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Digital Businesses for Sustainable Development: Empirical Evidence from EU Countries

Emilia Doina Herman
Prof. PhD., Faculty of Economics and Law, "George Emil Palade" University of Medicine, Pharmacy, Science, and Technology of Targu-Mures, Romania

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Abstract

This study aims to explore the interplay between digital businesses and sustainable development in EU countries. The comparative analysis shows that the business digitalization, based on the e-business indicators and digital intensity index, as well as the level sustainable development (measured by Sustainable Development Goals Index Score, the Global Green Economy Index and Human Development Index) vary significantly across EU countries. The results of the correlation and regression analysis suggest that the high level of the sustainable development in some EU countries can be explained by a high share of enterprises with at least a basic level of digital intensity. Based on the cluster analysis, the EU-27 countries were grouped into four clusters, highlighting both the differences and commonalities among EU nations regarding the relationship between the digitalization of businesses and the sustainable development. The greatest challenges for achieving both sustainable development and digital transition are identified in two clusters, particularly in Bulgaria, Romania, the Czech Republic, Poland, Slovakia and Greece. The findings emphasize the essential role of digital skills in improving the adoption of digital technologies by EU enterprises, which, in turn, contribute to achieving social, economic and environmental sustainability.

Keywords: Digital businesses, Digital technologies, Sustainable development, Sustainable Development Goals Index, Global Green Economy Index, EU countries.
Jel codes: O11, O47, O15

1. Introduction

The United Nations 2030 Agenda "Transforming our World: the 2030 Agenda for Sustainable Development" (UN, 2015) includes 17 Sustainable Development Goals (SDGs) which reflect worldwide priorities and address the economic, social, and environmental challenges affecting communities at both global and national levels by 2030. This agenda attempts to restore a balance between progress and sustainability by creating a sustainable world which includes all countries (Castro et al., 2021) and achieving the kind of "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987, p. 43). The SDGs are an integral component of EU strategies. Achieving the UN's 2030 Agenda is crucial to enhancing resilience and ensuring that economies can recover from future shocks as the world faces the twin green and digital transitions (European Commission-EC, 2021a,b). Successfully managing the twin digital and green and transitions, at the EU level, is seen as a key factor for achieving a resource-efficient and competitive economy, fostering a prosperous and fair society, and achieving zero net greenhouse gas emissions by 2050 (EC, 2019; Muench et al., 2022).

The extensive integration of digital technologies into the economy holds significant potential to achieve sustainable development (Wen et al., 2021). In the current environment, the adoption of digital technologies is a real challenge for any enterprise as it has important consequences both for the business and production process, and supply chains and sales channels (Jafari-Sadeghi et al., 2021; Hess et al., 2016).

There are real challenges both for digitalization of business and sustainability in EU countries. While most EU countries have made significant progress in recent years, statistical data (Eurostat Database, 2024a) reveal substantial gaps in the adoption of digital technologies by the EU enterprises. The proportion of SMEs with at least a basic level of digital intensity (defined as using at least four digital technologies) varies widely across EU countries: in seventeen countries, only 60% of SMEs meet this criterion. Regarding sustainable development at EU level, the Sustainable Development Report 2024 (Sachs et al., 2024) highlights significant disparities among EU countries in achieving the Sustainable Development Goals (SDGs). In 2023, the average SDG Index score of EU countries was 72%. However, Central & Eastern and Southern countries have reached approximately 60% of the SDG targets, while Northern countries have achieved over 80%.

Bearing this context in mind, *the aim of this study* is to highlight the potential role of the digital transformation of businesses in achievement of sustainable development in the EU countries. The *research objectives* focused on: performing a comparative analysis at EU countries level regarding different digital technologies used by EU enterprises; exploring the interlink between digital transformation of businesses and sustainable development (expressed by SDG Index score, HDI, GGE Index); identifying the common features and differences between EU member states based on their interrelationship between the digital transformation of businesses and sustainable development.

2. Literature Review

There are a lot of definitions of what digital transformation of businesses means for businesses ranging from "*the use of new digital technologies… to enable major business improvements"* (Fitzgerald et al., 2014) to "the application of technology to build new business models, processes, software and systems" (Schwertner, 2017) with a positive effect on the activity of enterprises. Moreover, Schwertner (2017) emphasized that for a successful digital transformation, business processes should be rethought and optimized to boost the development of companies.

