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A Bibliometric-Systematic Review of Digital Transformation in Indonesia's Economic Development

Arva Athallah Susanto[*1)], Ji Lu[2)], Aryadimas Suprayitno[1)], Nizar Hosfaikoni Hadi[3)]
[1)]Master of Islamic Economics Science Department, Airlangga University, Surabaya, Indonesia
[2)]Department of Business and Social Sciences, Dalhousie University, Truro, Canada
[3)]Department of Islamic Economics, State University of Surabaya, Surabaya, Indonesia
[1*]arvaathallah@gmail.com, [2]ji.lu@dal.ca, [3]aryadimassuprayitno@gmail.com, [4]nizarhadi@unesa.ac.id

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ABSTRACT

Digital transformation has become a key driver of technological innovation, economic restructuring, and institutional change in Indonesia, yet systematic synthesis of its scholarly development remains limited. This study addresses this gap by applying an integrated bibliometric and systematic literature review (SLR) approach to examine the intellectual structure, thematic evolution, and research dynamics of digital transformation scholarship in Indonesia from 2017 to 2025. Using Scopus-indexed publications, centrality-based bibliometric analysis identifies eleven major research clusters shaping the field. Among these, digital transformation emerges as the most structurally influential cluster, exhibiting the highest betweenness, closeness, and PageRank centrality, and functioning as an intellectual hub linking MSMEs, sustainability, circular economy, smart cities, environmental economics, and organizational transformation. Intermediate clusters, including digital economy, economics, MSMEs, and circular economy, reinforce the core discourse, reflecting growing academic attention to Industry 4.0, artificial intelligence, cybersecurity, and sustainable development. Smaller clusters, such as fintech, digitization, and developing countries, represent emerging research trajectories focused on governance, resilience, and digital inclusion. The SLR component complements the bibliometric mapping by synthesizing theoretical contributions, methodological trends, and research gaps within key thematic clusters, thereby enhancing conceptual coherence. The novelty of this study lies in its integrative mixed-method design, offering the most comprehensive mapping of Indonesia's digital transformation literature to date. The findings provide strategic directions for future interdisciplinary research and generate policy-relevant insights to support inclusive and sustainable digital transformation aligned with national and global development agendas.

1. Introduction

Digital transformation has become a defining force in shaping economic competitiveness, institutional performance, and societal development worldwide. In emerging economies such as Indonesia, the acceleration of digital technologies, ranging from artificial intelligence and cloud computing to advanced data analytics and mobile platforms, has fundamentally reshaped how governments, industries, and communities operate [1]. Over the past decade, Indonesia has positioned digital transformation as a national development priority, reflected through policy frameworks such as the "Digital Indonesia Roadmap 2021–2024," Industry 4.0 initiatives, and an expanding digital entrepreneurship ecosystem. As a result, scholarly research on digital transformation in Indonesia has grown rapidly, covering themes such as digital economy development, SME digitalization, sustainability transitions, smart governance, financial technology, and broader socio-economic impacts [2].

Despite this growing body of literature, a comprehensive understanding of the intellectual landscape and thematic evolution of digital transformation research in Indonesia remains limited. Existing studies tend to focus on sector-specific analyses, such as digital transformation in SMEs,

education, government services, or financial inclusion, without offering a holistic synthesis across disciplines [3]. Furthermore, the rapid expansion of publications raises questions about how research themes are connected, which topics dominate the field, and where future scholarly attention should be directed [4], [5]. Bibliometric analysis provides an effective lens to address these gaps by quantitatively mapping research structures, identifying influential themes, and visualizing the evolution of scientific discourse. Bibliometric analysis technique that has long been validated to aid in the identification of future research trends. Moreover, recent studies by [6] and [7] have utilized bibliometrics as a topic-clustering tool to map relevant themes, thereby providing an evidence base for policy formulation. This study evaluates bibliometric shortcomings that cannot fully explain theoretical insights or methodological developments in each thematic cluster [8]. Therefore, this study offers a novelty by combining bibliometric mapping with a systematic literature review (SLR) in explaining the context of digitalization in economic development. [9] asserts that Systematic Literature Review (SLR) offers a rigorous and highly informative approach to systematically collecting, evaluating, and synthesizing research within a domain, enabling both authors and readers to achieve a comprehensive understanding of what is known and unknown while identifying key research gaps that advance scholarly knowledge.

