International Journal of Digitalization and Applied Management

Journal homepage:
https://ojs.nmdjournals.org/index.php/ijdam

ISSN: 2976-0453

Integration of Digital Technologies in Circular Supply Chains: A Keyword-Based Analysis

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Article Info

Keywords:

Digital Technologies,
Circular Supply Chain,
Big Data, Blockchain,
Artificial Intelligence,
Internet of Things,
Keyword Analysis

JEL: M11, Q56, O33

Received: 30 August 2025
Accepted: 17 September 2025
Published: 19 September 2025

Abstract

In recent years, the integration of digital technologies into circular supply chains has gained significant attention in the literature. In fact, these technologies and their applications are shaping the future of circular supply chains. This paper explores the role of digital technologies in enhancing circular supply chains. Employing a keyword-based analysis, the study examines the most frequently occurring topics associated with digital technologies in circular supply chains. The outcomes of the analysis highlight the increasing prominence of keywords such as blockchain, big data, Artificial Intelligence (AI), digital twins and, Internet of Things (IoT), indicating a significant shift towards data-driven and automated solutions. The findings of this research contribute to the existing literature by providing a structured overview of the digital technologies transforming circular supply chains. By identifying core and emerging topics, this paper sets the framework for continued exploration and development in the field of digital technologies and circular supply chains.

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DOI : https://doi.org/10.23882/ijdam.25214
Peer-review under responsibility of the scientific committee of the IJDAM Review

Introduction

Circular supply chains mark a fundamental transformation in industrial ecology, moving beyond traditional models of production and consumption. This innovative approach integrates the principles of circular economy into the management of the supply chain with the aim of minimising waste and optimising resource efficiency through material recycling, reuse, and refurbishment (Farooque et al., 2019; Vegter et al., 2020). This approach is in opposition to the traditional linear model of the supply chain, which follows the "take, make, dispose" pattern (Sopiani et al., 2020).

Circular supply chains offer promising potential for sustainable production and consumption, yet the implementation process faces numerous challenges that need to be overcome. In this context, many organisations are turning to innovative solutions such as digital technologies that are increasingly recognised as essential for improving circular supply chains (Romagnoli et al., 2023).

Digital technologies include basic, critical, and breakthrough technologies, which can help transform an enterprise into a digital one (Obukhova et al., 2020). These technologies facilitate the transition from traditional linear models to circular models by enhancing transparency, traceability, efficiency, and collaboration among supply chain entities (Farazi, 2024).

In the context of circular supply chains, these tools are integrated across supply chain stages to facilitate circular economy practices such as reuse, recycling, remanufacturing, and waste reduction (Liu et al., 2023).

However, to the best of our knowledge, despite a growing body of literature that discusses digital technologies in circular supply chains, there is a lack of systematic, keyword-based syntheses that quantify the relative prominence of specific digital technologies and map how these topics cluster across the literature. This gap motivates the present study. Specifically, we provide a quantified, exploratory mapping of technology topicality in the circular supply chain literature.

In this paper, we aim to explore the role of digital technologies in enhancing circular supply chains. Specifically, we address the following research problem: which digital technologies are most frequently associated with circular supply-chain practices in the academic literature, and do technologies that improve transparency and traceability show stronger associations with circular practices than general-purpose digital systems?

As exploratory expectations, we propose two provisional, descriptive hypotheses to guide interpretation:

- **H1**: Keywords indicating greater topical prominence of digital technologies will more frequently appear in articles that discuss circular supply-chain practices.
- **H2**: Keywords referring to traceability and transparency technologies will more frequently appear in the same articles as terms describing circular practices than keywords for general purpose digital systems.

We stress that H1 and H2 are interpretive expectations derived from prior literature and that the analysis remains primarily descriptive. Empirical causal testing is beyond the scope of this bibliometric study.

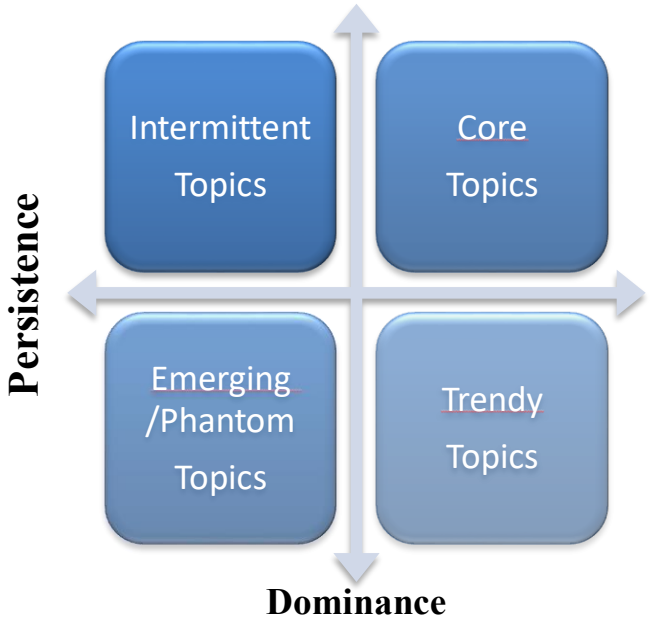
To examine the research question and the hypotheses, we performed a keyword-based analysis of peer-reviewed articles to identify the most frequently occurring terms associated with digital technologies in circular supply chains. Hence, this paper is structured as follows: first we present the methodology deployed to collect and analyse the data, then we report our findings, focusing on the most used technologies in circular supply chains. Finally, results are discussed while examining their benefits and limitations.

