

Revealing the Nexus of ESG Trends towards Circular Economy in E-Business with TCCM Framework: Refining Future Research Agendas

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ABSTRACT

Rapid technological advances and sustainability issues have urged researchers to create a link between digital innovation and ESG principles towards a circular economy in e-business as an important agenda in future research. This research is a bibliometric and thematic study from the ScienceDirect database. The purpose of this study is to portray the trend of ESG implementation in the e-business context as part of the circular economy initiative. This research conducts mapping on ESG and circular economy topics in the context of e-business by applying the Theory-Context-Characteristics-Methodology (TCCM) framework. A thematic study was conducted with the VOSviewer tool and obtained three main clusters, namely Green Finance & Policy, Carbon Emissions & Circular Practices, and Digital Governance & ESG Technology. This study found that there are numerous areas to be explored, including the social dimension of green financing, digital reputation of ESG-technology adoption, and digital-based circular supply chain governance. This study offers novel ideas for future research goals on the integration of digital innovation, behavioral perspectives, and performance assessment frameworks to facilitate the adoption of ESG and circular economy principles across diverse e-business ecosystems. This study also generates a proposed model and provides two propositions to be investigated as hypotheses using a quantitative method in future research. The findings of this study can contribute theoretically and practically to academics, businesses, and policymakers to implement sustainability strategies in the digital economy era that support the achievement of sustainable development goals (SDGs).

Keywords: ESG, e-business, circular economy, sustainability, SDGs.

INTRODUCTION

ESG is an important idea in the current business world. Considerations of environmental (E), social (S), and governance (G) aspects become an obligation for all business sectors, including electronic business (e-business). Tremendous developments in digital technology have been encouraging transformations and innovations that encourage rapid growth in e-business. The existences of Machine Learning, Artificial Intelligence (AI), Internet of Things (IoT), Augmented Reality (AR), and Virtual Reality (VR) have been boosting the advance development of e-business in many forms, such as electronic commerce (e-commerce), financial technology (fintech), cloud-based services, remote meeting applications, and many other platforms.

E-commerce is one of the most widely used e-business platforms globally. Along with the increasing number of internet users, which is currently estimated to have reached more than five billion worldwide, the growth of e-commerce businesses has also increased greatly. The value of e-commerce retail sales in 2025 reached 4.3 trillion, and this number is expected to continue to increase in the following years (van Gelder, 2025). In 2024, e-commerce contributed 17 percent of all retail sales worldwide, and the online segment is forecasted to increase to 21 percent of global retail sales by 2029 (Coppola, 2025). The rapid growth of e-commerce also requires the support of adequate digital financial innovation and technology, so the fintech industry is also progressing very quickly. There are currently around 30,000 fintech startups around the world. The revenue of the fintech industry is estimated to have reached \$201.91 billion. Seventy-five percent of global customers have been using payment and money transfer systems provided by fintech services, and two-thirds of all financial transactions are conducted online today (Kumar, 2025). By 2025, the fintech market size is estimated to have reached USD 356.73 billion, and is expected to reach USD 686.85 billion by 2030. The Compound Annual Growth Rate (CAGR) of the fintech industry is predicted to be more than 14% within the period 2025-2030 (Mordor Intelligence, 2025).

The modern business paradigm has changed society's view of business. Nowadays, businesses are run with more attention to other aspects around them. Environmental, social, and governance are very important and closely related aspects of business sustainability. ESG is a new development of integration between financial and non-financial aspects, which includes economic, social, and ecological aspects in business. The implementation of ESG in e-business is also an effort to run modern business practices in today's digital era, which also has an obligation to contribute to achieving the Sustainable Development Goals (SDGs).

Digitalization in the form of e-business has encouraged transparency and accountability practices in every business process, so that e-business becomes one of the key drivers of the SDGs achievement (Lyulyov *et al.*, 2024). Digital transformation in the form of digital operation efforts has also empirically proven to be able to improve ESG performance. In environmental performance, it contributes to optimizing resource usage and reducing environmental pollution. In social performance, it improves goodwill with stakeholders. In governance performance, it supports optimizing the management team and organizational structures (Ma *et al.*, 2023). Digitalization is also one of the key enablers of the circular economy (Oghazi *et al.*, 2024). The development of early-stage digitalization is empirically proven to encourage the shift to a circular economy. A study conducted on countries in Europe found that there is a nonlinear relationship between digitalization and circularity. It shows that digitalization will positively affect circularity if it has reached a certain level (Nham & Ha, 2022). In addition to solving environmental problems, e-business in this digital era is also expected to be an important driver for sustainable development in realizing a circular economy (Fatimah *et al.*, 2023).

Circular economy is well-known as an effort that aims to reduce carbon emissions and the efficient use of resources. To go through the transition to a circular economy, huge investments are needed in various forms of innovation. In actuality, the financing and investment landscape for the circular economy has evolved rapidly; however, academic study on its financial elements remains scarce (Ma, Xu, & Bititci, 2025). The circular economy is an answer to one of the most significant concerns of our day, where a paradigm shift is taking place that realizes that resources are limited and must be used more efficiently (Trevisan *et al.*, 2025).

