



DIGITAL TRANSFORMATION OF ENTERPRISES: ASPECTS OF INNOVATION FINANCING

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ABSTRACT

The digitalisation of enterprises is considered a fundamental factor for increasing the competitiveness, efficiency and sustainability of economies in the European Union (EU). According to the literature, the process of digital transformation in Bulgaria continues to lag behind EU averages, indicating unrevealed potential for Small and Medium Enterprises (SMEs). This study aims to present an exploration of the current state of digitalisation in SMEs in Bulgaria and to reveal the potential benefits and restraining factors of digital transformations. We use data from Eurostat on the European Commission's Digital Economy and Society Index (DESI) and the Digital Intensity Index (DII). The main barriers hindering the digitalization process are summarized and presented, such as the lack of qualified staff, limited financial capacity of SMEs, insufficient digital literacy and the lack of effective interaction between actors in the process. Important benefits related to digital transformation are highlighted, including cost optimisation, facilitating access to new markets, and improving customer service. Finally, the main financial instruments applied under the European Structural and Investment Funds (ESIF) to support digital business transformation are systematized, including loans, equity investments, guarantee mechanisms and combined financial products.

Keywords: digital transformation, level of digitalisation, financial instruments, SMEs

INTRODUCTION

In recent years, digital transformation has emerged as a key tool for achieving competitive advantage, optimising costs, and expanding companies' market presence (1). It is viewed as a powerful driver of innovation, enhancing profitability and expanding international participation, particularly for small and medium-sized enterprises (SMEs) (2). Academic literature highlights that with the advent of the Fourth Industrial Revolution, more commonly referred to as Industry 4.0, enterprises increasingly need to integrate digital technologies into their production and industrial processes to be sustainable in the labor market (3). Alongside this, numerous studies focus on the development of technological advances to improve living standards, develop education and stimulate economic activity (4). This highlights the need to examine digital transformation through different lenses,

focusing on the benefits and barriers to the adoption of advanced technologies. Particular attention is paid to the business perspective, where the focus is on the factors that drive digitalization (5).

MATERIALS AND METHODS

To track the speed of adoption of digital solutions by SMEs in Bulgaria, two widely used indicators were employed: the European Commission's Digital Economy and Society Index (DESI) and the Digital Intensity Index (DII). DESI is a comprehensive tool of the European Commission that measures the progress of EU Member States in the digital economy and society through indicators such as connectivity, human capital, digital public services, digital technology integration and digital public services. The range of indicators in these indices enables the identification of the position of Bulgarian enterprises in the transformation process and the drawing of subsequent conclusions. The scope of the data includes SMEs in Bulgaria with a 5-year period from 2017 to 2022. The second DII indicator, developed by Eurostat, measures the use of key

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digital technologies by EU enterprises and assesses their level of digital transformation.

To track and systematize the latest scholarly arguments on the potential benefits and limiting factors contributing significantly to the current level of digitization and to explore options for accelerating the transformation process, we first conducted a keyword search on the Web of Science (Core Collections) and Scopus scholarly literature platforms.

The paper follows the subsequent methodological approach: first, we survey the level of digitalisation of SMEs by 2024 by comparing enterprises' values with the average level of digital transformation in EU Member States. Next, the benefits of introducing advanced technologies in enterprises are discussed and systematized, with a view to establishing the potential for development and the existence of a long-term impact on the market performance of enterprises. In order to explore opportunities for accelerating the digital transformation process, potential barriers to the adoption of advanced technologies by Industry 4.0 are analyzed. The last section provides an analysis and summary of the main financial instruments employed within the ESIF as a tool to address market failures, particularly in terms of limited financial resources for enterprises and uneven access to financial markets.