Over the past two decades, businesses of all sizes, across various industries and economic sectors, have progressively adopted various digital technologies, which range from social media and digital platforms, Customer Relationship Management (CRM), Enterprise Resource Planning (ERP) to Cloud Computing (CC), 3D printing, robots, Internet of Things (IoT), artificial intelligence (AI), and so on (OECD, 2018; Grigorescu et al., 2020; EC, 2022).

Multiple positive effects at both micro and macro level of digital transformation of enterprises were identified by different studies (Feroz et al., 2021; Olczyk & Kuc-Czarnecka, 2022; Ivanović & Marić, 2021; Trască et al., 2019). Thus, the digital transformation of enterprises can significantly reduce operational costs, boost annual turnover, enhance productivity, and strengthen competitive advantage, while also creating new business model opportunities. Additionally, it can directly or indirectly drive economic growth and development, improve employment, and increase living standards. Moreover, other studies (Lv&Chen, 2024; WEF, 2024) pointed out that the integration of digital technologies as innovative, low-carbon technologies by businesses reshapes industrial structure, reduces carbon emissions, and contributes to environmental sustainability.

A moderate positive link was identified between the share of enterprises using industrial robots, on the one hand, and GDP per capita and labor productivity, on the other hand, by Stoica et al. (2022), in the case of 21 selected EU countries, in 2021. The integration of digital technologies linked to internal management information systems such as ERP and CRM, along with cloud computing services (CCS), enables companies to improve the firm's information flows (Ivanović & Marić, 2021; Brodny & Tutak, 2022), enhances the efficiency of their core transactional and supply chain processes (Zhang et al., 2021) resulting in optimized business operations, cost savings and increased labour productivity (Matarazzo et al., 2021; Cenamor et al., 2019).

Taking into account various digital technologies used by enterprises, such as ERP, CRM, cloud computing, robots, 3D printing, big data analysis, AI technologies, Brodny and Tutak (2022) found out a positive correlation between the level of digitalization of enterprises and GDP/capita, within EU-27 countries. Aly (2022), analyzing cross-sectional data from 25 developing countries, demonstrated a positive relationship between digital transformation (measured by Enabling Digitalization Index, Digital Adoption Index, and DESI) and key factors for sustainability like labor productivity, economic development, and employment. Herman (2022) showed a positive impact of digital entrepreneurship on the achievement of sustainable development (SDGs), at EU countries level. Gouvea et al. (2018), in a study of 139 countries, discovered that both Information and

Communication Technology (ICT), measured by the Network Readiness Index, and human development, assessed through the Human Development Index, positively influence environmental sustainability, as reflected by the Environmental Performance Index. Additionally, these factors exhibit interactive effects on sustainability outcomes.

Although numerous empirical studies examine the role of specific digital technologies adopted by enterprises in fostering socio-economic development or environmental sustainability, a gap remains in adopting a comprehensive and holistic approach to understanding the interaction between digital transformation in businesses and sustainable development.Therefore, this paper explores the potential role of digital businesses in achieving sustainable development, defined as the simultaneous advancement of the economic, social, and environmental pillars of sustainability, within the context of EU countries.

3. Data & Methodology

To conduct a comparative analysis of EU countries regarding the adoption of various digital technologies by enterprises, we selected eleven indicators (Table 1) based on a thorough literature review and the availability of relevant data. All these indicators are assessed as a percentage of total enterprises (with 10 or more employees).

