

Exploring the Impact of Artificial Intelligence on Digital Transformation of Businesses: A Bibliometric Analysis

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Abstract. *Digital transformation brings significant organizational changes while artificial intelligence (AI) is a key contributor to this aspect. This article aims at explaining how AI helps businesses to grow and change in the digital world. The authors used as main research method a bibliometric analysis based on data collected from the Web of Science covering 2021-2025 period to identify dominant trends and themes in the literature. The analysis was carried out by selecting 472 relevant articles, filtered according to the keywords “digital transformation”, “artificial intelligence”, and “business”. By using the VOSviewer software, thematic networks were mapped and essential connections between the studied topics were established. The results showed a growing academic interest in this field during the analyzed period, as well as an increasingly convergence between technology and business strategies. The study showed that AI impacts businesses in numerous ways as it helps automate tasks, improve operations, support decision-making, and drive innovation in business models. However, this research has limitations. As it relied on the databases used and mainly focused on quantitative metrics. In terms of results, the paper provided new insights into how AI and digital transformation interact. It helped to better understand the topic and suggested new directions of further research. Not only the study highlighted the transformative role of AI in digital business evolution but can also offer valuable guidance for academics and practitioners looking to leverage these technologies for competitive advantage.*

Keywords: digital transformation, artificial intelligence, business, VOSviewer software, bibliometric analysis, Web of Science database.

Introduction

Nowadays, artificial intelligence (AI) is a technology with a meaningful impact on the digital period, being a main facilitator for digital transformation of processes in business. As the business environment is characterized by intense competition and constant changing requirements, AI provides organizations further options which help to optimize operations and improve decision-making processes, while also creating value for stakeholders (Davenport et al., 2020).

Considering the impact it has on the activity and objectives of companies through digital technologies usage, digital transformation is considered to be a profound process (Vial, 2019). It has become a strategic priority for most companies, accelerated during the COVID-19 pandemic. Organizations were constrained to rapidly adopt digital solutions to ensure operational continuity and respond to economic and social challenges (Kraus et al., 2022).

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Considering all these factors, AI has evolved from a niche technological tool to an essential component of the digital transformation, used to analyze complex data and provide real-time predictive solutions (Holmström, 2022). The role of AI as an engine of digital transformation is not specific to large companies but also applies to small and medium-sized enterprises (SMEs).

This article aims to explore how AI accelerates digital transformation in the business environment, using a bibliometric approach.

Literature review

By analyzing the specific literature, the main purpose is to identify the important trends, while emphasizing the research gaps and the strategic implications of this complex relation.

Artificial Intelligence

Artificial intelligence is defined as the characteristic of a machine to simulate human cognitive processes, which include learning, reasoning and decision-making (Reier Forradellas & Garay Gallastegui, 2021). Throughout the decades, AI has become an essential tool in the business world, used in various processes. Among these we encounter consumer behavior analysis, supply chain management and personalization of customer experiences (Ruiz-Real et al., 2021).

Organizations which have adopted AI demonstrated an increased ability to reduce costs and provide innovative solutions to unusual challenges (Kraus et al., 2022).

Digital Transformation

Moving on to digital transformation, Vial (2019) suggests that it is a process that causes significant organizational structure changes through several elements such as: information, communication, and connectivity technologies. On the other hand, there is a distinction we must consider while talking about digitization and digitalization.

The first one presumes the transformation of analog data into a digital format, while the second one refers to the usage of the newly obtained format to optimize processes and interactions (Paul et al., 2024).

Studies have showed that organizations which invest in digital technologies, particularly in AI, can adapt more efficiently to market demands and maintain stronger relationships with their customers (Holmström, 2022).

Artificial Intelligence and Business

Considering the relation between artificial intelligence and businesses, one aspect stands out. AI is a groundbreaking technology of the 21st century, having the power to reshape businesses core operations and stimulate the creation of further innovative business models.

For example, AI is commonly used in marketing in order to personalize user experiences, while in supply chain management helps with the optimization of resources (Ruiz-Real et al., 2021; Martínez-López & Casillas, 2013). SMEs can also use AI to automate routine tasks and reduce operational costs. As showed by an MIT Sloan Management Review report (Ransbotham et al. 2017), 85% of business leaders believe that AI brings competitive advantages to their organizations, although implementation remains at a gradual level.

