



NEW DIGITAL TECHNOLOGIES: CHALLENGES AND OPPORTUNITIES

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ABSTRACT: This text explores the nature, applications, and challenges of new digital technologies as a key driver of transformation in the modern economy and society.

The first chapter defines the concept of “digital technologies” and presents the main technological domains-artificial intelligence, big data, the internet of things, cloud computing, blockchain, and digital twins. Their core characteristics, such as scalability, network effects, and data-driven models, are highlighted.

The second chapter analyzes the application of digital technologies across different sectors-services, healthcare, and education-showing how they stimulate innovation, productivity, and competitiveness. The discussion also covers the broader socio-economic effects, including changes in the labor market and skills, digital inequality, and the digitalization of public services.

The third chapter outlines the main challenges of digital transformation: technological integration, lack of standardized frameworks, digital divides, and ethical and security concerns. Future research directions are identified, focusing on multi-level analysis, sustainability, measurement and methodological development, and the inclusion of small and medium-sized enterprises and developing economies.

KEY WORDS: Engineering logistics, Digital transformation, Blockchain, Big Data, Machine Learning, Digital Twins, Cloud Computing, IoT, Multi-level.

Introduction

In the era of the Fourth Industrial Revolution, digital technologies have become a key driver of transformation in business, the economy, public life, and science. Technologies such as artificial intelligence, big data, cloud computing, the Internet of Things (IoT), and blockchain form a new digital ecosystem landscape and offer opportunities for innovation, productivity, and

competitiveness. For example, according to Digital transformation: A review and research agenda, “research on digital transformation is growing exponentially and covers a wide range of industries and technologies [8]”.

This article aims to examine three key dimensions of new digital technologies:

- (1) their nature and technological profile;
- (2) their application and impact across different sectors;
- (3) challenges and future research directions. The article is structured into three chapters corresponding to these dimensions.

Chapter 1: Nature and Technological Profile of New Digital Technologies

Definitions and Key Characteristics

The term “digital technologies” encompasses a wide range of information and communication technologies that transform information into digital format, enabling the collection, processing, analysis, and transmission of data through algorithms and communication networks. For instance, the article Digital technologies (Scientific Director) highlights the economic properties of digital technologies-their scalability, network effects, and their capacity to be combined with other digital resources [4].

Core Technologies

Some of the leading technologies that comprise the “new digital technologies” are:

- Artificial Intelligence (AI) and Machine Learning (ML): capable of extracting value from large volumes of data and supporting automated intelligent decisions.
- Big Data and Data Analytics: structured and unstructured data processed to extract insights and predictive models.
- Internet of Things (IoT): connecting physical devices and sensors to the internet, enabling real-time data collection and exchange.
- Cloud Computing: infrastructure that allows flexible, on-demand access to computing resources and services.
- Blockchain Technologies: decentralized ledgers that provide transparency, security, and immutability of data.
- Cyber-physical Systems and Digital Twins: integration of physical and digital models for monitoring and simulation.

Evolution and Trends

Research shows that interest in digital transformation (DT) has grown rapidly in recent years. For example, according to Plekhanov et al. in Digital transformation: A review and research agenda, a database of 537 academic papers on corporate transformations has been compiled. Similarly, Jiao et al. analyzed 685 articles on the relationship between digital technologies and innovation (Fig. 1 and Fig. 2) [3].

Meta-framework and Interactions

In the study by Jiao et al., a meta-framework is proposed that examines the direct and indirect role of digital technologies in innovation, introducing four levels of analysis-individual, firm, industry, and national [3]. This shows that digital technologies do not act independently but through complex interactions with organizational capabilities, strategy, institutions, and environment (Table 1).

Table 1 Characteristics of New Digital Technologies

Feature	Description
Scalability	Ability to rapidly expand and be implemented on a large scale
Network Effect	Benefits increase with the number of connected devices or systems
Combination Effect	Synergy created by combining different technologies (e.g., AI + IoT)
Mobility	Devices and services accessible anytime and anywhere
Data-driven Model	Data serve as a central resource for new business models and services