Table 1. Indicators for digitalization of enterprises

Variables	Significance
1. IoT (Internet of Things)	Enterprises use IoT (interconnected devices or systems that can be monitored or remotely controlled via the internet)* (2021)
2. AI (Artificial Intelligence)	Enterprises using AI technologies for at least one of the purposes: for marketing or sales/ for production processes/ for organization of business administration processes/ for management of enterprises/ for logistics/ for ICT security/ for human resources management or recruiting* (2021)
3. Robots	Enterprises use industrial or service robots* (2022)
4. Integration with customers/suppliers, supply chain management	Enterprises whose business processes are automatically linked to those of their suppliers and/or customers (2023)
5. CCS (Cloud Computing Services)	Enterprises who buy CCS used over the internet* (2023)
6. CRM (Customer Relationship Management)	Enterprises using software solutions like CRM*(2021)
7. ERP (Enterprise Resource Planning)	Enterprises who have ERP software package to share information between different functional areas* (2023)
8. VH_DI	Enterprises with very high (VH) digital intensity (DI) (digital intensity index -DII version 3)
9. BL_DI	Enterprises with at least basic level (BL) of digital intensity (DII Version 3)* (2023)
10. BL_DI_SMEs	SMEs (from 10 to 249 persons employed) with at least basic level of digital intensity (DII Version 3)* (2023)
11. BL_DI_Large enterprises	Large enterprises (250 persons employed or more) with at least basic level of digital intensity (DII Version 3)* (2023)

Note:*Percentage of enterprises.

Source: Eurostat Database (2024a).

To assess the level of *sustainable development* at the EU 27 countries level *three composite indexes* were used*:* Sustainable Development Goal (SDG) Index, Global Green Economy Index (GGEI) and Human Development Index (HDI). The Sustainable Development Goal (SDG) Index evaluates sustainable development by measuring the extent to which countries achieve the Sustainable Development Goals outlined in Agenda 2030. This index assesses each country's overall performance on the 17 SDGs, giving equal weight to each goal. A country's score reflects its position on a scale ranging from the worst possible outcome (0) to the target (100) (Sachs et al., 2024). The Global Green Economy Index (GGEI) evaluates the performance of countries across four key dimensions: climate change and social equity, markets and ESG investment, sector decarbonization, and environmental health. Using 18 indicators, the GGEI tracks progress and sets targets for 160 countries, offering policymakers insights into how policies, investments, and activism can drive a fair and effective transition to a green economy (EC, 2024; Global Green Economy Index Database, 2024). The Human Development Index (HDI) assesses the achievement in three key dimensions of human development: a long and healthy life, a high level of education and a decent standard of living. It was created to emphasize that people and their capabilities should be the ultimate criteria for assessing the development of a country, not economic growth alone (UNDP Database, 2024).

Nominal labour productivity per hour worked and GDP/capita (as percentage of EU-27 =100%) were used to measure economic development in the EU countries.

The statistical data were collected from the Sustainable Development Report Database (Sachs et al., 2024), Global Green Economy Index Database (2024), UNDP Database (2024), and Eurostat Database (2024a,b).

Descriptive statistics (mean, minimum, maximum, and standard deviation), correlation and regression analysis, and cluster analysis were used to investigate the role of digitalization in businesses in achieving sustainable development in EU member states. Data processing and analysis were conducted using IBM SPSS Statistics 26.0.

4. Results & Discussion

Table 2 and Figures 1-2 present the results of descriptive statistics, including minimum, maximum, mean, and standard deviation. These statistics provide insights into the distribution and characteristics of each analysed indicator, reflecting various aspects of digitalization in EU enterprises.

Statistical data (means values) show that the most widely used digital technology by enterprises in EU countries was CCS-cloud computing services (46.70% of EU enterprises), followed by ERP (Enterprise resource planning) software package to share information between different functional areas (41.29% of EU enterprises), and IoT - interconnected devices or systems that can be monitored or remotely controlled via the internet (27.90% of EU enterprises). The least used technologies reported by EU enterprises were AI (5.56%), Robots (5.86%) and CRM-Customer Relationship Management (18.99%). A higher standard deviation means more variation in the data. For instance, CCS has a standard deviation of 16.35, indicating high variability in comparison to Robots, which has a standard deviation of 2.44 (Table 2).

