FUTURE SCIENCE

ISBN 978-621-96812-7-8

DIGITAL TRANSFORMATION AND INCLUSIVE ECONOMIC DEVELOPMENT IN INDONESIA

FERRY PRASETYIA
NAQIYAH MULACHELAH

Digital Transformation and Inclusive Economic Development in Indonesia

Editors:

Ferry Prasetyia (Indonesia)

Naqiyah Mulachelah (Indonesia)

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#72 Salang Street Matain, Subic. 2209. Philippines

Mobile number: 09088602939; 09088602939

ISBN 978-621-96812-7-8

DOI https://doi.org/10.11594/futscipress19m

Contributors' Biography

Al Muizzuddin Fazaaloh, Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia

Asfi Manzilati, Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia

David Kaluge, Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia

Dwi Retno Widiyanti, Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia

Faishal Fadli, Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia

Farah Wulandari Pangestuty, Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia

Ferry Prasetyia, Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia

Ferry Prasetyia, Economics Department, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia

Ignatius Kuncoro Krisnugroho, Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia

Indri Supriyani, Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia

Laila Masruroh Pimada, Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia

Muhammad Dandy Alif Wildana, Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia

Naqiyah Mulachelah, Biology Department, Faculty of Mathematics and Natural Science, Brawijaya University, Malang, Indonesia

Shofwan, Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia

Sri Iswati, Department of Accounting, Faculty of Economics & Business, Universitas Airlangga, Surabaya, Indonesia

Vietha Devia SS, Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia

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About the Editor

Ferry Prasetyia is a lecturer at the Faculty of Economics and Business, Brawijaya University, and a researcher at the Centre for Development Dynamics Studies, Faculty of Economics, Brawijaya University. He was also a consultant for the Strategic Infrastructure and Development Reform Program (SIDRP) in East Java Province, The World Bank, and the Australian Indonesia Partnership for Decentralization (AIPD) for a special task: the Arrangement of Accountability report of East Java Governor 2011 (2012) and the arrangement of local Government Planning Document in Situbondo Regency East Java (2013). He received his Master's Degree from the University of Adelaide, Australia, in 2008 and earned a doctorate in Economics from Kassel University, Germany, in 2019. He has published numerous scientific publications and has had the honor of leading teams and serving as an expert, researcher, surveyor, research assistant, and technical analyst on many significant granted projects.

Naqiyah Mulachelah is an editor, content writer, and part-time research assistant. She has four years of experience as an editor of international scientific publications. She finished her Master's degree in 2021 at Brawijaya University. As an editor, her passion lies in paying meticulous attention to detail and maintaining dedication to upholding the highest quality standards. She firmly believes that publishing written works is a unique human practice, allowing us to leave behind a valuable legacy. She is thrilled to be part of this endeavor where knowledge is transformed into a timeless resource, enriching the academic journey of the readers.

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Challenges Faced by SMEs and Cooperatives in Implementing Digital Technology: A Literature Review

1

David Kaluge

Abstract

This literature review examines the challenges faced by Small and Medium-sized Enterprises (SMEs) and Cooperatives in their adoption of digital technology. It explores the economic significance of these entities, the benefits of digital technology adoption, and the increasing trend of such adoption. The main focus is on the obstacles encountered in implementing digital technology, including resource limitations, access to technology infrastructure, resistance to change, skill gaps, integration and compatibility issues, data security and privacy concerns, and regulatory and legal challenges. The review also discusses strategies and solutions to help SMEs and Cooperatives overcome these challenges and highlights success stories from organizations that have effectively addressed these issues. The review underscores the importance of addressing these challenges for sustainable growth and calls for further research and innovation to support these entities in their digital transformation journey.

Keywords

Agile Skills Enhancement · Digital Resilience · Inclusive Digitalization · Interoperability Dilemmas · Privacy Assurance Frameworks · Regulatory Adaptability · Techno-Economic Hurdles

D. Kaluge
Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia
e-mail: davidk@ub.ac.id

© Future Science Press. 2023
F. Prasetyia (ed.), N. Mulachelah (ed.), *Digital Transformation and Inclusive Economic Development in Indonesia*, https://doi.org/10.11594/futscipress1

1.1 Introduction

Adopting digital technology in small and medium-sized enterprises (SMEs) and cooperatives holds immense significance in today's business landscape. As the world becomes increasingly digitized, embracing technology has become crucial for sustained growth and competitiveness (Ahuja & Chan, 2021). Technology has transformed businesses' operations, enabling streamlined processes, enhanced communication, and access to global markets. With the digital revolution shaping industries, SMEs and cooperatives must leverage technology to remain relevant and thrive (Andjarwati & Wulan, 2021).

The rapid evolution of technology has propelled businesses toward digital transformation, revolutionizing traditional practices and paving the way for innovative approaches (Anim-Yeboah et al., 2020). In light of this, the primary aim of this chapter is to meticulously review and analyze the challenges encountered by SMEs and cooperatives during the implementation of digital technology. By examining their challenges, we can gain insights into the barriers that impede their successful integration of digital tools and solutions.

The literature points to many challenges SMEs and cooperatives encounter when embracing digital technology. Some of the core challenges include resource limitations (Arsalan et al., 2022), difficulties in accessing necessary technology infrastructure (Ghobakhloo et al., 2022), resistance to change (Li et al., 2017), skill gaps and training needs (Foroudi et al., 2017), integration and compatibility issues (Corr et al., 2017), data security and privacy concerns (Bond & Houston, 2003), and regulatory and legal complexities (Distanont & Khongmalai, 2022).

The cited literature underscores the complexities associated with overcoming these challenges. Various studies shed light on SMEs and cooperatives' struggles in adapting to new technologies and navigating the transformative process. Adopting digital technology requires technological acumen and organizational changes that extend to leadership, culture, and overall business strategies.

In conclusion, as SMEs and cooperatives continue to explore digital transformation, they encounter multifaceted challenges that impact their ability to harness the full potential of technology. This chapter serves as a comprehensive examination of these challenges, aiming to provide insights for practitioners, policymakers, and researchers into the barriers that must be addressed to facilitate successful technology integration and innovation in the SME and cooperative sectors. By acknowledging and understanding these challenges, stakeholders can work collaboratively to devise strategies

and solutions that pave the way for a more digitally empowered future for these vital components of the global economy.

1.2 Literature Review

1.2.1 Defining SMEs and Cooperatives and Their Role in The Economy

Small and Medium-sized Enterprises (SMEs) and cooperatives play a pivotal role in driving economic growth, innovation, and job creation in both developed and developing economies. SMEs are characterized by their relatively small size, limited resources, and potential for rapid growth. These enterprises encompass diverse industries, from manufacturing to services, and contribute significantly to a country's gross domestic product (GDP) and employment. Cooperatives, on the other hand, are member-owned organizations that operate for the mutual benefit of their members. Principles of democratic decision-making, autonomy, and social responsibility guide them.

SMEs and cooperatives are engines of innovation, often leading the way in adopting new technologies and business practices. In the digital era, adopting digital innovation and technology is crucial for these entities to remain competitive and sustainable. As highlighted in the works of Ahuja and Chan (2021) in their study on digital innovation in small firms in rural Canada and Andjarwati and Wulan (2021) in their research on technology transformation for sustainable Indonesian MSMEs and cooperatives, digitalization has become an essential strategy for SMEs and cooperatives to streamline operations, expand market reach, and enhance customer engagement.

Digital transformation involves the integration of digital technologies into all aspects of an organization's operations, leading to fundamental changes in how to conduct business. It holds the potential to bridge the gap between SMEs and larger enterprises, enabling them to access new markets and leverage data-driven insights for better decision-making. Anim-Yeboah et al. (2020) emphasize the implications of the digital transformation process on the capability and capacity of SMEs, underscoring the importance of adapting to new technologies to remain competitive.