Companies that integrate AI into their digital strategy also benefit from having better-informed decision-making processes and an enhanced ability to adapt to market changes.

The research questions of this study were formulated to guide the bibliometric analysis and to address relevant challenges related to the role of artificial intelligence in digital transformation. Key questions included:

- How does artificial intelligence contribute to the digital transformation of business models and operational processes?
- What are the main emerging directions and thematic clusters identified in AI and digital transformation research?
- How do geographical and institutional factors influence the distribution of research on the impact of AI in business?
- What emerging trends and challenges, such as sustainability and ethics, influence the implementation of AI in digital transformation?

Methodology

The bibliometric analysis is a rigorous and increasingly popular method for exploring and analyzing large volumes of scientific data.

Bibliometrics is known for its feature to provide an overview of a field, allowing the quantitative analysis of various elements, for example articles, authors, journals or keywords. This feature is valuable for interdisciplinary studies, such as the intersection of artificial intelligence and digital transformation in business, where the volume and complexity of the literature require both a structured and a detailed approach (Kirby, 2023).

Bibliometric analysis involves a structured process, defined by several important steps. The first one consists in defining the research purpose in which are established the objectives of the analysis and the research questions. In this case, the purpose was to analyze the role of AI as a promotor of digital transformation of businesses.

We chose Web of Science for this analysis due to the rigorous selection of publications and the reliability of bibliometric indicators, such as impact factor and H-index. However, this selection also has limitations, as WoS does not include all relevant studies, especially those from alternative databases such as Scopus, IEEE Xplore, or SSRN. For example, Google Scholar indexes a broader range of materials, including preprints, which can influence the perception of emerging trends. In contrast, Scopus covers more business and social science journals, which might have led to slightly different results (Tîmovanu et al., 2023).

Next, data analysis and visualization involves the use of specialized tools, such as VOSviewer or CiteSpace, to identify relationships between publications, authors or concepts (Kirby, 2023). Methods such as co-citation analysis, keyword analysis, or bibliographic analysis are among the most commonly used.

The last stage presumed the interpretation of the visualizations and data obtained, providing conclusions on the structure of the research field and identifying gaps and opportunities for future research (Donthu et al., 2021).

Applying these steps to the papers research firstly presumed to established the objectives, as follows:

1. Examining the volume and relevance of research on artificial intelligence and digital transformation, by analyzing bibliometric indicators.
2. Identifying thematic clusters and connections between concepts through keyword co-occurrence analysis and generating thematic maps.

3. Exploring geographical and institutional contributions to understand the global distribution of research and the role of international collaborations in promoting the application of AI in business.

The search strategy consisted in the use of relevant keywords, beginning with “digital transformation” as the main subject term, next “artificial intelligence” to direct the analysis toward technological impact, and “business” to focus on economic and managerial implications. The initial search using the term “digital transformation” returned a total of 39,784 articles. Adding the term “artificial intelligence” with the logical operator AND reduced the set to 2,749 documents. Subsequently, integrating the third term, “business”, narrowed the selection to 697 articles. To obtain the final dataset, the following filters were applied: time period and document type. Only articles published between 2021 and 2025 were selected, reducing the dataset to 553 documents, and articles and proceeding papers deemed most relevant to academic research were retained. After applying this filter, the final dataset comprised 472 articles.

The analysis of the temporal distribution of articles in the dataset revealed a significant increase in academic interest during the study period. The table below shows the number of articles published each year and their percentage of the total 472 articles.

Table 1. Temporal distribution of articles

Year of publication	Number of articles in the dataset	Percentage out of total
2021	99	20.97
2022	93	19.70
2023	90	19.06
2024	175	37.07
2025	15	3.17

Source: Authors’ own research.