Table 2. Indicators for digitalization of enterprises, in EU-27 countries: descriptive statistics

Indicators	Minimum	Maximum	Mean	Std. Deviation
E-Business indicators				
IoT	10.50 (RO)	50.80 (AT)	27.90	9.63
AI	1.10 (RO)	16.20 (DK)	5.56	3.48
Robots	1.70 (CY)	11.60 (DK)	5.86	2.44
CCS	17.50 (BG)	78.30 (FI)	46.70	16.35
Integration with customers/suppliers	9.40 (RO)	37.90 (CZ)	22.07	9.06
CRM	7.60 (HU)	30.80 (MT)	18.99	6.52
ERP	21.70 (BG)	67.30 (DK)	41.29	11.86
Business Digital Intensity indicators				
VH_DI: Enterprises with very high digital intensity (DI)	0.70 (FR)	13.00(FI)	5.41	3.02
BL_DI: Enterprises with at least basic level (BL) of digital intensity (DI)	27.90 (RO)	86.00 (FI)	59.14	14.28
BL_DI_SMEs	26.80 (RO)	85.60 (FI)	58.20	14.49
BL_DI_Large enterprises	60.90 (RO)	99.80 (FI)	90.74	9.03

Source: Own calculations based on statistical data provided by Eurostat Database (2024a).

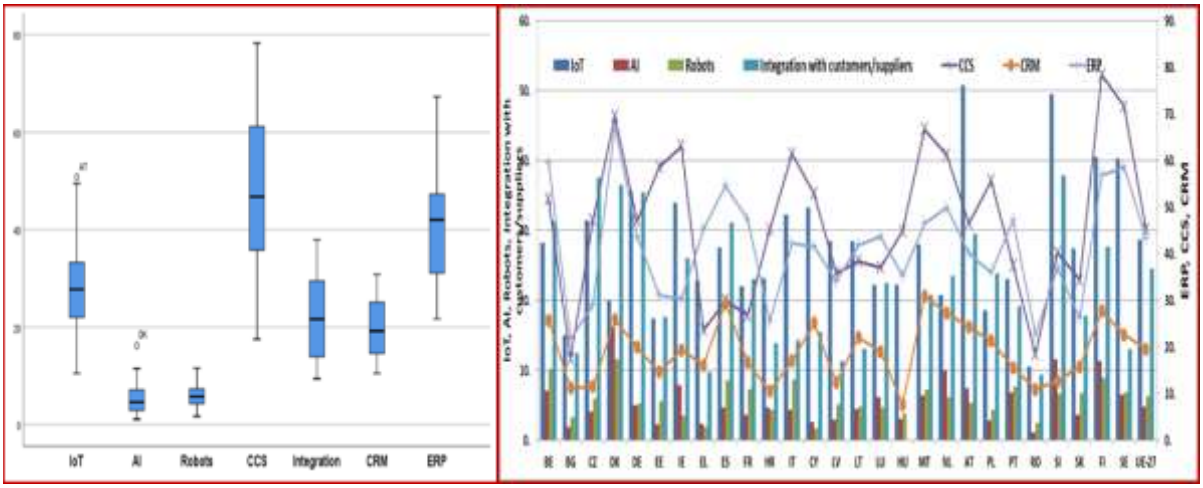

Figure 1. Indicators for digitalization of enterprises (e-businesses), in EU-27 countries.

Source: Based on statistical data provided by Eurostat Database (2024a).

Significant disparities in business digital intensity indicators (VH_DI, BL_DI, BL_DI_SMEs, and BL_DI_Large Enterprises) were observed across EU countries (Table 2 and Figure 2). The share of enterprises with very high digital intensity-defined as those using at least 10 out of 12 monitored digital technologies-ranges from just 0.7% in France to 13% in Finland. For enterprises with at least a basic level of digital intensity, defined as using at least four digital technologies, the share varies between 27.9% in Romania and 86% in Finland. Additionally,

notable differences were found between SMEs and large enterprises in achieving basic digital intensity, with 58.2% of SMEs meeting this threshold compared to 90.74% of large enterprises.

The share of SMEs with a basic level of digital intensity (defined as using at least four digital technologies) ranges from 26.80% in Romania to 85.60% in Finland. Consequently, achieving the "Europe's Digital Decade target by 2030 (EC, 2021b), which aims for more than 90% of SMEs to reach at least a basic level of digital intensity, appears to be a significant challenge, particularly for Eastern, Central, and Southern EU countries.