This paper aims to depict the trend of ESG implementation in e-business as an effort to realize the circular economy. This study is expected to provide benefits in the form of a literature review that can serve as a reference for the best practices of ESG implementation in global businesses. There have been many literature review studies conducted on topics related to ESG, e-business, and circular economy; however, papers that combine those three topics in a study are still very limited in number. Therefore, this paper offers novelty in the form of a fresh overview of the latest trends of these topics in 2025. The trends are presented systematically through a clear mapping with content analysis that uses the Theory-Context-Characteristics-Methodology (TCCM) Framework. Subsequent mapping is done completely and thoroughly using VOSviewer to show themes that emerge from previous literature published in 2025. This research will contribute theoretically and practically. The theoretical benefits of this research are in the form of insights and fresh ideas for further research derived from the gaps found through the SLR conducted by this research. The practical contribution of this research is in the form of an overview of the best practices of ESG implementation in e-business to achieve circular economy in various industrial sectors and regions in the world that can be emulated and applied further by other companies and industries.

Applying a systematic literature review from the ScienceDirect database, this paper purposes to answer the following research questions (RQ):

RQ1: How is the mapping of the key enablers on the topic of ESG implementation in e-business to realize a circular economy using the TCCM framework based on previous papers?

RQ2: What are the themes on the topic of ESG implementation in e-business to realize a circular economy that have been studied in previous literature?

RQ3: What model can be proposed to describe the trend of ESG implementation in e-business towards circular economy?

METHODOLOGY

This paper is conducted as a bibliometric study to portray the current trend of research in the area of ESG implementation in e-business to achieve the circular economy. It applies to a systematic literature review (SLR) and content analysis from the ScienceDirect database. The search and screening of previous research for the literature review were carried out in the following stages:

1. We chose and accessed the database of ScienceDirect by Elsevier in May 2025.
2. We determined the search keywords using Boolean, i.e., ESG and e-business and circular economy, then obtained the results of 879 papers.
3. Since we would discuss the current trend of this topic, we refined the search by year, and we chose only 2025, then obtained the results of 289 papers.
4. We refined the search by article type and chose only Research Articles, then obtained the results of 195 papers.
5. We refined the search by subject area and chose only Social Sciences, then obtained the final results of 41 papers.

SLR in this study uses the Theory-Context-Characteristics-Methodology (TCCM) framework. The TCCM framework is useful for mapping the analytical and empirical scope of a particular research area, which helps to make a critical review of the underlying theories used, the characteristics and applicability to various contexts, as well as the methodological approaches used by previous studies as a literature review (Paul *et al.*, 2023). After generating the results from SLR, this research will also use

VOS Viewer in the next stage of analysis. VOS Viewer can be used to visually show the clusters of themes obtained from the SLR results (Sitalaksmi *et al.*, 2024).

ANALYSIS AND DISCUSSION

The analysis and discussion of this study consist of two sections. The first section is to answer RQ1 regarding the mapping of previous studies. RQ1 is answered using an analysis of the TCCM framework. The second section is to answer RQ2 regarding the themes withdrawn from previous studies. RQ2 is answered using VOS Viewer.

The Mapping of Studies on ESG Implementation in E-Business to Realize a Circular Economy

This section will answer RQ1: *How is the mapping of the key enablers on the topic of ESG implementation in e-business to realize a circular economy using the TCCM framework based on previous papers?* Using the TCCM framework, this study will conduct a mapping of the previous research in the area related to ESG, e-business, and circular economy. The main benefit of using the TCCM framework is to obtain a thorough explanation of the theoretical and empirical aspects of a particular research domain (Österle *et al.*, 2024). This section will discuss the dimensions of theory, context, characteristics, and methodology of the 41 papers of the previous studies.

Theory

The underpinning theories applied in these papers can be synthesized into five groups of theories, i.e., 1) Sustainability & Social, and Governance (ESG) which includes 18 papers assessing environmental, social, and governance impacts; 2) Corporate Governance which includes 9 papers focusing on leadership roles, business ethics and stakeholder interests; 3) Green Economy & Environmental Kuznets Curve (EKC) which includes 8 papers discussing the relationship between economic growth and carbon emissions; 4) Technology-Adoption & Digital Transformation which includes 6 papers analyzing the developments and the impacts of technology in business and sustainability; 5) Reputation & Event Study which includes 1 paper analyzing ESG impact on corporate reputation. The following is the mapping of the Theory dimension:

Table 1: The Mapping of Theory Dimension

Groups of Theory	Dominant Theoretical Lens	Coverage	Example Studies
Sustainability & ESG	ESG Principles, Circular Economy, Green Finance, Sustainable Development Goals (SDGs)-oriented frameworks	43%	Shmelev & Shmeleva (2025), Rumsa <i>et al.</i> (2025), Baninla <i>et al.</i> (2025), Amin <i>et al.</i> (2025a)
Corporate Governance	Stakeholder Theory, Legitimacy Theory, Business, Ethics, Risk Management, Corporate Social Responsibility (CSR)	21%	Rodolaki <i>et al.</i> (2025), Mohy-ud-Din <i>et al.</i> (2025), Anani <i>et al.</i> (2025), Wang <i>et al.</i> (2025)
Green Economy & EKC	Environmental Kuznets Curve (EKC), Green Finance, Carbon Efficiency, Resource-Based View (RBV)	19%	Du <i>et al.</i> (2025), Amin <i>et al.</i> (2025b), Tao <i>et al.</i> (2025), Xu & Tian (2025)
Technology-Adoption & Digital Transformation	TAM, UTAUT, Experiential Learning, AI, Metaverse, Fintech models, Automation Research, Resource-Based View (RBV)	15%	Raman <i>et al.</i> (2025), Boone <i>et al.</i> (2025), Mishra <i>et al.</i> (2025), Li <i>et al.</i> (2025)
Reputation & Event Study	Crisis Management, Reputation Spillover, ESG Sentiment, Signaling Theory,	2%	Akyildirim <i>et al.</i> (2025)