Combining bibliometric and SLR methodologies allows the identification of central research clusters and deeper theoretical contributions within each cluster. Preliminary bibliometric findings in this study reveal eleven major clusters, with *digital transformation* emerging as the most structurally influential theme serving as a conceptual bridge across diverse topics such as sustainability, environmental economics, green economy, smart cities, forecasting, and SME development. Other clusters, such as *digital economy*, *economics*, *MSMEs*, and *circular economy*, demonstrate strong but more specialized roles in driving scholarly conversations. Previous studies have formulated how to provide a structure for developing research clusters, namely by identifying rapid and sustained increases in the number of annual publications and keyword frequency, reflecting strong annual growth, significant institutional contributions, and the gradual expansion and stabilization of new themes driven by these topics over time [10], [11], [12], [13], [14], [15]. Thus, the emerging clusters in this study, including *digitization*, *fintech*, and *developing countries*, highlight new directions in governance, resilience, and policy-driven digitalization efforts. Understanding how these clusters interact is essential for mapping the intellectual structure of digital transformation in Indonesia [16], [17], [18].

Addressing the fragmentation and limited synthesis in existing studies, this research aims to systematically map and evaluate the development of digital transformation in Indonesia through an integrated bibliometric–systematic literature review. This research seeks to bridge structural and conceptual analyses by employing bibliometric techniques to map publication trends, thematic trajectories, and collaboration patterns, alongside a systematic review of key thematic clusters, such as digital economy, MSMEs, and circular economy, to provide comprehensive macro and micro-level insights. The novelty of this research lies in its integrative approach, which not only offers the most comprehensive bibliometric mapping of Indonesia's digital transformation literature to date but also enhances theoretical coherence by consolidating fragmented research streams and identifying underexplored areas. The findings generate strategic directions for future research aligned with Indonesia's digital development agenda and global digital transformation dynamics, with important implications for advancing academic inquiry, informing evidence-based policymaking, and guiding practitioners in designing inclusive and sustainable digital strategies.

2. Methods

This study adopts an integrated methodological approach combining bibliometric analysis and systematic literature review (SLR) to rigorously map, assess, and interpret the evolution of digital transformation research in Indonesia. The research design emphasizes methodological transparency, analytical rigor, and reproducibility, employing established bibliometric techniques for quantitative science mapping alongside a structured SLR framework to ensure robustness and credibility [19], [20].

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Bibliometric data were retrieved from the Scopus database due to its extensive indexing coverage, citation reliability, and suitability for large-scale quantitative analysis. Using controlled keywords and Boolean operators ("digital transformation" AND "Indonesia"), the search was restricted to English-language journal articles and conference papers published between 2010 and 2024, capturing the formative phase of Indonesia's digital transformation scholarship. After screening and duplicate removal, 126 validated documents published between 2017 and 2025 were retained, revealing a pronounced growth in research output, particularly after 2020.

