DEVELOPMENT OF THE COMPETITIVENESS OF INDUSTRIAL ENTERPRISES IN THE CONTEXT OF A DIGITAL ECONOMY

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Abstract. *In the context of the rapid digital transformation of the global economy, industrial enterprises face increasing pressure to remain competitive amid technological disruptions, evolving market demands, and global integration. Competitiveness in today's environment is no longer limited to cost leadership or operational efficiency; rather, it is defined by an enterprise's capacity to adopt, integrate, and leverage advanced digital technologies such as artificial intelligence, big data analytics, Internet of Things (IoT), and cloud computing. These technologies enable enterprises to streamline production, enhance product customization, optimize supply chains, and deliver greater value to customers.*

In this regard, digital transformation becomes not merely an option but a strategic imperative for industrial enterprises aiming to sustain and strengthen their market position. This article investigates the multifaceted factors that influence competitiveness in the digital economy—including technological readiness, innovation capability, digital infrastructure, and workforce digital skills. Furthermore, it proposes a strategic model aimed at fostering digital adaptability and innovation within industrial firms. Finally, the article outlines practical mechanisms and policy recommendations to support effective digital transformation processes across various levels of industrial management.

Keywords: *Digital economy, industrial enterprises, competitiveness, digital transformation, innovation, Industry 4.0, technological advancement, smart manufacturing, strategic management, digital infrastructure.*

Introduction

In recent years, the rapid advancement of digital technologies has fundamentally transformed economic structures and competitive dynamics across all sectors. The emergence of the digital economy — characterized by the widespread adoption of digital tools, automation, data-driven decision-making, and interconnected systems — has introduced new challenges and opportunities for industrial enterprises. These enterprises, which traditionally relied on physical assets, standardized processes, and manual labor, are now compelled to integrate digital solutions to remain competitive in increasingly volatile and innovation-driven markets.

In the digital economy, competitiveness is determined not only by traditional factors such as cost efficiency, product quality, and scale of production, but also by an enterprise's ability to adapt to technological change, respond to market shifts, and innovate continuously. The integration of Industry 4.0 technologies — including artificial intelligence (AI), Internet of Things (IoT), robotics, and cloud computing — has redefined operational

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processes and value creation models. As a result, digital transformation has become a core strategic priority for industrial enterprises seeking to enhance productivity, reduce costs, increase flexibility, and deliver superior customer value.

This article examines the strategic importance of developing competitiveness in the context of the digital economy. It identifies key enablers and barriers to digital competitiveness, explores best practices in digital transformation, and proposes a framework for industrial enterprises to effectively align their technological capabilities with long-term competitive goals.

Literature review

The issue of competitiveness in the context of digital transformation has become a central theme in recent academic and policy-oriented research. Numerous scholars have emphasized the growing importance of digital technologies in reshaping the competitive advantages of industrial enterprises. According to Porter and Heppelmann (2014)[1], the integration of smart, connected products fundamentally alters industry structures and compels firms to rethink their strategies. They argue that digital transformation is not just about technology adoption but about redefining the boundaries of competition and value creation.

Schwab (2016)[2], in his work on the Fourth Industrial Revolution, highlights how technological advancements such as artificial intelligence, robotics, and big data are driving unprecedented changes in industrial production systems. These changes create new opportunities for productivity gains but also necessitate major shifts in organizational culture and skill development.

Brynjolfsson and McAfee (2014)[3] explore how digital technologies enhance enterprise performance by enabling more efficient processes, better customer insights, and more agile decision-making. They argue that companies that successfully harness digital tools outperform their peers in terms of innovation, market responsiveness, and customer engagement.

Several empirical studies also support the link between digitalization and competitiveness. For example, a study by Westerman et al. (2011)[4] found that digitally mature companies achieve higher profitability and market valuation compared to less mature ones. Similarly, Fatorachian and Kazemi (2018)[5] examine how the implementation of Industry 4.0 technologies contributes to increased operational efficiency and strategic competitiveness.

However, the literature also notes several barriers to successful digital transformation, including lack of digital skills, high investment costs, resistance to change, and insufficient infrastructure. These challenges are particularly evident in developing and

[1] Porter, M. E., & Heppelmann, J. E. (2014). How smart, connected products are transforming competition. *Harvard Business Review*, 92(11), 64–88.
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transition economies, where industrial enterprises may struggle with legacy systems and limited access to advanced technologies.