1. Methodology

In this paper, we adopt a keyword analysis methodology inspired by Fadlalla and Amani (2015) to explore the key trends and emerging digital technologies in circular supply chains. The essence of the research is captured through keywords, which reflect the researchers' perspectives on the topic. Our approach aims to identify and discuss key themes while categorising them according to their significance within the academic community.

Keywords are analysed based on two parameters: dominance, measured by the occurrence of a concept as a keyword and its temporal persistence, determined by the continuity of its usage over time. Dominance is quantified both in absolute numbers (based on article count) and relative terms (percentage of articles), while persistence is assessed by the number of years or the percentage of years a keyword appears. By applying average dominance and persistence values, we classify keywords into four quadrants: core, trendy, intermittent, and emerging or phantom topics (Figure 1).

Figure 1: The proposed framework



Source: Author's elaboration based on (Fadlalla and Amani, 2015)

Core topics refer to concepts with high persistence and dominance. This means that it is dealt with repeatedly, over a long duration, and is present in a significant number of articles. They represent the fundamental and structuring concepts of a research field, forming the stable core around which scientific production is organised.

Trendy topics represent concepts with low persistence but high dominance. They receive notable but brief attention, concentrated over specific time periods. Their sudden popularity may reflect a temporary enthusiasm in the scientific community, typically associated with specific contextual or technological issues. They are fashionable themes that have not yet acquired the maturity or stability of core concepts.

Intermittent topics are keywords with high persistence but low dominance. Although they are discussed over a long period, their frequency of appearance remains relatively low. They occur

intermittently, suggesting that they correspond to topics that are still being debated, emerging or cyclical, and whose interest may fluctuate according to specific research problems.

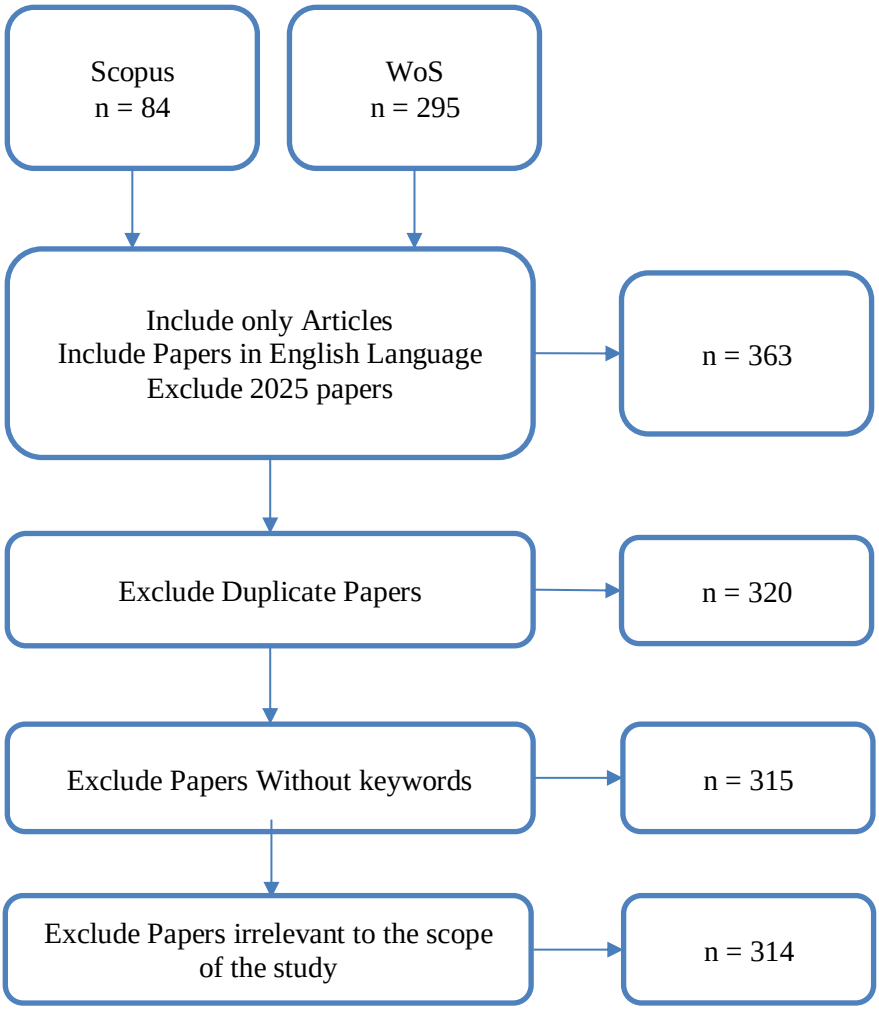
Emerging or phantom topics exhibit both low persistence and low dominance. They are often the result of a research interest limited in time and in academic scope. When they appear briefly without continuation, they are termed “phantoms”. When they represent new attempts still under development or exploration, they are classified as “emergent”.