RESULTS AND DISCUSSION

State of digitalization of enterprises in Bulgaria

The level of digitalisation of Bulgarian enterprises can be tracked through the Digital Economy and Society Index (DESI). Data for the 5-year period (2017-2022) show that Bulgaria continues to rank among the lowest in the categories of human capital, connectivity, digital technology integration, and digital public services (6). According to data, in 2024, only 13.5% of companies in Bulgaria used cloud services, which is significantly below the EU average of 38.97% (**Table 1**). Less than 30% of Bulgarian enterprises identified with at least a basic level of digital intensity, compared to an average of more than half of enterprises at the EU level, which can be defined as a significant gap. The trend is similar in the case of electronic information sharing, as it is carried out by only 20.51% of Bulgarian enterprises, compared to the EU average of 42.09%. Online trade among SMEs in Bulgaria is also limited in scope, with 13.03% of them selling electronically, compared to an EU average of 19.09%. The active use of social media by Bulgarian companies reaches only 13.18%, which is more than twice the EU average (30.64%). As for data analytics, a tool considered a key factor in competitiveness, it is applied by 21.20% of Bulgarian companies, compared to 32.09% of EU companies that use these solutions.

Table 1. Indicators for the level of digitalisation achieved by small and medium-sized enterprises (10-240 employees), 2024.

Indicators	Bulgaria	EU (averages)
SMEs selling online (% SMEs)	13.03%	19.09 %
SMEs with at least a basic level of digital intensity (% SMEs)	28.41%	57.90 %
Sharing electronic information	20.51 %	42.09%
Data analysis	21.20 %	32.09%
Social media	13.18%	30.64%
Cloud services	13.50 %	38.97%
Artificial intelligence	3.40 %	8.06 %
E-commerce turnover	3.40 %	12.17%

Source: EU DESI 2024 dashboard for the Digital Decade and own calculations (6)

The Digital Intensity Index (DII) (6), another widely used Eurostat indicator, also supports the need to accelerate the rate of digitisation (1). According to the DII, in 2022, a total of 82% of businesses in Bulgaria, measured as the sum of those with low and medium levels of digital

intensity, ranked the country last among EU countries in terms of enterprises (**Figure 1**). At the same time, the share of enterprises with very high digital intensity is only 1.6% (7) (**Figure 1**).

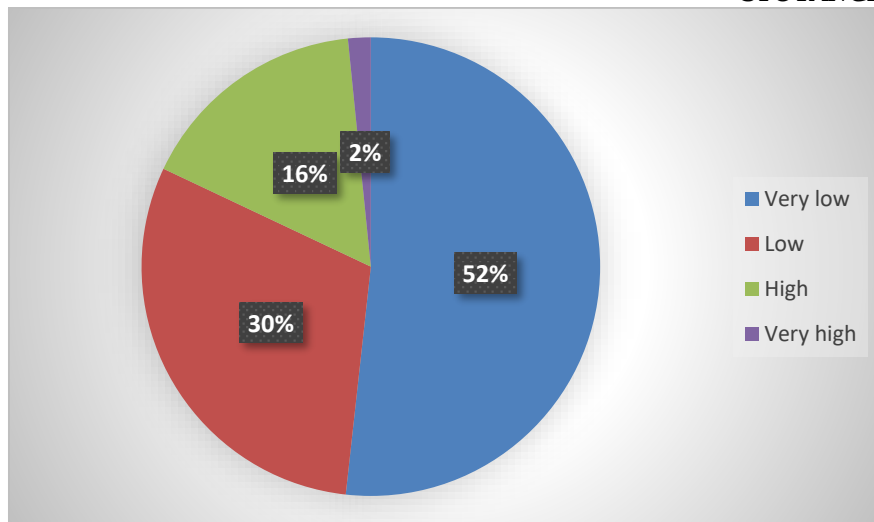


Figure 1. Digital intensity level in businesses, 2022 (as % of total businesses)
Source: Eurostat (2025) (8) and own research

There are significant differences in the level of digitalization of Bulgarian enterprises compared to the EU average, which testifies to the presence of significant barriers and limiting factors to the introduction of Industry 4.0 technologies. These results underline the need to strengthen targeted policies and measures at national level aimed at stimulating digitalization and overcoming the identified barriers. To accelerate digital transformation processes in the private sector, Bulgarian enterprises will require significant investments, both to expand access to modern digital infrastructure and to enhance the digital and ICT skills of their workforce.

