Jejakdigital
JURNAL ILMIAH MULTIDISIPLIN
Available online at https://indojurnal.com/index.php/jejakdigital

eISSN 3089-7734; pISSN 3089-7742
Vol. 2, No. 1, 2026
doi.org/10.63822/mmebf884
PP. 141-154

Digital Business Models in the Industry 4.0 Era: A Bibliometric Lens on Evolutionary Trends and Scholarly Trajectories

Saskia Usada[1], Rico Erlangga[2], Rafli Aly Yahya[3], Nashyifa Kayla[4], Muhammad Ramadhani Kesuma[5]
Mulawarman University, Samarinda City, East Kalimantan, Indonesia[1,2,3,4,5]

Email: saskiausada05@gmail.com

History Article:

Received *11 24, 2025*
Accepted *12 04, 2025*
Published *12 06, 2025*

ABSTRACT
The rapid advancement of Industry 4.0, driven by cyber-physical systems, IoT, AI, cloud computing, and big data analytics, has reshaped contemporary business landscapes. Digital Business Models (DBMs), characterized by scalability, platform-based value creation, and collaborative, data-driven processes, are critical enablers of this transformation. However, the growing body of DBM research lacks coherence and a unified conceptual framework within the context of technological evolution. This study adopts a bibliometric approach to systematically map the intellectual and thematic landscape of DBM research related to Industry 4.0 between 2019 and 2025. Using performance analysis and science mapping methods with VOSviewer, publication trends, thematic clusters, and collaboration networks were identified. Results reveal a shift from single-technology focus to multi-dimensional themes including platformization, value co-creation, digital transformation strategies, and ecosystem orchestration. Germany and Austria emerge as leading contributors in global research collaboration. This study contributes theoretically by defining the intellectual structure of the DBM field and identifying frontier topics. Practically, it offers actionable insights for enterprises deploying agile, technology-enabled DBMs under dynamic competitive environments and guides future research agendas in this rapidly evolving domain.

Keywords*: Digital Business Models; Industry 4.0; Digital Transformation*

How to Cite:

Usada, S., Rico Erlangga, Rafli Aly Yahya, Nashyifa Kayla, & Muhammad Ramadhani Kesuma. (2025). Digital Business Models in the Industry 4.0 Era: A Bibliometric Lens on Evolutionary Trends and Scholarly Trajectories. Jejak Digital: Jurnal Ilmiah Multidisiplin, 2(1), 141-154. https://doi.org/10.63822/mmebf884

INTRODUCTION

Digital transformation has opened up a world, namely Industry 4.0, where organizations and industries go through radical structural and operational changes. This is the convergence between sophisticated technologies of digitalization, AI, IoT, big data, blockchain, and cyber-physical systems. These are not tools only to get automation or efficiency better, but instead act as a seismic paradigm shift in how organizations consider their stakeholders, structure how they do business, and compete in ever more fast-moving markets. With evolution of digital infrastructure, the lines between real-world and digital environments are increasingly becoming blurred, paving the way for emerging modalities of organizational agility, real-time responsiveness and data-based governance (Avtalion et al., 2024).

In this regard, the Digital Business Model (DBM) has become relevant in facilitating firms in adapting to digital innovation. In contrast to linear value chains and physical assets, DBMs are dynamic, platform-based, data-driven, and inherently collaborative. They empower businesses to co-create value with customers, partners, and larger ecosystems through digital interfaces, modular architecture, and service-based revenue models. (Wang et al., 2025) note that in a complex environment, DBM innovation needs knowledge-based perspective that integrates technological capability, organizational learning, and strategic vision to address uncertainty and support long-term resilience.

The importance of DBM is rising alongside the development of Industry 4.0 technology. These technologies are not only catalyzing (Henrika, 2025), but also enabling the business model transformation. For example, IoT enables real-time collection of data, AI supports predictive analytics and intelligent automation, and blockchain provides traceability and trust in decentralized interactions. (Islam et al., 2024) contend that contemporary Industry 4.0 literature increasingly examines digital innovation and adoption, technological preparedness, and strategic fit, emphasizing the importance for entities to re-examine the basis of their operations. As companies incorporate these emerging technologies, they are compelled to reengineer their business models to align with new forms of value creation and customer engagement.

Although DBM and Industry 4.0 has seen a breakneck growth in studies, the area remains fragmented. Most of the current studies focus on a set of technology or industry. Therefore, there is no integrated field of knowledge (Ferrigno et al., 2022). This fragmentation hampers the cumulative knowledge construction of scholars and inhibits practitioners in making research-related insights applicable to real-world contexts. Differences in terminology and methodologies only exacerbate the challenge in synthesizing common findings or the finding of general findings.

