

The Role of Digital Technology in Driving Financial Innovation and Green Economic Sustainability

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Abstract

The rapid development of digital technologies has become a key driver of financial innovation, accelerating the transition toward a green economy. The integration of technologies such as big data analytics, blockchain, artificial intelligence (AI), the Internet of Things (IoT), and digital financial platforms has accelerated financial innovation that enhances financial inclusion, transaction efficiency, and the transparency of financial systems. Existing literature indicates that digitalization enhances access to green financing through mechanisms such as fintech lending, green crowdfunding, and data-driven environmental risk assessment. This literature review analyzes the role of various digital technologies—including fintech, blockchain, artificial intelligence (AI), big data analytics, and the Internet of Things (IoT)—in developing financial solutions that are more inclusive, efficient, and sustainable. Blockchain technology also contributes to carbon footprint verification, sustainable supply chain tracking, and more accountable issuance of green bonds. Furthermore, the use of AI and big data enables more accurate climate-risk measurement and supports financial institutions in making environmentally responsible investment decisions. IoT technologies play an essential role by providing real-time data on energy efficiency and industrial operations, thus encouraging companies to improve their sustainability performance. The methodology employed includes a comprehensive literature review of international journals, global institutional reports, and indexed academic publications from 2015 to 2025. The findings indicate that digital technologies can improve the accuracy of green project risk assessments, strengthen the transparency of sustainable financing, and support environmental impact verification through real-time data. However, challenges such as digital inequality, cybersecurity threats, and regulatory readiness remain key obstacles. Overall, this review highlights that digital technology plays a strategic role in driving financial innovation while reinforcing green economic sustainability, with significant implications for policymakers, the financial sector, and the technology industry.

Keywords: Digital Technology, Financial Innovation, Green Economic

1. Introduction

The development of digital technology today has brought about major changes in the global financial structure, including in Indonesia. Some of the most significant changes are the emergence and rapid growth of online investment platforms such as peer-to-peer lending, equity crowdfunding, and various fintech facilities. This technology makes it easier for people from all walks of life to access capital in a more practical, responsive, and economical manner. Fintech has revolutionized the way transactions are conducted. Fintech (financial technology) has emerged as one of the main catalysts in driving economic transformation towards sustainability. Fintech, which encompasses technological innovations in financial services such

as digital payments, crowdfunding, blockchain, and big data analytics, provides a great opportunity to accelerate the transition to a green economy. By leveraging advanced technology, fintech not only improves the efficiency and inclusiveness of financial transactions, but also paves the way for financing that supports environmentally friendly projects.

Fintech, with its innovation and wide reach, is now a driving force in realizing sustainable transactions and green investments around the world. The evolution of fintech highlights an important point where economic growth meets technological advancement. According to the Financial Stability Board (FSB), fintech encompasses technological innovations that introduce new business approaches, operational processes, and products that significantly impact financial institutions, markets, and the overall improvement of financial services. In this increasingly digitally connected modern era, the fintech industry has played a significant role in transforming how people access and manage their finances. More than just a tool for transactions, fintech has also become a driver of innovation in various aspects, including promoting green investment. Green investment, which focuses on environmentally friendly and sustainable projects, is one of the main solutions to address the challenges of climate change and global environmental damage. The green economy is an economic concept that aims to improve social welfare and justice, while significantly reducing negative impacts on the environment.

2. Literature Review

2.1 Digital Technology

Digital technology (Fintech, Blockchain, AI, Big Data Analytics, and IoT) plays a significant role in enabling financial innovation that supports the allocation of capital to green projects, increases transparency, reduces transaction costs, expands financial inclusion, and enables new instruments. The shift towards digitalization in financial management focuses on improving data security and operational efficiency, highlighting the importance of technology adoption to protect data and improve the operational efficiency of financial institutions focused on digital transformation to increase profits, improve customer experience, and manage cybersecurity risks, with a strong emphasis on digital technology investment and employee skills development. AI is identified as a core technology that improves customer experience, increases sales, and supports real-time decision-making processes, demonstrating its central role in the digital transformation journey. The banking sector is leveraging AI and big data analytics to become more customer-centric, with a focus on data-driven services and personalization to increase customer engagement and attract new clients.