However, the adoption of digital technologies in SMEs and cooperatives has challenges. Factors such as a lack of resources, limited technological expertise, and resistance to change can hinder the successful implementation of digital initiatives (Arsalan et al., 2022). Additionally, barriers like organizational culture, regulatory constraints, and financial constraints have been identified as obstacles that SMEs face when trying to match new technologies with market opportunities (Bond & Houston, 2003).

Research has shown that government policies, IT capabilities, and collaboration within the SME ecosystem can significantly influence the success of digital transformation initiatives (Mai et al., 2023; Marmaridis & Unhelkar, 2011). Moreover, leadership, entrepreneurship, and developing digital skills within SMEs are critical in ensuring effective digital adoption and transformation (Fanelli, 2021; Foroudi et al., 2017).

In conclusion, SMEs and cooperatives play a significant role in driving economic development. Adopting digital technologies is essential for their survival and growth in modern business. While digitalization offers immense opportunities for SMEs and cooperatives, overcoming resources, skills, and organizational culture challenges is crucial for successful implementation. As we explore the extensive literature on this topic, we find a rich tapestry of research highlighting the complexities and opportunities associated with the digital transformation journey of these entities.

1.2.2 Benefits of Digital Technology Adoption for Business Growth and Efficiency

Adopting digital technology has brought numerous benefits for businesses, particularly Small and Medium Enterprises (SMEs), leading to enhanced growth and operational efficiency. According to Ahuja and Chan (2021), incorporating digital innovation in small firms in rural Canada has facilitated access to broader markets, reduced operational costs, and improved overall business performance. Andjarwati and Wulan (2021) emphasized how digitalization has promoted sustainability among Indonesia's Micro, Small, and Medium Enterprises (MSMEs) and cooperatives, enabling them to streamline operations, reach broader audiences, and contribute to economic growth. As highlighted by Anim-Yeboah et al. (2020), the digital transformation process has led to increased

capability and capacity in SMEs, allowing them to adapt more swiftly to market changes, innovate, and provide better customer experiences.

Digital technology adoption has also been linked to improved information and communication technology (ICT) capabilities within SMEs, as discussed by Arsalan Nazir and Saleem Khan (2022). This, in turn, has resulted in enhanced communication, collaboration, and knowledge sharing among employees and stakeholders, fostering greater operational efficiency and innovation. Azevedo and Almeida (2021) pointed out that embracing digital transition through training courses can empower decision-makers within SMEs, enabling them to leverage digital tools for operational excellence and strategic growth effectively.

In addition to the internal benefits, digital technology adoption has opened up new avenues for market expansion and customer engagement. Bond and Houston (2003) identified that overcoming barriers to adopting new technologies can lead to increased market opportunities and improved competitiveness. Burke (2010) highlighted how SMEs in the agribusiness sector have harnessed the power of the Internet and ICT to access broader markets, connect directly with customers, and improve supply chain management. Adopting new digital technologies has enabled SMEs to enhance their relationships with customers and partners, leading to increased brand loyalty and overall growth (Foroudi et al., 2017).

Furthermore, the digitalization of manufacturing processes, often called Industry 4.0, has revolutionized the operational efficiency of manufacturing SMEs. Ghobakhloo et al. (2022) conducted a systematic review and transformation roadmap, revealing that embracing Industry 4.0 technologies results in improved production processes, reduced lead times, enhanced quality control, and better resource utilization. These technological advancements have also been linked to environmental sustainability, as firms can minimize waste and optimize resource consumption (Molinillo & Japutra, 2017).

Government policies play a crucial role in encouraging digital technology adoption among SMEs. Mai et al. (2023) emphasized that supportive policies can incentivize SMEs to invest in digital transformation, resulting in improved innovativeness and resilience, especially in post-COVID contexts. The alignment of digital technology adoption with sustainability goals is another aspect that deserves attention. Šimberová et al. (2022) explored how digital transformation strategies can lead to sustainable development, highlighting the need for SMEs to integrate environmental and social considerations into their digital initiatives.

In conclusion, SMEs' adoption of digital technology offers many benefits, ranging from improved operational efficiency and market expansion to enhanced customer engagement and environmental sustainability. This transformational shift has the potential to revolutionize the way SMEs conduct business, leading to increased competitiveness, growth, and overall success.

1.2.3 Increasing Trend of Technology Adoption among SMEs and Cooperatives

In recent years, there has been a notable increase in the adoption of digital technologies among Small and Medium Enterprises (SMEs) and cooperatives. This trend has been widely studied and documented, shedding light on the factors, implications, and challenges associated with this transition. Ahuja and Chan (2021) explore the digital innovation landscape in small firms located in rural areas of Canada. Their research delves into the impact of digitalization on entrepreneurial activities in such contexts, highlighting the unique challenges and opportunities presented by the digital era (Ahuja & Chan, 2021).

Similarly, Andjarwati and Wulan (2021) focus on the transformation of technology and its role in promoting sustainability within Indonesian SMEs and cooperatives. Their work underscores the significance of digitalization in fostering sustainable growth and development in emerging economies (Andjarwati & Wulan, 2021).

The concept of digital transformation is a central theme in the literature. Anim-Yeboah et al. (2020) delve into the digital transformation process within SMEs, exploring its implications for their capabilities and capacities. Their research highlights how digitalization can reshape the fundamental aspects of these enterprises and discusses the challenges and opportunities inherent in this transformative journey (Anim-Yeboah et al., 2020).

Ardjouman (2014) takes a broader perspective by examining factors influencing technology adoption among SMEs, specifically in Cote d'Ivoire. This study identifies various barriers and enablers that impact the decision-making process of SMEs in adopting and utilizing technology. The findings contribute to a deeper understanding of the complex interplay between organizational, environmental, and technological factors (Ardjouman, 2014).

From a different regional perspective, Arsalan Nazir and Saleem Khan (2022) investigate the impact of information and communication technology (ICT) adoption on Pakistani SMEs. They analyze the factors affecting the adoption process and how this adoption translates into tangible outcomes. This study provides insights into SMEs' challenges in adopting ICT and sheds light on the factors that facilitate or hinder successful implementation (Arsalan et al., 2022).

The challenges of digital transition are also explored by Azevedo and Almeida (2021), who offer a training course aimed at equipping decision-makers in SMEs with the knowledge and skills to navigate the complexities of digital transformation. This study recognizes that digitalization goes beyond technology and necessitates changes in organizational practices and culture (Azevedo & Almeida, 2021).

Barriers to technology adoption within SMEs have been a recurring theme. Bond and Houston (2003) discuss barriers established firms face in matching new technologies with market opportunities. Their research emphasizes the importance of aligning technological investments with business strategies to overcome these barriers (Bond & Houston, 2003).

Furthermore, the role of digital technology adoption in specific industries is explored. Burke (2010) focuses on the impact of Internet and ICT use among agribusiness SMEs and producers. This study uncovers how technology adoption influences business operations and relationships within the agricultural sector (Burke, 2010). Corr, Pejcic, and Volpe (2017) delve into the enabling factors that drive the adoption of new digital technologies in manufacturing firms. Their research provides insights into the factors that encourage firms to embrace digitalization and discusses the role of organizational characteristics and external support in this process (Corr et al., 2017).

Distanont and Khongmalai (2022) contribute to the discourse by examining the adoption of digital technology in SMEs. Their study emphasizes the importance of aligning technology adoption with organizational strategies and explores the factors influencing this alignment (Distanont & Khongmalai, 2022). The notion of barriers is revisited by Fanelli (2021), who focuses on barriers to adopting new technologies within rural SMEs. The study identifies challenges SMEs face in rural settings and highlights the importance of addressing these barriers to facilitate technology adoption (Fanelli, 2021).

Foroudi et al. (2017) approach the topic from a marketing management perspective. Their research explores the relationship between digital technology and marketing management capability, emphasizing how technology integration can contribute to SMEs' growth (Foroudi et al.,

2017). Furjan, Tomičić-Pupek, and Pihir (2020) delve into digital transformation initiatives through case study analysis. Examining various cases provides insights into the motivations, challenges, and outcomes of digital transformation efforts within different SMEs (Furjan et al., 2020).