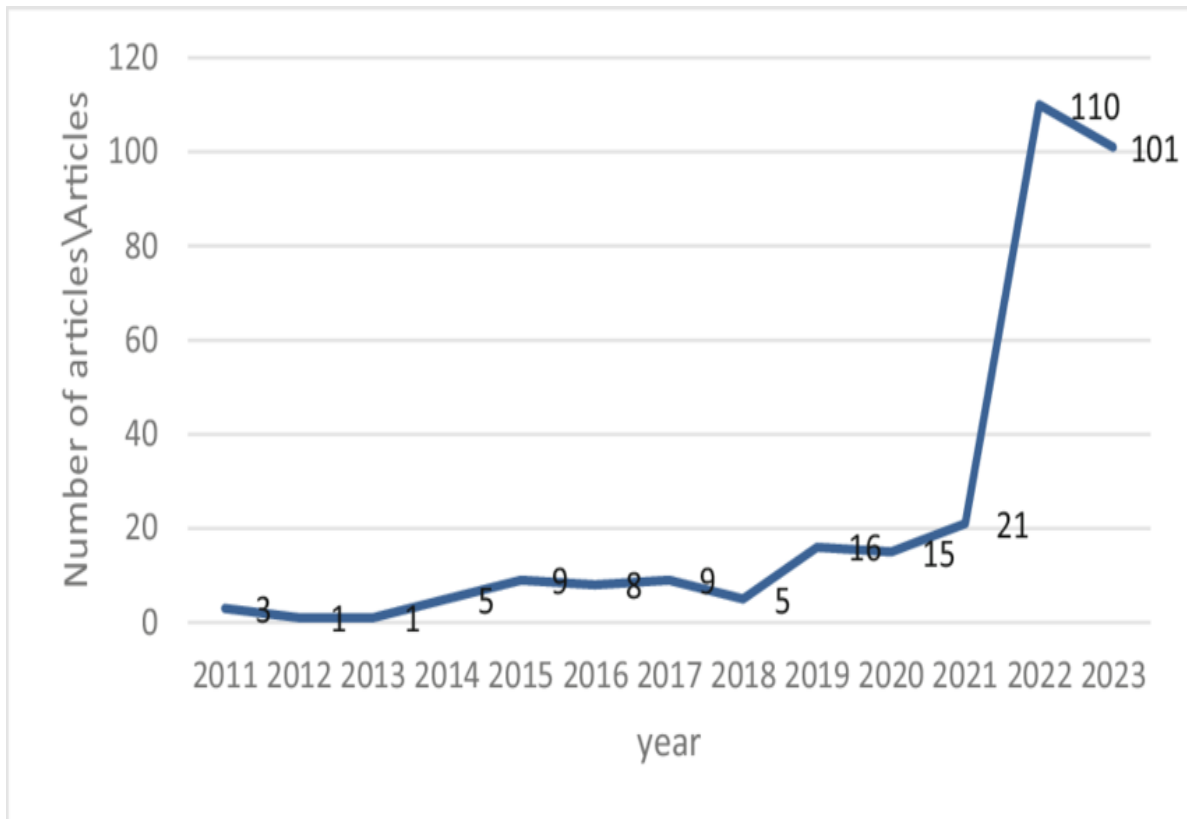


Fig. 1. Number of publications on digital transformation

Accelerating digital transformation the top priority in 2021

What is the single most important change that has to be implemented in your organisation over the next year?