Source: Data processed

The theories are divided into 5 groups. Each group has its own dominant theoretical lens. The dominant theoretical lens is the main perspective used in research to understand a topic in the context of TCCM. The coverage (%) refers to the percentage of studies that use the respective theory as the main framework. Example studies refer to specific studies or scholarly articles that exemplify the application of the dimension being discussed, in terms of theory, context, characteristic, or methodology. From the results of this theory mapping, the current research trend is still dominated by ESG and SDGs frameworks, and there are also emerging studies that touch on AI and Fintech, but the interdisciplinary relationship between these theories must be explored further. In addition, technology-specific theories (TAM/RBV) are still poorly applied outside of digital field studies in relation to ESG and circular-economy topics. In addition, the SLR results also show that there is very little use of Reputation & Event

Study theory implemented in research related to ESG and circular economic topics. It opens opportunities for future research to explore Reputation & Event Study theory because this approach offers a unique perspective on how ESG events affect perception, market value, and social legitimacy of an organization in real time.

Context

Context will answer the question of where and in which domain ESG is implemented in e-business to achieve a circular economy. In this section, the context in terms of geographical areas and domains that are the object of previous studies related to this topic will be shown.

Geographical area

From a geographical aspect, this SLR is divided into 5 regional areas that are the object of research, namely 1) China-specific, found in 11 papers; 2) Global and multi-regional, found in 11 papers; 3) Developing countries such as BRICS, Nigeria, and India, found in 6 papers; 4) Europe, which includes discussions on the European Union and European countries separately, found in 5 papers; 5) United States, found in 4 papers. The following is the mapping of the Context dimension according to geographical area:

Table 2: The Mapping of Context Dimension according to Geographical Area

Geographical Area	Focus of Research	Coverage	Example Studies
China-specific	Green Finance, Fintech, ESG adoption.	30%	Du <i>et al.</i> (2025), Wang <i>et al.</i> (2025), Xu & Tian (2025)
Global and multi-regional	Cross-country sustainability research—diverse methodologies.	30%	Rodolaki <i>et al.</i> (2025), Raman <i>et al.</i> (2025), Baninla <i>et al.</i> (2025)
BRICS and Emerging Markets (Nigeria & India)	Sustainability development & green governance lagging in policy adoption.	16%	Amin <i>et al.</i> (2025b), Usman <i>et al.</i> (2025), Anshima <i>et al.</i> (2025)
Europe (EU-wide and Single Countries)	Sustainability metrics & circular economy.	13%	Shmelev & Shmeleva (2025), Trevisan <i>et al.</i> (2025), Rumsa <i>et al.</i> (2025), Nikou (2025)
United States	Corporate governance, green finance, and energy efficiency.	11%	Mohy-ud-Din <i>et al.</i> (2025), Boone <i>et al.</i> (2025), Balakrishnan <i>et al.</i> (2025)

Source: Data processed

The research trend on this topic in 2025 is dominated by research with a regional focus on China. Most of the research focuses on the fields of Green Finance, Fintech, and ESG Adoption. Multi-regional research that focuses on sustainability between countries also accounts for 30%. Research on this topic in developing countries, Europe, and the United States in 2025 has less than 20% coverage. This opens opportunities for future research to be conducted in unexplored countries, such as Asian countries, Latin American countries, and African countries.

Based on the results of the SLR in this study, countries that currently urgently need studies on ESG and circular economy include India, Indonesia, China, Brazil, and Nigeria. India is experiencing rapid economic growth, high urbanization, and increasing environmental pressures, which call for ESG integration in the manufacturing and textile sectors, electronic and plastic waste management, and circular economy adoption in the informal sector. Indonesia is an archipelago with a high risk of climate change and environmental degradation, requiring research focusing on ESG in the forestry, palm oil, and tourism sectors, as well as the circular economy for municipal and marine waste management. China is the world's largest producer and consumer, with fast-evolving ESG policies. Therefore, China needs research on the effectiveness of local ESG policies and the circular economy in the construction and electronics sectors.

In addition to Asian countries, Latin American countries such as Brazil also need more research on ESG in agribusiness and forestry, and the circular economy for biomass and agricultural waste. African countries such as Nigeria also have a high dependence on extractive industries and fossil energy, and face environmental governance challenges, so they need more research on ESG in the energy and mining sectors, as well as circular economy strategies for agricultural waste and plastics.