Ghobakhloo et al. (2022) explored the role of Industry 4.0 technologies and systematically reviewed the drivers and barriers of Industry 4.0 technology adoption among manufacturing SMEs. This study outlines the landscape of Industry 4.0 adoption and provides a transformation roadmap for manufacturing SMEs (Ghobakhloo et al., 2022).

The Indian context is the focus of Sridevi et al. (2019) as they investigate the adoption of information technology among Indian SMEs. This study contributes to understanding technology adoption within a specific regional context and discusses the challenges faced by Indian SMEs (Sridevi et al., 2019). Li et al. (2017) presented a capability perspective on digital transformation by SME entrepreneurs. Their study emphasizes the role of entrepreneurs' capabilities in driving digital transformation efforts and highlights the dynamic interplay between individual and organizational factors (Li et al., 2017).

The Malaysian context is explored by Low, Hengky Latan, and Charbel J Chiappetta Jabbour (2021), who investigate digitalization adoption among Malaysian SMEs. This study uncovers the drivers of digitalization adoption and underscores the industry-based heterogeneity in technology adoption (Low et al., 2021).

Mai et al. (2023) shifted the focus to government policy, IT capabilities, and digital transformation in the post-COVID context of Vietnamese SMEs. This study highlights the role of external and internal factors in shaping the digital transformation landscape for SMEs (Mai et al., 2023). Miharja and Muhammad (2023) present a case study on the digital transformation strategy of SMEs in the Borondong Industry. Their research provides insights into the practical implementation of digital transformation initiatives and the impact on SMEs' development (Miharja & Muhammad, 2023).

Marmaridis and Unhelkar (2011) explore collaboration's role in technology adoption. Their study focuses on the role of collaboration in enabling SMEs to implement green ICT. This research underscores the importance of collaborative efforts in driving technological change (Marmaridis & Unhelkar, 2011). Martin and Matlay (2001) discuss the ladder adoption model, which examines the promotion of ICT in small firms. Their study offers lessons from the DTI ladder adoption model and emphasizes the need for tailored approaches to promoting ICT within SMEs (Martin & Matlay, 2001).

Technology acceptance and usage are investigated by Mayowa et al. (2017), who explore how technology adoption catalyzes better performance in 21st-century Nigerians.

SMEs. This study demonstrates the role of technology as a catalyst for enhancing SME performance (Mayowa et al., 2017).

The role of government policy and digital ecosystems in enhancing digital transformation for SMEs is discussed by Nurhidayati (2020). This study emphasizes the role of knowledge management capability and the digital ecosystem in shaping the digital transformation landscape for SMEs (Nurhidayati, 2020).

The barriers to ICT adoption in SMEs are explored by Ongori (2008), who offers evidence from a developing country perspective. This research highlights the challenges SMEs in developing countries face in adopting ICT and discusses the implications for their growth (Ongori, 2008). Philbin, Viswanathan, and Telukdarie (2022) contribute to the literature by conducting a systematic literature review on how digital transformation can enable SMEs to achieve sustainable development. This study offers insights into the role of digital transformation in fostering sustainability within SMEs (Philbin et al., 2022).

The role of collaboration in enabling digital transformation is revisited by Ritchie and Brindley (2005), who explore the implications of ICT adoption for relationships and management within SMEs. Their study emphasizes the importance of collaboration in driving successful technology adoption (Ritchie & Brindley, 2005).

Shahadat et al. (2023) focus on technological, environmental, and organizational factors that influence digital technology adoption in emerging countries. This study uncovers the multifaceted nature of technology adoption and its implications for SMEs in emerging economies (Shahadat et al., 2023).

The intersection of digital transformation and sustainability is explored by Šimberová et al. (2022), who presents a case study analysis of SMEs in the Czech Republic. This research highlights the threats and opportunities associated with digital transformation from a sustainability perspective (Šimberová et al., 2022).

Slamet et al. (2017) contribute insights from the Indonesian context, discussing strategies for developing digital SMEs in the face of evolving markets. This study offers a perspective on the challenges and strategies for SMEs operating in a rapidly changing market landscape (Slamet et al., 2017).

The role of cooperative organizations in digital technologies is examined by Sobolev et al. (2020), who emphasize the significance of

cooperatives in fostering digital technology adoption. This study highlights the cooperative model as a catalyst for technology adoption within SMEs (Sobolev et al., 2020). Steyn and Leonard (2012) present a conceptual framework for guiding SMEs in adopting technology. Their research offers a practical approach to navigating the challenges of technology adoption, providing SMEs with a structured roadmap (Steyn & Leonard, 2012).

The concept of a digital transformation model for SMEs is explored by Szopa and Cyplik (2020). This study delves into the components of a digital transformation model, providing a comprehensive framework for SMEs to embark on their digital journey (Szopa & Cyplik, 2020). Venkatesh and Jakka (2023) provide insights into digital recruitment technology implementation in Indian companies. This research explores the practical implementation of digital recruitment technologies and discusses their impact on talent acquisition (Venkatesh & Jakka, 2023).

The role of entrepreneurial orientation in moderating the relationship between digital technology adoption and sustainability is investigated by Vrontis, Chaudhuri, and Chatterjee (2022). Their study underscores the importance of aligning digital technology adoption with sustainability goals (Vrontis et al., 2022).

Wielicki and Arendt (2010) revisit barriers to ICT adoption among SMEs, comparing the perceptions of US and European SMEs. This study provides insights into the evolving perception of ICT adoption barriers and discusses the regional variations in these perceptions (Wielicki & Arendt, 2010). Zairis (2020) and Zairis (2021) contribute to the discourse by examining SMEs' effective use of digital technology. Their research explores the strategies and practices that enable SMEs to leverage digital technologies effectively, offering insights into successful digital transformation efforts (Zairis, 2020; Zairis, 2021).

The role of digital transformation in SMEs is reviewed by Zamani (2022), who conducts a systematic literature review on adopting technologies in SMEs. This study provides an overview of the current research state and highlights the literature's themes and trends (Zamani, 2022).

1.2.4 Conclusion

The extensive exploration of literature underscores the increasing trend of technology adoption among SMEs and cooperatives. Various studies have shed light on this transition's factors, implications, and challenges. From understanding the unique challenges rural SMEs face to examining the role

of collaboration and sustainability, the literature offers a multifaceted perspective on the evolving landscape of digital transformation. As SMEs embrace technology, further research will be crucial to staying attuned to this arena's dynamic changes and developments.

1.3 Challenges in Implementing Digital Technology

1.3.1 Resource Limitations: Financial Constraints and Limited Human Resources Hindering Technology Adoption

In small and medium enterprises (SMEs), adopting new technologies frequently encounters significant barriers due to financial constraints and limited human resources. These challenges hinder the swift integration of digital innovations into the operations of SMEs, hampering their ability to stay competitive in the rapidly evolving digital era.

- *Financial Constraints*: SMEs, by nature, have constrained budgets compared to larger enterprises, making it difficult to allocate sufficient funds for technology adoption. The financial burden of investing in new hardware, software, and training can be overwhelming, particularly for those SMEs operating in rural or economically disadvantaged areas. The study by Ahuja and Chan (2021) highlights how rural Canadian SMEs face financial limitations that impede their ability to embrace digital innovation (Ahuja & Chan, 2021). This study aligns with findings from research conducted in Indonesia, revealing that MSMEs need more financial resources when undertaking digital transformations (Andjarwati & Wulan, 2021). Furthermore, Ardjouman (2014) sheds light on the impact of financial constraints on SMEs in Cote d'Ivoire, impeding their adoption and utilization of technology (Ardjouman, 2014).
- *Limited Human Resources*: Another crucial factor is the scarcity of skilled personnel within SMEs who can effectively implement and manage new technologies. The shortage of IT experts and professionals capable of driving digital transformations poses a considerable challenge. Anim-Yeboah et al. (2020) emphasize that SMEs need more human resources with the required capabilities and capacities to ensure SMEs' successful transition to digital platforms

(Anim-Yeboah et al., 2020). This shortage of skilled human capital is echoed in studies examining SMEs' adoption of information and communication technology in Pakistan and other countries (Arsalan et al., 2022; Mayowa et al., 2017).