The accelerated growth observed in 2024 regarding research on AI’s impact on digital transformation can be attributed to several factors. Advances in technological development, such as the rapid evolution of AI technologies like ChatGPT (OpenAI) and Gemini (Google DeepMind), have revolutionized multiple industries. The release of GPT-4.5 and Gemini’s enhancements in contextual understanding have expanded AI’s practical applications in business, ranging from process automation to data-driven decision-making (McKinsey, 2024). Nkomo and Mupa (2024) discuss the application of machine learning methods like Gradient Boosted Decision Trees (GBDT) in enhancing demand prediction by analyzing historical transaction data, contributing to improved delivery efficiency and customer satisfaction.

During the COVID-19 pandemic organizations were forced to adapt rapidly and AI became a key technology for ensuring operational continuity, such as automating customer support during surges in demand. Belhadi et. al (2021) provide examples of AI applications in automating customer support to handle increased service demands during the pandemic.

Additionally, debates surrounding the responsible use of AI and the European legislative framework for AI (2024) have sparked significant discussions on the future of adopting these technologies. The ethical and considerations regarding regulation have gained a significant interest among the themes treated in the scientific literature. The proposal of the European Commission for regulating AI, entitled Artificial Intelligence Act, aims to ensure that AI systems, available on the Union market, are safe and respect the existing laws on fundamental rights and values.

Following data collection, the analysis proceeded with an examination of data provided by the Web of Science platform and bibliometric analysis. These allowed mapping the field and highlighting the relationships between the subjects studied.

The keyword co-occurrence analysis identified the main research themes, outlining three primary directions: process automation, impact on SMEs, and digital sustainability. Analysis of citation networks highlighted the most impactful papers and authors, establishing essential benchmarks for the field. Bibliographic analysis revealed connections between articles based on common references, helping to identify emerging themes. The co-citation analysis showed groups of papers frequently cited together, highlighting the main research directions and their points of convergence.

Through these methods, the field was better mapped, providing a clear perspective on the relationships between the analyzed topics and strengthening the validity of the results.

Results and discussions

In order to address the research questions and objectives, various analyses were performed, using both figures and tables elaborated from Web of Science data and maps resulted from VOSviewer software.

Core indicators of publication impact and relevance

The first bibliometric indicators analyzed were regarding the volume, impact and relevance of the publications included in study (table 2). The dataset comprises 472 publications, explicitly focusing on articles relevant to artificial intelligence and digital transformation in business between 2021 and 2025.

Table 2. Main indicators of dataset

Indicator	Value	Explanation
Publications	472	Total number of publications included in the bibliometric analysis
Citing Articles	5259	Total number of articles citing the publications in the dataset
Citing Articles (excl. self-citations)	5160	Number of citing articles, excluding self-citations
Times Cited	5955	Total number of citations received by the included publications
Times Cited (excl. self-citations)	5771	Number of citations received, excluding self-citations
Average Citations per Item	12.62	The average citations per publication, indicates the impact of each article
H-Index	40	The H-Index value shows that 40 articles have been cited at least 40 times

Source: Authors' own research.

The 5259 citing articles demonstrate the extensive influence of the analyzed publications on the scientific literature. Of these, 5160 exclude self-citations, underscoring the external validity of these contributions and indicating a high level of recognition from other researchers. The total of 5955 citations further consolidates the academic relevance of the included publications. An

average of 12.62 citations per article signifies a considerable impact of each work on advancing knowledge in this field. When self-citations are excluded, the total citation count decreases to 5771, confirming that the majority of citations originate from independent sources, thereby reinforcing the objectivity of this indicator.

Another critical aspect is the H-index value, which signifies that at least 40 articles in the dataset have been cited at least 40 times each. This indicator combines author productivity with the academic relevance of their publications, reflecting significant influence within the specialized literature. The H-index serves as a measure of the consistency and durability of the research’s impact, further establishing this field as a focal point of scientific interest.

Global contributions to research on AI and digital transformation of businesses

Artificial intelligence accelerates the digital transformation of SMEs by automating repetitive tasks, improving decision-making, personalizing the customer experience, and facilitating access to finance. For example, the use of RPA reduced document processing time by more than 60% (Ivančić et al., 2019), and Machine Learning algorithms improved demand predictions by 25% in the e-commerce sector (Nkomo & Mupa, 2024). At the same time, AI increased customer satisfaction in retail by 35% thanks to intelligent chatbots (Ruiz-Real et al., 2021). These examples show that AI is not only for large companies but also an essential tool for the development of SMEs.