Research domain

In addition to categorizing its geographical regional aspects, the Context dimension also conducts mapping based on its research domain. SLR in this study divides previous research into 8 domains, namely 1) Finance & Green Finance, which are discussed in 8 papers; 2) Technology & Digital (AI, Metaverse, Blockchain, Fintech), which are discussed in 8 papers; 3) Supply-chain & Logistics, which are discussed in 7 papers; 4) Manufacturing, which is discussed in 6 papers; 5) Energy & Climate Policy, which

are discussed in 6 papers; 6) Mining, Extractives, & Metals, which are discussed in 5 papers; 7) Tourism, Hospitality, & Aviation, which are discussed in 3 papers; 8) Human Resources (HR) & Education, which are discussed in 3 papers. The following is the mapping of the Context dimension according to the research domain:

Table 3: The Mapping of Context Dimension according to Research Domain

Geographical Area	Coverage	Example Studies
Finance & Green Finance	17%	Du <i>et al.</i> (2025), Xu & Tian (2025), Wang <i>et al.</i> (2025), Tao <i>et al.</i> (2025), Amin <i>et al.</i> , (2025b), Chen <i>et al.</i> (2025), Schoenmaker & Schramade (2025), Chang & Wang (2025)
Technology & Digital (AI, Metaverse, Blockchain, Fintech)	17%	Raman <i>et al.</i> (2025), Li <i>et al.</i> (2025b), Boone <i>et al.</i> (2025), Mishra <i>et al.</i> (2025), Lee <i>et al.</i> (2025), Tian <i>et al.</i> (2025), Tao <i>et al.</i> (2025)
Supply-chain & Logistics	15%	Turek <i>et al.</i> (2025), Boone <i>et al.</i> , 2025), Cao <i>et al.</i> (2025), Mishra <i>et al.</i> (2025), Chen <i>et al.</i> (2025), Balakrishnan <i>et al.</i> (2025), Wang <i>et al.</i> (2025)
Manufacturing	13%	Trevisan <i>et al.</i> (2025), Rumsa <i>et al.</i> (2025),
Energy & Climate Policy	13%	Du <i>et al.</i> (2025), Lee <i>et al.</i> (2025), Nikou (2025)
Mining, Extractives, & Metals	11%	Rodolaki <i>et al.</i> (2025), Anani <i>et al.</i> (2025), Baninla <i>et al.</i> (2025), Dowling & Otero (2025)
Tourism, Hospitality, & Aviation	7%	Trabelsi (2025), Akyildirim <i>et al.</i> (2025)
Human Resources (HR) & Education	7%	Trevisan <i>et al.</i> (2025), Schoenmaker & Schramade (2025), Anshima <i>et al.</i> (2025)

Source: Data processed

This mapping shows the gaps of previous studies that can open big opportunities for further research. It is strongly suggested that further studies be conducted in the underexplored or emerging domains/sectors, such as Tourism & Hospitality and Education. Research on ESG and circular economy is crucial for the tourism & hospitality industry as the sector is at the forefront of the interaction between people, the environment, and the local economy. Research on ESG and circular economy in the education sector is very important because educational institutions are not only places to transfer knowledge, but also agents of sustainable social change and culture.

Characteristics

The dimension of Characteristics will answer the question of what variables dominate the previous studies. This SLR generates 5 groups of construct clusters, i.e., 1) Environmental Outcomes; 2) Governance & Policy Instruments; 3) Financial Market; 4) Social & Stakeholder Outcomes; 5) Technology Attributes. The following is the mapping of the Characteristics dimension that shows the construct clusters along with the typical indicators for each cluster:

Table 4: The Mapping of Characteristics Dimension

Construct Cluster	Typical Indicators	Number of Papers
Environmental Outcomes	CO ₂ , carbon efficiency, GTFEE, biodiversity, water intensity	17
Governance & Policy Instruments	GFRIP, LCCP, GCA competition, contract monitoring, ESG ratings	15
Financial Market	Green finance, board diversity, loan terms, profit/job objective in MOMIP	14
Social & Stakeholder Outcomes	Social License to Operate (SLO) narratives, inclusion, employment, social spillovers	12
Technology Attributes	AI intensity, Fintech index, metaverse adoption, blockchain traceability	11

Source: Data processed

In this SLR, there are several papers that have intersections with each other in several construct clusters, so the number is non-exclusive. Based on the results of this mapping, carbon is still the main issue that dominates. This indicates that carbon issues are still very interesting to explore further. Meanwhile, the issue of technological attributes, which includes the use of AI and Fintech, still requires more exploration and integration with other aspects. Research on ESG and circular economy involving technological attributes is becoming increasingly important in today's digital era, as technology is no longer just a tool, but has become a key enabler in the sustainable transformation.

Methodology

The dimension of Methodology will answer the question of how these studies were conducted and what analytical tools they used. The results of this SLR classify these previous studies into 6 methodological groups, namely 1) Quantitative Econometrics; 2) Machine Learning & AI; 3) Bibliometric & SLR; 4) Qualitative, Case Study, & Delphi; 5) Optimization; and 6) Mixed-Methods. The following are the mapping results based on the Methodology dimension, with the tools and models used in each of these methods:

Table 5: The Mapping of Methodology Dimension

Method	Tools / Models	Number of Papers	Coverage
Quantitative Econometrics	Panel FE, DID, ARDL/NARDL, Spatial Durbin	17	41%
Machine Learning & AI	BERTopic, Earth.ai NLP, Double/debiased ML, Bayesian Net, ensemble regressors	9	22%
Bibliometric & SLR	PRISMA, bibliographic coupling, TCCM coding	7	17%
Qualitative, Case Study, & Delphi	Interviews, narrative analysis, Delphi panels	6	15%
Optimization	MOMIP, MCDA, Multinomial Logit portfolio, WINGS-CODAS	5	12%
Mixed-Methods	Combos of SEM-NCA + Delphi, SLR + survey, case + modelling	5	12%