To conduct this analysis, we searched the Scopus and Web of Science databases with a specific query: TITLE-ABS-KEY ("digital technolog*" AND (("circular economy" AND "supply chain")) OR "circular supply chain") AND (LIMIT-TO (DOCTYPE , "ar")).

The initial search, conducted in February 2025, yielded 379 results, which were filtered to exclude documents without keywords, duplicate and irrelevant documents, resulting in a final sample of 314 articles (Figure 2). Documents were evaluated based on titles, abstracts, and the presence of authors' keywords to ensure alignment with the research theme.

The analysis then proceeded with a descriptive phase to understand the temporal scope and key topics. The keywords were categorised into groups reflecting their dominance and persistence, facilitating the identification of prominent and emerging themes.

Figure 2: Papers selection process



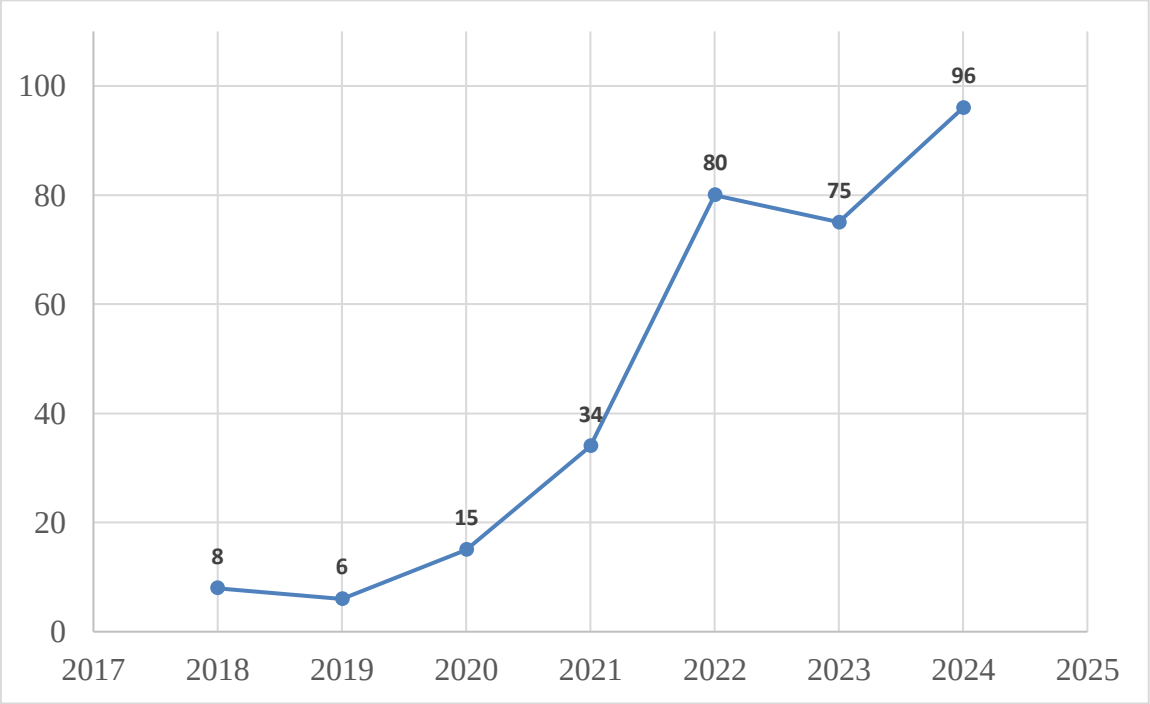
Source: Author’s elaboration

2. Results

In this section we will begin by analysing papers along several dimensions, including period time and source of publications. The proposed framework will thereafter be employed to present the core, trendy, intermittent and emerging concepts.

The number of papers published between 2018 and 2024, relating to digital technologies integration in circular supply chains, increased year on year, particularly between 2020 and 2022 (Figure 3). This remarkable fivefold increase can be explained by researchers' heightened interest in digital technologies during and after the Covid 19 crisis (Liu et al., 2023).