Furthermore, the authors examined the repartition of the articles considering the country which originated the papers. The database contained contributions from a total of 83 countries, highlighting the international nature of research on the impact of artificial intelligence on digital transformation. This geographical diversity reflects global engagement in studying and implementing advanced technologies across various economic and social contexts.

Among these, 10 countries stand out with a significant number of publications (fig.1), representing nearly 74% of the total 472 articles in the analysis.

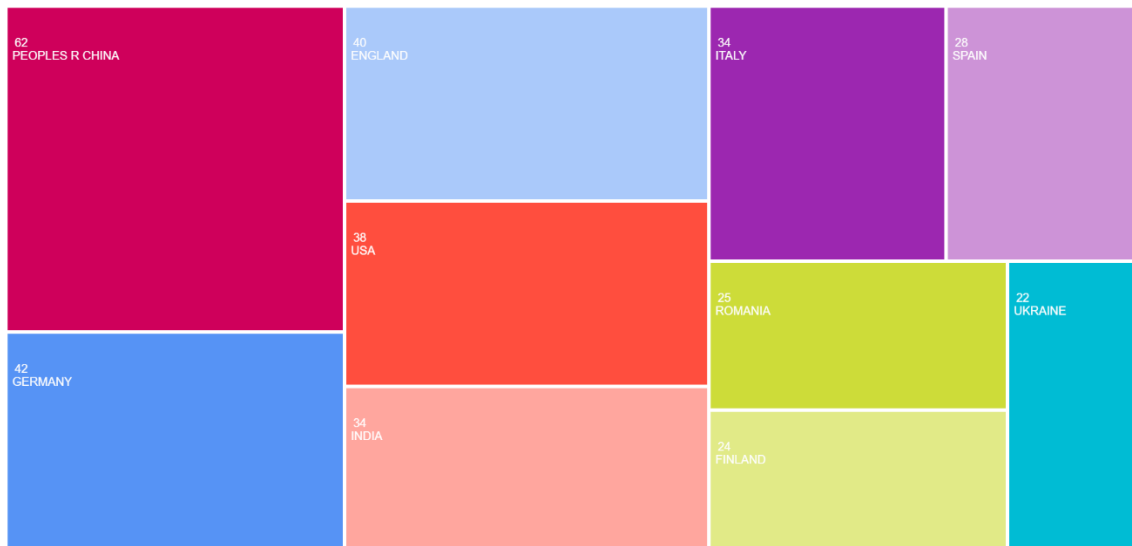


Figure 1. Top 10 contributing countries

Source: Web of Science.

China is one the major contributors with 62 publications (13.13%), followed by Germany with 42 (8.89%) and England with 40 (8.47%). The United States ranks fourth with 38 articles (8.05%), while India and Italy share the fifth and sixth positions, each contributing with 34 publications (7.2%). Countries like Spain, Romania, Finland and Ukraine completed the ranking with 28 (5.93%), 25 (5.29%), 24 (5.08%) and 22 articles (4.66%).

From a regional perspective, Asia can be considered a key contributor, as countries like China and India, account for 20.33% out of the total publications.

Existing research emphasis that AI adoption and digital transformation vary across regions, influenced by government investments, digital infrastructure, and regulations.

The EU prioritizes AI regulation (Artificial Intelligence Act) and balanced development through funding programs (Horizon Europe), with Germany, France, and the UK leading research at a slower pace than the U.S. and China (Holmström, 2022). India and Southeast Asia are rapidly expanding AI adoption due to lower costs and a skilled workforce, with Singapore and South Korea investing in automation and supply chain optimization (OECD, 2023).

Eastern Europe, including Romania and Ukraine, is advancing in AI research through EU-funded projects but faces challenges from limited private investment and digital infrastructure (Tîrnovanu et al., 2023).

Leading institutions and contributors

Regarding institutional affiliations (fig.2), the Ministry of Education and Science of Ukraine leads with 19 publications, emphasizing Ukraine’s active engagement in this area of research. The Bucharest University of Economic Studies follows with 11 publications, reflecting Romania’s focus on exploring the intersection of digital transformation and AI in business.