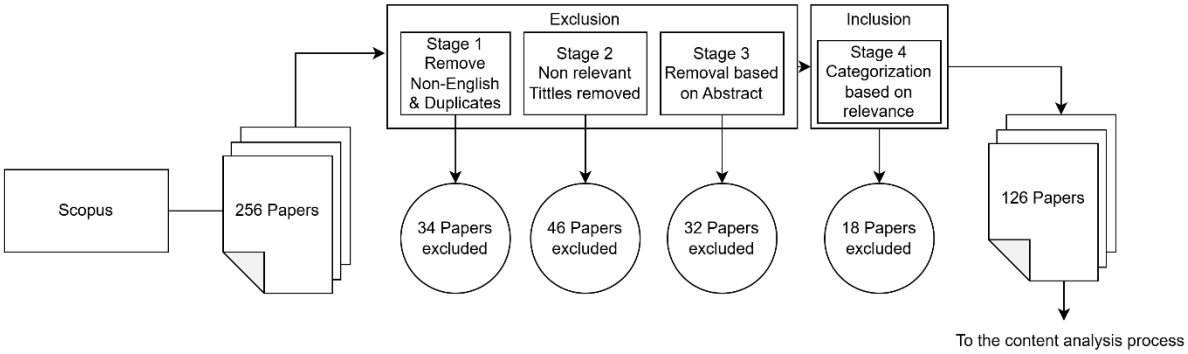

Figure 1. Exclusion and Inclusion Criteria based on Simplified-PRISMA diagram

The SLR component followed a structured process encompassing identification, screening, eligibility, and inclusion, with studies assessed for relevance, methodological rigor, and thematic alignment with digital transformation in Indonesia. Qualitative synthesis focused on three core thematic clusters: digital economy, MSMEs, and circular economy, systematically capturing key findings, dominant methodological approaches, theoretical contributions, and future research directions through a standardized analytical matrix. The integration of bibliometric and SLR findings enables a complementary analytical perspective, wherein bibliometric mapping provides macro-level structural insights and the SLR delivers micro-level theoretical synthesis. By aligning SLR themes with bibliometric clusters, this mixed-method approach strengthens analytical validity and offers a robust framework for understanding the structural and conceptual dynamics of digital transformation research patterns in Indonesia.

As shown in Figure 1, a total of 256 papers were initially retrieved from the Scopus database. After removing non-English publications and duplicate records, 222 papers remained for title screening. Subsequently, 46 papers were excluded due to non-relevant titles, resulting in 176 papers for abstract evaluation. Following the abstract screening process, 32 papers were removed because they did not align with the study objectives and thematic focus. Finally, 126 papers were included in the content analysis after categorization based on relevance and methodological suitability.

3. Results and Discussions

3.1 Results

To explore the intellectual structure of digital transformation research in Indonesia, a Three-Field Plot analysis in Figure 1 was employed to visualize the relationships among cited references, authors, and author keywords. Figure 1 illustrates the interconnections between highly cited references, active authors, and frequently used keywords in the Indonesian digital transformation literature. The visualization highlights digital transformation, Indonesia, and the circular economy as central thematic anchors, indicating their strong association with leading authors and foundational references.

Word frequency analysis in this study serves primarily as a descriptive tool to illustrate the central positioning of digital transformation research in Indonesia, rather than as standalone evidence of thematic dominance or research salience. This limitation arises because keyword frequency is strongly

influenced by dataset construction and therefore cannot independently reflect the substantive focus of the literature. To overcome this limitation, the analysis incorporates temporal publication trends associated with the identified keywords. The findings demonstrate a significant increase in the number of studies published between 2017 and 2025, particularly after 2020, indicating growing scholarly attention toward digital transformation within the Indonesian context. Accordingly, the observed temporal growth provides stronger evidence of evolving research priorities than raw keyword frequency alone. These results suggest that the literature on digital transformation in Indonesia has expanded not only in quantity but also in academic engagement over time.

While the terms "digital transformation" and "Indonesia" appear most frequently across the corpus, it is important to note that both keywords were part of the initial search string. Therefore, their high occurrence

Figure 2. Word Cloud

As illustrated in Figure 2, themes connected to global sustainability agendas are also prominent within the digital transformation literature in Indonesia. The strong occurrence of "digital economy" (19) signals Indonesia's increasing focus on platform-driven growth, e-commerce scaling, fintech innovations, and the rise of digital entrepreneurship. In parallel, the presence of "economics" (9) and "economic growth" (4) indicates sustained interest in understanding how digital transformation translates into macro-economic benefits, including productivity enhancement, inclusiveness of digital markets, and post-pandemic economic recovery. Meanwhile, the terms "circular economy" (8) and "sustainable development" (8) frequently appear, indicating that scholars increasingly integrate environmental considerations into digital transformation discourse. This trend aligns with Indonesia's national policy direction toward green economy transition, waste management innovation, and low-carbon industrial development. Figure 2 further demonstrates the prominence of "sustainability" (5) and "innovation" (4), reflecting a growing emphasis on the role of digital technologies in supporting long-term environmental and organizational resilience. In addition, the appearance of "digitalization" (7) and "digitization" (5) highlights continued scholarly interest in both technical adoption processes and organizational integration of digital systems. The coexistence of these terms suggests ongoing academic efforts to differentiate between technological implementation (digitization) and broader organizational transformation (digitalization).

The third analysis is based on cluster distribution through a keyword co-occurrence network analysis using author keywords extracted from the final dataset. In total, five thematic clusters were identified based on the co-occurrence relationships among keywords, where each keyword represents a node and its joint appearance within the same document constitutes a link. The clustering procedure was conducted using a network-based modularity optimization algorithm, which groups keywords according to the strength of their relational ties. Centrality measures, including betweenness, pagerank, and closeness centrality, were then calculated at the cluster level by aggregating the centrality values of keywords within each cluster.

