

THE ROLE OF ERP AND IoT SOLUTIONS IN IMPROVING THE BUSINESS PERFORMANCE OF SMALL AND MEDIUM-SIZED ENTERPRISES

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Abstract: Digital transformation increasingly influences the competitiveness, flexibility, and sustainability of small and medium-sized enterprises (SMEs), with its importance being particularly evident within the structure of the Serbian economy. Digital technologies have become an integral part of the everyday operations of SMEs. Their application is changing the way business activities are planned, resources are utilized, and market demands are addressed. Against this background, the paper examines how different levels of digitalisation affect business performance, with a particular focus on ERP systems and IoT technologies. The analysis is based on data collected through a survey of 163 enterprises from various industrial sectors. Descriptive statistical measures, one-way analysis of variance (ANOVA), and multiple linear regression were applied in the data analysis. The findings indicate that the implementation of ERP and IoT solutions contributes to greater efficiency and productivity, although the high costs of implementation continue to limit their wider adoption. Nevertheless, the greatest

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contribution of digitalisation is observed when it is aligned with the long-term development orientation of enterprises, as this ensures greater coherence in management activities and the gradual strengthening of digital capabilities.

Keywords: *business digitalisation, small and medium-sized enterprises, ERP systems, IoT technologies, operational efficiency, business performance.*

INTRODUCTION

Digital transformation constitutes a fundamental driver of change in contemporary business, reshaping the organisation of processes, decision-making mechanisms, and value creation. The integration of digital technologies enhances operational efficiency and organisational flexibility, with its significance becoming particularly evident in the context of rapid technological advancement and intensifying global competition. Within the framework of the fourth industrial revolution (Industry 4.0), digital technologies have evolved into an integral component of business systems, fundamentally altering the structure of both industrial and service activities (Schwab, 2016), thereby redefining the foundations of modern business operations.

Small and medium-sized enterprises (SMEs) represent a fundamental component of the economic structure of the Republic of Serbia, contributing substantially to employment and gross domestic product. Their capacity to respond to digital change has a direct bearing on the competitiveness and long-term sustainability of the economy. Despite this, SMEs frequently encounter constraints in the process of digital transformation, particularly in terms of limited financial resources, insufficient digital competences and inadequate strategic support (OECD, 2021). At the same time, their inherent organisational flexibility may act as an enabling factor in the adoption of new digital solution.

This model places emphasis on the technological dimension, especially in relation to enterprise resource planning (ERP) systems and Internet of Things (IoT)-based solutions within digital transformation. Therefore, these systems and technologies create integrated business functions while providing real-time data sources to enhance operational efficiency as well as to make better decisions about their business (Porter & Heppelmann, 2014; Balaha et al., 2025). On the one hand, digitalisation costs are an important aspect of sustainability as a greater level of digitalisation will

potentially affect the economic sustainability and the long-term use of digital technologies.

Digitalisation is becoming increasingly relevant as SMEs in developing countries continue to explore new ways to improve their business processes through digital transformation. However, there is still little available research on how all components of digital transformation contribute to the overall performance of SMEs. In particular, there is limited research that examines the combined effect of both technological and organisational dimensions on SME performance within the context of developing economies. This paper examines the effect of digital transformation on SME performance within the Republic of Serbia, focusing on productivity and economic efficiency related to the implementation of ERP systems, the utilization of IoT technologies, and the efficient management of operating expenses. This research contributes to the existing literature by examining the combined effects of the technological and cost dimensions of digital transformation to show how they quantitatively impact SME productivity, thus providing a better understanding of the factors that have influenced the success of digitisation in this industry.