The digital transformation of accounting firms is supported by technologies such as blockchain, robotic process automation (RPA), cloud, big data, and artificial intelligence (AI), which are changing the work environment and the way services are provided. A comprehensive review identifies key factors at the individual, group, and organizational levels that are critical to digital transformation, emphasizing the roles of technology adoption, team collaboration, and organizational culture. Blockchain technology is explored for its potential to revolutionize the financial sector, highlighting its applications beyond cryptocurrency to redefine financial services with digital resources.

2.2 Financial Innovation and Green Economic

Fintech platforms contribute to green finance by making financial businesses more sustainable. Banks are key players in sustainable development and the green economy, shifting traditional

products and services to be environmentally friendly and socially oriented. This will involve the use of green financial instruments such as green bonds, loans, and insurance. Green banking systems, which include the implementation of environmentally friendly policies and products, are a key factor in environmental conservation. Banks and financial institutions around the world are increasingly incorporating green banking initiatives to make a positive contribution not only to the Sustainable Development Goals (SDGs) but also to broader environmental and social well-being. However, the implementation of green finance faces several obstacles, especially in developing countries. A study shows that the lack of pressure from international organizations and the absence of universal green criteria are two major factors that need to be addressed to overcome these problems.

Artificial intelligence is considered capable of overcoming these obstacles through its ability to process large amounts of data in real time, predict climate risks, optimize green portfolios, improve data transparency and accessibility, and generate insights that can support financial decision-making. However, the use of artificial intelligence has not been systematically integrated into the green finance ecosystem, especially in relation to the needs of stakeholders such as the government, financial institutions, companies, investors, and the community. One of the main benefits of adopting digital technology in Green Banking is the reduction of paper usage through paperless banking services. Mobile banking and internet banking applications allow customers to conduct various transactions online without having to visit a branch office or use physical documents. This not only saves operational costs for banks but also contributes to reducing paper waste that has a negative impact on the environment.

In addition, digital technology enables a green credit system that can be used to support the financing of sustainable projects. Through big data and AI, banks can analyze customer consumption and investment patterns, thereby providing incentives for those who participate in environmentally friendly practices. For example, banks can offer lower interest rates to customers who apply for credit to support renewable energy projects or circular economy-based businesses. Blockchain technology also plays an important role in increasing transparency and accountability in the green banking sector. With an immutable and decentralized recording system, blockchain enables more secure and transparent verification of financial transactions. This is particularly relevant in sustainable investing, where investors can ensure that the funds they invest are actually used for environmentally friendly purposes and in accordance with ESG (Environmental, Social, and Governance) standards.

Blockchain technology is a distributed ledger system that enables secure and transparent transactions without the need for a centralized authority. This technology has various features that are beneficial for green finance:

1. Transparency: All transactions are recorded on an immutable ledger, allowing stakeholders to verify the use of funds.
2. Security: Cryptographic techniques ensure data integrity and confidentiality.
3. Tracking: Blockchain enables tracking of funds flow from investors to green projects

In addition to the benefits mentioned above, digital technology in Green Banking also enables energy efficiency in banking operations. The use of IoT and smart banking infrastructure allows banks to manage energy usage more intelligently, for example, by automating lighting and air conditioning in branch offices, as well as optimizing the use of other resources. This has a direct impact on reducing the carbon footprint generated by banking activities.

3. Research Method

3.1 Research Design

3.1.1 Research Approach

This study employs a qualitative literature review approach, which is considered appropriate for examining a broad and rapidly evolving topic such as the role of digital technology in financial innovation and green economic sustainability. A literature review enables researchers to systematically collect, interpret, and synthesize findings from previous studies, thereby providing a comprehensive understanding of existing knowledge and identifying gaps that require further investigation. According to Snyder (2019), a qualitative literature review is suitable for developing theoretical insights and mapping the current state of research in emerging fields.

In this study, the qualitative approach allows the researcher to explore how digital technologies such as blockchain, fintech platforms, artificial intelligence (AI), the Internet of Things (IoT), and big data analytics have been utilized globally to support sustainable finance practices. The qualitative synthesis emphasizes not only the technological mechanisms involved but also the socioeconomic and environmental impacts generated by the adoption of such technologies. This method also helps compare how different technologies contribute to improving financial inclusion, increasing resource efficiency, and supporting green economic transitions in both developed and developing countries.