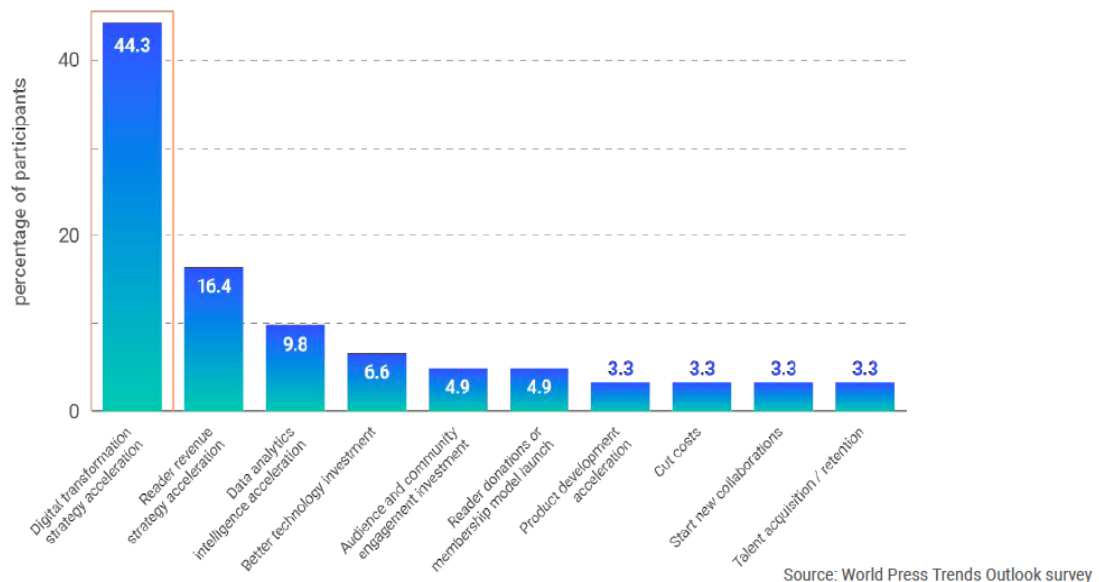


Fig. 2. The exponential growth of publications in the field of digital transformation since approximately 2014 [2]

Chapter 2: Applications and Impact Innovation and Business Models

Digital technologies are transforming how firms innovate and create value. For example, in the relationship between digital technologies and innovation, it is emphasized that digital technologies can stimulate new products, services, business models, and processes [3].

Sectoral Examples (Fig. 3 and Fig. 4)

Services

In service sectors (finance, healthcare, education), digital transformation is particularly active. The study Digital transformation trends in service industries reviews real cases and explores how service firms apply DT [1].

Healthcare

In healthcare, new technologies facilitate clinical trials, telemedicine, and digital health solutions. For instance, using digital technologies in clinical trials reviews technology applications over the past five years [9].

Education

In education, digital technologies support learning, particularly through digital tools for reading and writing-see a scoping review of research on the use of digital technologies for teaching reading fluency [7].

Impact on Productivity and Competitiveness

Research shows that firms successfully adopting digital technologies can achieve higher productivity, lower costs, better customer service, and greater innovation. For example, Marino-Romero et al. emphasize that digital transformation “increases firms’ productivity and competitiveness” [5].



Fig. 3. Sectoral distribution of digital technology implementation

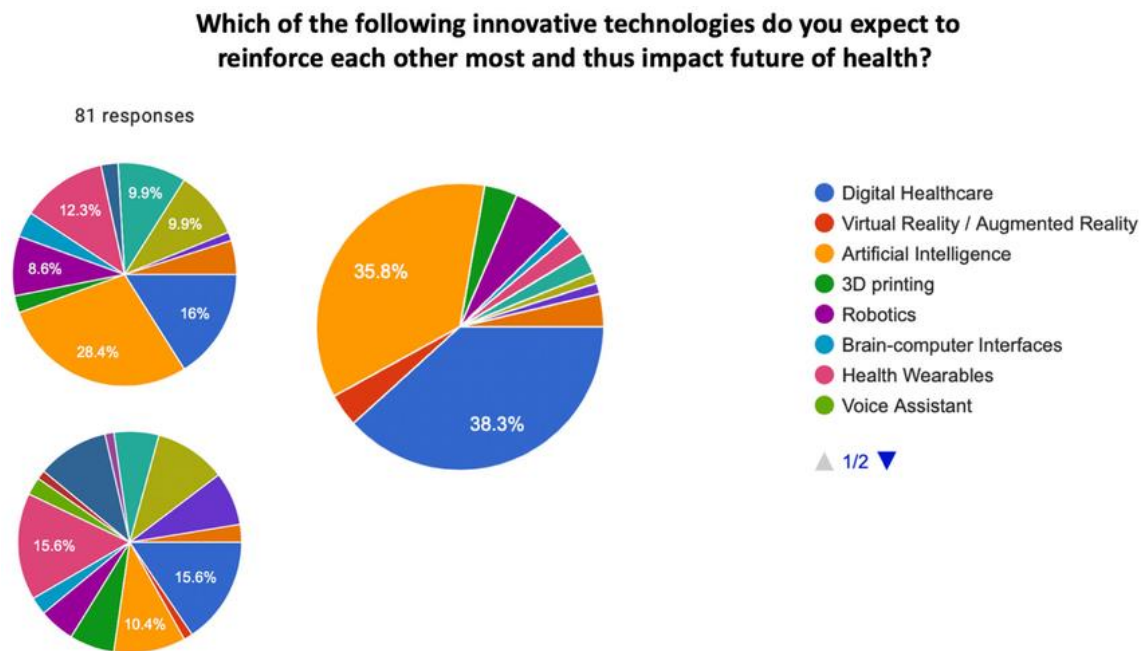


Fig. 4. How different sectors (industry, services, healthcare, education) are adopting digital technologies at different rates.