DIGITALISATION OF SMES AND ITS IMPACT ON BUSINESS PERFORMANCE

Digitalisation in SMEs does not represent a uniform or linearly predictable process; rather, it comprises a set of interrelated changes encompassing technology, organisational structures and approaches to resource management. Its effects on business performance do not arise automatically from the mere adoption of digital solutions, but depend on the extent to which these solutions are embedded within core business processes and on firms' capacity to leverage them for improved decision-making and operational optimisation. In this regard, digitalisation operates as an indirect mechanism influencing performance through enhanced efficiency, cost reduction and more effective resource allocation (Westerman, Bonnet & McAfee, 2014). The realisation of these effects further depends on the alignment between technological solutions, organisational capabilities and the external environment, as any misalignment may constrain value creation and lead to fragmented technology adoption (Huang & Liu, 2026), thereby necessitating a systemic alignment of key elements of digital transformation.

A distinctive feature of SMEs lies in the pronounced heterogeneity of their approaches to digitalisation. Limited financial and human resource capacities often lead to the selective and phased adoption of technologies, with priority given to solutions that deliver immediate operational benefits. At the same time, lower organisational complexity enables faster implementation of changes and shorter adaptation cycles. This combination of partial implementation and high adaptability results in considerable variation in the outcomes of digitalisation across SMEs, depending on the extent to which technologies are aligned with existing business models. Successful digital transformation in SMEs requires the development of interrelated capabilities, including digital awareness, strategic planning, effective implementation and continuous improvement (Kahveci, 2025). Their alignment constitutes a key condition for achieving a sustainable competitive advantage.

The performance effects of digitalisation can be understood through several interrelated mechanisms. Integration of business functions via information systems reduces information asymmetries and accelerates information flows, thereby enhancing coordination and limiting operational inefficiencies. Availability of real-time data enables more accurate planning and tighter process control, while digitalisation also contributes to lower transaction and administrative costs. Such benefits are most pronounced in firms that align technological investments with organisational change and contemporary management practices (Brynjolfsson & Hitt, 2000). Nevertheless, the impact of digital transformation on performance is often mediated by business model innovation (Merín-Rodríguez, Dasí & Alegre, 2024). In this respect, organisational innovation serves as a key mechanism through which digital investments translate into sustained performance gains.

Digital maturity represents a critical factor underpinning the stability and sustainability of business performance. Firms that consistently develop digital capabilities tend to achieve higher levels of productivity and greater resilience to changes in the external environment (Kane et al., 2015). Despite their significant role in the economy, SMEs often face constraints related to limited resources and insufficient digital competences (OECD, 2017). Although basic digital infrastructure is frequently in place, the level of effective integration of digital technologies remains low, particularly in areas requiring more advanced skills and organisational change (Moreira et al., 2025). Such conditions further hinder the transition from partial to systemic digital transformation.

Within SMEs, the deployment of specific digital tools, such as digital marketing, enhances business performance by increasing market visibility and strengthening customer relationship management (Vapa & Vapa Tankosić, 2022; Sharabati et al., 2024). The application of Big Data technologies further improves decision-making quality and operational efficiency, although its adoption is often constrained by technical and organisational barriers (Kgakatsi et al., 2024). Such constraints include high implementation costs, limited time availability and insufficient integration of digital solutions (Telukdarie et al., 2023). Consequently, digitalisation in SMEs typically progresses incrementally and is accompanied by substantial organisational adaptation.

In addition, the development of technology in recent years has enabled for businesses to improve their operations through the application of both innovation and sustainability (Kannan & Gambetta, 2025). The ways that businesses utilize technology have significantly improved the productivity of total factors of production because of their combined use (Nucci, Puccioni & Ricchi, 2023). The use of artificial intelligence (AI) based analytical tools to make business decisions has improved business management performance (Aljehani et al., 2026). Finally, it is assumed that when all levels of the businesses use AI-based analytical tools for decision-making then the organisation will have good control of the entire unit.

By developing knowledge management and innovation strategies, SMEs can improve business performance and gain a competitive advantage (Lekić et al., 2023; Achmad & Wiratmadja, 2025). Small and medium businesses can develop the ability to take in information from external sources, process it and use it to improve their business operations (i.e., absorptive capacity). The greater the absorptive capacity of SMEs, the greater their ability to leverage external knowledge through open innovation, collaboratively develop new products, services, and technologies, and overcome challenges that they would otherwise face individually (Carrasco-Carvajal, García-Pérez-de-Lema, & Castillo-Vergara, 2023). As an organisation learns from others, it is able to rapidly communicate new information to all parts of its organisation, combine new technology with existing business objectives, and adjust its business strategies to reflect a new or changing competitive landscape (Achmad & Wiratmadja, 2025) thereby improving their competitive advantage over time.