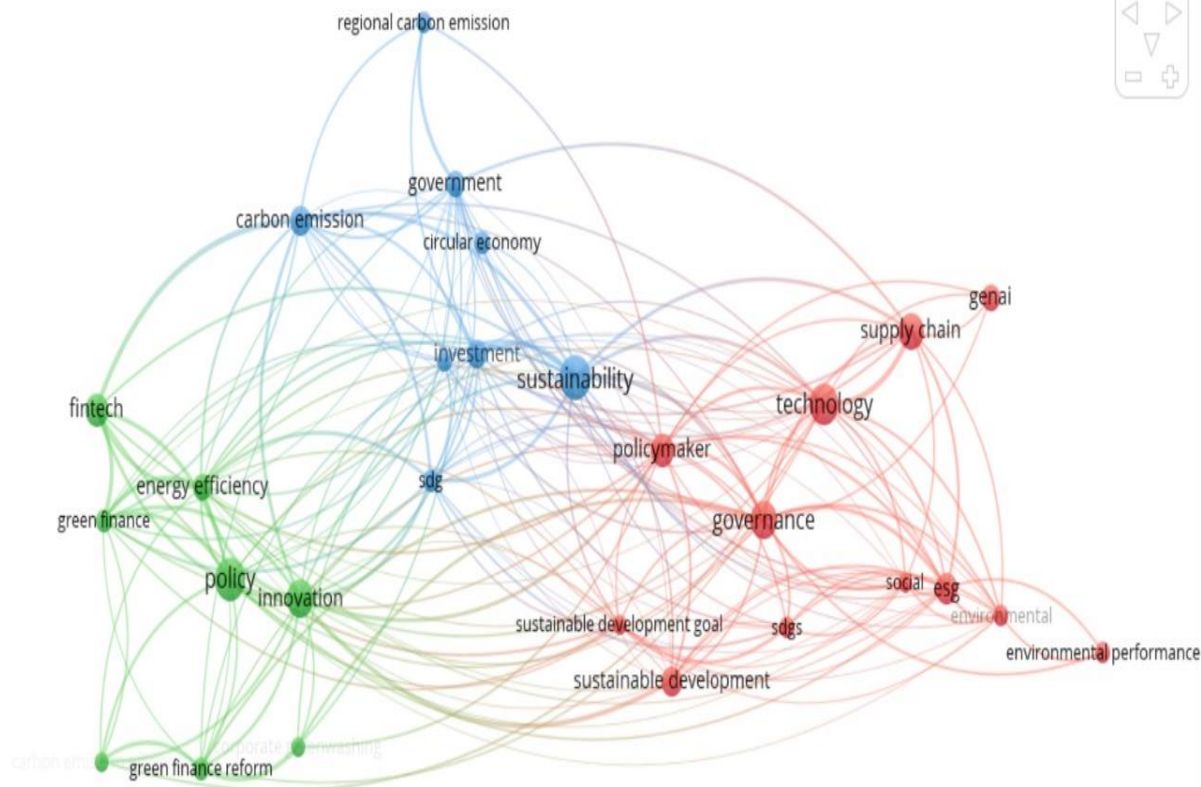
Source: Data processed

The number of papers is non-exclusive, and the percentage is greater than 100%, as there are some papers that overlap because they use hybrid methods or combinations of some methods with several tools and models in a study. From this SLR, research using quantitative econometrics methods still dominates, with a coverage of 41%. The use of machine learning and AI is still ranked second, with a coverage of 22%. This opens opportunities for future research to further explore new methods that adopt digital technology as an analytical tool. An advantage of using machine learning and AI in research is being able to process data on a large scale (big data) and detect hidden patterns that cannot be captured by conventional statistics. In addition, the use of digital technology as a method and analytical tool in research is an effort for time efficiency, and it also allows for rapid replication.

Besides encouraging the use of digital technology in research, the results of this SLR can also encourage the use of mixed methods in future research. The mixed methods enable a research approach with a more comprehensive perspective, sharpening validation and triangulation so that it will be better to verify and strengthen the findings in the research results. In addition, research conducted with mixed methods will also be better to answer diverse patterns of research questions with deeper exploration, for example, in the form of a sequential-exploratory design.

The Themes of Studies on ESG Implementation in E-Business to Realize a Circular Economy

This section will answer RQ2: *What are the themes on the topic of ESG implementation in e-business to realize a circular economy that have been studied in previous literature?* Using VOSviewer, this study will generate themes of the previous research in the area related to ESG, e-business, and circular economy. VOSviewer is a tool that makes it easier for researchers to draw some themes from the content analysis that has been carried out. VOSviewer provides a visual representation of the theme clusters obtained from SLR (Anggadwita & Indarti, 2024). VOSviewer is a software used for bibliometric visualization and analysis, especially in network maps of relationships between publications, authors, or keywords in scientific research. This research uses VOSviewer as a tool to help answer the research questions because VOSviewer is strongly helpful in evaluating trends in a particular field of science and is able to map themes that are the result of the contribution of each relevant discipline. The following is an image of the results of drawing themes from this study using VOSviewer:



Source: Data processed using VOSviewer (2025)
Figure 1: The Display of Themes from VOSviewer

From Figure 1, the results of the SLR show that there are 3 clusters, which are distinguished in colors of green, blue, and red. The first cluster is the green one. This cluster consists of 6 items, i.e., policy, innovation, fintech, energy efficiency, green finance, and green finance reform. The research in this green cluster focuses on policies that regulate innovation in the green economy, especially green finance. This cluster shows the close relationship between regulation, technology, and the environment. Innovation by utilizing digital technology in the financial industry in the form of fintech is expected to support green finance initiatives that encourage green finance reform. To ensure that this mechanism runs well, it needs to be strengthened by regulatory enforcement in the form of policies.