In addition, related to the Three-Field Plot, it visualizes the relationships among cited references (CR), authors (AU), and keywords (KW_Merged) within the digital transformation research landscape in Indonesia. The figure demonstrates how influential references and prominent authors are

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interconnected with dominant research themes, thereby revealing the intellectual structure of the field. The analysis shows that "digital transformation" and "Indonesia" are the most connected keywords, indicating their central position within the research network. Other frequently connected themes include "circular economy," "digitalization," "sustainable development," "economics," "MSMEs," and "sustainability," reflecting the multidimensional nature of digital transformation studies in Indonesia. These findings suggest that current research increasingly integrates technological, economic, and sustainability perspectives.

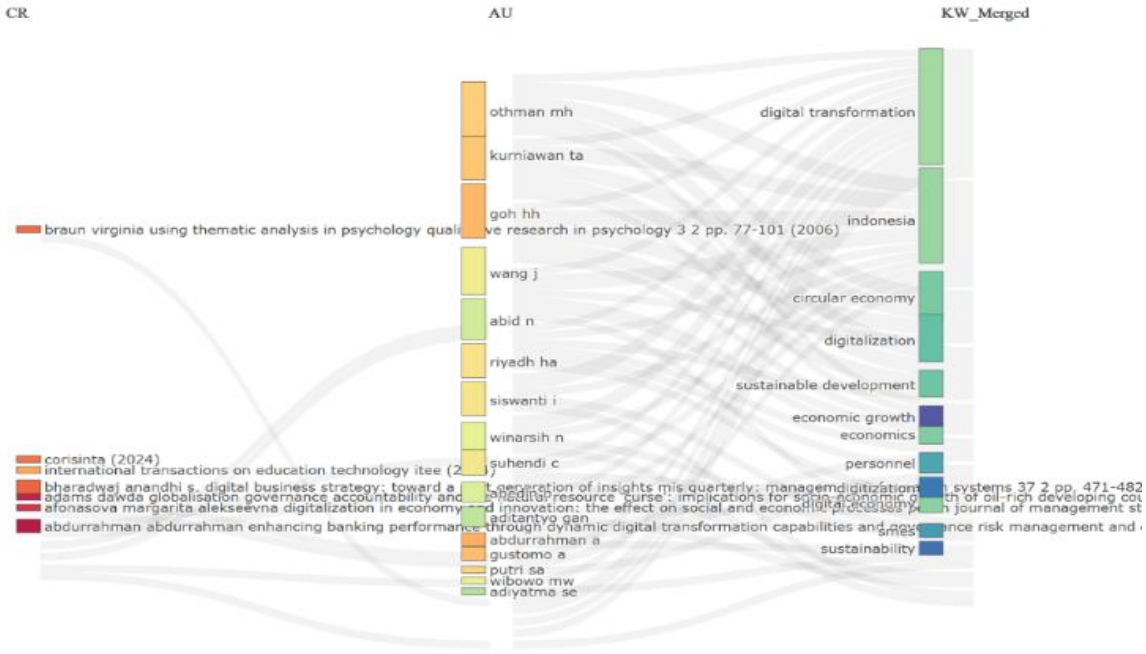

Figure 3. Three Field Plot

Figure 3 describes the author dimension. Several scholars, such as Othman MH, Kurniawan TA, Goh HH, Wang J, and Abid N, appear prominently connected to multiple thematic areas, indicating their significant contribution to the development of digital transformation research. Their studies are linked not only to technological adoption and economic development but also to sustainability and organizational transformation issues. Meanwhile, the cited references highlight foundational studies that shape the intellectual direction of the field. For example, references related to thematic analysis, digital business strategy, digitalization in economies, and banking performance demonstrate the interdisciplinary character of the literature. Overall, Figure 3 illustrates a strong interaction between influential references, active scholars, and emerging keywords, confirming that digital transformation research in Indonesia continues to evolve through interconnected themes of economy, sustainability, and organizational change.

Moreover, as shown in Figure 4, smaller clusters such as "developing countries," "digitization," and "fintech" represent emerging but more specialized research areas. Their lower centrality and PageRank values indicate that they provide contextual depth rather than strong structural influence within the network. In particular, the "fintech" cluster focuses on resilience and the informal sector, highlighting a niche but growing research topic. Overall, Table 1 and Figure 3 demonstrate that digital transformation acts as the central research theme, while other clusters contribute thematic diversity and emerging perspectives.