In light of these challenges, bibliometric analysis has emerged as an increasingly common and systematic method of mapping intellectual structures and thematic (Kesuma et al., 2025) evolution within a given research domain (Klassen et al., 2012). This approach consists of quantitative analysis of empirical papers using statistics such as citation volume, co-authorship network, keyword co-occurrence, in order to observe themes and the relevant clusters across publication. Techniques help us to pinpoint significant works, to chart the emergence of central themes, and to see relationships between lines of research. (Stefanis et al., 2025) present methodological innovations in bibliometrics, such as AI-assisted filtering and dual-tool analysis, which increase findings' robustness and accuracy.

There are a number of key benefits of the application of a bibliometric analysis of DBM in the context of Industry 4.0. It offers a detailed introduction on how the field changes and progresses over time and discusses prominent and emerging themes. This means it identifies its intellectual foundation, mapping extensively cited authors and appropriate journals. Third, it reveals collaborations and knowledge networks within scientific sectors. Finally, bibliometrics uncovers research voids and unexplored avenues directing

future research agendas.

The intersection of DBM and Industry 4.0 has received more explicit attention in recent research, recognizing the two as mutually reinforcing. For instance, (Ji et al., 2024) explore the transformation of Digital Business Models under Industry 4.0 ecosystems through AI-driven analytics. Successful application also relies in large part on an organization's institutional culture, data management, and the environment and culture of coordination, indicating a requirement for an integrated strategy of technology and strategy during innovation (J.Anix Joel Singh & Sarathsimha Bhattaru, 2024).

The impact of integrating DBM with Industry 4.0 technologies on business practices can be significant. Firms that face the challenges associated with digital transformation must reconcile technical skills shortages, internal resistance to change, and regulatory uncertainties at scale. This article looks at business processes (Kesuma et al., 2025) of decision-making to DBM technology. DBM design is critical for organizations to fully benefit from these industrial technologies as new technologies become more advanced and widely accessible at an increasing pace: platform-based models for collaboration, data-driven services for customization and efficiency, and modularity for experimentation and adaptability (Ariswati, 2025). Together, these features fortify organizational resilience against disruptive innovation.

Due to DBM research's rapid conceptual and practical dissemination (mainly since 2019) and development, the study employs bibliometric perspective to summarize the accumulated knowledge and suggest future research areas. More specifically, this study seeks to establish the intellectual architecture of DBM-related research, note emerging and dominant themes, examine the scientific impact and collaboration networks and identify research gaps and recommend agendas for the future. A survey of publications from 2019 to 2025 offers a nuanced overview of the evolution of this field and helps confirm the study contains recent advancements consistent with Industry 4.0 (Reyes Domínguez et al., 2024).

This study contributes in both theory and practice. In theory, it makes foundational concepts stronger by dissection of the structure and theme of each of the three DBM literature pieces but it encourages the exploration of intersections of these theoretical pathways for new theories to emerge. In practical terms, it offers practical advice relevant to managers, policymakers, and entrepreneurs in planning and implementing successful business models for the contemporary industrial landscape say (Ahumada-Tello et al., 2023). Professionals can make informed decision-making about technology adoption, capability development, or long-term strategic alignment by reading academic writing.

Digitalization is not simply a fad. It is a structural change, one that requires us to think, organize, and compete at new levels in the modern global business world (Kesuma et al., 2025). Digital Business Models are currently developed with the help of high tech, which is just one of the ways we are moving forward with fast-paced industrial innovation (Lang, 2021). In order to truly exploit them we need to be aware of their intellectual origins, thematic thought and evolutionary path. This paper offers evidence-based, evidence-driven insights into the progress of DBM research through bibliometric analysis to build a more coherent and meaningful literature of these ideas as the technology revolution continues to take place.

METHODS OF RESEARCH

This study employs a bibliometric approach to analyze the development and scientific structure of Digital Business Models within the context of Industry 4.0. The bibliometric method is selected because it enables a broad understanding of publication patterns, category connections, and thematic mapping that emerge within the research field (Kulakli et al., 2024). The analysis is conducted using a descriptive quantitative approach, which means the study does not evaluate the content or quality of individual articles. Instead, it focuses solely on identifying patterns and knowledge networks derived from the total set of publications.

The research data were collected from the Scopus database, selected due to its comprehensive and credible coverage of academic literature suitable for bibliometric studies (Ibrahim et al., 2023). The search criteria were determined using relevant keywords such as "digital business model," "Industry 4.0," and "digital transformation." To ensure the study remains up-to-date and aligned with the emphasis on recent literature, the publication period was limited to 2019–2025. The raw metadata (titles, authors, keywords, abstracts, affiliations, and reference lists) were exported in a standard format and prepared for bibliometric software processing. Before analysis, the dataset was cleaned by removing duplicate entries and standardizing variations in terminology (e.g., different spellings of keywords or variations in author names).