In the green cluster, there is a strong relationship between green finance and policy. Many previous studies in this cluster are descriptive and focus on macro-level policies. The research gap found in this cluster is the lack of empirical cross-country and cross-sectoral evaluations. Thus, there are opportunities for future research to fill the gaps in previous studies. A topic that can be proposed is a study on the effectiveness of green financing policies in developing countries using a comparative method (cross-country ESG policy benchmarking). In addition, studies in this cluster also show a strong link between energy efficiency and regulation. Previous research is linked to policy, but not much to digital technologies or supply chains. It shows that there is a lack of exploration of how digital technologies such as IoT and AI can support energy efficiency in an ESG context. Therefore, further research based on case studies in the manufacturing sector is needed to examine the integration of AI for energy efficiency as an effort to achieve ESG performance.

In the green cluster, the theme of "governance" appears several times, but there are few connections to "reputation" and "stakeholders". It shows the lack of studies on how ESG governance is practically applied to the operational level of companies and institutions. So, further research on the ESG governance maturity model and its impact on achieving a circular economy is still needed. Some studies in this cluster also discuss social metrics in green finance, but the word "social" is not prominent in this cluster. It shows that the discussion on green finance has not received adequate attention. For this reason, further research that reviews whether the benefits of green finance products are truly socially inclusive for the entire community needs to be conducted. For instance, it is important to conduct research on access to green lending for MSMEs. In addition, this green cluster also shows a weak relationship between "policy" and "technology". Existing policies are not yet fully responsive to advances in digital technologies such as blockchain and smart ESG reporting. Thus, there is a need to develop research on adaptive policy frameworks that respond to digital evolution in ESG monitoring.

The second cluster is the blue one. This cluster consists of 7 themes, namely sustainability, investment, government, carbon emission, regional carbon emission, circular economy, and SDGs. This blue cluster centers on the issue of sustainability. Research in this cluster shows a strong link between carbon emissions, ESG-based investment, and the circular economy. Good and efficient management of carbon emissions will be one of the supporting factors for the industry to attract investment. Currently, environmental issues are important in the financial industry, so investors and businesspeople in the financial sector regard ESG compliance as an important consideration in investment decisions. In addition, the role of government as a regulator is also needed to ensure such compliance in the regional and global areas to support the reduction of industrial waste and emissions, especially in terms of carbon, for the realization of a circular economy. This is an important effort to achieve the Sustainable Development Goals (SDGs).

The blue cluster focuses on the themes of carbon emissions, circular economy, investment, and sustainability. There is a strong relationship between carbon emissions and investment, but most studies are still conceptual and aggregate. Sector-based and company-level studies are lacking. Therefore, it is necessary to develop studies that discuss decarbonization practices and ESG-based ROI in the energy, logistics, or manufacturing sectors. In addition, "circular economy" appears as a major node but is not closely connected with "governance" and "technology". It shows the research gap that the circular economy implementation is still seen as a technical approach; there are not many integrative studies that include organizational structure or technological support. Thus, research that addresses the integration between circular governance and digital innovation is urgently needed, for example, a study that explores how ERP or IoT systems support the circular economy.

In this blue cluster, the link between "investment" and "sustainability" is dominant, but the relationship with impact metrics is weak. Not many studies have developed or tested ESG performance indicators related to circular economy portfolios. Therefore, it is necessary to develop research that examines ESG-integrated risk-return models for circular investments using data-driven or machine learning approaches. The connection between "carbon emission" and sectors, such as hospitality, education, or the creative economy, is also still very minimal. Existing research still focuses on heavy sectors such as industry and energy. Studies on the decarbonization of services and social sectors are needed, including the measurement of indirect emissions. In addition, the blue cluster also shows a lack of conceptual footprint from behavioral perspectives such as investor psychology and consumer ESG behavior. The human aspect of sustainability decision-making has not been studied much. For this reason, there is still a need for more studies on behavioral economics in the adoption of sustainable investment, or consumer preferences for products from the circular economy.

The third cluster is the red one. This cluster consists of 12 themes, namely technology, supply chain, governance, policy maker, ESG, GenAI, sustainable development, sustainable development goal, SDGs, environmental, environmental performance, and social. Previous studies in this cluster focus on technology, governance, supply chain, ESG, and GenAI. This shows that the advancement of digital technology cannot be ignored and is an important aspect that can be integrated with environmental, social, and governance issues. For example, the existence of generative artificial intelligence (GenAI) can be utilized to encourage ESG-based e-supply chains. This is also an effort to implement sustainable development to encourage the achievement of the SDGs. This cluster also shows the roles of policymakers in regulating the implementation of ESG aspects, i.e., environment, social, and governance, by utilizing advanced digital technology to achieve the SDGs. Thus, there is an integration between advances in AI technology and sustainability agendas.