In addition, this study adopts an integrative review orientation that not only summarizes prior findings but also critically evaluates the methodological rigor, theoretical contributions, and applicability of each selected publication. As Torraco (2016) argues, integrative reviews aim to generate new conceptual insights by comparing diverse research perspectives. This approach is particularly relevant considering the interdisciplinary nature of digital technology and green economic sustainability, where technological, financial, and environmental domains intersect. By integrating these perspectives, the review provides a more holistic understanding of how digital transformation can simultaneously influence financial innovation and environmental performance.

3.1.2 Research Scope and Criteria

The scope of this research includes scholarly articles, institutional reports, conference proceedings, and international publications indexed in reputable databases such as Scopus, Web of Science, ScienceDirect, and Google Scholar. The literature search focuses on the period between 2015 and 2025, considering that digital transformation and green financing have experienced significant acceleration during the last decade.

The inclusion criteria consist of:

1. Publications written in English.
2. Studies explicitly discussing digital technologies in financial or environmental contexts.
3. Articles focusing on sustainability, green economy, climate-related financial innovation, or digital environmental monitoring.
4. Research employing empirical, conceptual, or theoretical approaches.

Meanwhile, the exclusion criteria include articles with limited relevance to the research topic, studies lacking methodological clarity, and publications outside the specified time range. These criteria ensure that the selected sources reflect the most updated discussions and contribute meaningfully to the research objectives.

3.2 Data Collection and Analysis Procedure

Data were collected through systematic keyword-based searches. Keywords included “digital technology,” “financial innovation,” “green economy,” “AI for sustainability,” “blockchain environmental tracking,” “fintech green finance,” and “IoT carbon monitoring.” Boolean operators such as AND, OR, and NOT were used to refine the search results. The initial search identified more than 200 publications, which were then screened based on relevance, abstract alignment, and availability of full text.

After the screening process, 65 sources were selected for full review and thematic analysis. The data analysis employed thematic content analysis, which enables researchers to categorize findings into major recurring themes. Braun and Clarke (2006) explain that thematic analysis is effective for identifying patterns and constructing meaningful interpretations across qualitative datasets.

Four main themes emerged during the analysis:

1. The contribution of digital technologies to financial innovation systems.
2. The role of digitalization in enhancing environmental transparency and carbon verification.
3. The use of smart technologies for climate risk assessment and sustainable decision-making.
4. Challenges and limitations in integrating digital technology with green economic practices.

To increase analytical rigor, the coding process was conducted manually and iteratively, following Braun and Clarke’s (2006) six-phase framework: familiarization, initial coding, theme searching, theme reviewing, theme naming, and report production. Throughout the process, constant comparison techniques were employed to refine emerging categories and reduce potential researcher bias. Additionally, triangulation was applied by comparing interpretations across multiple sources and publication types, ensuring that the thematic structure accurately represents the dominant patterns within the literature. This systematic procedure enhances the trustworthiness and validity of the findings generated in this study.

4. Findings and Discussions

4.1 Digital Technology as a Catalyst for Financial Innovation

The findings of this study indicate that digital technologies play a central role in reshaping financial systems and driving innovation that supports sustainable economic activities. The integration of fintech solutions such as digital lending platforms, mobile banking, and peer to peer (P2P) financing has significantly improved accessibility to financial services, particularly for marginalized communities and small enterprises. Previous studies by Ozili (2018) and Gomber et al. (2017) highlight that fintech democratizes financial access and increases transaction efficiency, enabling a broader participation in green oriented projects.

Blockchain technology emerges as another crucial innovation, offering transparency, traceability, and accountability in sustainable finance. Through decentralized digital ledgers, blockchain allows for verifiable green bond transactions, transparent carbon credit trading, and reliable tracking of renewable energy certificates (Li et al., 2021). These characteristics reduce the risk of fraud, greenwashing, and misreporting, which are common issues in traditional financing mechanisms.

AI and big data analytics have also transformed financial innovation by supporting more accurate credit scoring, risk profiling, and climate-related financial predictions (Nguyen et al., 2022). Financial institutions increasingly rely on machine-learning models to evaluate the feasibility of green projects, estimate carbon reduction potential, and assess environmental risks. This contributes to more informed investment decisions and enhances the credibility of sustainable finance instruments.