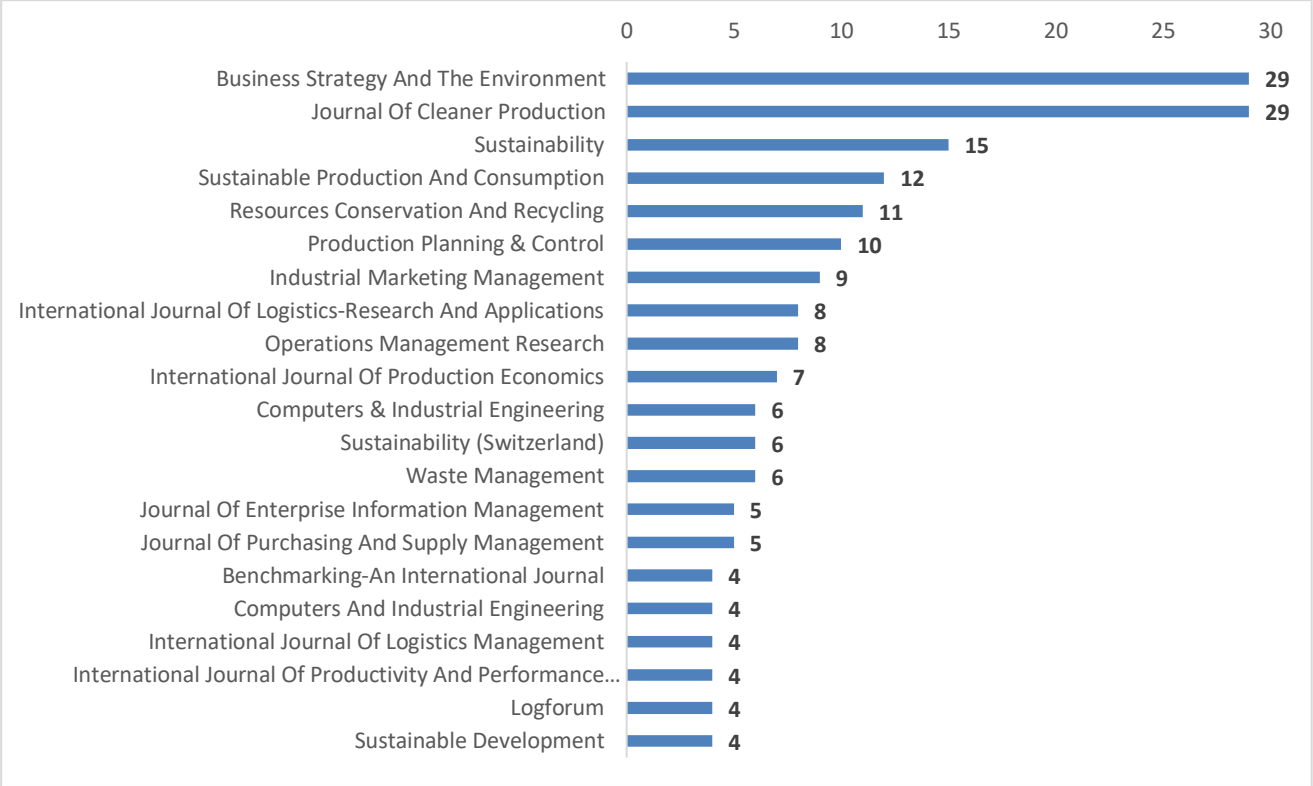
Figure 3: Number of published articles per year



Source: Author's elaboration

The analysis of the publication sources revealed a dominance of contribution from "*Business Strategy and the Environment*" and "*Journal of Cleaner Production*", which emerged as the most prominent sources of digital technologies integration in circular supply chains articles published during 2018-2024. Both journals averaged over four publications per year. The "*Sustainability*" journal took the third place averaging more than two publications annually. Taken together, these three journals accounted for over 22% of the publications included in this analysis.

Figure 3: top journals by number of published articles: 2018-2024



Source: Author's elaboration

The reviewed papers identified a total of 1825 keywords, of which 742 are unique. The keywords used to retrieve data from Scopus and Web of Science, i.e. "digital technologies", "circular economy", "supply chain", "supply chain management", "circular supply chain", were not retained in the analysed dataset as they were likely to yield significantly high dominance and persistence values, compromising the validity of the findings. In addition, some refinements were conducted; for example, manual changes and adjustments to remove variation in letter cases, abbreviations, or variation in singular/plural forms.

An initial examination of the results reveals that the keyword 'Barriers' was the only term to demonstrate continuous presence throughout the entire seven-year period under review. In contrast, two other keywords ("Sustainability" and "Sustainable Development") appeared consistently over a span of six years, while ten keywords maintained their presence for five years (Table 1).

Table 1 Number of keywords per persistence count

Persistence Count	Number of keywords
1	600
2	82
3	34
4	12
5	10
6	2
7	1

Source: Author's elaboration

While the persistence of a keyword over time is an important indicator, it is not the only metric to consider. Accordingly, Table 2 presents the distribution of keywords based on their frequency of occurrence within the article dataset. For instance, the keyword 'Sustainability' appears 55 times while 'Industry 4.0' appears and 41 times, as shown in Table 2.

Table 2 Number of keywords per dominance count

Dominance Count	Number of keywords
1	568
2	87
3	27
4	17
5	18
6	5
7	3
8	6
10	2
11	2
18	1
19	1
20	1
26	1
41	1
55	1