Socio-economic Effects

Beyond the corporate environment, digital technologies have broader social and economic implications:

- Changes in the labor market and skills: increasing demand for digital competencies.

- Inequality across groups and regions: the digital divide may deepen disparities.

- Impact on the public sector and government services: digital administration and e-government (Table 2).

Table 2 Applications and Effects of New Digital Technologies

Technology	Application	Main Effects
Internet of Things (IoT)	Smart devices, sensors	Real-time monitoring and automated processes
Artificial Intelligence / Machine Learning (AI / ML)	Data analysis and forecasting	Improved decision-making and personalization
Cloud Computing	Flexible IT infrastructure	Cost reduction and scalability
Blockchain	Decentralized ledgers	Enhanced security, transparency, and trust mechanisms
Big Data	Consumer and market analytics	New business insights and innovations

Chapter 3: Challenges and Future Research Directions

Key Challenges

Technological Integration and Sustainable Transformation

Technology implementation alone is not enough-it is essential to integrate it into business strategy, organizational culture, and processes. As Fadhlurrahman et al. note, “technology itself is only a tool, but transformation requires strategy and a supportive culture” [2].

Lack of Standards and Frameworks

The literature highlights the absence of unified metrics and frameworks for measuring digital transformation, as well as the need for conceptual consolidation.

Uneven Distribution and Digital Divide

Studies show that the effects of digital technologies can be uneven across regions, firms, and social groups. Sectoral and regional differences remain significant.

Ethical, Legal, and Security Issues

As digitalization expands, so do the risks-personal data protection, cybersecurity, and regulation-requiring academic and practical attention.

Future Research Directions (Fig. 5 and Fig. 6)

Multi-level Analysis

As Jiao et al. emphasize, the relationship between digital technologies and innovation must be studied at the individual, firm, industry, and national levels.

Sustainability and Social Responsibility

Alongside economic impacts, research should explore how digital technologies support sustainable development, social resilience, and digital inclusion.

Measurement and Methodology

There is a need for standardized metrics and frameworks-both quantitative and qualitative-for assessing digital transformation.

Small and Medium-sized Enterprises (SMEs) and Developing Economies

Research has focused primarily on developed economies and large firms; there is a significant lack of empirical studies on SMEs and developing economies.

Practical Recommendations

-Organizations should develop a digital strategy, not merely adopt technologies.

-Invest in digital skills and a culture of continuous learning.

-Pay attention to ethical and legal issues surrounding data and security.

-Government and institutional policies should promote digital inclusion and fair digitalization.