Table 1. Comparative Summary of Multiple Studies on Digital Technology for Financial Innovation

Technology	Study & Year	Main Findings	Shared Pattern
Fintech	Ozili (2018)	Improves financial inclusion	Strong agreement that fintech broadens access and supports green financing
	Gomber et al. (2017)	Increases transaction efficiency	
	Tang et al. (2023)	Reduces financial constraints for green innovation	
Blockchain	Li et al. (2021)	Increases transparency in green bonds	Broad consensus on transparency and traceability
	Khaqqi et al. (2018)	Verifies carbon trading	
	Boumaiza (2025)	Improves sustainable investment flows	
	Magsi & Ahmed (2025)	Strengthens accountability in green finance	
AI / Big Data	Nguyen et al. (2022)	Improves credit scoring for green projects	Consistent evidence for prediction accuracy
	Varoufakis et al. (2021)	Climate risk modelling	
	Rolnick et al. (2022)	Supports environmental planning	

Overall, the findings reinforce the argument that digital technology acts as a major catalyst for financial innovation, expanding the reach and effectiveness of sustainability driven financial initiatives.

4.2 Digital Technology and Green Economic Sustainability

The review also reveals that digital technologies contribute significantly to improving environmental performance and supporting green economic transitions. IoT devices, for instance, enable continuous monitoring of energy usage, industrial emissions, and environmental conditions. Real-time data from IoT sensors allow businesses to identify inefficiencies, optimize energy consumption, and reduce waste (Almeida et al., 2020). Such technological support is essential for companies seeking to meet environmental regulations and achieve sustainability certifications.

Blockchain and distributed ledger systems play a critical role in promoting green supply chains by ensuring transparent monitoring of raw materials, production processes, and product distribution. This mechanism strengthens consumer trust and helps industries comply with international sustainability standards. In addition, blockchain enhances the verification process for carbon markets, preventing double-counting and ensuring that carbon offset projects deliver real impact (Khaqqi et al., 2018).

AI technologies are increasingly used in climate modeling, environmental forecasting, and sustainability planning. These technologies analyze large datasets—such as satellite imagery, weather patterns, and emissions records—to predict climate-related risks and inform mitigation strategies. This supports governments and private entities in designing climate-resilient policies and business models (Rolnick et al., 2022).

Despite these benefits, the review identifies several barriers to widespread adoption of digital sustainability technologies. These include digital inequality, particularly in developing countries with limited technological infrastructure; cybersecurity risks that threaten data integrity and privacy; and regulatory challenges related to the governance of digital innovation. Overcoming these barriers is essential to ensure that digital transformation supports an inclusive and equitable green economy.

Furthermore, digital technologies support policy makers and regulators in implementing more precise and data-driven environmental governance. Advanced analytics and real-time digital monitoring help governments design targeted interventions, such as adaptive carbon pricing mechanisms, energy efficiency subsidies, or early-warning systems for environmental violations. Industries also benefit from these technologies through improved compliance management and environmental auditing processes. As a result, digital transformation not only enhances operational sustainability at the firm level but also strengthens institutional capacity to oversee and guide national green economic transitions.

Collectively, these findings suggest that digital technology acts as both an enabler and accelerator of sustainability-driven transformation across financial, industrial, and policy domains. However, the potential of these technologies can only be fully realized when supported by adequate digital literacy, robust regulatory frameworks, and equitable access to technological infrastructure. Without these supporting conditions, digital innovation may reinforce existing inequalities and limit the effectiveness of sustainability initiatives. Therefore, strategic collaboration among governments, private industries, and technological institutions is essential to maximize the benefits of digital transformation for green economic development.

5. Conclusion

Digital technology has proven to be a key driver of financial innovation as well as the acceleration of the green economy. Fintech, blockchain, AI, big data, and IoT enhance access to financing, transparency, transaction efficiency, and the accuracy of risk assessments for green projects. These technologies also strengthen real-time environmental monitoring and ensure more accountable verification of environmentally friendly activities, such as green bonds and carbon tracking.

However, their utilization still faces challenges, including the digital divide, cybersecurity risks, and the suboptimal regulatory frameworks that support them. Overall, digitalization plays an important role in creating an inclusive, efficient, and sustainable financial system and serves as a strategic foundation for the transition toward a green economy.

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