Source: Author's elaboration

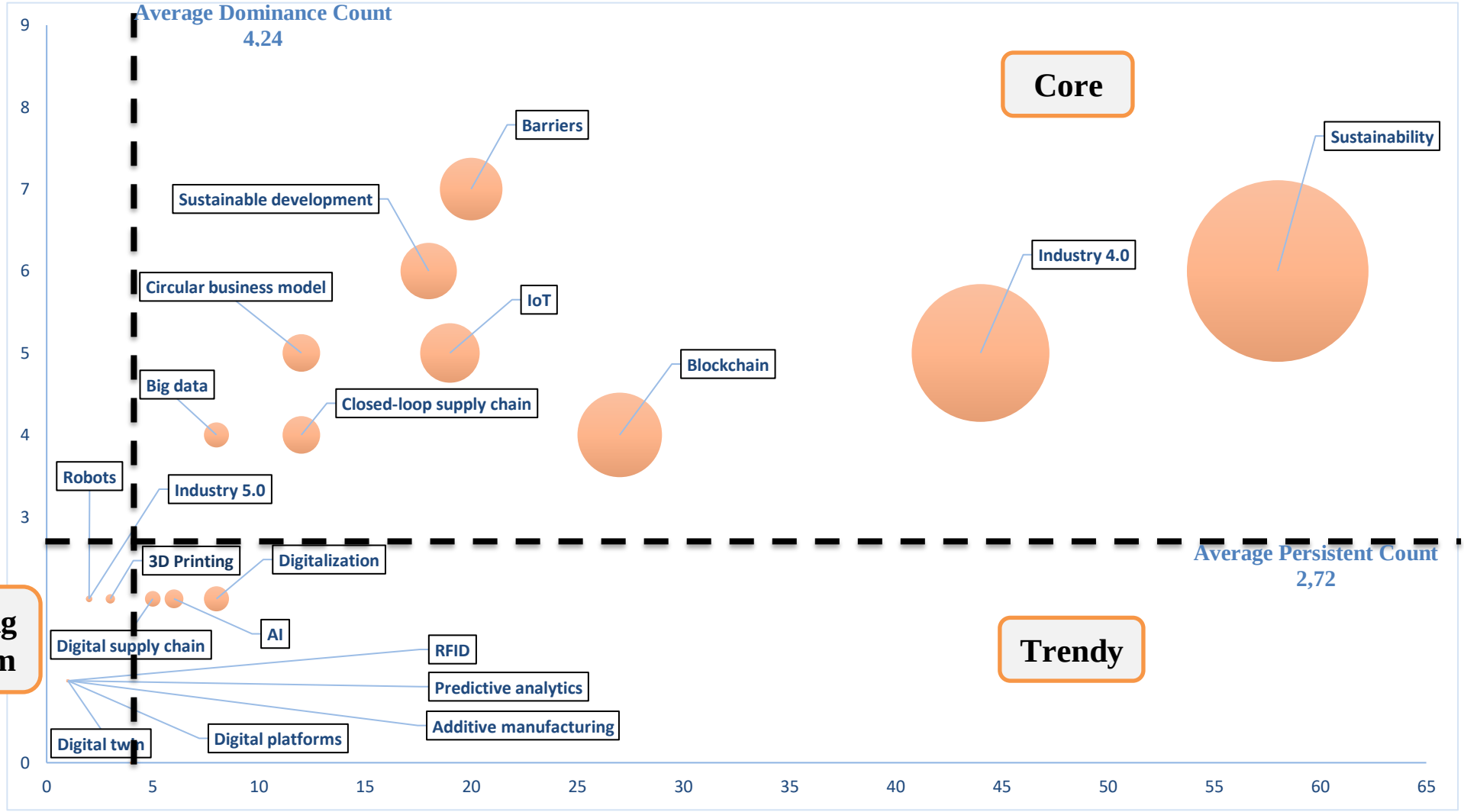
To assess the significance of a keyword, the average dominance count (ADC) and the average persistence count (APC) values were calculated, filtering out values equal to 1, in order to be more efficient (Fadlalla and Amani, 2015). We selected APC/ADC because they directly quantify two properties that are central to our research questions. Persistence asks whether a technology is discussed consistently across the literature, and dominance asks whether it is a leading topic within selected papers. These measures therefore map cleanly onto our aim to identify which digital technologies are most strongly associated with circular supply chain practices in the literature.

Compared with other commonly used bibliometric approaches, APC/ADC present two main practical advantages for this study. Firstly, they operate directly on keyword frequencies and presence, making them particularly suitable for a keyword-based analysis that focuses on technologies rather than citation structure. Secondly, they are computationally light and robust for corpora of our size (314 papers and 1825 keywords), simplifying reproducibility and transparency.

By contrast, citation-based clustering methods such as co-citation or bibliographic coupling (Song et al., 2022) emphasize epistemic ties and historical citation structure but can under-represent emergent terminology, whereas co-word analysis (Soriano-Pinar et al., 2023) highlights term co-occurrence patterns but do not directly quantify persistence across papers.

In our analysis, the ADC is 4,24 and the APC is 2,72 (Figure 5).

Figure 4: Keywords classification based on their dominance and persistence



Source : Author's elaboration

3. Discussions

3.1. Core topics

A closer exploration of the dominance-persistence charting in figure 5 shows *core topics* located in the quadrant characterised by a dominance value higher than the ADC 4,24 and the persistence value higher than the APC 2,72. These topics, including 'sustainability', 'industry 4.0', 'blockchain', 'barriers', 'sustainable development', 'IoT', 'circular business model', 'closed-loop supply chain' and 'big data', are pertinent and established keywords in the literature.

Blockchain is a technology that securely records transactions in a decentralised, tamper-proof ledger. Blockchain is increasingly used in circular supply chains in order to improve transparency and traceability helping companies track products and materials throughout their lifecycle and support circular economy goals (Khan et al., 2021).

The Internet of Things (IoT), defined as a network of connected physical devices—ranging from embedded sensors to industrial machinery—enables the continuous exchange and analysis of data in real time (Jum'a et al., 2024). In theory, such connectivity holds promise for circular supply chains: by offering greater visibility across the product lifecycle, IoT may facilitate smarter resource allocation and more sustainable operational practices (Liu et al., 2023; Farazi, 2024).