The analysis was performed using VOSviewer, a software package widely used for visualizing and mapping bibliometric associations. This tool was used to generate visualizations of author collaboration, co-occurrence, citations, and co-citations in several types of units for analysis. The visualizations will be presented in the form of network visualization, overlay visualization, and density visualization (Darman et al., 2023).

Network visualization is used to illustrate patterns of relationships between elements in a dataset, such as countries, authors, or keywords. In this visualization, each node represents an element, while connecting lines indicate relationships, such as collaborations or co-occurrences. The size of the nodes indicates the level of importance or frequency of occurrence, while different colors indicate the formation of clusters or thematic groups. Through this visualization, it is possible to identify the most dominant elements and the network structure formed in research on Digital Business Models, including countries that actively collaborate and interrelated themes.

Meanwhile, overlay visualization provides a temporal perspective on the elements being analyzed. This visualization displays color gradients that indicate the average year of appearance of a keyword or publication, making it easier to identify old topics, transitional topics, and newer or emerging topics. Elements with brighter colors (yellow) indicate newer themes, while blue elements represent themes that were discussed earlier in the literature. Thus, overlay visualization helps show how the focus of research has evolved over time and reveals the direction of research development in this field.

In addition, there is density visualization that serves to illustrate the density level of occurrence and the strength of relationships between elements. Yellow areas indicate the highest intensity or frequency of occurrence, while green or blue areas indicate lower intensity. This visualization highlights the core topics or hotspots that are most frequently researched and become the center of attention in the literature, while also identifying themes that are still rarely mentioned and have the potential to become research opportunities in the future. Overall, these three types of visualization provide a comprehensive understanding of the structure, development, and focus of research in the study of Digital Business Models in the Industry 4.0 era.

Overall, the bibliometric method enables this study to provide a comprehensive overview of how research on Digital Business Models has evolved during the Industry 4.0 period. Furthermore, the use of these three types of visualization also provides an understanding of the structure, development, and focus of research in the study of Digital Business Models in the Industry 4.0 era, which provides insight into the direction of research development and serves as a basis for proposing a future research agenda.

RESULT AND DISCUSSION

1) Co-authorship by Countries (Network Visualization)

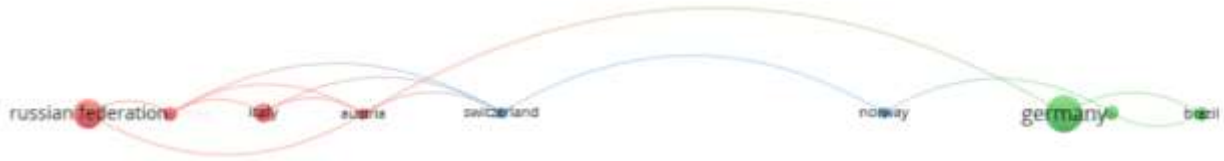

Figure 1. Co-authorship by Countries (Network Visualization)
(Source: *VOSviewer, 2025*)

Co-authorship analysis between countries shows that only certain countries have strong collaboration in their research. Network visualization shows the collaborative relationships between countries in publications related to Digital Business Models and Industry 4.0. Each node represents a country, while the size of the node reflects the number of publications or the level of contribution of that country. The lines (links) indicate scientific collaboration relationships.

The map was generated from several countries that form the main network components, while other countries appear as small or separate nodes. In the image, 9 of the 13 countries collaborate with each other, namely the Russian Federation, South Korea, Italy, Austria, Switzerland, Norway, Germany, the United Kingdom, and Brazil. Meanwhile, the other 4 countries that also contribute significantly, but as countries with nodes that are not connected to other countries, are Indonesia, Brazil, Ukraine, and South Africa. The visualization results show that Germany is the country with the most dominant scientific collaboration contribution. The largest node size indicates that the country contributes the most to research. However, Austria remains the most prominent country as a center of global research collaboration networks because it collaborates with 5 countries, namely the Russian Federation, South Korea, Italy, Switzerland, and Germany.

This pattern shows that DBM research tends to be concentrated in countries with high digital research capacity. Countries in central positions (central nodes) have high total link strength, meaning they are more active in collaborating on international publications. Meanwhile, countries on the periphery (peripheral nodes) contribute to publications but without intense collaboration with other countries. These results confirm that DBM research in the Industry 4.0 era has an uneven geographical basis, and the formation of global collaboration centers indicates the existence of dominant knowledge hubs.