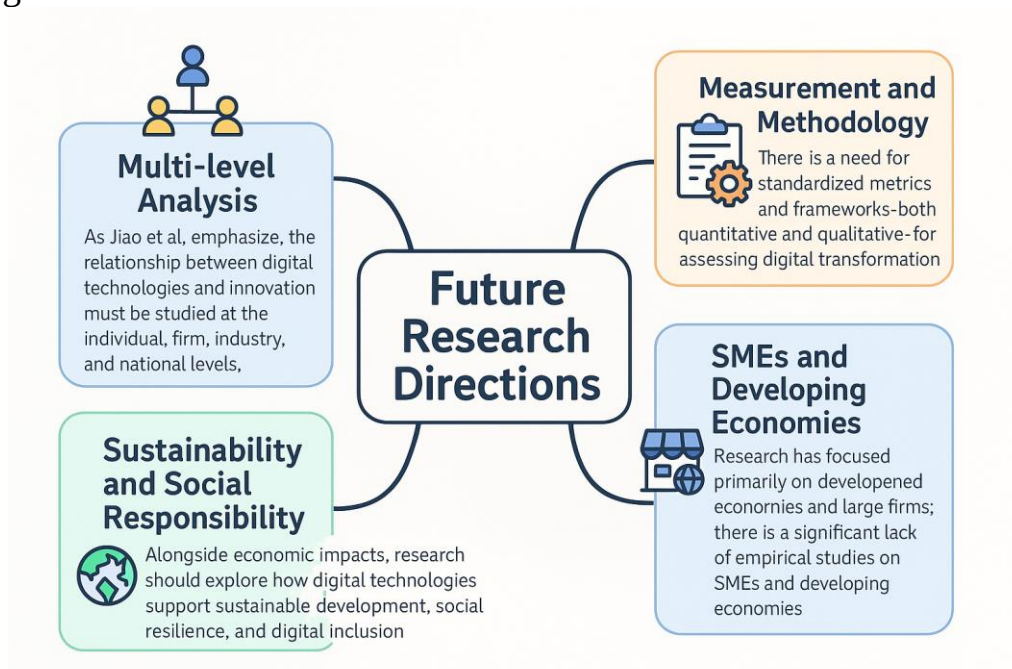


Fig. 5. Mind Map of Future Research Directions in Digital Transformation

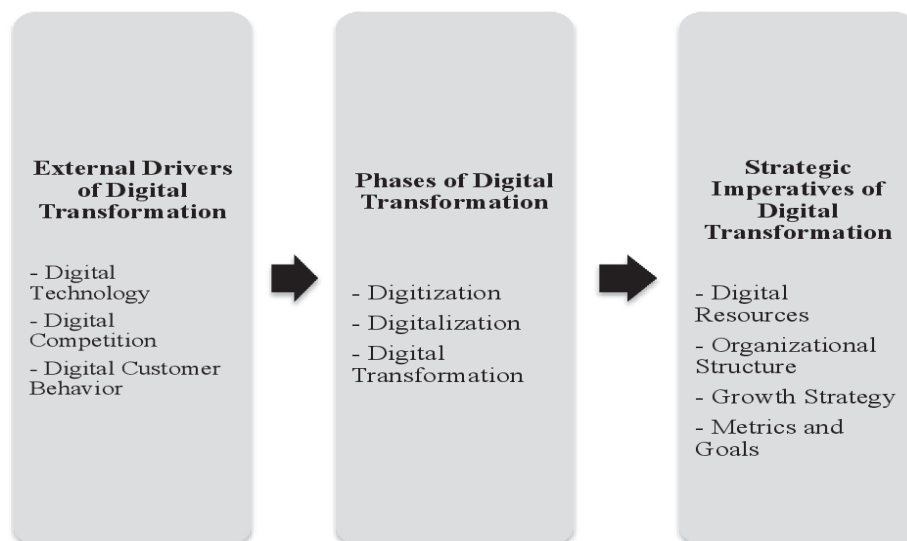


Fig. 6. Key research directions for the future

Conclusion

New digital technologies are a powerful catalyst for change: they transform business models, industries, and society as a whole. This article examined their nature and technological profile, their applications and impacts, as well as challenges and future research directions. In conclusion, the key messages are:

- Digital technologies should be viewed not only as tools but as part of the broader transformation of organizations and society.

- Successful application requires synergy between technologies, strategy, processes, and people.
- Academic research must focus on measurement, comprehensive frameworks, sustainability, and global perspective.

Given the rapid pace of development, ongoing research and monitoring of new digital technologies remain critically important for the academic community, business, and society.

Acknowledgments

This scientific article under project number RD-08-123/07.02.2025 „Research on the application of ergonomics in activities related to engineering logistics“ is funded.

References:

- [1] Anderson, K., "The CVE Ecosystem: A Decade of Standardizing Vulnerability Identification," Journal of Cybersecurity Advances, vol. 5, no. 2, pp. 45-60, 2021, ISSN 1234-5678, DOI: 10.1000/cyber.2021.12345.
- [2] Chin, H. S. et al. (2022). Digital transformation trends in service industries. PMC.
- [3] Fadhlurrahman, M. A. (2024). An academic analysis of digital transformation. SIT J.
- [4] Jiao, H., Wang, T., Libaers, D., Yang, J., Hu, L. (2025). The relationship between digital technologies and innovation: A review, critique, and research agenda. Innovation & Knowledge, 10(1).
- [5] Li, H. (2024). Digital technologies (Scientific Director). ScienceDirect.
- [6] Marino-Romero, J. et al. (2024). Digital transformation: A literature review in the context. SAJBM.
- [7] Massa, S. (2023). Digital technologies and knowledge processes: new emerging Journal of Knowledge Management.
- [8] Oakley, G. (2024). A scoping review of research on the use of digital technologies for teaching reading fluency. Education Sciences, 14(6):633.
- [9] Plekhanov, D. (2023). Digital transformation: A review and research agenda. Technological Forecasting & Social Change.
- [10] Rosa, C. (2020). Using digital technologies in clinical trials. PMC.
- [11] Vărzaru, A. A. (2024). Digital transformation and innovation: The influence of MDPI Systems.