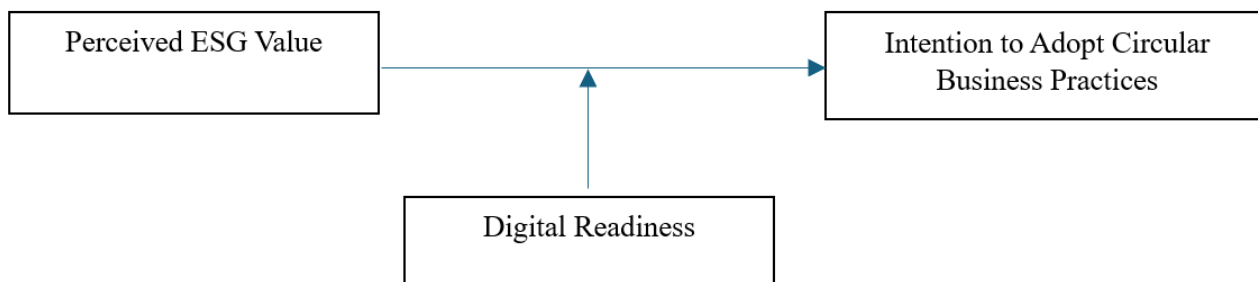
The red cluster shows that "governance" is connected to ESG, but the connection with operational governance or compliance mechanisms is still minimal. There is still a lack of research on how ESG is integrated into the company's operational governance structure. Studies on the "ESG governance maturity model" or the impact of board diversity on ESG integration and circularity are currently needed. The technology aspect is also still an important issue in the red cluster. "GenAI" appears, but there are not many connections to policy, social, or performance metrics. It shows that there are still few studies on technology adoption and its impact on ESG qualitatively, including reputation and transparency. So, it is necessary to conduct research on the impact of GenAI adoption on ESG reporting, automated sustainability disclosure, and greenwashing detection.

Supply Chain emerges as an important node, but the link to carbon emissions or circularity is weak. It indicates a lack of research on closed-loop supply chain or circular supply chain integrated with ESG. Therefore, it is necessary to develop a study on the Circular Supply Chain Governance (CSCG) model based on ESG principles and digital traceability. In addition, there is no visible connection between technology and aspects of reputation or social legitimacy. The reputational effects of ESG technology adoption have not been widely explored quantitatively or using event studies on red clusters. Thus, future research can use event study and sentiment analysis approaches to measure the reputational impact of the adoption of digital ESG tools. Again, the social aspect is still sidelined. This is shown by the lack of linkage between "technology" and social variables such as "employee", "consumer", or "behavior". The user perspective or social impact of sustainability technology is still marginalized. Thus, there is a need to study the user acceptance of ESG tech, or the ethical and behavioral impact of AI in sustainability reporting.

THE PROPOSED MODEL

This study is an initial stage for research related to ESG and the circular economy. The results of this research can be continued in further research. Based on the results of mapping using the TCCM framework and the themes obtained through VOSviewer, further synthesis was carried out to formulate constructs that can become variables and indicators for further research. This is the answer to RQ3 regarding the model that can describe the trend of ESG implementation in e-business towards the circular

economy. The model consists of three variables, i.e., independent variable, dependent variable, and moderating variable. The future research can be conducted empirically by verifying the causal relationship between variables using quantitative research methods. Figure 2 shows the proposed model as the result of this study:



Source: Data processed

Figure 2: The Proposed Model of ESG Trend in E-business towards The Circular Economy

This model shows that Perceived ESG Value is the independent variable, and Intention to Adopt Circular Business Practices is the dependent variable. Between the two variables, there is a moderating variable, namely Digital Readiness. This model shows the causal relationship between Perceived ESG Value towards Intention to Adopt Circular Business Practices, and the moderating effect of Digital Readiness. This model will reveal whether Digital Readiness can strengthen the causal relationship between the two variables. Digital Readiness will assess the extent to which an individual or organization is ready to adopt digital technology, including competencies, infrastructure, and digital culture. A person or organization that has a high Perceived ESG Value may have a strong Intention to Adopt Circular Business Practices if he or it has digital readiness. Or vice versa, a person or organization may already have a high Perceived ESG Value but does not have Digital Readiness; hence, the Intention to Adopt Circular Business Practices is weak. High Digital Readiness can strengthen the relationship between Perceived ESG Value and Intention to Adopt Circular Business Practices because digital technology is often a key enabler in the implementation of circular practices, such as the use of AI for resource efficiency and the use of blockchain for material and product traceability. Previous studies have shown the role of digital technology as an important element for ESG, sustainability, and sustainable development (Almatoq & Al Mubarak, 2025). A study that is an advanced development of the Resource-Based View (RBV) and institutional theory also shows the results that technological innovation plays an important role in moderating the relationship between institutional quality and resource efficiency (Limei *et al.*, 2025). Thus, according to the proposed model, two propositions are formulated as follows:

Proposition 1: Perceived ESG Value can influence Intention to Adopt Circular Practices

Proposition 2: Digital Readiness will positively moderate the relationship between Perceived ESG Value and Intention to Adopt Circular Business Practices