- *A Multifaceted Challenge*: The interplay between financial constraints and limited human resources creates a multifaceted challenge for SMEs seeking to embrace digital innovations. As Azevedo and Almeida (2021) highlight, SME decision-makers often grapple with the challenge of allocating funds for digital transition while also addressing the skills gap within their organizations (Azevedo & Almeida, 2021). This dilemma is further compounded by the findings of Corr, Pejcic, and Volpe (2017), who reveal that firms' inability to attract skilled personnel can hinder the successful adoption of new digital technologies (Corr et al., 2017).

In conclusion, the confluence of financial constraints and limited human resources poses significant obstacles to SMEs' aim to adopt new technologies. This phenomenon is evident across various geographical contexts and industries, from rural Canada to Indonesia and beyond. To overcome these challenges, SMEs need targeted support, including access to affordable financing options, training programs, and collaborations with industry partners, as suggested by various studies in the field.

1.3.1.1 The Impact of Resource Limitations on Technology Implementation

Exploring the impact of resource limitations on technology implementation has been the subject of significant research in the realm of small and medium-sized enterprises (SMEs). Various studies shed light on how constrained resources can influence the adoption and utilization of digital technologies.

Ahuja and Chan (2021) studied digital innovation in small firms in rural Canada. They found that limited financial resources and access to technology infrastructure hindered the widespread adoption of digital technologies among rural SMEs (Ahuja & Chan, 2021). Andjarwati and Wulan (2021) focused on sustainable technology transformation in Indonesian MSMEs. Their research highlighted that resource constraints, such as financial limitations and inadequate digital skills, hindered these businesses' effective adoption and integration of digital technologies (Andjarwati & Wulan, 2021).

Anim-Yeboah et al. (2020) delved into the digital transformation process and its implications for SMEs. They discovered that resource limitations, including budget constraints and lack of IT expertise, can impede the successful implementation of digital technologies in these enterprises (Anim-Yeboah et al., 2020).

Similarly, Ardjouman (2014) examined technology adoption in SMEs in Cote d'Ivoire and identified resource-related challenges, such as financial constraints and lack of technical knowledge, as significant barriers to technology implementation (Ardjouman, 2014). In a study by Arsalan Nazir and Saleem Khan (2022) in Pakistan, they found that resource limitations, including inadequate financial resources and lack of IT skills, hindered the adoption of information and communication technologies by SMEs (Arsalan et al., 2022).

Azevedo and Almeida (2021) offered insights into the challenge of digital transition in SMEs. They highlighted that limited financial resources and inadequate training can hinder SMEs' ability to embrace digital technologies effectively (Azevedo & Almeida, 2021). Bond and Houston (2003) explored barriers to adopting new technologies in established firms. Resource constraints, such as limited budgets for technology investment, were identified as critical obstacles SMEs face (Bond & Houston, 2003).

Corr, Pejcic, and Volpe (2017) empirically investigated firms' adoption of new digital technologies. They found that resource availability, including financial resources, influenced the firms' ability to adopt and integrate digital technologies (Corr et al., 2017). Distanont and Khongmalai (2022) investigated the adoption of digital technology in SMEs. They revealed that resource limitations, such as financial constraints and lack of technical expertise, were significant factors affecting the pace of technology adoption (Distanont & Khongmalai, 2022).

Fanelli (2021) studied barriers to adopting new technologies within rural SMEs. Limited financial resources and lack of IT knowledge were identified as key challenges in technology implementation among these enterprises (Fanelli, 2021). Foroudi et al. (2017) explored the relationship between digital technology and marketing management capability in SMEs. They highlighted that resource constraints, including financial limitations, influenced the extent to which SMEs could leverage digital technologies for marketing (Foroudi et al., 2017). Furjan, Tomičić-Pupek, and Pihir (2020) analyzed digital transformation initiatives and resource limitations in SMEs. They found that inadequate resources, such as budget

constraints, hindered the full-scale implementation of digital transformation initiatives (Furjan et al., 2020).

These studies collectively underline the significant impact of resource limitations, including financial constraints and lack of technical expertise, on the adoption and implementation of digital technologies among SMEs. It is evident that overcoming these challenges is crucial for SMEs to fully embrace digital innovation's benefits.

1.3.2 Access to Technology Infrastructure

1.3.2.1 Addressing the Digital Divide for SMEs and Cooperatives

The digital divide, characterized by unequal access to technology infrastructure and digital resources, has substantial implications for small and medium-sized enterprises (SMEs) and cooperatives. This divide, both within and between countries, presents challenges and opportunities that influence their adoption of digital technologies. According to Ahuja and Chan (2021), SMEs in rural areas of Canada face barriers due to limited access to reliable internet connections and technology infrastructure. Similarly, Andjarwati and Wulan (2021) highlight the significance of technology transformation in promoting sustainable SMEs and cooperatives in Indonesia. This transformation is vital for enhancing their competitiveness in the digital era.

The digital divide can hinder SMEs' digital transformation processes, impacting their capability and capacity to adopt and leverage digital technologies (Anim-Yeboah et al., 2020). Ardjouman (2014) emphasizes that technological adoption by SMEs in regions like Cote d'Ivoire is influenced by multiple factors, including access to technology resources. Furthermore, Arsalan Nazir and Saleem Khan (2022) examine the impact of the adoption of information and communication technology on SMEs in Pakistan, indicating the need to address infrastructure-related barriers.

Globally, the digital divide is a multi-dimensional challenge. A study by Azevedo and Almeida (2021) highlights the necessity for targeted training courses to enable decision-makers in SMEs to embrace digital transition effectively. The lack of access to technology infrastructure can act as a barrier, preventing SMEs from aligning new technologies with market opportunities (Bond & Houston, 2003).

In the context of cooperatives, the digital divide poses similar challenges. Montegut-Salla, Cristóbal-Fransí, and Gómez-Adillón (2013)

stress that ICT adoption in agricultural cooperatives requires an understanding of the factors influencing adoption. These cooperatives often struggle with access to technology infrastructure, impacting their ability to fully harness the benefits of digitalization.

The implications of the digital divide extend beyond technological challenges; it affects innovation, growth, and competitiveness. Mihardja and Muhammad (2023) note that SMEs' digital transformation strategies in sectors like the Borondong Industry must address infrastructure limitations to ensure effective implementation. Moreover, digital transformation initiatives among SMEs must consider the role of the digital divide in shaping their sustainability and value-creation efforts (Vrontis et al., 2022).

Addressing the digital divide requires collaborative efforts at the policy level and through industry initiatives. Initiatives such as government policies, training programs, and collaboration with technology providers can be crucial in bridging the gap (Mai et al., 2023; Molinillo & Japutra, 2017). Shahadat et al. (2023) stress that technological, environmental, and organizational factors influence digital technology adoption in emerging economies, underscoring the need for holistic approaches.

In conclusion, the digital divide significantly impacts SMEs and cooperatives, shaping their adoption of digital technologies and their potential for growth and innovation. Addressing this divide requires targeted interventions to improve access to technology infrastructure and build digital capabilities. Bridging the digital divide is essential for these entities to thrive in the increasingly digital landscape.

1.3.2.2 Exploring Disparities

Access to necessary technological infrastructure is a critical factor influencing the digital transformation of small and medium enterprises (SMEs). Disparities in access to such infrastructure can significantly impact the adoption and utilization of digital technologies, affecting SMEs' competitiveness and growth potential. Various studies shed light on these disparities and their implications.

Ahuja and Chan (2021) highlight the challenges small firms face in rural Canada in adopting digital innovations due to limited access to robust technology infrastructure (Ahuja & Chan, 2021). Similarly, Andjarwati and Wulan (2021) discuss how technology transformation in sustainable Indonesian SMEs is hindered by inadequate access to digital infrastructure (Andjarwati & Wulan, 2021). Anim-Yeboah et al. (2020) emphasize the capacity implications for SMEs during their digital transformation process,

revealing that lack of access to technological infrastructure can hinder capability development (Anim-Yeboah et al., 2020).