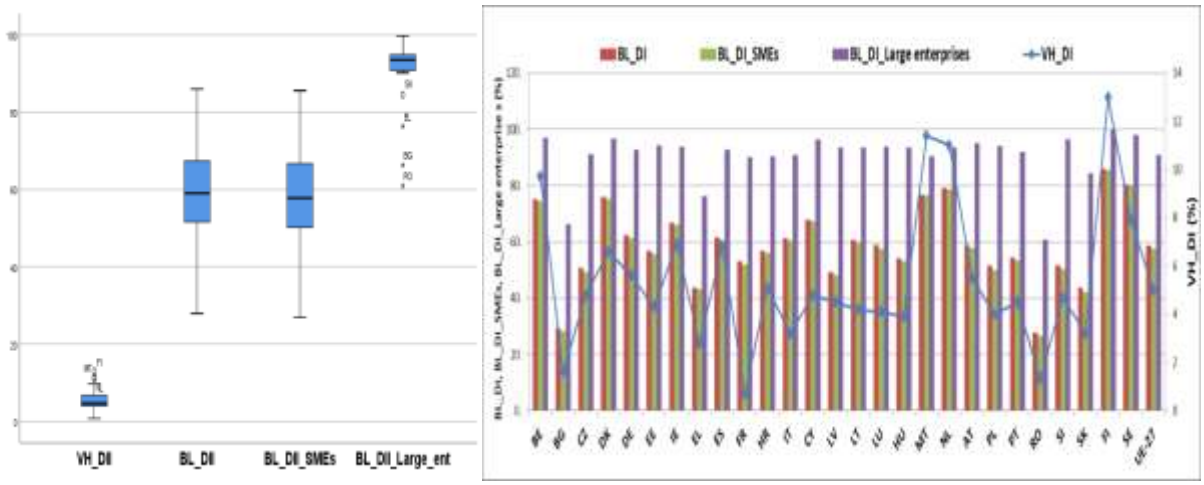

Figure 2. Business Digital intensity indicators, in EU-27 countries.

Source: Based on statistical data provided by Eurostat Database (2024a).

A correlation analysis was conducted to identify which digital and technological practices are most strongly associated with higher labor productivity and economic development (GDP per capita) at the EU level. The correlation results (Table 3) pointed out that AI, CRM, Integration with customers/suppliers, and various forms of digital intensity (DI) (such as BL_DI and VH_DI) show strong positive correlations with both labor productivity and GDP per capita. IoT and Robots have weaker and less consistent correlations, indicating they may have a more limited or context-dependent impact on labour productivity and GDP per capita. The high significance of many correlations ($p < 0.01$) strengthens the reliability of these relationships, especially for variables like AI, CRM, ERP, and BL_DI types, which show robust correlations with both labour productivity and GDP per capita. A high share of enterprises with at least basic digital intensity and a high share of enterprises which use AI, CRM, and ERP are significantly correlated with high levels of both labour productivity and economic development. Therefore, adopting these technologies might enhance both individual productivity and a broader economic performance.

Table 3. Correlations between macroeconomic performance indicators (labour productivity and GDP/capita) and digitalization of enterprises in the EU countries

Correlation	Nominal labour productivity per hour worked[1]	GDP[1]/ capita
IoT	0.386	0.340
AI	0.754**	0.715**
Robots	0.466*	0.372
CCS	0.497*	0.595**
Integration with customers/suppliers	0.584**	0.579**
CRM	0.585**	0.659**
ERP	0.508**	0.568**
VH_DI	0.641**	0.615**
BL_DI	0.714**	0.758**
BL_DI_SMEs	0.707**	0.759**
BL_DI_Large_ enterprises	0.472*	0.531**

Note:* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed). [1] Percentage of EU-27 (from 2020) total (based on million purchasing power standards), current prices (EU-27 =100%).

Source: Own calculations based on Eurostat Database (2024 a,b).

To explore the connection between the digital transformation of businesses and sustainable development (the second objective of this paper), we conducted a correlation analysis between the share of enterprises with at least a basic level of digital intensity (BL_DI) and three composite indexes: the SDG Index score, HDI, and the GGE Index. These indexes reflect achievements in the economic, social, and environmental pillars of sustainability. The correlation results (Table 4) show a positive correlation between digital businesses and all three variable related to sustainable development across EU countries. Digital intensity in enterprises (Enterprises with at least basic level of digital intensity-BL_DI) is strongly linked with human development (r=0.830) and moderately linked with sustainability metrics, such as SDG Index (r=0.391) and Global Green Economy Index (r=0.555). This could indicate that digital advancement supports human development and environmental goals. Therefore, a minimum digital capability in enterprises could support not only economic development but also sustainable development which includes economic, social (human) and environmental development goals. HDI is positively related to both SDG goals (r=0.478) and green economy performance (r=0.629) which implies that development efforts in education, health, and income can align with sustainability and environmental improvements.