Figure 2. Top 10 affiliations

Source: Web of Science.

Other notable contributors include the Indian Institute of Management System (10 publications), the University of Vaasa (9 publications) and Qatar University (8 publications). Additionally, institutions such as the Lulea University of Technology, the University of Naples Federico II and the University System of Ohio each contribute with seven publications, while the

Russian Academy of Sciences and King Abdulaziz University have six publications each. These results demonstrate the global distribution of research efforts, with significant representation from Europe, Asia, and the Middle East.

In terms of individual contributions, the dataset included a total of 1507 authors. Among them, Parida V. is the most prolific author, contributing with seven publications, which represent 1.48% of the total. Rana N.P. follows with five publications (1.05%). Other notable contributors, included Chowdhury S., Lyytinen K., Mithas S., Pappas I.O., Pereira V., Sjödin D., Tang J., and Topi H., each having three publications, accounting for 0,63% of the total dataset per author. Moreover, 66 authors have contributed with two publications each (0.42% per author), reflecting the collaborative and interdisciplinary nature of this field.

Table 3. Main contributing authors

Authors	Number of articles	Percentage out of total
Parida V.	7	1.48%
Rana N.P.	5	1.05%
Chowdhury S.	3	0.63%
Lyytinen K.	3	0.63%
Mithas S.	3	0.63%
Pappas I.O.	3	0.63%
Pereira V.	3	0.63%
Sjödin D.	3	0.63%
Tang J.	3	0.63%
Topi H.	3	0.63
Yang Y.	3	0.63

Source: Authors' own research.

These findings reveal strong correlations between institutional focus and author productivity, with leading institutions often associated with the most prolific contributors. For instance, institutions such as the University of Vaasa and the Indian Institute of Management System are linked to key authors driving advancements in this domain. This global and collaborative effort underscores the importance of partnerships across regions and disciplines in addressing complex challenges associated with AI and digital transformation.

Co-occurrence analysis of author keywords

Co-occurrence analysis of author keywords is a key bibliometric method used for identifying core themes and research clusters. This technique examines the frequency with which keywords appear together in scholarly articles, offering insights into the structure of a research domain (Öztürk et. al, 2024). Authors considered that using co-occurrence analysis with author keywords offers a more precise and relevant exploration of the research papers. Author keywords are deliberately chosen by researchers to reflect the main focus and intent of their studies, ensuring a more accurate representation of the field's central themes. Furthermore, author keywords improve thematic clustering, as they naturally align with distinct research subfields, for example in this case automation in business or sustainability.

Cluster	Key themes and keywords	Focus
Cluster 3	Emerging technologies and governance: blockchain, IoT, Industry 4.0, Industry 5.0, supply chain management, governance, sustainable development	Explores the advancement of technologies and the legislation supporting AI's adoption in businesses.
Cluster 4	Digital economy and ethical business practices: business models, digital platforms, digital economy, ethics, value creation, bibliometric analysis, digitization, accounting	Addresses economic impacts, ethical considerations, and modernized business processes using AI.
Cluster 5	Pandemic-induced transformations: COVID-19, SMEs, digital servitization, sustainability, dynamic capabilities, fintech	Highlights AI-driven adaptations during the pandemic, particularly for SMEs and service innovations.
Cluster 6	Data infrastructure for businesses: big data, cloud computing, blockchain technology, IoT, Industry 4.0	Focuses on technologies which enables data-driven decision process and automation.
Cluster 7	Advanced AI Applications for Businesses: ChatGPT, generative AI, enterprise architecture, technology adoption	Reflects the transformative potential of cutting-edge AI tools in business operations and creativity.

Source: Authors' own research.

The analysis showed that “business” is a recurrent theme within the co-occurrence map, showing its strong connections with core AI technologies and their applicability. Also, keywords such as “automation”, “data analytics”, “robotic process automation” or “cloud computing” demonstrates how AI is being used to improve efficiency and optimization of resource allocation. Several examples were identified such as, AI utilization by General Electric for predictive maintenance of wind turbines, which reduced the nonfunctioning time by 30% or RPA adoption by UiPath (Ivančić et al., 2019).