Alongside IoT, big data has emerged as another pillar of digital transformation. Typically characterised by its volume, velocity, and variety, big data defies traditional processing methods and necessitates more sophisticated approaches—advanced analytics, AI, machine learning, and the like (Tiwari et al., 2018; Cheng et al., 2021). When applied judiciously, big data can enhance circular supply chains by enabling real-time data generation, resource efficiency, and adaptive decision-making (Patil et al., 2023).

The dominance and persistence of blockchain and IoT reflect their functional role as traceability and trust enablers. This mechanism directly facilitates reverse flows and is consistent with H2's descriptive expectation that keywords referring to traceability and transparency technologies (blockchain and IoT) will more frequently appear in the same articles as terms describing circular practices than keywords for general-purpose digital systems (Kouhizadeh & Sarkis, 2018).

3.2. Trendy topics

Trendy keywords are those falling into the quadrant associated with a dominance value higher than the ADC and the persistence value lower than the APC. Although these keywords have appeared in the literature recently, they have attracted significant research interest. These keywords include: 'digitalisation', 'artificial intelligence' and 'digital supply chain'.

Artificial Intelligence (AI) refers to computer systems that can perform tasks typically requiring human intelligence, such as learning, reasoning, and decision-making (Wu et al., 2025). In fact, the integration of AI-based analytics in circular supply chains supports closed-loop flows (Lödar-Miculeac et al., 2025). AI's application in circular supply chains is newer compared to IoT and blockchain, which have established roles in traceability and real-time monitoring (Liu et al., 2023; Farazi, 2024). In addition, AI is often positioned as an enabler that amplifies the benefits of IoT, big data, and blockchain, rather than replacing them (Priyanshu et al., 2024; Sah et al., 2024).

The rising prominence of AI is consistent with the idea that analytics tools strengthen firms' ability to detect and operationalise circular opportunities (Zamani et al., 2023). This pattern is consistent with H1's descriptive expectation that keywords indicating greater topical prominence of digital technologies will more frequently appear in articles discussing circular supply-chain

practices, particularly in contexts where firms report routines to transform data into operational decisions.

3.3. Emerging or Phantom topics

The third quadrant with a dominance value lower than the ADC and the persistence value lower than the APC represents the emerging topics. The topics includes, but not limited to, '3D printing', 'Industry 5.0', 'robots', 'digital twins', etc. These keywords have been used for a short time in academic studies (phantom) or are just beginning to gain interest from researchers (emerging).

3D printing, also known as additive manufacturing, is a process that builds objects layer by layer from digital designs, allowing for rapid prototyping, customisation, and the creation of complex shapes that are difficult or impossible with traditional methods (Shree et al., 2020; Bhalla et al., 2021). 3D printing offers significant benefits for circular supply chains by enabling waste reduction, local production, and material recycling (Thomas & Mishra, 2022; Garmulewicz et al., 2018).

Digital twins are virtual representations of physical assets, processes, or systems that are continuously updated with real-time data, enabling monitoring, simulation, and optimisation throughout the product lifecycle (Kamble et al., 2022; Nathany, 2025). In the context of circular supply chains, digital twins offer significant benefits by enabling tracking of products for reuse, remanufacturing, and recycling (Islam, 2024). In addition, digital twins facilitate reverse logistics and resource recovery, aligning with circular economy goals (Chen & Huang, 2021).

Emerging technologies such as 3D printing and digital twins align with circular business model innovation. Their status as emerging or phantom in the literature likely reflects implementation, scalability and institutional barriers rather than lack of potential to support circular practices (Despeisse et al., 2017).

Thus, the results discussed in the previous subsections highlight the different digital technologies used in the context of circular supply chains. The table below summarises the different technologies with their benefits for circular supply chains as well as the barriers that limit their integration (Table 3).

Table 3 Benefits and barriers of digital technologies in the context of circular supply chain

Digital Technologies	Identified benefits	Barriers to implementation
Blockchain	Enhance traceability of materials and products, supporting closed-loop systems and compliance with environmental standards (Kouhizadeh & Sarkis, 2018)	Inconsistent regulations, lack of standardisation, and insufficient policy support
IoT	Support real-time monitoring, predictive maintenance, and optimal allocation of resources, reducing waste and improving efficiency (Jum'a et al., 2024)	High implementation costs, lack of interoperability, data security concerns, and technological complexity

Big Data	Support predictive analytics, demand forecasting, and decision-making (Zamani et al., 2023)	Require significant digital skills and data management capabilities
AI	Predictive analytics, automation, resource optimisation, and decision-making support (Zamani et al., 2023)	High implementation costs, technical complexity, and the need for organisational change
3D printing / Additive manufacturing	Facilitate product remanufacturing, reuse, and recycling, extending product lifecycles and supporting circular strategies (Despeisse et al., 2017)	Limited financial resources, inadequate infrastructure, and high upfront investment requirements
Digital twins	Real-time data sharing reduces information asymmetry, supporting better material circulation (Islam, 2024)	Lack of standardisation, data integration issues, and the need for significant IT infrastructure

Source: Author's elaboration

Conclusion

Digital technologies are transforming circular supply chains by enabling more efficient resource use, waste reduction, and improved sustainability. Technologies such as the Internet of Things, artificial intelligence, blockchain, big data analytics, and digital twins support real-time monitoring, traceability, and data-driven decision-making across product life cycles, from design to end-of-life management. These technologies help companies optimise resource distribution, enhance transparency, and extend product lifespans through remanufacturing, recycling, and reuse.