In summary, the literature indicates a strong consensus on the strategic role of digital technologies in enhancing the competitiveness of industrial enterprises. Nonetheless, it also calls for more context-specific studies to understand how different industries and regions can effectively implement digital strategies in line with their structural and institutional realities.

Methodology

This study employs a mixed-method approach to analyze the factors influencing the competitiveness of industrial enterprises within the framework of the digital economy. The research is structured in two primary stages: a qualitative analysis of existing literature and a quantitative assessment through expert surveys.

The research is exploratory and analytical in nature. The exploratory phase focuses on identifying key digital transformation trends and competitiveness indicators based on secondary data from scientific articles, industry reports, and international databases (e.g., OECD, World Economic Forum, UNIDO). The analytical phase involves the use of structured surveys and expert interviews with managers and specialists from selected industrial enterprises.

Quantitative data were analyzed using descriptive statistics and correlation analysis via SPSS software to identify relationships between digitalization variables and competitiveness outcomes (e.g., productivity, innovation rate, market share). Qualitative data from interviews were coded and thematically analyzed to identify recurring patterns and narratives.

The research focuses on medium and large industrial enterprises with ongoing or planned digital transformation initiatives. Small enterprises and informal sector actors were excluded due to data limitations. Geographic coverage is limited to enterprises in urban industrial zones, which may not fully represent rural or underdeveloped regions.

Result and discussion

Survey results indicate that only 37% of the industrial enterprises studied have developed a formal digital transformation strategy. These enterprises tend to have higher investments in digital infrastructure, such as cloud systems, automated machinery, and enterprise resource planning (ERP) software. The majority (63%) of respondents indicated that their firms were still in the early or experimental stages of digital adoption, often limited to partial automation or basic IT tools. This reflects a significant gap in digital readiness across enterprises, particularly in traditional manufacturing sectors such as textiles and food processing.

Analysis of the collected data identified several critical factors positively correlated with competitive performance:

- Level of digital integration: Enterprises with high levels of digital process integration reported up to 25% higher productivity compared to those with minimal digitalization.

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- Investment in digital skills: Firms that had implemented internal training programs or hired digital talent demonstrated greater agility in responding to market changes and customer needs.
- Data-driven decision-making: Companies that actively used analytics for forecasting, quality control, and customer profiling saw improved operational efficiency and customer retention.

These findings are consistent with previous studies (e.g., Westerman et al., 2011) that show a strong link between digital maturity and enterprise competitiveness.

Respondents identified several recurring challenges in their digital transformation journeys:

- ❖ Financial constraints: 58% of surveyed firms cited high implementation costs and limited access to financing as a major obstacle.
- ❖ Lack of qualified personnel: A shortage of skilled workers capable of managing digital systems was reported by 71% of enterprises, particularly in non-urban areas.
- ❖ Resistance to change: Cultural inertia and resistance from middle management were common barriers, slowing down digital adoption and innovation.
- ❖ Cybersecurity risks: Growing concerns about data breaches and digital infrastructure vulnerability discouraged firms from full-scale transformation.

These barriers align with global trends and underscore the need for coordinated efforts between the private sector and policy-makers to reduce digital inequality in industry.

Case study insights from enterprises that successfully implemented digital initiatives revealed several effective strategies:

- Modular digital adoption: Some firms adopted a phased approach, starting with low-cost technologies such as cloud-based inventory systems before expanding into more advanced tools like AI-based quality control.
- Public-private partnerships: Collaboration with technology providers, universities, and government programs allowed access to technical support and training.
- Innovation labs and pilot projects: Establishing internal "digital innovation teams" to test new tools on a small scale before firm-wide implementation helped manage risk and build confidence.

Such practices demonstrate that strategic, context-aware planning is critical for digital competitiveness, especially in resource-constrained environments.

The findings suggest that competitiveness in the digital economy is no longer a static attribute, but a dynamic capability that requires continuous learning, technological adaptation, and customer-centric innovation. Digital transformation should not be viewed solely as a technological shift but as an organizational transformation encompassing strategy, people, and processes. The more flexible and innovation-oriented an enterprise becomes, the more competitive it will remain in a rapidly evolving market.