2) Co-authorship by Countries (Overlay Visualization)

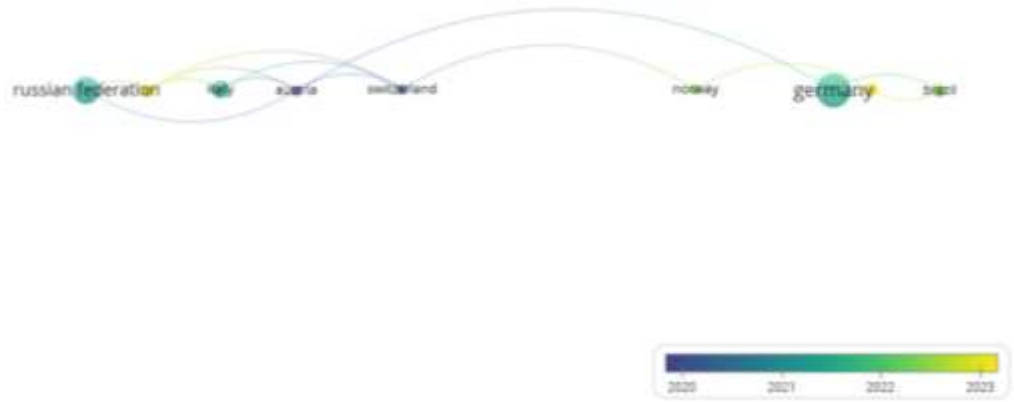

Figure 2. Co-authorship by Countries (Overlay Visualization)
(Source: *VOSviewer, 2025*)

This visualization shows that most countries are colored green-yellow, indicating that Digital Business Models and Industry 4.0 are relatively new and still evolving topics. Countries colored yellow (South Korea and the United Kingdom) indicate that they are very active in recent publications and are the most up-to-date contributors in this field. Conversely, nodes colored blue or bluish green indicate contributions in the early period (2019–2021). This coloring pattern confirms a global shift in research interest from an initial focus on Industry 4.0 technology to the strategic development of Digital Business Models.

3) Citation by Countries (Network Visualization)

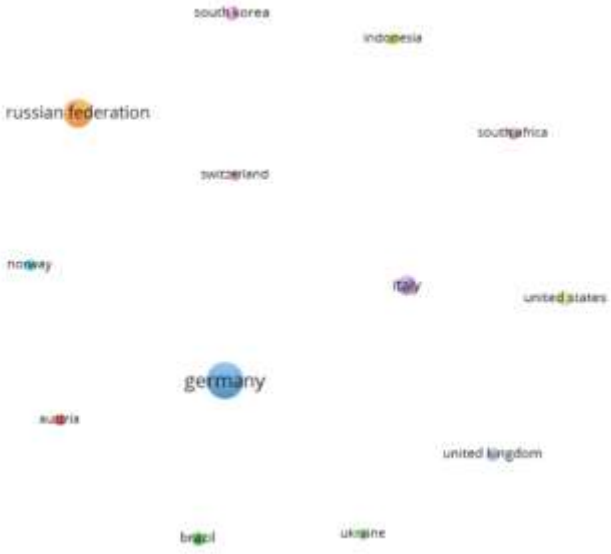

Figure 3. Citation by Countries (Network Visualization)
(Source: *VOSviewer, 2025*)

In the country citation visualization, the size of the nodes reflects the cumulative number of citations received by publications from that country. Large nodes indicate countries with higher scientific impact. This map shows that only a few countries dominate in terms of scientific influence. This can be seen in the citation visualization results, which show that Germany has the highest number of citations, making it the country with the greatest scientific influence in the fields of DBM and Industry 4.0. A high number of citations indicates that scientific works from that country are widely used as theoretical bases and methodological references by other researchers. In addition, the Russian Federation and Italy also have a significant impact, but lower than Germany. Several other countries may not have publications or citation quality as good as these three countries, but their works remain important references in DBM and Industry 4.0 literature.

4) Co-occurrence by All Keywords (Network Visualization)