In a broader context, Ardjouman (2014) explores factors influencing technology adoption in SMEs in Cote d'Ivoire, highlighting infrastructure-related challenges (Ardjouman, 2014). Nazir and Khan (2022) provide insights from Pakistan, underlining the impact of information and communication technology adoption in SMEs and the factors affecting it (Nazir & Khan, 2022). Azevedo and Almeida (2021) emphasize the need for SMEs to grasp the challenges of digital transition, focusing on decision-makers and their engagement with technology infrastructure (Azevedo & Almeida, 2021).

Furthermore, Bond and Houston (2003) discuss barriers established firms face in matching new technologies with market opportunities, often related to technological infrastructure constraints (Bond & Houston, 2003). Distanont and Khongmalai (2022) analyze the adoption of digital technology in SMEs, identifying the role of access to technology infrastructure as a crucial determinant (Distanont & Khongmalai, 2022). Ghobakhloo et al. (2022) provide a systematic review of Industry 4.0 technology adoption, highlighting the role of technology infrastructure access as both a driver and a barrier (Ghobakhloo et al., 2022).

Li et al. (2017) presented a capability perspective on digital transformation by SME entrepreneurs, stressing the importance of technology infrastructure as an enabler (Li et al., 2017). Philbin et al. (2022) underscore the potential of digital transformation to enable SMEs to achieve sustainable development, with technology infrastructure as a critical consideration (Philbin et al., 2022). Zairis (2020, 2021) discusses SMEs' effective use of digital technology, addressing the significance of technology infrastructure in facilitating successful adoption (Zairis, 2020, 2021).

These studies collectively emphasize that disparities in access to technology infrastructure pose challenges for SMEs in their digital transformation journey. Addressing these disparities is crucial for enabling SMEs to harness the full potential of digital technologies, enhance their capabilities, and achieve sustainable growth.

1.3.3 Resistance to Change

1.3.3.1 Detailing the Reluctance to Shift from Traditional Practices to Digital Methods

Resistance to Change in Shifting to Digital Methods among Small and Medium Enterprises (SMEs) has been a significant challenge, particularly in the context of rural and developing regions. The reluctance to embrace digital innovation stems from factors inhibiting the transition from traditional practices to modern digital methods.

Ahuja and Chan (2021) shed light on this issue in their study of Digital Innovation in Small Firms in Rural Canada. They discuss how SMEs in rural areas often face barriers such as a lack of digital infrastructure, limited technological literacy, and inadequate resources, contributing to their resistance to adopting digital practices (Ahuja & Chan, 2021, pp. 60–79). Similarly, Andjarwati and Wulan (2021) highlight how Sustainable Indonesia MSMEs and Cooperatives encounter challenges in adopting digitalization due to resource constraints, lack of awareness, and fear of technological complexity (Andjarwati & Wulan, 2021).

Anim-Yeboah et al. (2020) emphasize the implications of digital transformation processes on the capabilities and capacities of SMEs. They point out that resistance often arises due to concerns over workforce skills mismatch, operational disruptions, and uncertainty about returns on technology investments (Anim-Yeboah et al., 2020, pp. 26–44). Ardjouman (2014) explores factors influencing technology adoption in SMEs in Cote d'Ivoire and underscores how the lack of financial resources, limited IT expertise, and perceived risks contribute to resistance (Ardjouman, 2014).

Nazir and Khan (2022) offer insights into Pakistan's SME landscape and highlight how factors like perceived complexity, cost, and concerns about data security create reluctance towards adopting Information and Communication Technology (ICT) (Nazir & Khan, 2022, pp. 20–46). Azevedo and Almeida (2021) discuss a training course aimed at helping SME decision-makers address the challenges of digital transition. This finding suggests that a lack of understanding and skills can contribute to resistance (Azevedo & Almeida, 2021, p. 151).

Bond and Houston (2003) delve into established firms and identify organizational inertia and aversion to change as critical barriers to adopting new technologies (Bond & Houston, 2003, pp. 120–135). Distanont and Khongmalai (2022) explore the adoption of digital technology in SMEs and highlight how resistance may stem from the perceived incompatibility

of digital solutions with existing processes and concerns about potential disruptions (Distanont & Khongmalai, 2022, pp. 141–146).

Fanelli (2021) focuses on rural SMEs and outlines how resistance can be attributed to factors like lack of technology-related knowledge, limited financial resources, and fear of negative impact on business operations (Fanelli, 2021). The study by Foroudi et al. (2017) emphasizes that limited digital marketing knowledge and skills hinder SMEs' adoption of new technologies (Foroudi et al., 2017, pp. 230-246). Moreover, Ongori (2008) examines ICT adoption barriers in SMEs from a developing country perspective, highlighting factors such as lack of awareness, skills, and financial resources (Ongori, 2008).

In conclusion, the resistance to shifting from traditional practices to digital methods among SMEs is multifaceted. Factors such as limited resources, lack of digital infrastructure, perceived complexity, and concerns about operational disruptions contribute to this resistance. Addressing these challenges and providing targeted support can be crucial in facilitating a smoother transition towards digital innovation.

1.3.3.2 Challenges in Overcoming Resistance to Change within Small and Medium-Sized Enterprises (SMEs) During Digital Innovation Adoption

In today's rapidly evolving business landscape, SMEs are presented with opportunities to transform their operations through digital technologies, such as digitalization, Industry 4.0, and digital transformation initiatives. However, embracing these changes frequently encounters resistance from various quarters.

Several case studies shed light on these challenges. For instance, Ahuja and Chan (2021) delve into the resistance faced by small firms in rural Canada when adopting digital innovation (Ahuja & Chan, 2021). Similarly, Andjarwati and Wulan (2021) highlight the resistance that Indonesia's MSMEs encounter while undergoing technology transformation via digitalization (Andjarwati & Wulan, 2021). Anim-Yeboah et al. (2020) explore SMEs' capability and capacity implications during the digital transformation process (Anim-Yeboah et al., 2020). These studies provide valuable insights into the factors that hinder the successful implementation of digital technologies.

Resistance to change can stem from multiple factors. Organizational culture, lack of technological readiness, and concerns about the unknown consequences of digitalization can all contribute to resistance. For

example, Azevedo and Almeida (2021) suggest that a lack of preparedness and familiarity with digital transition can create barriers in SMEs (Azevedo & Almeida, 2021). Shahadat et al. (2023) investigate the influence of technological, environmental, and organizational factors on digital technology adoption in emerging countries (Shahadat et al., 2023).

Moreover, issues like resource constraints and the need for upskilling can exacerbate resistance. Miharja and Muhammad (2023) discuss the digital transformation strategy of SMEs, emphasizing the challenges they face in adapting Borondong Industry to the digital era (Miharja & Muhammad, 2023). These challenges often require a comprehensive approach involving technological changes and the development of new skills and competencies among employees.

Interestingly, some studies explore the role of government policies and external support in mitigating resistance. Mai et al. (2023) investigated the impact of government policies and IT capabilities on digital transformation in Vietnamese SMEs (Mai et al., 2023). This finding suggests that a conducive policy environment and external assistance can play a crucial role in facilitating technology adoption.

These case studies and analyses underline the complex interplay of factors contributing to resistance to change in SMEs' digital innovation journeys. It is essential for SMEs to recognize these challenges and implement strategies that address both technical and human-related obstacles to ensure successful digital transformation.

1.3.4 Skill Gaps and Training Needs

1.3.4.1 Explaining the Skills Required for Effective Technology Utilization

The skills required for effective technology utilization in small and medium enterprises (SMEs) have gained significant attention in recent research. In digital innovation and transformation, several studies highlight vital skills that enable SMEs to harness technology for competitive advantage. A diverse range of skills is necessary to navigate the complexities of technological adoption and integration. These skills are essential for SMEs to effectively leverage digital tools and strategies to enhance their business operations, customer engagement, and overall performance.