The keyword analysis positions our findings within the key research streams on digital technologies and circular supply chains. Previous reviews and empirical studies have emphasised the central role of blockchain and IoT for enabling provenance, trust and reverse-flow contracts. Our analysis results confirm this emphasis by showing that these technologies occupy the most persistent and dominant topical positions in the literature. Analytics technologies such as big data and AI are recognised as enablers of adaptive and predictive circular operations. We find these topics to be increasingly prominent, which extends the literature by documenting a shift from proof-of-concept studies toward growing research attention on data-driven decision support. The literature has identified 3D printing and digital twins as promising but under-tested avenues. Our mapping aligns with that claim by identifying these technologies as emerging topics and underscores the need for more firm level and sectoral empirical studies.

However, despite the promise of digital technologies in advancing circular supply chains, empirical evidence of their impact remains limited. Their large-scale deployment is often constrained by unreliable IoT data, weak interoperability, and fragmented governance structures. In addition, high implementation costs, technological complexity, and regulatory constraints continue to present significant challenges.

As with other academic studies, this paper has limitations. The reliance on Scopus and Web of Science restricts coverage mainly to peer-reviewed and English-language publications, thereby excluding grey literature such as industry reports and limiting access to non-English perspectives. Furthermore, the dataset analysed in this study covers publications up to 2024, which means that the most recent advances may not yet be reflected.

Future research on digital technologies in circular supply chains should move toward

integrated frameworks that combine multiple tools, supported by quantitative methods and clear performance metrics to assess economic, environmental, and social outcomes. Future studies should also explicitly incorporate diverse evidence sources, such as grey literature and industry reports, and multilingual approaches to capture regional and practice-based variation while extending the time coverage beyond 2024 to reflect the most recent developments. Further investigation of technology-specific applications, as well as sectoral contexts, will be essential to fully capture the potential of digital technologies in advancing supply chain circularity.

References

Bhalla, G. S., Singh, H., & Bawa, P. (2021). 3D printing incorporated with supply chain management and associated waste production. In Sandhu, K., Singh, S., Prakash, C., Subburaj, K., Ramakrishna, S. (eds) *Sustainability for 3D Printing* (pp. 159–178). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-75235-4_9.

Chen, Z., & Huang, L. (2021). Digital twins for information-sharing in remanufacturing supply chain: A review. *Energy*, *220*, 119712. https://doi.org/10.1016/j.energy.2020.119712.

Cheng, T., Kamble, S., Belhadi, A., Ndubisi, N., Lai, K., & Kharat, M. (2021). Linkages between big data analytics, circular economy, sustainable supply chain flexibility, and sustainable performance in manufacturing firms. *International Journal of Production Research*, *60*(22), 6908–6922. https://doi.org/10.1080/00207543.2021.1906971.

Despeisse, M., Baumers, M., Brown, P., Charnley, F., Ford, S. J., Garmulewicz, A., ... & Rowley, J. (2017). Unlocking value for a circular economy through 3D printing: A research agenda. *Technological Forecasting and Social Change*, *115*, 75–84. https://doi.org/10.1016/j.techfore.2016.09.021

Fadlalla, A., & Amani, F. (2015). A keyword-based organizing framework for ERP intellectual contributions. *Journal of Enterprise Information Management*, *28*(5), 637–657. https://doi.org/10.1108/JEIM-09-2014-0090

Farazi, M. Z. R. (2024). Designing circular supply chains with digital technologies for competitive sustainability: An operation management perspective. *International Journal of Science and Research Archive*, *13*(1), 2346-2359. https://doi.org/10.30574/ijsra.2024.13.1.1928

Farooque, M., Zhang, A., Thürer, M., Qu, T., & Huisingh, D. (2019). Circular supply chain management: A definition and structured literature review. *Journal of cleaner production*, *228*, 882–900. https://doi.org/10.1016/J.JCLEPRO.2019.04.303.

Garmulewicz, A., Holweg, M., Veldhuis, H., & Yang, A. (2018). Disruptive technology as an enabler of the circular economy: what potential does 3D printing hold?. *California Management Review*, *60*(3), 112–132. https://doi.org/10.1177/0008125617752695.

Islam, M. T. (2024). A systematic literature review on building resilient supply chains through circular economy and digital twin integration. *Frontiers in Applied Engineering and Technology*, *1*(01), 304–324. https://doi.org/10.70937/faet.v1i01.44.

Jum'a, L., Ikram, M., & Jabbour, C. J. C. (2024). Towards circular economy: A IoT enabled framework for circular supply chain integration. *Computers & Industrial Engineering*, *192*, 110194. https://doi.org/10.1016/j.cie.2024.110194.

Kamble, S. S., Gunasekaran, A., Parekh, H., Mani, V., Belhadi, A., & Sharma, R. (2022). Digital twin for sustainable manufacturing supply chains: Current trends, future perspectives, and an implementation framework. *Technological Forecasting and Social Change*, *176*, 121448. https://doi.org/10.1016/j.techfore.2021.121448.