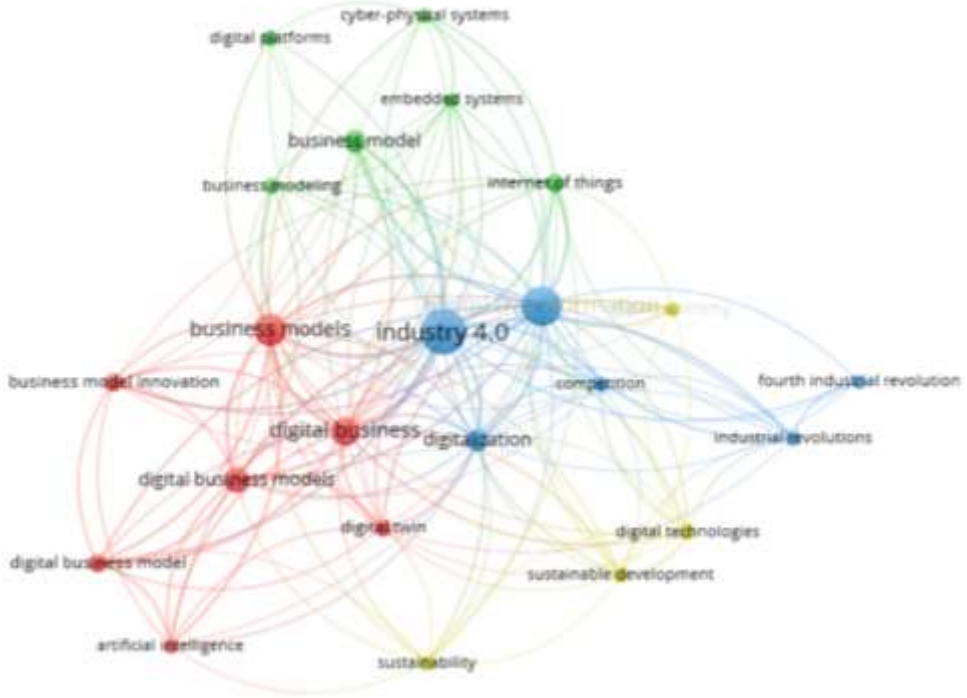

Figure 4. Co-occurrence by All Keywords (Network Visualization)
(Source: *VOSviewer, 2025*)

The co-occurrence visualization displays several clusters of research themes marked with different colors. Each node is a keyword, and the size of the node represents the frequency of occurrence of that word in publications. Co-occurrence analysis shows that research on Digital Business Models (DBMs) in the context of Industry 4.0 is dominated by several key words that form the conceptual structure of this field of study. The keyword “Industry 4.0” emerges as the most central term with the highest occurrences (47) and the greatest total link strength (112), indicating that all discussions about DBM are almost always placed within the framework of Industry 4.0 transformation. This term is consistently linked to the concepts of digital transformation and other supporting technologies, making it the main connecting node in the keyword network.

The second major theme is indicated by the keyword "digital transformation," which has 37 occurrences and a total link strength of 88. This confirms that Digital Business Models are not only viewed from a technological perspective, but also from the perspective of organizational transformation towards digital-based operations. These two terms form the center of gravity of the research, followed by other keywords such as "digital business" (19 occurrences; 79 TLS) and "business models" (24 occurrences; 77 TLS), which show that the literature links DBM with discussions of business models in general. Meanwhile, more specific terms such as "digital business models" (16 occurrences; 54 TLS) and "digital business model" (8 occurrences; 36 TLS) show that the academic focus is also directed at truly Digital Business Models, not just businesses that use digital technology.

In addition, several key Industry 4.0 technologies also appear to have significant connectivity within the keyword network. Terms such as "digitalization" (12 occurrences; 45 TLS), "digital twin" (7 occurrences; 32 TLS), "internet of things" (8 occurrences; 28 TLS), and "artificial intelligence" (5 occurrences; 28 TLS) indicate that DBM is greatly influenced by the ability of digital technology to create new value. The presence of this technology strengthens the relationship between digital transformation and structural changes in business models. Then, from the innovation side, terms such as "business model innovation" (8 occurrences; 27 TLS) and "business modeling" (5 occurrences; 19 TLS) show that research also focuses on how business models must adapt, innovate, and be redeveloped amid rapid technological changes. This signifies a shift in the literature from simply utilizing technology to a systematic effort to redesign business models.

Furthermore, a number of keywords such as "sustainable development" (6 occurrences; 21 TLS), 'sustainability' (6 occurrences; 18 TLS), and "digital economy" (5 occurrences; 13 TLS) indicate that issues of sustainability (Irianto, 2025) and the long-term impact of digitalization are also beginning to enter academic discourse. The presence of these topics illustrates that DBM is now not only associated with efficiency or technological innovation, but also with broader social and economic values.

Overall, this keyword connectivity pattern shows that research on DBM is developing in four main clusters:

1. Digital technology and infrastructure,
2. Business transformation and strategy,
3. Digital business models, and
4. Sustainability and the digital economy.

These four clusters form a clear intellectual map of how DBM is understood, researched, and developed in the Industry 4.0 era. The results show that research on Digital Business Models and Industry 4.0 forms a multidimensional cluster, not centered on a single theme.