Expected benefits for enterprises

The potential benefits of accelerating the digitisation process have been widely discussed in the literature. Research indicates that by adopting digital technologies, enterprises can significantly increase their efficiency and productivity, achieving long-term and sustainable benefits (9). Schwab, K points out that digital transformation significantly enhances the innovation capacity of enterprises. By introducing technologies such as the Internet of Things (IoT), big data and automation, enterprises have the opportunity to accelerate their processes. This leads to faster implementation of internal processes, optimization of business models, and improved service quality (10). The digital economy also contributes to the creation of high value-added jobs and to the development of skills in line with new market realities (11). According to the European Commission (2022), businesses with a higher level of digital integration perform better in terms of both revenue and employment

growth. Other researchers focus on the impact of digitalisation on cost optimisation and operational efficiency. Additionally, according to Li et al. (2022), digital technologies help reduce transaction costs, improve logistics and production processes, and decrease lead times. This allows organizations to not only be more agile, but also offer higher value to the end customer. The adoption of advanced technologies by SMEs is expected to play a key role in enhancing their competitiveness, particularly by improving customer service and facilitating adaptation to a rapidly changing business environment (12).

In summary, digital transformation is expected to have a positive and long-term impact on the efficiency, sustainability and innovation capability of enterprises. The benefits of digitalisation are seen not only in increasing the economic value and competitiveness of firms, but also in creating social and labour effects conducive to overall economic development.

Barriers to accelerated adoption of digital technologies

The low level of digitalisation and the slow digital transformation of SMEs indicate the presence of a number of barriers to the smooth adoption of advanced Industry 4.0 technologies. Scientific researches stated that successful digital adoption requires coordination between government institutions, suppliers and end-users (13). Lack of enterprises' technical capacity and digitally skilled personnel emerge as barriers to the digital transformation process in SMEs (14). Furthermore, the widely observed existing resistance to change from employees, provoked by uncertainty and fear of change, may further contribute to the slower

pace of digitisation (15). In most economic sectors, there is an excess demand for experts with digital skills compared to the supply of labour force, which makes it difficult not only to attract skilled employees but also to integrate and retain them in the enterprises (16). Significant obstacles for SMEs innovation activity are the financial constraints and uneven access to financial markets (15-17). Several authors highlight the high upfront costs associated with implementing digital solutions, including investments in software, hardware, and staff training, which significantly hinder SMEs' ability to adopt new technologies (18). Financial constraints are perceived to lead to technology lag and hinder digital transformation (19), while active technology adoption facilitates access to external finance (20). In an attempt to support the digitalisation process through various policies, a number of institutions, including the OECD¹, have highlighted budget constraints as a significant barrier for SMEs and have emphasized the need for targeted financial support programs (21). At the same time, some studies point out that even when public or private funding support programs are available, enterprises are often not sufficiently informed or find the application procedures too complex (22).

A further constraining factor to accelerating the digital transformation process refers to the issue of data security. According to some authors, protecting information requires significant investment in advanced cyber protection technologies and continuous staff training, which is often a challenge for enterprises, especially SMEs (23). Furthermore, research highlights that the lack of adequate cyber security increases the risk of data breach incidents, which can cause serious financial and reputational damage (24). Last but not least, attention has been drawn to the need for an integrated approach to cybersecurity that includes both technological solutions and organisational policies for risk management and employee training. It is widely agreed that without a focused and consistent effort to strengthen cyber defenses, digital transformation could be significantly delayed or even halted (25).

In conclusion, the process of digital transformation faces several challenges to the

accelerated adoption of advanced technologies from Industry 4.0, among which we can identify the main ones as follows: a lack of internal technical capacity, a shortage of qualified specialists, financial constraints, resistance to change, and risks related to cybersecurity. Additionally, the lack of coordination and trust between key actors in the process also contributes to limiting the opportunities for the effective implementation of digital solutions. Overcoming these challenges requires a comprehensive approach, including investment in human capital, access to finance, and the development of cybersecurity policies, as well as the coordination of multiple actors to achieve a sustainable digital transformation.