Firstly, a solid foundation in digital literacy is imperative. SMEs need employees proficient in using digital tools and platforms, capable of

understanding and utilizing various software applications, and adept at adapting to new technologies. Digital literacy encompasses basic computer proficiency, navigating online interfaces, and using digital communication tools effectively.

Secondly, data analysis and interpretation skills are vital. SMEs should be able to collect, analyze, and interpret data to make informed decisions. This action involves understanding key performance indicators, conducting data-driven assessments, and using data analytics tools to gain insights into customer behavior, market trends, and operational efficiency.

Thirdly, strong cybersecurity skills are crucial. As SMEs increasingly rely on digital platforms and data storage, the ability to ensure the security of sensitive information is paramount. Employees should be trained in cybersecurity best practices to prevent data breaches, protect customer information, and safeguard the business against cyber threats.

Furthermore, practical project management skills are essential for implementing digital initiatives. SMEs need professionals who can plan, execute, and monitor technology projects, ensuring they are completed on time and within budget. Project management skills involve resource allocation, risk assessment, and effective communication to ensure successful technology integration.

In addition, SMEs must possess strong communication and collaboration skills. Communicating effectively with technical and non-technical stakeholders is crucial for conveying ideas, addressing challenges, and fostering a collaborative environment that supports technology adoption and innovation.

Creativity and problem-solving skills play a significant role in identifying opportunities for technological improvement within SMEs. Employees should be encouraged to think creatively, adapt to changing circumstances, and develop innovative solutions to challenges during digital transformation.

Furthermore, continuous learning and adaptability are essential in the fast-paced digital landscape. SMEs need employees open to learning about new technologies, staying updated on industry trends, and adapting their skills to keep pace with technological advancements.

Lastly, strategic thinking and business acumen are critical for aligning technology utilization with overall business objectives. SMEs should have individuals who can strategically assess how technology can contribute to the company's growth, competitive advantage, and long-term sustainability.

In conclusion, SMEs aiming to utilize technology for innovation and growth effectively require a combination of digital literacy, data analysis,

cybersecurity, project management, communication, collaboration, creativity, problem-solving, continuous learning, adaptability, and strategic thinking skills. These skills empower SMEs to navigate the challenges and opportunities presented by digital transformation, ultimately contributing to their success in the digital era.

1.3.4.2 Discussing How Skill Gaps Among Employees Pose Obstacles to Technology Implementation

Skill gaps among employees can significantly hinder the successful implementation of technology within organizations. This challenge has been widely studied in the context of small and medium-sized enterprises (SMEs) across different regions. Research by Ahuja and Chan (2021), Andjarwati and Wulan (2021), Anim-Yeboah et al. (2020), Ardjouman (2014), and Arsalan Nazir and Saleem Khan (2022) emphasized that SMEs often face barriers related to insufficient technical and non-technical skill sets needed for adopting and effectively utilizing digital technologies. These skill gaps can arise due to a lack of training, inadequate education, or even employee resistance to change.

Studies by Azevedo and Almeida (2021), Bond and Houston (2003), Burke (2010), and Corr et al. (2017) highlight the significance of providing relevant training to address these skill gaps. SMEs need training programs catering to decision-makers and employees alike, fostering a comprehensive understanding of the adopted technologies. However, the effectiveness of training programs can vary, as explored in the research by Distanont and Khongmalai (2022), Fanelli (2021), and Foroudi et al. (2017), underscoring the need for tailored approaches that consider the specific requirements and learning preferences of different employees.

Moreover, the cultural and contextual factors influencing technology adoption within SMEs have been examined in research by Furjan et al. (2020), Ghobakhloo et al. (2022), Sridevi et al. (2019), Li et al. (2017), and Low et al. (2021). These studies stress the importance of recognizing the socio-economic, organizational, and regional differences that affect skill development and technology integration. Localized strategies that account for these variations can help bridge skill gaps effectively.

The role of government policies and industry-specific regulations in shaping skill development and technology adoption is highlighted in the works of Mai et al. (2023) and Miharja and Muhammad (2023). Collaborative efforts between governments, educational institutions, and industries can play a crucial role in providing training and upskilling opportunities that target the specific needs of SMEs.

Furthermore, organizational factors such as leadership commitment, communication, and employee engagement impact the success of technology implementation. Shahadat et al. (2023), Šimberová et al. (2022), Steyn and Leonard (2012), and Zairis (2020) delve into how leadership support and a culture of continuous learning can mitigate skill gaps and foster a more tech-savvy workforce.

In conclusion, the literature underscores that addressing skill gaps is pivotal for SMEs to overcome obstacles in technology implementation. By offering tailored training programs, considering contextual factors, and promoting a supportive organizational culture, SMEs can effectively empower their employees to embrace and leverage digital technologies.

1.3.4.3 Providing Examples of Training Programs aimed at Bridging These Gaps

In recent years, integrating digital technologies and innovation has become crucial for the growth and competitiveness of Small and Medium Enterprises (SMEs) in various sectors. Several studies have explored SMEs' skill gaps and training needs to navigate digital transformation successfully. For instance, Ahuja and Chan (2021) examined digital innovation in small firms within rural Canada, shedding light on the challenges and opportunities faced by these enterprises. Similarly, Andjarwati and Wulan (2021) focused on promoting sustainable Indonesian MSMEs and cooperatives through digitalization, emphasizing the transformative potential of technology in emerging markets.

Anim-Yeboah et al. (2020) delved into the digital transformation process and its implications for the capabilities and capacities of SMEs. Their research underscores the need for tailored training programs to equip SMEs with the skills to harness digital technologies effectively. Ardjouman (2014) explored factors influencing technology adoption among SMEs in Cote d'Ivoire, providing insights into the barriers that training programs should address.

As technological adoption varies across countries, Arsalan Nazir and Saleem Khan (2022) examined the impact of information and communication technology adoption in Pakistani SMEs, offering valuable insights for training initiatives in specific regions. Azevedo and Almeida (2021) developed a training course aimed at decision-makers in SMEs, focusing on the challenges and opportunities of digital transition.

Furthermore, various studies emphasize the significance of training programs in addressing skill gaps. Foroudi et al. (2017) linked digital technology and marketing management capability to SME growth,

suggesting that targeted training can foster digital readiness. Li et al. (2017) explored digital transformation from an entrepreneurial perspective, highlighting the importance of training programs to enhance digital capabilities among SME entrepreneurs.

In the context of specific countries, Low, Hengky Latan, and Charbel J Chiappetta Jabbour (2021) examined digitalization adoption among Malaysian SMEs, identifying drivers and industry-based differences. Mai et al. (2023) investigated the role of government policy, IT capabilities, and digital transformation in Vietnamese SMEs, emphasizing the need for training programs aligned with policy frameworks.

It is evident from these studies that addressing skill gaps and offering tailored training programs is essential for SMEs' successful digital transformation. The training initiatives should consider regional contexts, industry-specific challenges, and the diverse needs of decision-makers and entrepreneurs. As SMEs navigate the digital landscape, effective training programs will play a pivotal role in bridging skill gaps and facilitating sustainable growth.

1.3.5 Integration and Compatibility

1.3.5.1 Exploring Difficulties in Integrating New Digital Systems with Existing Processes

Integrating new digital systems into existing processes poses challenges for small and medium-sized enterprises (SMEs). Research by Ahuja and Chan (2021) highlights rural Canadian firms' difficulties during digital innovation, emphasizing the need for compatibility (Ahuja & Chan, 2021). Meanwhile, Andjarwati and Wulan (2021) explore the promotion of sustainable Indonesian SMEs through digitalization (Andjarwati & Wulan, 2021).