5) Co-occurrence by All Keywords (Density Visualization)

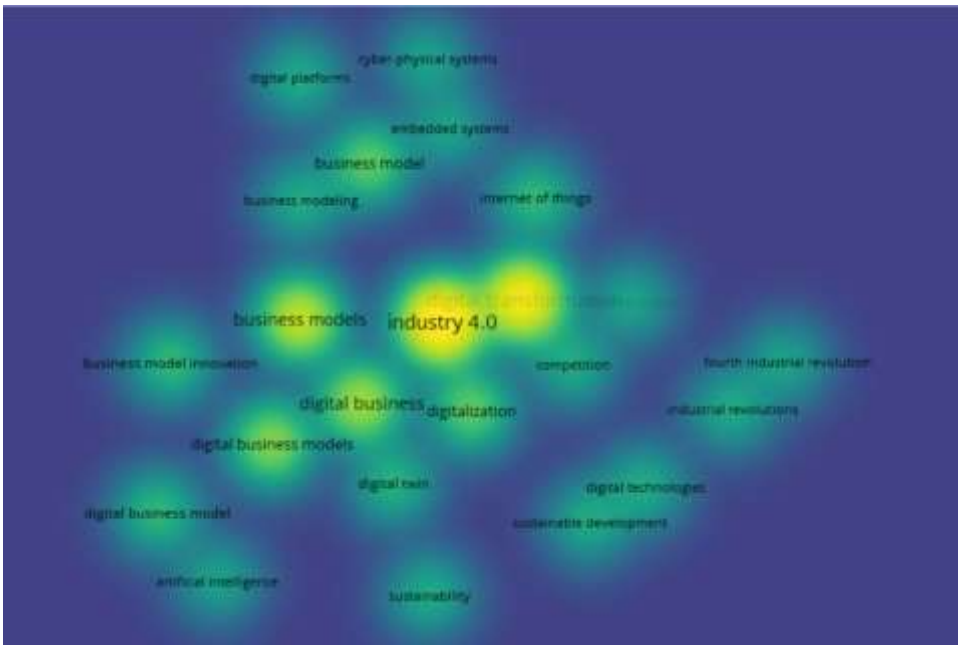

Figure 5. Co-occurrence by All Keywords (Density Visualization)
(Source: *VOSviewer, 2025*)

Density visualization is used to identify the density of keyword occurrences and connections in the literature, thereby helping to reveal which concepts are most dominant and which are still developing in research on Digital Business Models (DBMs). Lighter colors indicate higher frequency of occurrence and stronger connections with other keywords, while darker colors indicate lower intensity. In this visualization, the brightest area is seen around the keyword "Industry 4.0" (47 occurrences; 112 total link strength), "digital transformation" (37; 88), "business models" (24; 77), and "digital business" (19; 79), indicating that these four themes are the focus of study and form the main foundation for the development of digital business models in the Industry 4.0 era. Keywords such as "digital business models," "digitalization," "internet of things," "artificial intelligence," and "business model innovation" are in the green area, indicating that these themes have a moderate contribution and serve as supporting topics that enrich the main discourse. Meanwhile, keywords with low intensity such as "digital economy," "digital platforms," "fourth industrial revolution," and "sustainability" appear in darker colors, indicating that these topics are still relatively rarely discussed and have the potential to become new research directions in the future.

6) Citation by Authors (Network Visualization)

Figure 6. Citation by Authors (Network Visualization)
(Source: *VOSviewer, 2025*)

The visualization of citations by authors displays researchers who have had the greatest impact on the literature based on the number of citations received. In this display, there are no connecting lines between authors, so the visual focus is entirely on the size of the nodes, which represent the scientific influence of each researcher. The larger the node, the higher the number of citations received by the author, giving them a more prominent position in the research map.

Table 1. Data from The Selected Citation by Authors in Figure 6

Author	Documents	Citations	Total Link Strength
Aaagaard, Annabeth A.	2	39	0
Beiersdorff, Sandra	2	1	0
Brecht, Patrick	2	2	0
Hahn, Carsten H.	2	2	0
Hicking, Jan	2	36	0
Hüttemann, Detlef	2	1	0
Kolomiichuk, Sergii	2	1	0
Kummer, Robert	2	1	0
Locher, Bernd	2	1	0
Parida, Vinit	2	83	0
Presser, M.	2	39	0
Reuss, Maximilian	2	1	0
Schuh, Günther	2	36	0
Stich, Volker	2	36	0
Thomas, Simone	2	1	0

(Source: *Data Processed, 2025*)

The researcher with the largest node is "Parida, Vinit," indicating that his works are the strongest references in the fields of DBM and Industry 4.0. This makes him dominant in building the intellectual architecture of this field. Other researchers such as "Aagaard, Annabeth a." and "Presser, M." also play an important role as frequently cited contributors. This visualization shows that only a few researchers have very large nodes, indicating that scientific influence in the topic of Digital Business Models tends to be concentrated among a small group of core researchers. Meanwhile, other nodes with smaller sizes represent researchers whose contributions remain relevant but have lower citation counts. Thus, this visualization provides a clear picture of the distribution of scientific influence in the field of study and identifies the authors who are the main references in the development of research related to Industry 4.0 and Digital Business Models.