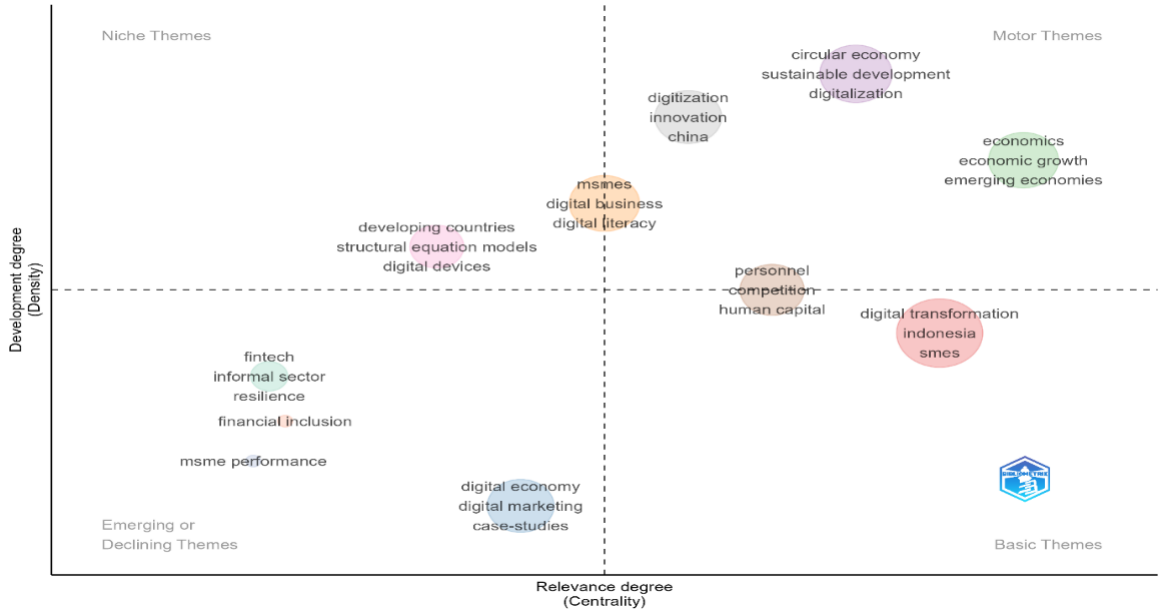

Figure 4. Thematic Map

In contrast, clusters such as digital economy, economics, MSMEs, and circular economy show moderate centrality values, suggesting that they are influential but more focused on specific themes rather than serving as cross-cutting connectors. For example, the digital economy cluster integrates topics like AI, cybersecurity, and regulation, which are important but operate more as specialized branches of the broader transformation narrative. Similarly, the economics cluster reflects traditional economic themes: growth, development, and digital ecosystem, indicating that economic analyses continue to play a complementary yet secondary role in shaping the discourse compared to the leading cluster. Details of clusters are described in Table 1 below.

Table 1. Cluster Mapping

Cluster Number	Cluster Label	Cluster Keywords	Between Centrality (btw)	Clos Centrality (avg)	Pagerank (avg)
1	digital transformation	digital transformation; smes; sustainability; transformation; green economy; covid-19; efficiency; environmental economics; finance; forecasting; green HRM; small-and-medium enterprise; smart city; sustainability performance	1126.63	0.016	0.021
2	digital economy	digital economy; digital marketing; case-studies; regulation; artificial intelligence; community participation; cybersecurity; SME	557.95	0.005	0.006
3	economics	economics; economic growth; emerging economies; e-commerce; economic and social effects; economic development; business strategy; digital ecosystem; digital technology; digitalisation; economic growths; ecosystems; technological development; technology adoption; telecommunication	282.52	0.006	0.006
4	circular economy	circular economy; sustainable development; digitalization;	218.94	0.007	0.007