The two propositions can be verified through hypothesis testing with further quantitative and empirical research using several constructs that are indicators of each variable. The variable of Perceived ESG Value consists of three aspects, namely environmental, social, and governance. Indicators in the environmental aspect can be in the form of awareness, commitment, and transparency. Awareness in this case is awareness in anticipating the environmental impact of business, including awareness to reduce waste and carbon emissions. Commitment can include a commitment to resource efficiency and the use of renewable energy in business operations. Transparency can be assessed by how transparent the business is in conveying its information regarding environmental impact reports and how easily the information can be accessed by the public. Indicators on social aspects can be in the form of corporate social responsibility and community development carried out by businesses. Another indicator is fairness and inclusion in employment that upholds diversity and equality. In addition, social aspect indicators can also include the protection of workers' rights and employee welfare. Indicators in the governance aspect might include ethics and integrity in decision-making which can be reflected by the existence of a clear and firm anti-corruption policy, transparency and accountability in management which is indicated by disclosure of financial reports and socialization of company policies, as well as responsible and inclusive leadership which can be reflected by diversity and relevant competencies in the Board of Directors (Alhazemi, 2025).

Indicators of Digital Readiness consist of: 1) Digital strategy and governance which includes a digital vision that is integrated with business strategy, top management support for digital transformation, and internal policies and regulations that support digitalization; 2) Technology infrastructure which includes the availability of adequate hardware and software, the quality of internet connectivity and communication systems, and the integration of digital systems in core business processes; 3) HR competence and digital literacy which includes employee comfort level in using digital technology, availability of digital training and development, and technology adoption by various levels of the organization; 4) Digital workflows and processes which include business process automation, use of data for decision making, and technology-based operational efficiency and flexibility;

5) Organizational culture and readiness which includes an open attitude towards innovation and change, cross-functional collaboration through digital platforms, and digital leadership that drives transformation; 6) Measurement and evaluation which includes the implementation of digital KPIs (e.g. digital engagement and system adoption rates), monitoring and evaluation of digital initiatives, and feedback systems from internal and external digital technology users (Caton *et al.*, 2025; Herden *et al.*, 2021).

Indicators for the variable of Intention to Adopt Circular Business Practices were obtained by adopting the Theory of Planned Behavior (TPB). The indicators for this variable consist of: 1) Behavioral Intention, an indicator that measures the extent to which individuals or organizations intend to adopt circular practices; 2) Attitude Towards Circular Practices, which is an indicator that measures the positive attitude of individuals or organizations towards the benefits and value of circular practices; 3) Subjective Norms, which is an indicator that measures the social influence or external pressure that encourages the adoption of circular business practices; 4) Perceived Behavioral Control, which is an indicator that measures confidence in an individual's or organization's ability to implement circular business practices; 5) Long-Term Orientation, an indicator that measures an individual or organization's commitment to long-term sustainability (Tran-Thi-Thanh & Nguyen-Thi-phuong, 2023).

CONCLUSION AND SUGGESTIONS

Bibliometric and thematic mapping in this study shows that there are still numerous gaps in previous research that provide several opportunities and new ideas for further research. The combined analysis of the TCCM framework and theme visualization with VOSviewer resulted in the grouping of findings into four categories based on the dimensions of the TCCM framework. In terms of Theory, ESG and green finance have a strong relationship with policy, but there is not much exploration of social and technological aspects, which implies further research to focus on the integration of policymaking, technology, and governance in sustainability. In terms of Context, the concept of ESG is currently dominated by supply chain, investment, and carbon emission. It implies further research to conduct deeper exploration of sustainability in specific industries (e.g., education, manufacturing, tourism). In terms of Characteristics, the term "social" still has weaker connections than "environmental" and "governance" in the research cluster network. This implies the potential for future research to further emphasize the social impact of ESG, such as inclusion and economic justice, in order to achieve the SDGs in terms of reducing inequalities. In terms of Methodology, text-based analysis or bibliometrics show conceptual linkages but have not explored data-driven models. Thus, the implication for future research is the development of machine learning or AI-based sustainability tracking approaches.

Subsequent mapping of a thematic study using VOSviewer shows that there are three main clusters, namely Green Finance & Policy, Carbon Emissions & Circular Practices, and Digital Governance & ESG Technology. Thus, there are some topics for a future research agenda that can be provided by the findings of this study, i.e., the role of technology, such as AI, Blockchain, IoT, in accelerating ESG and circular economy adoption; AI-based predictive model for real-time sustainability monitoring; the influence of green finance on business sustainability; social impact of ESG policies on worker welfare, economic inclusion, and climate justice; ESG reputation effects on firm market value using AI-based event study and natural language processing (NLP).

This research also produces a model and propositions that can be used to generate new ideas for further research. The proposed model consists of three variables with two propositions. The variables that support this model are Perceived ESG Value as an independent variable, Intention to Adopt Circular Business Practices as a dependent variable, and Digital Readiness as a moderating variable. From this model, two propositions can be investigated in further research through quantitative hypothesis testing, namely: 1) Perceived ESG Value can influence Intention to Adopt Circular Business Practices; 2) Digital Readiness will positively moderate the relationship between Perceived ESG Value and Intention to Adopt Circular Business Practices.

In addition to contributing theoretically to the form of emerging ideas for future research, the findings of this study can also provide practical recommendations for industry and regulation. Practical recommendations for industry include the application of ESG and circular economy in digital technology-based supply chain management, using GenAI, for instance, in the manufacturing industry and service industries, such as education and hospitality. In addition, practical recommendations can also be given to policymakers in the form of proposed regulations and policies that accelerate the adoption of sustainable technologies.

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