Table 4. Correlations between digitalization of enterprises and sustainable development in the EU countries

	Descriptive Statistics				Pearson Correlation (r)			
Variables	Minimum	Maximum	Mean	Std. Deviation	BL_DI	SDGI	GGEI	HDI
BL_DI	27.90 (RO)	86.00 (FI)	59.18	14.28	1	0.391*	0.555**	0.830**
SDGI	72.92(CY)	86.35 (FI)	80.24	3.06		1	0.475*	0.478*
GGEI	0.56 (HU)	0.80 (SE)	0.665	0.06			1	0.629**
HDI	0.80 (BG)	0.95 (SE)	0.903	0.04				1

Note: *Correlation is significant at the 0.05 level (2-tailed), **. Correlation is significant at the 0.01 level (2-tailed).

Source: Own calculations based on Eurostat Database (2024a), Sustainable Development Report Database (Sachs et al., 2024), Global Green Economy Index Database (2024), and UNDP database (2024).

To identify the common features and differences between EU member states based on their interrelationship between the digital transformation of businesses and sustainable development (the third objective of this paper), we conducted the cluster analysis (hierarchical cluster analysis and k-means cluster analysis) (Everit et al., 2011) using four variables (BL_DI, SDGI, GGEI and HDI). Based on the data in Figure 3, EU countries were grouped into four performance clusters regarding the relationship between the aforementioned variables. The first cluster includes the top-performing countries, while the fourth cluster contains the lowest-performing countries.

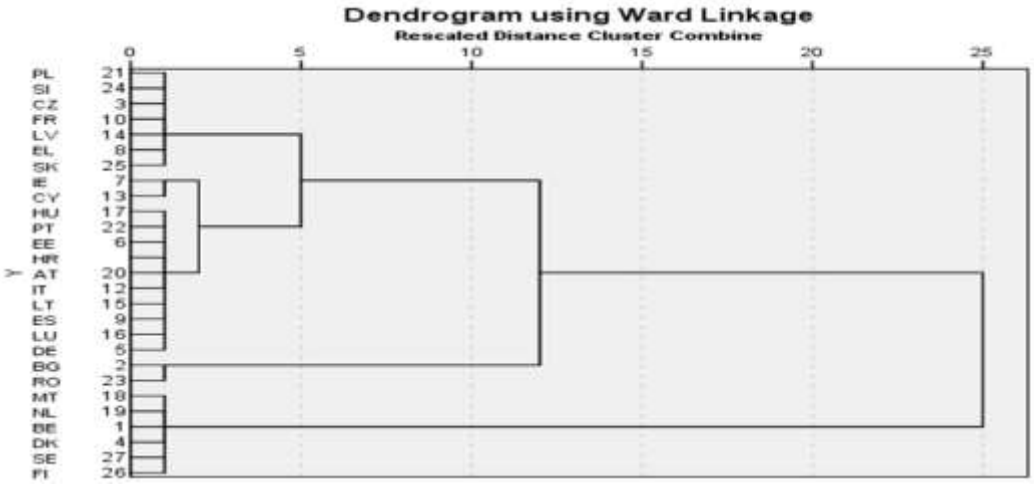

Figure 3. Results of cluster analysis

Source: Own calculations statistical data provided by Own calculations based on Eurostat Database (2024a), Sustainable Development Report Database (Sachs et al., 2024), Global Green Economy Index Database (2024), and UNDP database (2024).

Cluster 1, which consisted of seven countries (Denmark, Ireland, Belgium, Malta, Sweden, Finland, and the Netherlands), old member states (OMS) except for Malta, *is the best performer cluster* in terms of the link between the level of digitalization of businesses and the level of sustainable development. As shown in Figure 4, this cluster is characterized by the highest average values for all variables: SDGI score = 82.21%, GGEI = 0.713, HDI = 0.942, and the share of enterprises with at least a basic level of digital intensity = 78.97%.