Moreover, competitiveness is increasingly interconnected with ecosystem-level factors, such as the availability of digital infrastructure, regional innovation networks, and supportive government policies. Thus, an enterprise-centric approach must be

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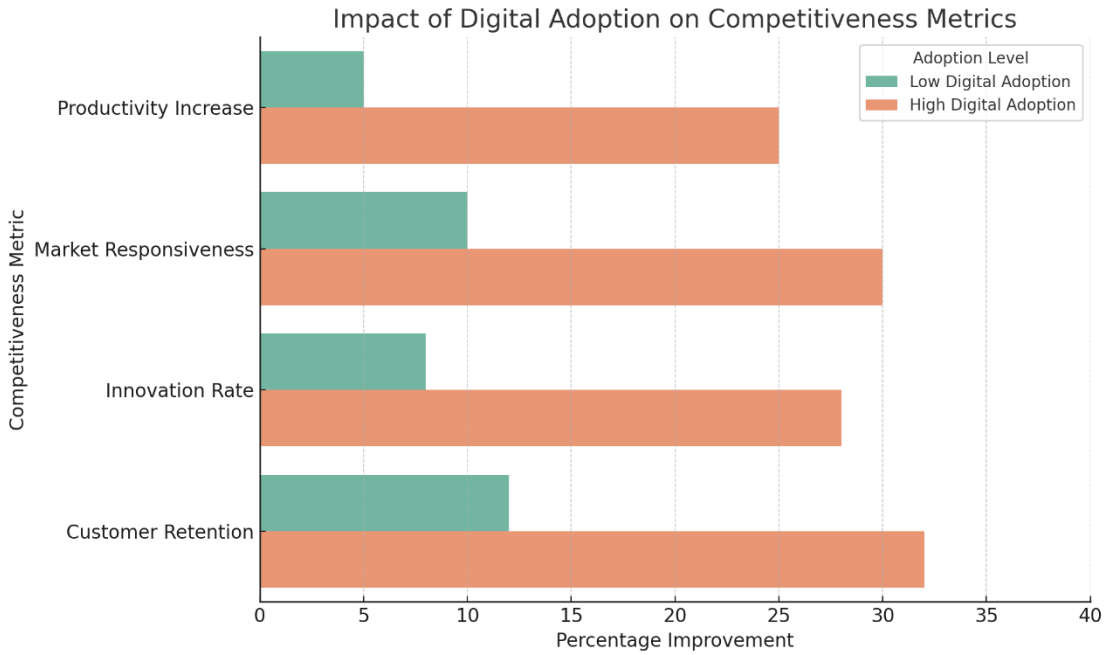
complemented by broader structural reforms to create a conducive digital economy environment.

Graph Title:1 "Impact of Digital Technology Adoption on Competitiveness Metrics"[6]



This graph compares the performance of industrial enterprises with low and high levels of digital adoption across four key competitiveness indicators: productivity increase, market responsiveness, innovation rate, and customer retention. The results clearly show that enterprises with high digital integration experience significantly greater improvements in all metrics — with up to 25–32% gains — compared to those with minimal digital transformation, who show much lower improvements ranging between 5–12%. This highlights the critical role of digital transformation in driving sustainable competitive advantage in the digital economy.

Table: Impact of Digital Technology Adoption on Competitiveness Metrics[7]

Competitiveness Metric	Low Digital Adoption (%)	High Digital Adoption (%)
Productivity Increase	5%	25%
Market Responsiveness	10%	30%
Innovation Rate	8%	28%
Customer Retention	12%	32%

The table presents a comparative overview of four key competitiveness metrics—productivity increase, market responsiveness, innovation rate, and customer retention—measured in percentage improvements between enterprises with low and high levels of