EU financial instruments

EU financial instruments are a form of support through financial products provided through special structures, as an alternative to grants, for investments with a return (26). Over the last decade, EU financial instruments have established themselves as a strategic tool for public investment policy in the Member States. They go beyond traditional bank lending, providing a variety of financing mechanisms, particularly targeting SMEs, including loans, equity injections, guarantees and combined financial products, with the main objective of facilitating access to capital and stimulating economic development (27) (**Figure 2**). A key advantage of these instruments is their ability to be self-sustaining. The funds returned by the final recipients are reinvested, which provides continued support to achieve the programme's objectives without the need for additional public funding (28). By leveraging additional public and private funds, financial instruments increase the total resources available to final beneficiaries, amplifying the impact of European funding through financial leverage (29). Financial resources are managed by financial intermediaries with expertise in the relevant sectors, who assess risk and select projects with sustainable business potential (27). EU budget funds are allocated between countries and regions to achieve the EU's strategic objectives, with managing authorities determining whether to use grants or other financial instruments depending on specific needs (30).

¹ OECD - Organization for Economic Co-operation and Development

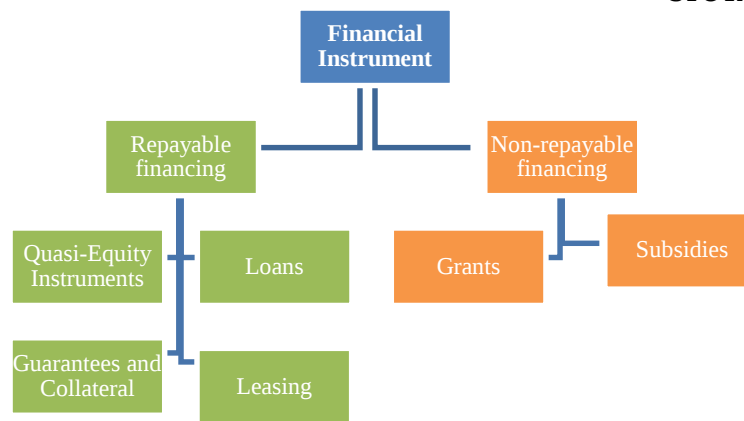


Figure 2 . Classification of ESIF Financial Instruments

Source: Adapted classification of ESIF financial instruments based on European Investment Bank (2015) (28)

Financial instruments play a crucial role in addressing financing gaps and market inefficiencies in sectors such as innovation adoption, digital transformation, and digitalisation (20). In addition to traditional instruments such as loans and guarantees, financial instruments also take the form of equity and quasi-equity participations, which support start-ups and growing businesses by reducing risk for lenders and facilitating access to finance (31). Equity instruments enable investors to participate in an enterprise's profits and are particularly suitable for companies with high growth potential (32). Quasi-equity instruments combine features of debt and equity financing, providing flexibility for enterprises in need (21). A combination of financial services enables public and private resources to maximise investment, utilising EU funds to share risk and leverage private capital (32). In conclusion, financial instruments are an essential element of EU policy, combining sustainability, efficiency and the ability to mobilise additional resources to support innovation, digitisation and economic development.

CONCLUSION

The digitalisation of enterprises is essential for the economies of the EU and is expected to lead to the optimisation of business processes, as well as an increase in competitiveness and market presence. The results of the survey confirm that there is a significant lag in Bulgarian enterprises compared to the European average levels of digitisation in key indicators such as electronic information sharing, online trading, and data analysis. The main challenges highlighted in the study include a shortage of

skilled professionals, financial constraints, resistance to change, and cybersecurity risks. Additionally, a lack of coordination and trust between key actors is also expected to contribute to weakening the effective implementation of digital solutions.

Activities to address financial constraints and facilitate access to the financial market through various funding programmes under the ESIF can be identified as significant. In addition to grants (applied on a limited scale), the financial instruments employed include a variety of financial mechanisms, such as loans, guarantees, equity and quasi-equity participations, and combined instruments.

In conclusion, we can point out that the benefits of implementing digital solutions can be summarized and tracked in cost optimization, increased operational efficiency, reduced transaction costs, improved logistics and production processes. At the same time, we observe a lagging behind digitalization process and resistance to change, leading to an unsatisfactory investment and innovation policy of enterprises. There is an obvious need for active and targeted measures at national level and for combining the efforts of different actors, including the state (through its policies and instruments), to support the process and overcome the identified barriers. The state support to enterprises should extend beyond financial assistance; it should also involve more engaged participation by providing competencies and helping enterprises develop long-term strategies to adopt advanced technologies and transition to a new business model.

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