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		electronic commerce; sales; digital technologies; industry 4.0; recycling; resource recovery; user experience; users' experiences; waste management; wastes recycling; zero-waste; zero waste			
5	MSMEs	MSMEs; digital business; digital literacy; business model; entrepreneurship; market orientation; sustainable business; big data; business performance; chain management; corporate performance; creative industries; MSME; small business; supply chain management	245.57	0.006	0.005
6	personnel	personnel; competition; human capital; technology; tourism; commerce; competitive advantage; digital; information use; marketing; performance	221.52	0.004	0.006
7	developing countries	developing countries; structural equation models; digital devices; environmental challenges; environmental sustainability; learning systems; metadata	125.29	0.005	0.005
8	digitization	digitization; innovation; China; governance; India; local government; Brazil; governance approach; natural resources; policy implementation; rural development; Russian Federation; stakeholder; Turkey	175.90	0.005	0.006
9	fintech	fintech; informal sector; resilience	204.72	0.003	0.003

As presented in Table 1, the "digital transformation" cluster has the highest betweenness centrality value (1126.63), showing its dominant role as the main bridge connecting various research themes. It also has the highest PageRank value (0.021), indicating that this cluster is the most influential in the network. The cluster includes topics such as SMEs, sustainability, green economy, finance, and smart cities, demonstrating that digital transformation serves as the core theme within the Indonesian research landscape.

Other clusters, such as "digital economy," "economics," "circular economy," and "MSMEs," have moderate centrality values, suggesting that they support and expand the broader digital transformation discussion. For example, the "digital economy" cluster connects themes related to digital marketing, artificial intelligence, cybersecurity, and regulation, while the "circular economy" cluster emphasizes sustainability issues such as waste management, recycling, and Industry 4.0.

3.2 Discussions

To deepen the discussion and transition toward the cluster-based synthesis, Tables 2, 3, and 4 summarize key empirical findings from recent Indonesian studies, emphasizing how each cluster contributes to the broader intellectual structure of digital transformation. Specifically, the evidence is organized into three major thematic clusters: digital economy, MSMEs, and circular economy. These clusters highlight dominant research focus, methodological approaches, theoretical contributions, and future research directions. This structured presentation enables a clearer comparison across clusters while demonstrating how digital transformation operates as a unifying concept that shapes diverse sectoral and policy-relevant debates in the Indonesian context.

Table 2. Cluster of Digital Economy

Authors	Main Findings	Theoretical Contribution	Future Research Directions

[19], [21], [22]	Indonesia's digital economy is primarily driven by e-commerce platforms, digital marketplaces, and fintech, expanding market access and financial inclusion, though impacts remain uneven across regions.	Extends Platform Economy and Digital Ecosystem theories by showing how platform-based value chains evolve in an emerging-market context.	Comparative studies between Java and non-Java regions to assess infrastructure gaps and inclusiveness.
[23], [24], [25]	Digital marketing capability improves SME performance, yet adoption remains limited to basic social media use.	Reinforces Dynamic Capability Theory and RBV by framing digital marketing as a strategic digital capability.	Intervention-based and experimental studies assessing structured digital marketing support for SMEs.
[26], [27], [28]	Regulatory frameworks both enable and constrain digital economy growth, particularly for start-ups and cross-border platforms.	Advances the concept of Regulatory Readiness by linking institutional design with digital innovation.	Development of a sector-specific Digital Regulatory Readiness Index for Indonesia.
[20], [29], [30]	AI and data analytics adoption remains concentrated in large firms, with most SMEs limited to basic digitization.	Enriches TOE and Innovation Diffusion Theory through an emerging-economy perspective on AI readiness.	Research on scalable, low-cost AI solutions and their productivity impacts for SMEs.
[31], [32], [33]	Community-based digital ecosystems play a key role in extending digital benefits beyond major cities.	Contributes to a Community-Centric Digital Economy framework emphasizing social capital and grassroots innovation.	Studies on governance models, scalability, and sustainability of community-driven digital platforms.
[34], [35], [36]	Cybersecurity and digital trust issues increasingly affect user confidence in Indonesia's digital economy.	Extends TAM, UTAUT, and Trust–Risk frameworks with developing-country evidence.	Behavioral and design-based interventions to strengthen digital trust and secure user behavior.
[37], [38], [39]	Fintech expansion raises challenges in balancing innovation and consumer protection.	Bridges Digital Finance and Regulatory Governance through adaptive regulation perspectives.	Scenario-based simulations of alternative fintech regulatory approaches and outcomes.