In digital transformation, Anim-Yeboah et al. (2020) investigate the capacity implications for SMEs (Anim-Yeboah et al., 2020), while Ardjouman (2014) studies factors influencing technology adoption in Cote d'Ivoire (Ardjouman, 2014). The impact of ICT adoption in Pakistani SMEs is examined by Arsalan Nazir and Saleem Khan (2022) (Arsalan Nazir & Saleem Khan, 2022). Azevedo and Almeida (2021) address the challenge of digital transition with a training course for decision-makers (Azevedo & Almeida, 2021).

Barriers to integrating technologies and market opportunities are discussed by Bond and Houston (2003) (Bond & Houston, 2003). Burke

(2010) explores the internet and ICT use in SME agribusiness (Burke, 2010), and Corr, Pejcic, and Volpe (2017) focus on enabling factors for technology adoption (Corr et al., 2017). Distanont and Khongmalai (2022) delve into adopting digital technology in SMEs (Distanont & Khongmalai, 2022).

Digital technology's impact on rural SMEs is assessed by Fanelli (2021) (Fanelli, 2021), and Foroudi et al. (2017) investigate how digital technology and marketing management capability contribute to SME growth (Foroudi et al., 2017). Furjan et al. (2020) analyze digital transformation initiatives (Furjan et al., 2020), and Ghobakhloo et al. (2022) review Industry 4.0 technology adoption among manufacturing SMEs (Ghobakhloo et al., 2022).

ICT adoption among Indian SMEs is explored. Li et al. (2017) provided a capability perspective on digital transformation by SME entrepreneurs (Li et al., 2017). Low et al. (2021) study digitalization adoption among Malaysian SMEs (Low et al., 2021), while Mai et al. (2023) focused on government policy, IT capabilities, and digital transformation in Vietnamese SMEs (Mai et al., 2023).

Marmaridis and Unhelkar (2011) emphasize collaboration as an enabler for SMEs implementing green ICT (Marmaridis & Unhelkar, 2011), and Martin and Matlay (2001) present lessons from the DTI ladder adoption model in the UK (Martin & Matlay, 2001). Mayowa et al. (2017) examine technology acceptance and usage in Nigerian SMEs (Mayowa et al., 2017), while Miharja and Muhammad (2023) outline a digital transformation strategy for SMEs (Miharja & Muhammad, 2023).

Theoretical reviews on organizational adoption of digital information and technology are provided by Molinillo and Japutra (2017) (Molinillo & Japutra, 2017), and Montegut-Salla et al. (2013) focus on ICT adoption in agricultural cooperatives (Montegut-Salla et al., 2013). Nurhidayati (2020) explores knowledge management capability and the digital ecosystem's role in SME digital transformation (Nurhidayati, 2020), while Ongori (2008) identifies barriers to ICT adoption in SMEs (Ongori, 2008).

Philbin et al. (2022) conducted a systematic literature review on digital transformation's role in SME sustainable development (Philbin et al., 2022). Ritchie and Brindley (2005) discuss ICT adoption's implications for SME relationships and management (Ritchie & Brindley, 2005), and Shahadat et al. (2023) examine factors influencing digital technology adoption in emerging countries (Shahadat et al., 2023).

Šimberová et al. (2022) consider threats and opportunities in digital transformation for SME sustainability (Šimberová et al., 2022), while Slamet et al. (2017) address digital strategy for SMEs in a free-market era

(Slamet et al., 2017). Sobolev et al. (2020) discuss cooperative organizations and digital technologies (Sobolev et al., 2020), and Steyn and Leonard (2012) provide guidance for SMEs in adopting technology (Steyn & Leonard, 2012).

Szopa and Cyplik (2020) propose a digital transformation model for SMEs (Szopa & Cyplik, 2020), and Venkatesh and Jakka (2023) study digital recruitment technology implementation (Venkatesh & Jakka, 2023). Vrontis et al. (2022) analyze digital technology adoption for sustainability and value creation in SMEs (Vrontis et al., 2022), and Wielicki and Arendt (2010) compare ICT implementation barriers in US and European SMEs (Wielicki & Arendt, 2010). Zairis (2020) examines the effective use of digital technology by SMEs (Zairis, 2020), and Zamani (2022) conducts a systematic literature review on technology adoption in SMEs (Zamani, 2022).

1.3.5.2 Discussing the challenges posed by compatibility issues between different technologies

Compatibility issues between different technologies in the context of digital innovation in small firms is a critical aspect of technological integration that often requires careful consideration. The literature provided sheds light on the factors that influence the adoption and use of digital technologies by small and medium enterprises (SMEs). Several themes emerge from the research articles mentioned regarding the challenges and implications of technology compatibility.

One of the critical challenges identified in the literature is the complexity of integrating different technologies within SMEs. The rapid pace of technological advancements means that SMEs must integrate multiple digital tools and platforms to stay competitive. However, ensuring the compatibility of these technologies can take time and effort, as they may have different technical requirements, interfaces, and data formats. This can lead to inefficiencies, data discrepancies, and potential disruptions in business operations.

Furthermore, the issue of resource constraints within SMEs is highlighted as a barrier to effectively addressing compatibility challenges. Limited financial and human resources can hinder the ability of SMEs to invest in advanced technology solutions or hire specialized personnel to manage integration processes. This action can result in suboptimal use of technologies, as SMEs may use legacy systems less compatible with newer tools.

Organizational factors also play a significant role in technology compatibility. The organizational culture and mindset toward technology adoption can influence the willingness to address compatibility challenges. Resistance to change, lack of technology-related skills among employees, and insufficient training programs can impede the successful integration of new technologies.

Moreover, regulatory and environmental factors impacted technology compatibility within SMEs. Adhering to industry standards, data privacy regulations, and cybersecurity requirements can introduce additional complexity to technology integration efforts. SMEs must ensure that their technology solutions comply with relevant regulations, which can further complicate compatibility issues.

Interestingly, the literature suggests that collaboration and knowledge sharing can serve as strategies to mitigate compatibility challenges. SMEs that actively engage in partnerships, knowledge networks, and collaborative projects may find it easier to address compatibility issues by leveraging the expertise of others in the ecosystem.

In conclusion, the literature points out that compatibility challenges between different technologies are a significant concern for SMEs aiming to embrace digital innovation. Addressing these challenges requires a holistic approach considering technical, organizational, financial, and regulatory aspects. By fostering a culture of collaboration and knowledge exchange, SMEs can navigate the complexities of technology compatibility and enhance their digital transformation efforts.

1.3.6 Data Security and Privacy Concerns

1.3.6.1 Highlighting the significance of data security in the digital age

In today's digital age, the significance of data security cannot be overstated, especially in the context of small and medium-sized enterprises (SMEs) embracing digital innovation. As highlighted by various researchers, the adoption of digital technologies is a pivotal driver of growth and success for SMEs, enabling them to compete and thrive in a rapidly changing business landscape (Ahuja & Chan, 2021; Anim-Yeboah et al., 2020; Arsalan et al., 2022). However, along with the benefits of digital transformation come data security and privacy concerns that must be carefully addressed to ensure the sustainable development of these enterprises (Andjarwati & Wulan, 2021; Azevedo & Almeida, 2021).

Numerous studies have explored the barriers and enablers of technology adoption in SMEs, shedding light on the complexities involved (Bond & Houston, 2003; Corr et al., 2017; Ghobakhloo et al., 2022). These barriers can range from organizational challenges to technological factors, and understanding and overcoming them is crucial for successfully implementing digital initiatives. Furthermore, governmental policies and IT capabilities must be considered, particularly in a post-Covid environment where digital transformation and innovativeness are imperative for survival (Mai et al., 2023).

The literature underscores the need for a comprehensive strategy encompassing both the technological aspects and the human and organizational dimensions of digital transformation (Distanont & Khongmalai, 2022; Li et al., 2017). SME entrepreneurs play a central role in driving digital transformation within their organizations, and their capabilities and perspectives are critical to its success (Mayowa et al., 2017; Miharja & Muhammad, 2023). Collaboration and knowledge management also emerge as important factors, emphasizing the interconnectedness of various elements in the journey towards digitalization (Marmaridis & Unhelkar, 2011; Nurhidayati, 2020).

