;

Between poverty reduction and improved health status, in the sense that people would have more resources for food, housing, and medical services;

Between an independent judiciary—which can increase public trust in institutions—and investments in digitalization and research.

The analysis of relationships between variables was also conducted using network analysis, with the results illustrated in the following graph:

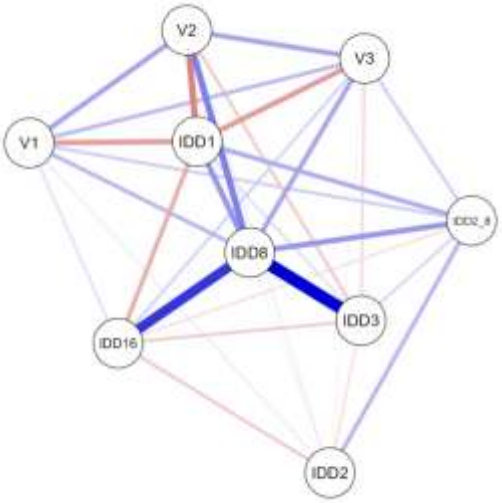


Figure no. 1: Network analysis
Source: Own processing using JASP, 2025

From the analysis of the graph, we can establish the following correlations:
significant direct correlations between digitalization and the economic growth indicator, which leads to the validation of the first hypothesis of the research.
a significant inverse correlation between digitalization and the risk of poverty, which validates the second hypothesis of the research.
significant direct correlations between digitalization and the indicator reflecting the level of judicial independence. even though there are two categories of actors in this sector—traditionalists, who are not proponents of digitalization, and modernists, who see digitalization as a step towards solving issues in the justice system—studies and research demonstrate the necessity of implementing digitalization in this sector as well. these aspects lead to the validation of the third hypothesis.
weaker significant direct correlations between digitalization and agricultural sector indicators, which partially validates the fourth hypothesis of the research.
We can therefore state that, according to the connections identified between IDD 8 (GDP per capita) and IDD 3 (perceived health), IDD 16 (judicial independence), and IDD 1 (risk of poverty), an increase in GDP per capita is associated with better health status, higher trust in the justice system, and a reduction in the risk of poverty.
Total revenues from e-commerce (V2) are more strongly connected to IDD 1 (risk of poverty), with the connection represented by a red line. This can be interpreted as follows: an increase in income for a specific category of individuals does not necessarily imply a reduction in the overall level of poverty. However, V2 is also

connected to IDD 8 (GDP) — this time represented by a blue line — which may be interpreted to mean that rising revenues from e-commerce contribute to economic growth.

Conclusions

One of the European Union's key objectives is to achieve a minimum of 75% digitalization among businesses, a target supported by various European funding programs. Digitalization is essential in the current economic and social context, having a significant impact across all domains of human activity, including health, education, public administration, and entrepreneurship. Among the main goals of digitalization are: increasing efficiency and productivity, real-time access to information, improving service quality, continuous innovation and development, sustainability and environmental protection, enhancing competitiveness, and building resilience to various types of crises, among others.

Digitalization must be aligned with the principles of sustainable development, although the impact of this alignment varies by sector. In the agricultural sector, digitalization offers a path forward for development but also necessitates substantial changes, from human capital adaptation to technological advancement.

For entrepreneurs, the benefits of digitalization in European businesses include cost reduction, optimized use of raw materials, increased productivity, and waste minimization. However, these benefits are often at odds with environmental concerns, such as the increase in electronic waste and the strain on natural resources, which are commonly regarded as negative externalities associated with digitalization.

The research conducted on the impact of digitalization on sustainable development indicators across EU member states yielded the following findings:

A significant inverse correlation between the risk of poverty (as an indicator of economic well-being) and entrepreneurial-level digitalization, particularly regarding the increase in sales through internet and e-commerce platforms.

A direct but weak correlation between digitalization in e-commerce and the agricultural sector, where transactions are still predominantly conducted directly between sellers and buyers, bypassing online intermediaries.

A direct correlation between economic growth—measured by real GDP per capita—and digitalization.

A significant positive correlation between digitalization and the justice system, indicating that digitalization contributes meaningfully to the modernization and efficiency of judicial processes.

A significant positive correlation between economic growth, justice, and online access to public services.

The development of this research paper also revealed several limitations:

- The lack of detailed and comprehensive data from Eurostat limited the scope of the analysis regarding the correlation between sustainable development and sustainability across the three sectors;
- The presence of statistical correlations does not imply causation, and no definitive cause-and-effect relationships can be concluded;

- Sustainability in agriculture is inherently multidimensional, encompassing economic, social, and ecological components;
- The indicators used may not fully capture the complexity of the relationship between sustainable development and sustainability, potentially distorting the actual reality;
- The existence of latent variables—which may influence both sustainability and agricultural development simultaneously—was not accounted for in the study.

Looking ahead, we intend to expand the scope of this research to include other economic sectors. As new data become available through Eurostat, we plan to incorporate additional variables to explore further the relationship between digitalization and sustainable development.

In conclusion, digitalization has varying effects across different sectors. While in the agricultural sector, digitalization often comes into conflict with sustainability goals, in other areas such as justice and entrepreneurship, it has the potential to bring significant added value.

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