Table 3. Cluster of MSMEs

Authors	**Main Findings**	**Theoretical Contribution**	**Future Research Directions**
[40], [41], [42]	Digital transformation significantly improves MSME performance in Indonesia by enhancing efficiency, market reach, and digital payment adoption, although adoption remains uneven across regions and sectors.	Strengthens Resource-Based View and Dynamic Capability Theory by positioning digital capability as a strategic source of competitive advantage for MSMEs.	Sector- and province-specific studies to identify disparities in digital transformation among MSMEs.
[43], [44], [45]	MSMEs widely adopt basic digital tools, while advanced systems such as CRM, ERP, and analytics remain rare, particularly among micro-enterprises.	Extends Digital Maturity literature by contextualizing maturity models for Indonesia's informal-dominated MSME ecosystem.	Development of an MSME Digital Maturity Framework tailored to Indonesia's institutional and infrastructural conditions.
[46]	Limited digital literacy remains a major barrier to effective MSME digitalization, affecting	Extends Human Capital Theory by demonstrating that digital skills are foundational	Scalable digital training models, including AI-assisted and micro-

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Authors	Main Findings	Theoretical Contribution	Future Research Directions
	marketing, cybersecurity awareness, and data use.	enablers of successful transformation.	learning approaches for MSMEs.
[47]	Digital tools strengthen market orientation by enabling faster responses to customer needs, though advanced analytics use is concentrated among medium-sized firms.	Advances Digital Market Orientation theory by linking customer insight generation with digital capability in a developing economy.	Evaluation of AI-driven marketing decision tools and their performance impacts on MSMEs.
[48]	Digitalization supports sustainable MSME practices, though adoption remains concentrated in environmentally oriented sectors.	Contributes to Digital Sustainability frameworks by illustrating how technology enables green MSME business models.	Assessment of policy incentives that effectively promote digital sustainability adoption.
[49]	Big data and analytics adoption among MSMEs remains low due to perceived cost and complexity barriers.	Enhances Technology Perception literature by identifying MSME-specific barriers in mixed formal–informal markets.	Longitudinal studies testing low-cost analytics solutions for MSMEs.
[50]	Digital supply chain integration among MSMEs is increasing but remains constrained by infrastructure and coordination gaps.	Contributes to Digital Supply Chain Theory by capturing the fragmented evolution of MSME supply chains.	Research on hybrid digital–traditional supply chain models, especially in peripheral regions.
[51]	Creative MSMEs benefit strongly from digital transformation, gaining competitiveness and export potential.	Strengthens Digital Creative Economy literature by linking digital platforms with cultural and creative industries.	Analysis of AI-based creative tools and their impact on MSME competitiveness.

Table 3 reveals that Indonesia's digital economy is predominantly shaped by platform-based ecosystems, particularly e-commerce, digital marketplaces, and fintech, which have expanded market access and financial inclusion but continue to generate uneven regional and firm-level outcomes. Collectively, the studies demonstrate that digital capabilities, including digital marketing, AI, and data analytics, function as strategic resources that enhance performance, yet their adoption remains highly uneven, especially among SMEs, reinforcing the persistence of digital maturity gaps. Regulatory frameworks emerge as a double-edged factor, simultaneously enabling innovation and constraining growth, thereby highlighting regulatory readiness as a critical condition for sustainable digital development. At the same time, community-based digital ecosystems and digital trust issues underscore the importance of social capital, governance design, and user confidence in extending digital benefits beyond urban centers.

Table 4 demonstrates that digital transformation has a generally positive and performance-enhancing impact on Indonesian MSMEs, particularly through improved operational efficiency, market expansion, digital payments, and competitiveness, although adoption remains highly uneven across regions, sectors, and firm sizes. The literature consistently shows that most MSMEs remain at a basic level of digitalization, relying on social media and online marketplaces, while advanced systems such as analytics, CRM, ERP, and AI are concentrated among medium-sized and creative enterprises. Persistent barriers, including skill deficits, perceived cost and complexity, weak supply chain integration, and limited access to advanced technologies, continue to constrain deeper digital upgrading. At the same time, emerging links between digitalization, sustainability, and creative industries suggest that MSME digital transformation is increasingly intertwined with green practices and export-oriented growth.