At the opposite pole is *cluster 4*, which includes only two countries (Bulgaria and Romania) and has the lowest values for all analyzed variables (Figure 4). The lowest value for BL_DI (28.65%) reflects that, on average, enterprises in countries within this cluster have a basic level of digital intensity that is 2.76 times lower compared to the level achieved by cluster 1 (the best performer). Moreover, statistical results showed the significant gaps in relation to clusters 2 and 3 (Figure 4).

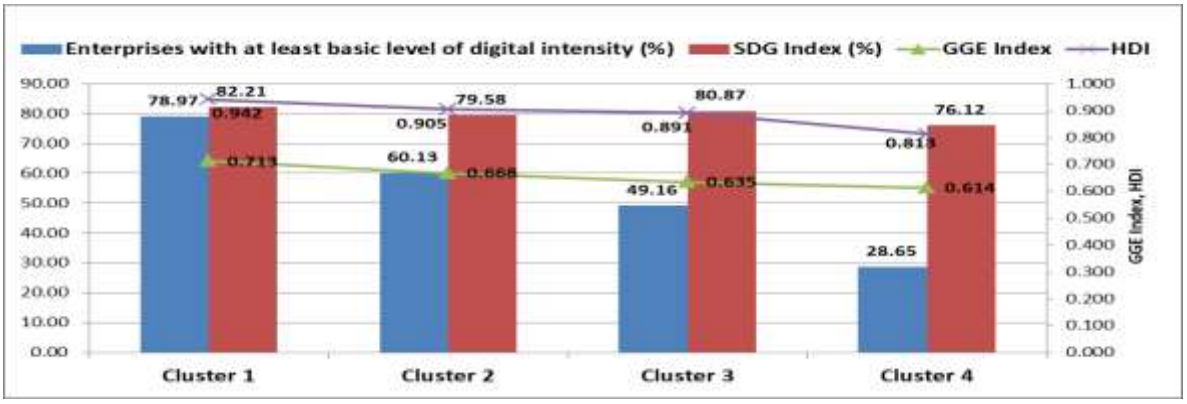

Figure 4. Share of enterprises with at least a basic level of digital intensity and sustainable development variables (mean values per cluster).

Source: Own calculations based on Eurostat Database (2024a), Sustainable Development Report Database (Sachs et al., 2024), Global Green Economy Index Database (2024), and UNDP database (2024).

The second-best performing cluster is *cluster 2*, which contains twelve EU member states: Germany, Estonia, Ireland, Spain, Croatia, Italy, Cyprus, Lithuania, Luxemburg, Austria, Portugal, and Hungary. In this cluster, Germany leads both in terms of the SDGI (with a score of 83.45%) and HDI (0.950). As regards the Enterprises with at least a basic level of digital intensity, Cyprus and Ireland achieved the highest levels of enterprise digitalization with 67.9% and 66.9%, respectively, while Portugal and Hungary had the lowest levels in this cluster, 54.5% and 54.2%, respectively.

Cluster 3 includes Greece, France, Czech Republic, Latvia, Poland, Slovenia and Slovakia (7 countries). This cluster exhibits high heterogeneity. France leads the cluster in three of the four analyzed variables (SDGI score=82.76%, GGEI=0.744, and Enterprises with at least a basic level of digital intensity=53.1%). Greece reported a share of enterprises with at least a basic level of digital intensity of 43.8%, which is 9.3 percentage points lower than France. Greece and Slovakia reported the lowest SDGI score (78.71% and 79.35%) and HDI score (0.893 and 0.855) within this cluster.

The results of cluster analysis highlighted both similarities and differences among EU economies regarding the relationship between the level of digitalization of businesses and sustainable development. Higher business digital intensity aligns with better HDI, SDG scores, and GGEI, suggesting that digital adoption in enterprises supports both human development and sustainability goals. Clusters with higher HDI scores also tend to perform better on the SDG and green economy indices. This implies that human development and environmental progress are often interconnected. Therefore, policies to promote digital adoption may support broader social, economic, and environmental goals.