Furthermore, keywords such as “sustainability” and “green technology”, reflects a growing trend of businesses which incorporate environmentally conscious practices while using AI-driven solutions. Google DeepMind reported a 40% drop of energy consumption with the integration AI technologies (McKinsey, 2024).

Ethical considerations are also present, words such as “ethics” and “cybersecurity” indicating the importance of using AI in business contexts with responsibility. Amazon Web Services uses AI to successfully manage the cloud infrastructure and cybersecurity.

Emerging technologies, such as “ChatGPT”, reveal AI’s potential to further develop the way business communicate. The inclusion of “digital transformation” underscores the integration of AI into strategic business initiatives, reshaping industries through innovative digital models.

These findings highlight both current trends and underexplored areas, offering opportunities for future studies. Existing research emphasizes AI integration in industrial automation and cybersecurity, but a potential direction is the development of more secure AI models against cyber threats. Additionally, AI is increasingly used to optimize business processes, yet its impact on strategic management and digital leadership remains an open field for exploration. Another key aspect is AI’s role in sustainability, paving the way for research into energy-efficient AI models. In the economic sphere, AI is reshaping business models while raising significant ethical concerns, suggesting a need for in-depth studies on regulation and responsible AI usage. The pandemic has accelerated digitalization, particularly for SMEs, making it essential to analyze

how AI can support their long-term resilience. These research directions will enhance the understanding of AI's transformative potential for the economy and society in the coming years.

Conclusion

This article studied the role of artificial intelligence as an important factor in business's digital transformation, by using a bibliometric analysis to explore the trends, contributions and major themes in the academic literature.

The wide adoption of AI is conditioned by overcoming multiple legal and ethical barriers, such as algorithm bias, lack of decisional transparency, data protection and AI usage regulation in business. AI models can amplify existing bias present in the data sets, which can lead to discriminatory decisions, for example in the financial or medical sectors (Bellamy et al., 2019). Also, the complex algorithms are often perceived as black boxes, which can bring up explanatory issues in fields like banking. Moreover, massive data collection exposes risks regarding confidentiality of users and GDPR regulation breaches. The lack of a global regulation frame only accentuates the incertitude of adopting AI by companies (Rudin, 2019).

Concrete and relevant measures are required to address these issues, such as the EU's Artificial Intelligence Act which proposed varying restrictions based on the risk level of AI applications. To further address these challenges several solutions could be explored, for example the development of explainable and auditable models through Explainable AI techniques, the use of diverse datasets to reduce bias, the implementation of strict data protection policies, and the establishment of clear legal frameworks at the international level (Brundage et al., 2020; Bertino et al., 2021). Initiatives such as IBM's AI Fairness 360 and the OECD AI Principles highlight the importance of collaborative approaches between the private sector, governments, and the academic community to ensure responsible and transparent AI adoption (Bellami et al, 2019; OECD, 2023).

The limitations of the study are influenced by several factors which must be considered. The bibliometric analysis is depended on the selection of the database, which relied exclusively on Web of Science publications. Certain research directions such as the impact of artificial intelligence upon startups or SMEs could be underrepresented. Another limitation worth mentioning derives from the citation analysis which does not always reflect the real impact of a paper. Citations can be influenced by auto-citation or networks of researchers which cite papers among each other which can also overestimate the importance of such studies.

Also, the bibliometric methodology implies its own limitations, as the keyword co-appearances analysis depends on the quality of the metadata and the frequency of word utilization in titles or abstracts, which can affect the representativity of certain concepts in the theme clusters.

The interpretation of the clusters generated by VOSviewer software can imply a certain degree of subjectivity as well. A deeper understating of the relations between clusters could require a combination of bibliometric analysis with qualitative methods such as case studies or interviews with industry experts. Although these aspects do not diminish the relevance of the results, they must be considered for a more nuanced interpretation of the conclusions.

The results of this paper can provide insightful guidance to both academic community and practitioners in utilizing the potential of AI to address the economic and social challenges of the digital age.

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