Table 4. Cluster of Circular Economy

Authors	Main Findings	Theoretical Contribution	Future Research Directions
[52], [53], [54]	E-commerce and digital marketplaces support circular practices through resale, rental, and sharing models, although these activities remain underexplored in Indonesia.	Contributes to Digital Sharing and Reuse Economy literature by showing how platforms can extend product lifecycles and reduce waste.	Examination of platform design, incentives, and trust mechanisms that encourage reuse, repair, and resale behavior.
[55], [56], [57]	Digital and Industry 4.0 technologies improve resource efficiency and energy use, indirectly supporting circular economy objectives, though often framed as productivity gains.	Strengthens the link between Industry 4.0 and Circular Economy by reframing digitalization as a pathway to sustainable resource management.	Development of a digital circular readiness framework integrating infrastructure, data culture, and environmental commitment.
[58], [59], [60]	Digital waste management and recycling platforms are emerging in Indonesian cities, connecting households, informal workers, and recyclers.	Advance the Inclusive Circular Economy theory by illustrating how digital platforms bridge formal and informal waste systems.	Assessment of scalability, inclusiveness, and economic viability of digital waste platforms across different urban contexts.
[21]	User experience and digital engagement features strongly influence participation in recycling and zero-waste applications, particularly among younger urban users.	Extends technology acceptance and behavior-change theories by incorporating environmental values into digital engagement models.	Design and testing of behaviorally informed digital interfaces, including gamification and incentive-based features.
[19]	Circular economy governance in Indonesia remains fragmented, with digital solutions often advancing faster than regulatory frameworks.	Introduces the concept of Digital–Policy Misalignment in Circular Economy, integrating governance and digital transformation perspectives.	Design of multi-level governance models aligning national policy, local implementation, and digital innovation.
[28]	Circular economy initiatives are frequently driven by community-based movements using digital platforms to coordinate and scale activities.	Strengthens Community-Based Circular Economy perspectives by highlighting the role of digital platforms in collective environmental action.	Long-term analysis of sustainability, resilience, and partnership models for community-led circular initiatives.

Table 5 synthesizes evidence showing that digitalization is increasingly central to advancing circular economy practices in Indonesia, primarily through platform-based models, Industry 4.0 technologies, and digitally mediated waste and recycling systems. Existing studies indicate that e-commerce platforms facilitate reuse, resale, and sharing practices, while digital and Industry 4.0 tools enhance resource and energy efficiency, thereby extending circular economy theory beyond production efficiency toward sustainable resource management. At the same time, the emergence of digital waste platforms and community-based initiatives highlights the importance of inclusivity and the integration of formal and informal actors in achieving circular outcomes. However, fragmented governance and digital–policy misalignment remain critical constraints, limiting the scalability and long-term effectiveness of digitally enabled circular initiatives.

4. Conclusion

This study provides a rigorous bibliometric–systematic synthesis of digital transformation research in Indonesia by integrating quantitative science-mapping techniques with qualitative thematic analysis. The findings reveal a rapidly expanding and increasingly multi-dimensional research landscape, mirroring Indonesia's accelerating digitalization agenda and intensified scholarly engagement with technology-driven economic and institutional change. Overall, the results indicate that digital

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transformation scholarship in Indonesia has evolved into a mature, interconnected, and dynamic domain, shaped by both national development priorities and broader global innovation trajectories.

The findings offer clear practical guidance for stakeholders supporting Indonesia's digital transformation. Academic institutions should use the identified thematic clusters to strengthen interdisciplinary research agendas and adopt more rigorous methodological approaches. Policymakers can translate the dominance of MSMEs, sustainability, and circular economy themes into actionable programs by expanding digital infrastructure, enhancing digital literacy, improving MSME financing, and embedding environmental standards in digital economy policies. MSMEs and private-sector actors are encouraged to invest in digital capabilities, data-driven business models, and affordable, sector-specific technologies while ensuring regulatory compliance and user trust. Overall, coordinated engagement among academia, government, and industry is essential to transform research insights into inclusive and sustainable digital outcomes.

Looking forward, future research should emphasize interdisciplinary and methodologically advanced approaches that move beyond descriptive mapping toward causal, comparative, and longitudinal analyses of digital transformation outcomes. Cross-country comparative studies are particularly essential to contextualize Indonesia's digital transformation trajectory and enhance the generalizability of findings. Scholars are encouraged to address underexplored dimensions, including digital inclusion, regulatory and governance frameworks, data security, and the long-term implications of digitalization for productivity, inequality, and environmental sustainability. Strengthening mixed-method designs, sector-specific case studies, advanced quantitative modeling, and international research collaboration will be critical for developing a forward-looking and policy-relevant research agenda aligned with Indonesia's digital development strategy and global digital transformation trends.

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