However, the positive effects of digitalisation are neither automatic nor uniformly distributed. Their realisation depends on firms' capacity to

manage the costs of digital investments and to rigorously assess their economic viability. In resource-constrained settings, misallocation of investments or underutilisation of implemented technologies may limit or even offset the expected benefits. Variations in digital maturity further account for differences in outcomes, with many SMEs remaining at early stages of digital transformation (Quenum, Vallée & Ertz, 2025). At the same time, the digital economy creates new opportunities while simultaneously imposing greater demands in terms of knowledge and managerial competences (Morrar, Arman & Mousa, 2017). These considerations underscore the need for a strategically grounded and carefully designed approach to digital transformation.

Therefore, when analysing the digitalisation of SMEs, we must not be limited to the aggregate effect, but should consider the individual technological and economic factors that drive business results. Three areas of particular significance are the effect of integrating information systems, the use of data-driven technologies, and the cost of digitalisation. The combination of these factors will produce a specific effect of digitalisation on productivity and economic efficiency.

RESEARCH METHODS

The research was conducted using the Quantitative Approach, which was derived from the deductive Research Model developed by Saunders et al. (2019) based on theoretical and empirical research, hypotheses were formulated and subjected to research for validation purposes. This study examines how digital transformation contributes to the performance of SMEs in Serbia across various dimensions. The three main digital transformation variables (dimensions) included in this research project are: 1) ERP systems implementation; 2) IoT technology utilization; 3) operating cost management.

The sample comprised 163 small and medium-sized enterprises (SMEs) across manufacturing, trade and services. Data were collected between September and October 2026 using a structured questionnaire. Of the 250 questionnaires distributed, 163 were retained for final analysis (65.2%) following checks for completeness and response consistency.

Productivity was operationalised as the dependent variable, measured as the percentage change following the implementation of digital solutions. Independent variables included the implementation of ERP systems and the use of IoT technologies (dichotomous variables: 0 = no, 1 = yes), as well

as the reduction in operating costs (a quantitative variable expressed as a percentage). The level of digitalisation was operationalised through the number of implemented technologies (ERP, IoT and cloud), on the basis of which enterprises were classified into three groups: low, medium and high levels of digital maturity.

The SPSS software package was utilized for statistical analysis. Descriptive statistics, one-way ANOVAs to evaluate differences between groups based on the degree of digitalisation, and multiple-linear regressions to estimate impact of independent variables on productivity were included in the analytical process. A level of significance at $p < 0.05$ was used to establish statistical significance.

In line with the research objective, the null hypothesis (H0) posits that digital transformation (ERP, IoT and cost management) has no statistically significant effect on SME productivity in the Republic of Serbia. The following specific hypotheses are defined:

(H1) Higher levels of digital transformation are positively associated with SME productivity;

(H2) The implementation of ERP and IoT technologies is positively associated with SME business performance;

(H3) Effective management of digital transformation costs is positively associated with SME business performance.

Hypothesis H1 is tested using one-way analysis of variance (ANOVA), whereas hypotheses H2 and H3 are tested using multiple linear regression.

RESULTS AND DISCUSSION

Descriptive statistics provide insight into the patterns of change in SME business performance following the adoption of digital solutions, as reported in Table 1. Average productivity increased by 13.87%, while operating costs declined by 11.92%, suggesting an overall positive effect of digital transformation on SME business performance. At the same time, relatively high standard deviations (7.42 for productivity and 6.98 for costs) and coefficients of variation (53.49% and 58.56%) indicate substantial heterogeneity in outcomes across enterprises. Productivity ranged from -4.85% to 32.41%, whereas operating cost reductions varied between 0.00% and 24.70%, highlighting that the effects of digital transformation depend on implementation practices and the organisational readiness of firms.