7) Co-citation by Cited Sources (Network Visualization)

Figure 7. Co-citation by connected cited sources (Network Visualization)
(Source: *VOSviewer, 2025*)

Figure 8. Co-citations by unlinked cited sources
(Source: *VOSviewer, 2025*)

Co-citation visualization at the source level shows patterns of interrelationships based on the frequency with which journals are cited together in a publication. This map shows that there are only three sources that are interconnected, namely "business and information systems engineering," "management science," and "strategic management journal," as indicated by the lines connecting one node to another. This interconnection indicates that these three sources often appear together in the reference lists of research on Digital Business Models and Industry 4.0, thus forming a core group with strong co-citation

relationships. The nodes of these three sources are usually larger, indicating a higher level of influence and citation frequency compared to other sources.

Conversely, the other four sources appear as separate nodes without connecting lines. The absence of connections indicates that although these sources are cited often enough to meet the visualization threshold, they are not cited in conjunction with any other source in the dataset. In other words, their contributions are individual and do not form a co-citation network with other sources. These standalone nodes reflect a scattered or fragmented citation pattern, in which these sources serve as supporting references but are not part of the core of interconnected literature.

Overall, these visualization results confirm that the co-citation structure in DBM-related research is still centered on a few core journals, while most other sources make more independent contributions without forming a strong network of referential connections.

CONCLUSION

This bibliometric study provides a comprehensive overview of how research on Digital Business Models (DBM) has developed in the context of Industry 4.0 between 2019 and 2025. By analyzing publication patterns, collaboration structures, dominant themes, and scientific influence, the findings show that DBM research is influenced by a small number of active countries and influential authors, supported by a set of interconnected core concepts and technological drivers.

Cross-country analysis shows that global scientific activity is concentrated in digitally advanced countries, with Germany emerging as the most influential contributor and Austria as a hub for international collaboration. Keyword mapping confirms that discussions on DBM consistently center on the convergence of Industry 4.0 technologies, organizational transformation, and evolving business model logic. The thematic structure is supported by several dominant concepts, such as Industry 4.0, digital transformation, and business models supported by emerging fields such as AI, IoT, digital twins, sustainability, and the digital economy, which represent growing research opportunities. Further analysis of author citations highlights that academic influence is concentrated among a small group of researchers, led by Vinit Parida and several other frequently cited contributors.

Overall, the results of the study show that the study of Digital Business Models (DBM) is growing, focusing not only on technology but also on strategy, organizational transformation, and the digital ecosystem. Although this field already has a strong conceptual foundation, uneven patterns of collaboration between countries, weak new themes, and unconnected sources of reference indicate that there are still many opportunities for further research. These opportunities include cross-disciplinary integration, strengthening theory, and exploring digital topics that have not yet been widely researched.

REFERENCE

Ahumada-Tello, E., Ovalle-Osuna, O. O., & Evans, R. D. (2023). Strategic Roadmapping for Technological Change. *IEEE Technology and Engineering Management Society Body of Knowledge (TEMSBOK)*, 53–67. https://doi.org/10.1002/9781119987635.ch3.

Ariswati, L. D., Kesuma, M. R., Aini, R. N. ., Irianto, E. D. O., Widaryo, C. M., & Henrika, M. (2025). Does financial literacy drive SME success in resource-rich regions?. Priviet Social Sciences Journal, 5(11), 308–321. https://doi.org/10.55942/pssj.v5i11.714

Avtalion, Z., Aviv, I., Hadar, I., Luria, G., & Bar-Gil, O. (2024). Digital Infrastructure as a New Organizational Digital Climate Dimension. *Applied Sciences*, *14*(19), 8592. https://doi.org/10.3390/app14198592.

Darman, Judijanto, L., Harsono, I., & Putra, A. S. B. (2023). Bibliometric Analysis of Human Resource Development: Trends, Research Focuses, and Recent Developments. *West Science Journal Economic and Entrepreneurship*, *1*(11), 329–338. https://doi.org/10.58812/wsjee.v1i11.373.

Ferrigno, G., Del Sarto, N., Piccaluga, A., & Baroncelli, A. (2022). Industry 4.0 Base Technologies and Business Models: A Bibliometric Analysis. *Academy of Management Proceedings*, *2022*(1). https://doi.org/10.5465/AMBPP.2022.16225abstract.