Can a high level of digital skills boost the adoption of digital technologies by enterprises? The results of correlation and regression analysis (Table 5 and 6) reveal that individual digital skills (Individuals with basic or above basic overall digital skills as percentage of individuals) are strongly associated with digital intensity in enterprises (BD_DI and VH_DI). Digital skills have a positive impact on the digital intensity in enterprises (BD_DI) (β=0.775, Table 6). Our results confirm that an increasing in human capital, particulary in digital skills at the individual, is crucial for increasing digital adoption in businesses, and in turn for enhance human development, as supported by other empirical research (Herman & Suciu, 2019).

Table 5. Digital skils, business digital intensity and sustainable development

Correlations (r)	Enterprises with at least basic level of digital intensity	Enterprises with very high digital intensity	SDGI	GGEI	HDI
Digital Skills[1]	0.775**	0.724**	0.461*	0.448*	0.697**

Note: ** Correlation is significant at the 0.01 level (2-tailed).* Correlation is significant at the 0.05 level (2-tailed). [1]Individuals with basic or above basic overall digital skills (all five component indicators are at basic or above basic level) (Percentage of individuals).

Source: Own calculations based on Eurostat Database (2024a), Sustainable Development Report Database (Sachs et al., 2024), Global Green Economy Index Database (2024), and UNDP database (2024).

Table 6. Results of regression analysis: influence of digital skills on business digital intensity (BD_DI)

		Unstandardized Coefficients		Standardized Coefficients		
	Variables	B	Std. Error	Beta (β)	t	Sig.
Digital skills⇨ Business Digital intensity (BD_DI)	(Constant)	8.784	8.414		1.044	0.306
	Digital skills*	0.874	0.143	0.775	6.122	0.000

Note: Dependent variable: BD_DI- Enterprises with at least basic level of digital intensity; $R^2 = 0.600$, adjusted $R^2 = 0.584$; Std. error of the estimate = 9.20882; $F(1, 25) = 37.478$, $p < 0.001$; *Individuals with basic or above basic overall digital skills (all five component indicators are at basic or above basic level) (Percentage of individuals).

Source: Own calculations based on statistical data provided by Eurostat Database (2024a).

Digital skills demonstrate moderate, positive relationships with the SDG Index (r=0.461) and the Global Green Economy Index (r=0.448), with the correlation to the SDG Index reaching statistical significance (Table 5). However, the correlation is slightly weaker compared to HDI (r=0.697). This suggests that a high level of digital skills supports broader sustainability goals, particularly in the area of human development.

5. Conclusion

This study has explored the potential role of digital transformation in businesses in promoting sustainable development across EU countries. The results of the comparative analysis provide a comprehensive overview of the extent to which enterprises in the EU-27 have adopted and utilized various digital technologies, highlighting significant gaps between countries in the use of these technologies. The positive correlation identified between digital businesses and macroeconomic performance (labor productivity and GDP per capita) in EU countries highlights the crucial role of increasing digital technology adoption by enterprises to enhance macroeconomic outcomes.

Digitalization of business, sustainability, and human development are interrelated at a national level, with higher levels of digital intensity in enterprises linked to positive outcomes in both human and environmental development. Higher levels of digital intensity in enterprises are associated with better performance in human development, SDG progress, and green economy practices. Thus, a minimum digital capability in enterprises could support not only economic development but also environmental and human development goals.

Based on the cluster analysis, the EU-27 countries were grouped into four clusters, highlighting both the differences and commonalities among EU nations in terms of the relationship between the digitalization of businesses and sustainable development. The greatest challenges for the sustainable economy and digital transition are identified in the EU countries within cluster 3 and cluster 4, particularly in Bulgaria, Romania, Poland, the Czech Republic, Slovakia and Greece.

Targeted measures should be designed to effectively address the specific challenges faced by these countries. The findings emphasize the essential role of digital skills in improving the adoption of digital technologies by EU enterprises, which, in turn, contribute to achieving social, economic and environmental sustainability. Achieving successful digital transformation in businesses requires adapting and aligning HR strategies with the digital technologies adopted by enterprises (Herman, 2024). Moreover, to meet the targets of the "Europe's Digital Decade" by 2030 (EC, 2021b) and achieve the SDGs across EU countries, greater public and private investments are required in R&D, digital infrastructure, and digital technologies, including low-carbon technologies.

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