Table 1. Descriptive statistics: productivity and cost reduction (N = 163)

Statistical indicator	Productivity (%)	Cost reduction (%)
Mean	13.87	11.92
Standard deviation	7.42	6.98
Coefficient of variation (%)	53.49	58.56
Range (min–max)	–4.85 – 32.41	0.00 – 24.70

Source: Authors' research.

To examine whether productivity differs across enterprises with varying levels of digitalisation, ANOVA was applied, with results presented in Table 2. Three levels of digital maturity were considered: low, medium and high. Average productivity increases consistently with the level of digitalisation, from 7.96% in low-digitalised enterprises to 19.74% at a medium level and 29.63% in highly digitalised firms.

The F-statistic ($F(2,160) = 42.58$; $p < 0.001$) indicates statistically significant differences across groups at the specified significance level ($p < 0.05$). These findings provide empirical support for H1, suggesting that higher levels of digital transformation are positively associated with greater productivity. At the same time, the increase in standard deviation highlights the importance of implementation quality and organisational capabilities in shaping outcomes.

Table 2. Productivity by level of digitalisation

Level of digitalisation	Number of enterprises (N)	Mean productivity (%)	Standard deviation
Low	45	7.96	3.98
Medium	55	19.74	5.21
High	63	29.63	6.15

Source: Authors' research.

To assess the effects of individual dimensions of digital transformation on productivity, a multiple linear regression model was estimated, with results reported in Table 3. All explanatory variables exhibit statistically significant positive coefficients ($p < 0.001$). ERP implementation is associated with a 6.18 percentage point increase in productivity ($B = 6.18$;

$p < 0.001$), while the adoption of IoT technologies shows a stronger effect of 8.72 percentage points ($B = 8.72$; $p < 0.001$). The reduction in operating costs also contributes positively ($B = 0.58$), although its effect is smaller relative to the technological variables.

Table 3. Results of multiple regression analysis

Independent variable	Unstandardised coefficient (B)	t-value	p-value
ERP implementation	6.18	9.54	< 0.001
IoT technologies	8.72	13.02	< 0.001
Reduction in operating costs (%)	0.58	7.84	< 0.001
Constant (intercept)	4.22	5.11	< 0.001
Coefficient of determination (R^2):	0.748		

Source: Authors' research.

Coefficient of determination ($R^2 = 0.748$) indicates that a substantial share of the variance in productivity is explained by the model. Strong explanatory power supports its adequacy for analysing relationships between digital factors and SME business performance. Results provide empirical support for H2, confirming a statistically significant contribution of ERP and IoT technologies to productivity, as well as for H3, highlighting the importance of effective cost management in improving SME performance.

Presented results indicate that digital transformation exerts a positive, yet uneven, effect on the business performance of small and medium-sized enterprises. While average values point to higher productivity and lower costs, pronounced variability indicates that outcomes depend on implementation practices and organisational readiness (Tafrā & Vapa Tankosić, 2025). These findings are consistent with prior research showing that the effects of digital transformation are contingent upon the degree of integration of digital solutions into business processes, as well as on organisational capabilities and firms' ability to utilise external knowledge (Vial, 2019; Zhao et al., 2023; Lekić et al., 2026).

Further analysis suggests that higher levels of digital maturity are associated with increased productivity, yet do not guarantee consistent

outcomes across firms. Recent firm-level evidence likewise indicates that the effects of digital technologies depend on how they are implemented and on the organisational context (Nucci et al., 2023), while broader structural and environmental constraints may further condition firm performance (Kabange & Simatele, 2022). Earlier contributions by Brynjolfsson and Hitt (2000) similarly argue that information and communication technologies affect productivity indirectly, primarily through improvements in organisational practices and business models.