Henrika, M., Ariswati, L. D., Kesuma, M. R., Widaryo, C. M., Irianto, E. D. O., & Aini, R. N. (2025). Trade wars and tech giants: The U.S.–China policy effect on American technology companies. JEMBA: Jurnal Ekonomi Pembangunan, Manajemen & Bisnis, Akuntansi, 5(1), 65–74. https://doi.org/10.52300/jemba.v5i1.20277

Ibrahim, Z. S., Rifqiyah, F., Sultan, J., & Retnawati, H. (2023). A Visualized Bibliometric Analysis for Mapping Research Trends of Machine Learning in Academic Research. *Materials of International Practical Internet Conference "Challenges of Science,"* 271–279. https://doi.org/10.31643/2023.34.

Irianto, E. D. O., Kesuma, M. R., Aini, R. N., Henrika, M., & Ariswati, L. D. (2025). The Role of sustainable finance in driving environmental, social and governance (ESG) based investments. JEMBA : Jurnal Ekonomi Pembangunan, Manajemen dan Bisnis, Akuntansi, 5(1), 36-46. https://doi.org/10.52300/jemba.v5i1.20029

Islam, M. N., Hossain, M. M., & Ornob, M. S. S. (2024). Business research on Industry 4.0: a systematic review using topic modelling approach. *Future Business Journal*, *10*(1), 111. https://doi.org/10.1186/s43093-024-00398-2.

J.Anix Joel Singh, P. S. A. K. J., & Sarathsimha Bhattaru, P. R. P. S. (2024). Digital Transformation in the Era of Industry 4.0: Implications for Business Models and Operations. *Journal of Informatics Education and Research*, *4*(2). https://doi.org/10.52783/jier.v4i2.979.

Ji, F., Zhou, Y., Zhang, H., Cheng, G., & Luo, Q. (2024). Navigating the Digital Odyssey: AI-Driven Business Models in Industry 4.0. *Journal of the Knowledge Economy*, *16*(1), 5714–5757. https://doi.org/10.1007/s13132-024-02096-4.

Kesuma, M. R., Henrika S., M., & Ariswati, L. D. (2025). The Impact Of Capital Intensity On Financial Stability Of Energy Sector Companies In Indonesia. Journal of Financial Economics & Investment, 5(2), 115–127. https://doi.org/10.22219/jofei.v5i2.40516

Kesuma, M. R., Irianto, E. D. O., Henrika, M., Ariswati, L. D., Aini, R. N., & Widaryo, C. M. (2025). Unveiling Sentiment and Financial Risks: OJK's 10% Co-Payment in Health Insurance. RIGGS: Journal of Artificial Intelligence and Digital Business, 4(2), 3150–3159. https://doi.org/10.31004/riggs.v4i2.997

Kesuma, M. R., Yustianingrum, A., Najwaa, N. A., Kobi, K. J., & Salsabila, R. (2025). Optimalisasi UMKM melalui Pemanfaatan Big Data: Digitalisasi MENATA Event Organizers untuk Transformasi Bisnis. Jurnal Pengabdian Masyarakat STIE Surakarta, 4(1), 36–43. https://doi.org/10.56456/dimaseta.v4i1.142

Klassen, A. C., Creswell, J., Plano Clark, V. L., Smith, K. C., & Meissner, H. I. (2012). Best practices in mixed methods for quality of life research. *Quality of Life Research*, *21*(3), 377–380. https://doi.org/10.1007/s11136-012-0122-x.

Kulakli, A., Arikan, C. L., & Birgun, S. (2024). The landscape of Industry 4.0 and business model innovation: A scientometric analysis of research trends and emerging patterns. *Journal of Infrastructure, Policy and Development*, *8*(14), 9552. https://doi.org/10.24294/jipd9552.

Lang, V. (2021). Digitalization and Digital Transformation. *Digital Fluency*, 1–50. https://doi.org/10.1007/978-1-4842-6774-5_1.

Reyes Domínguez, D., Infante Abreu, M. B., & Parv, A. L. (2024). Main Trend Topics on Industry 4.0 in the Manufacturing Sector: A Bibliometric Review. *Applied Sciences*, *14*(15), 6450. https://doi.org/10.3390/app14156450.

Stefanis, C., Stavropoulou, E., Stavropoulos, A., Gyriki, D., Nikolaidis, C. G., Vassos, V., Nena, E., Tsigalou, C., & Bezirtzoglou, E. (2025). Innovative methodological pillars for bibliometric studies: AI screening, data normalization and dual-tool analysis. *Discover Applied Sciences*, *7*(9), 973. https://doi.org/10.1007/s42452-025-07653-3.

Wang, L., Jiang, Z., & Qu, G. (2025). Digital Business Model Innovation in Complex Environments: A Knowledge System Perspective. *Systems*, *13*(5), 379. https://doi.org/10.3390/systems13050379.