Khan, S. A. R, Yu, Z., Sarwat, S., Godil, D. I., Amin, S., & Shujaat, S. (2021). The role of block chain technology in circular economy practices to improve organisational performance. *International Journal of Logistics Research and Applications*, *25*(4–5), 605–622. https://doi.org/10.1080/13675567.2021.1872512.

Kouhizadeh, M., & Sarkis, J. (2018). Blockchain Practices, Potentials, and Perspectives in Greening Supply Chains. *Sustainability*, *10*(10), 3652. https://doi.org/10.3390/su10103652

Liu, L., Song, W., & Liu, Y. (2023). Leveraging digital capabilities toward a circular economy: Reinforcing sustainable supply chain management with Industry 4.0 technologies. *Computers & Industrial Engineering*, *178*, 109113. https://doi.org/10.1016/j.cie.2023.109113.

Lödar-Miculeac, R., Szeberényi, A., Gallego-Nicholls, J., & Guijarro-García, M. (2025). Leveraging ai-driven supply chain analytics for accelerating the circular economy: a focus on real-time resource management and extended product life-cycles. *9th FEB International Scientific Conference: Sustainable Management in the Age of ESG and AI: Navigating Challenges and Opportunities*, 415–423. FEB International Scientific Conference. https://doi.org/10.18690/um.epf.5.2025.39.

Nathany, D. (2025). Digital Twins for Resilient and Sustainable Supply Chains. *International Journal For Multidisciplinary Research*, *7*(1), 1–10 https://doi.org/10.36948/ijfmr.2025.v07i01.40768.

Obukhova, A., Merzlyakova, E., Ershova, I., & Karakulina, K. (2020). Introduction of digital technologies in the enterprise. *The 1st International Conference on Business Technology for a Sustainable Environmental System*, 1–10. *E3S Web of Conferences*. https://doi.org/10.1051/e3sconf/202015904004.

Patil, A., Dwivedi, A., & Moktadir, M. A. (2023). Big data-Industry 4.0 readiness factors for sustainable supply chain management: Towards circularity. *Computers & Industrial Engineering*, *178*, 109109. https://doi.org/10.1016/j.cie.2023.109109.

Priyanshu, D., Alabdulraheem, A., Sadath, S., & Almuqbil, N. (2024). Optimizing AI-driven algorithms for sustainable supply chains: integrating IoT and blockchain technologies. *2024 4th International Conference on Technological Advancements in Computational Sciences (ICTACS)*, 570–574. https://doi.org/10.1109/ICTACS62700.2024.10840676.

Romagnoli, S., Tarabu', C., Maleki Vishkaei, B., & De Giovanni, P. (2023). The impact of digital technologies and sustainable practices on circular supply chain management. *Logistics*, *7*(1), 1. https://doi.org/10.3390/logistics7010001.

Sah, B. P., Hasan, M. M., Shofiullah, S., & Faysal, S. A. (2024). AI-driven IoT and blockchain integration in Industry 5.0: A systematic review of supply chain transformation. *Innovatech Engineering Journal*, *1*(01), 99–116. https://doi.org/10.70937/itej.v1i01.12.

Shree, M., Dhinakaran, V., Rajkumar, V., Ram, P., Vijayakumar, M., & Sathish, T. (2020). Effect of 3D printing on supply chain management. *Materials Today: Proceedings*, *21*(1), 958–963. https://doi.org/10.1016/j.matpr.2019.09.060.

Song, Y., Lei, L., Wu, L., & Chen, S. (2023). Studying domain structure: a comparative analysis of bibliographic coupling analysis and co-citation analysis considering all authors. *Online Information Review*, *47*(1), 123–137. https://doi.org/10.1108/OIR-12-2020-0540

Soriano-Pinar, I., Díaz-Garrido, E., & Bermejo-Olivas, S. (2023). Digital transformation for a circular economy: Insights from co-word analysis. *The Journal of Technology Transfer*, 1-30. https://doi.org/10.1007/s10961-023-10041-x

Thomas, A., & Mishra, U. (2022). A sustainable circular economic supply chain system with waste minimization using 3D printing and emissions reduction in plastic reforming industry. *Journal of Cleaner Production*, *345*, 131128. https://doi.org/10.1016/j.jclepro.2022.131128.

Tiwari, S., Wee, H. M., & Daryanto, Y. (2018). Big data analytics in supply chain management between 2010 and 2016: Insights to industries. *Computers & Industrial Engineering*, *115*, 319-330. https://doi.org/10.1016/j.cie.2017.11.017.

Vegter, D., van Hillegersberg, J., & Olthaar, M. (2020). Supply chains in circular business models: processes and performance objectives. *Resources, Conservation and Recycling*, *162*, 105046. https://doi.org/10.1016/j.resconrec.2020.105046.

Wu, H., Liu, J., & Liang, B. (2025). AI-Driven Supply Chain Transformation in Industry 5.0: Enhancing Resilience and Sustainability. *Journal of the Knowledge Economy*, 16, 3826–3868. https://doi.org/10.1007/s13132-024-01999-6.

Zamani, E. D., Smyth, C., Gupta, S., & Dennehy, D. (2023). Artificial intelligence and big data analytics for supply chain resilience: a systematic literature review. *Annals of Operations Research*, *327*(2), 605–632. https://doi.org/10.1007/s10479-022-04983-y