Closer examination of the observed relationships indicates that technological components play a leading role in driving productivity gains, whereas organisational capabilities shape the magnitude of these effects, as highlighted in research on dynamic capabilities in digital transformation (Warner & Wäger, 2019). Stronger effects of advanced digital technologies align with the arguments of Porter and Heppelmann (2014), who emphasise that connected systems and real-time data analytics enhance operational efficiency and support more effective decision-making.

Findings indicate that digital transformation functions as a significant, yet conditional, driver of improved SME business performance. Variation in outcomes is attributable to the level and quality of digital solution implementation, with technological components exerting a dominant influence, while organisational capabilities shape the magnitude of these effects.

CONCLUSION

The effectiveness. Research shows that digital technology enhances productivity and efficiency; however, the extent of these improvements depends on the level of organisational preparedness to implement and integrate digital solutions into core business activities. Digital technology on its own does not fully explain how digital transformation shapes business performance; rather, outcomes emerge from the interaction between technological solutions and organisational processes. Therefore, digital transformation is more accurately understood as a strategic business process.

The findings demonstrate that cost optimisation tends to be more of an adjunct to productivity, and that technology is the major driver. That is, technological factors mainly ERP and IoT, overwhelmingly dominate as the key drivers of productivity. This confirms that the impact of

digitization extends beyond operational efficiency, affecting value generation and overall market positioning. In addition, the findings also correlate with recent empirical studies showing how digital technologies interact with their environment (Nucci et al., 2023; Zhao et al., 2023) and prior theoretical work demonstrating the indirect effect of information and communication technologies on productivity through organisational practices (Brynjolfsson and Hitt, 2000; Vial, 2019).

This study's limitations concern the absence of qualitative data, specifically the digital skills of the employees and their supervisors' management practices. Addressing these limitations would likely broaden the understanding of implementation outcomes. While the sample included in this study provides a strong quantitative base for analysis, future research could improve upon this by accessing larger and more diversified samples. Future research on this topic should attempt to address these issues by including both sectoral and regional diversity to gain a better understanding of what influences digital transformation.

Digital transformation has emerged as a structural source of competitive advantage for businesses, contingent on organisations aligning their technological and organisational infrastructure with their long-term vision through digitalisation. The advent of digital technology represents a major contingency factor for SME productivity and overall business performance.

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ULOGA ERP I IoT REŠENJA U UNAPREĐENJU POSLOVNIH PERFORMANSI MALIH I SREDNJIH PREDUZEĆA

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Sažetak: Digitalna transformacija sve izraženije utiče na unapređenje konkurentnosti, fleksibilnosti i održivosti malih i srednjih preduzeća (MSP), pri čemu njen značaj posebno dolazi do izražaja u strukturi srpske ekonomije. Digitalne tehnologije danas su postale sastavni deo svakodnevnog poslovanja malih i srednjih preduzeća. Njihova primena menja način na koji se planiraju aktivnosti, koriste resursi i odgovara na zahteve tržišta. Polazeći od toga, u radu je razmatrano kako različiti nivoi digitalizacije utiču na poslovni učinak, sa naglaskom na ERP i IoT sisteme. Analiza je zasnovana na podacima prikupljenim anketom u 163 preduzeća iz više industrijskih oblasti. U obradi podataka primenjeni su deskriptivni statistički pokazatelji, jednofaktorska analiza varijanse (ANOVA) i višestruka linearna regresija. Dobijeni nalazi ukazuju da uvođenje ERP i IoT rešenja doprinosi većoj efikasnosti i produktivnosti, ali da visoki troškovi njihove implementacije i dalje ograničavaju njihovu širu primenu. Ipak, najveći doprinos digitalizacije uočava se u situacijama kada je ona povezana sa dugoročnim razvojnim opredeljenjima preduzeća, jer se tada obezbeđuje veća usklađenost upravljačkih aktivnosti i postepeno jačanje digitalnih kapaciteta.

Ključne reči: digitalizacija poslovanja, mala i srednja preduzeća, ERP sistemi, IoT tehnologije, operativna efikasnost, poslovne performanse.