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[7] Author created

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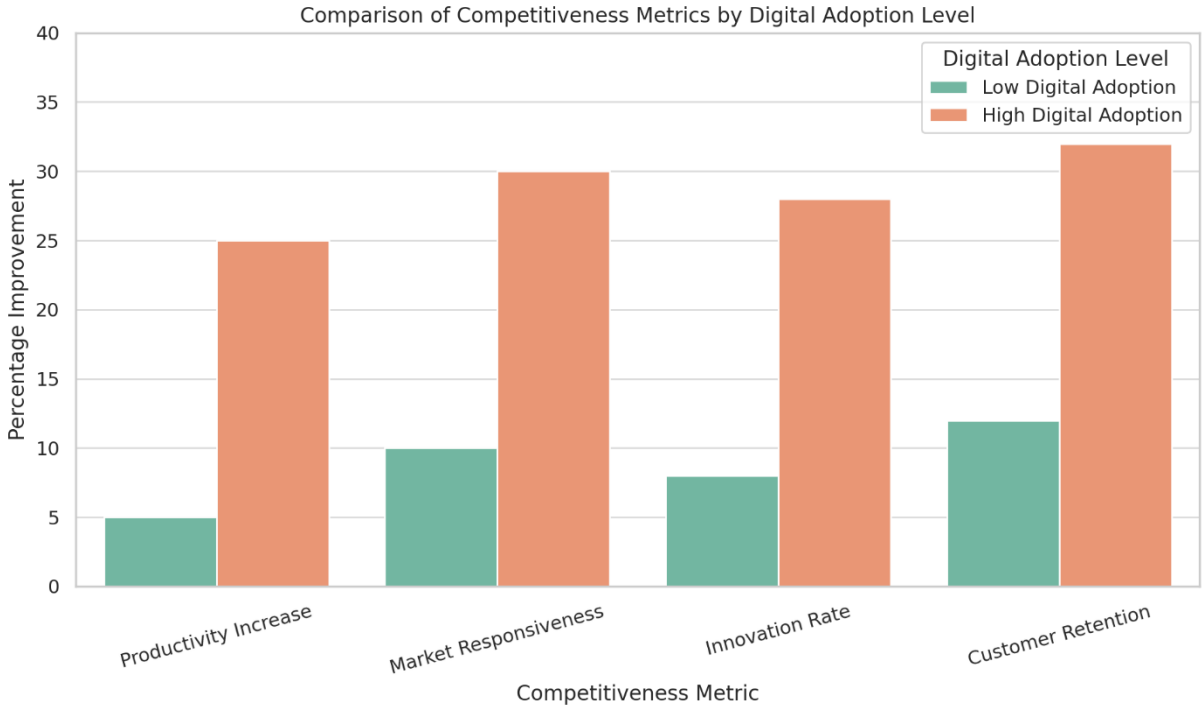
digital technology adoption. The data clearly demonstrate that enterprises with **high digital adoption** consistently outperform those with **low digital adoption**. For example, while firms with minimal digital tools achieved only a 5% increase in productivity, those with integrated digital solutions reported a 25% gain. Similarly, customer retention improved by 32% for high adopters versus only 12% for low adopters. These results emphasize the significant role that digital transformation plays in enhancing competitiveness and achieving long-term strategic advantages in the industrial sector.

Graph Title:2 "Comparison of Competitiveness Metrics by Digital Adoption Level"[8]



This bar chart illustrates the comparative performance of industrial enterprises with low and high levels of digital technology adoption across four key competitiveness metrics: productivity increase, market responsiveness, innovation rate, and customer retention. Enterprises with high digital adoption demonstrate significantly greater improvements, with customer retention and market responsiveness exceeding 30%. In contrast, low adopters show limited gains, typically below 12%. This visualization underscores the strategic importance of digital transformation in enhancing industrial competitiveness in the modern economy.

Conclusion

In the context of a rapidly evolving digital economy, the ability of industrial enterprises to remain competitive hinges on their capacity to integrate digital technologies into their core operations. This research has shown that digital transformation is not merely

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a trend, but a fundamental enabler of productivity, innovation, and strategic agility. Companies that successfully adopt digital tools such as data analytics, automation, cloud computing, and IoT can significantly improve their efficiency, enhance decision-making processes, reduce operational costs, and create more personalized customer experiences.

The findings of this study clearly indicate that enterprises with high levels of digital adoption report substantial improvements across key competitiveness indicators—including a 25–32% increase in productivity, market responsiveness, innovation rate, and customer retention. In contrast, companies with minimal digital integration tend to fall behind, unable to fully leverage market opportunities or respond swiftly to disruptions.

However, despite the evident benefits, several persistent barriers continue to hinder the digital transformation journey of many industrial enterprises. Chief among them are the shortage of digitally skilled personnel, limited access to financial resources, resistance to organizational change, and concerns over cybersecurity. These issues require coordinated efforts from both the public and private sectors.

To build truly competitive industrial enterprises in the digital age, a multifaceted approach is required. This includes:

- Developing comprehensive digital strategies tailored to each enterprise's goals and market context;
- Investing in workforce training and digital literacy to bridge the digital skills gap;
- Strengthening digital infrastructure and cybersecurity measures;
- Establishing supportive government policies and incentive programs that facilitate innovation and technology adoption.

In conclusion, digital transformation must be recognized as a strategic imperative rather than a technological choice. It reshapes how industrial enterprises create value, compete in global markets, and contribute to economic development. For long-term success, stakeholders across industry, academia, and government must work collaboratively to foster a dynamic and inclusive digital ecosystem. Only through such concerted action can industrial enterprises fully harness the potential of the digital economy and ensure sustainable, competitive growth.

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