It is important to note that while digitalization offers tremendous opportunities for SMEs, it has challenges. Cybersecurity threats, data breaches, and privacy breaches can have severe consequences, underscoring the urgency of robust data security measures (Ritchie & Brindley, 2005; Shahadat et al., 2023). As SMEs strive to leverage digital technology for sustainable development, adopting a proactive and comprehensive approach to data security becomes paramount.

In conclusion, the digital age has brought unprecedented opportunities for SMEs, intertwined with data security and privacy concerns that must be comprehensively addressed. The literature highlights the multifaceted nature of digital transformation, encompassing technological, organizational, and human aspects. As SMEs navigate this transformative journey, they need to recognize the significance of data security and privacy, adopting measures that enable innovation, safeguard sensitive information, and ensure the long-term viability of their operations.

1.3.6.2 Presenting findings on the concerns of SMEs and Cooperatives regarding data breaches and privacy

Small and Medium Enterprises (SMEs) and cooperatives increasingly embrace digital innovation to stay competitive. However, this transition

comes with many challenges, particularly regarding data security and privacy. The rapid adoption of digital technologies exposes these entities to the risk of data breaches and unauthorized access, which can have severe financial and reputational repercussions.

Numerous studies underscore these concerns. For instance, Ahuja and Chan (2021) highlight the vulnerability of SMEs in rural Canada to digital innovation-related risks. Similarly, Andjarwati and Wulan (2021) emphasized the need for sustainable digitalization among Indonesian SMEs and cooperatives. Such vulnerabilities persist due to factors like limited IT capabilities and resources, as Ardjouman (2014) demonstrated in the context of SMEs in Cote d'Ivoire.

The complexity of data security challenges further intensifies in the age of digital transformation. Research by Ghobakhloo et al. (2022) reviews the drivers and barriers to Industry 4.0 technology adoption among manufacturing SMEs, which includes data security considerations. These concerns are echoed in the study by Shahadat et al. (2023), which delves into the technological, environmental, and organizational factors influencing digital technology adoption in emerging countries.

Several studies also highlight the impact of these challenges on various industries and regions. For instance, the study conducted by Low et al. (2021) focuses on digitalization adoption heterogeneity among Malaysian SMEs. In a different context, the work of Miharja and Muhammad (2023) examines the digital transformation strategy of SMEs in the Borondong Industry. These investigations provide valuable insights into industry-specific data security concerns.

Moreover, it is noteworthy that this issue is not limited to developed countries. Mayowa et al. (2017) explore the catalyst role of technology acceptance and usage in enhancing the performance of 21st-century Nigerian SMEs. The role of government policy and IT capabilities in promoting digital transformation and innovativeness among Vietnamese SMEs is examined by Mai et al. (2023).

In summary, the digital era presents SMEs and cooperatives with numerous growth opportunities and exposes them to data security and privacy concerns. Understanding and addressing these challenges is crucial for their success in a technology-driven environment.

1.3.7 Regulatory and Legal Challenges

1.3.7.1 Explaining how regulatory frameworks and legal complexities impact technology adoption

Regulatory frameworks and legal complexities are pivotal in shaping technology adoption within the business landscape. These factors significantly influence the decisions and strategies of small and medium-sized enterprises (SMEs) when integrating digital innovations into their operations. A comprehensive understanding of these challenges is crucial for SMEs, as it can impact their ability to harness the potential of digital transformation effectively.

One of the critical aspects of regulatory and legal challenges is their potential to either facilitate or impede the adoption of new technologies. Ahuja and Chan (2021) shed light on how these challenges manifest in the context of small firms in rural Canada, emphasizing the need for adaptable strategies to navigate the evolving regulatory landscape. Similarly, Andjarwati and Wulan (2021) highlight the role of technology in promoting sustainability among Indonesian SMEs and cooperatives. They underline the importance of aligning regulatory frameworks with the digitalization goals of SMEs to ensure a conducive environment for technology adoption.

Numerous studies offer insights into the factors that influence SMEs' technology adoption. Ardjouman (2014) explores SMEs' adoption and use of technology in Cote d'Ivoire, pointing out the significance of government policies and support mechanisms in overcoming regulatory barriers. Arsalan Nazir and Saleem Khan (2022) delve into the factors affecting information and communication technology adoption in Pakistani SMEs, highlighting the interplay between legal factors and organizational readiness.

Moreover, regulatory and legal challenges can intersect with other barriers, affecting the overall digital transformation process. Foroudi et al. (2017) emphasize the role of digital technology and marketing management capability in achieving growth for SMEs, indicating the need for a multi-faceted approach to address legal complexities and other obstacles.

It is worth noting that different industries and regions may experience varying degrees of regulatory and legal challenges. Low et al. (2021) discuss the industry-based heterogeneity of digitalization adoption among Malaysian SMEs, further underscoring the importance of context in understanding these challenges.

In conclusion, the adoption of technology by SMEs is intricately linked with the regulatory and legal frameworks in which they operate. Navigating these challenges requires a combination of strategic adaptation, government support, and alignment with broader digital transformation goals. As SMEs strive to harness the benefits of technology, addressing regulatory and legal complexities will continue to be a critical determinant of their success in the digital era.

1.3.7.2 Discussing Examples of Industries Where Stringent Regulations Affect Digital Transformation

In various industries, stringent regulations have posed significant challenges to digital transformation efforts. These regulations impact the adoption of new technologies and digital innovations in ways that can shape the landscape of industries. For instance, in the context of small and medium-sized enterprises (SMEs) in different regions, researchers have explored the effects of regulations on digital transformation.

One notable example is the study by Ahuja and Chan (2021) that focuses on digital innovation in small firms within rural Canada. They analyze how regulatory frameworks influence the ability of these businesses to adopt and implement digital technologies. Similarly, Andjarwati and Wulan (2021) investigated the role of regulations in promoting sustainable digitalization among Indonesian micro, small, and medium enterprises (MSMEs) and cooperatives.

Regulations also impact the digital transformation process for SMEs. Anim-Yeboah et al. (2020) delve into the capability and capacity implications of the digital transformation process for SMEs. They emphasize how regulatory constraints can affect the adoption and integrating of new technologies, ultimately influencing a firm's competitiveness and growth.

Furthermore, regulatory challenges extend to industries in specific countries. Arsalan Nazir and Saleem Khan (2022) explored the impact and factors affecting the adoption of information and communication technology (ICT) in small and medium-sized enterprises (SMEs) in Pakistan, offering insights into the regulatory environment's role.

The influence of regulations is particularly pronounced in the context of Industry 4.0 technologies. Ghobakhloo et al. (2022) systematically reviewed Industry 4.0 technology adoption among manufacturing SMEs, highlighting how stringent regulations can create barriers to adopting advanced manufacturing technologies.

In the Malaysian SME context, Low et al. (2021) delve into the drivers and industry-based heterogeneity of digitalization adoption. They consider the impact of regulations alongside other factors that influence the adoption of digital technologies among Malaysian SMEs.

Government policies and regulations also intersect with digital transformation. Mai et al. (2023) investigated the role of government policy, IT capabilities, and digital transformation in Vietnamese SMEs, especially in the post-COVID context. This research underscores the significance of regulatory environments in facilitating or hindering digital transformation.

As the digital transformation landscape evolves, regulatory challenges remain pivotal. Shahadat et al. (2023) analyze technological, environmental, and organizational factors influencing digital technology adoption in SMEs in emerging countries, highlighting the complex interplay of regulations and other factors.

In conclusion, stringent regulations profoundly impact digital transformation efforts in various industries, particularly among SMEs. The studies mentioned underscore the need to consider regulatory environments when exploring the adoption and integration of digital technologies, and they emphasize the role of regulations in shaping the path of digital transformation in diverse contexts.

1.4. Strategies and Solutions

1.4.1 Presenting Various Approaches that SMEs and Cooperatives Can Adopt to Address the Challenges

Various strategies and solutions that SMEs and Cooperatives can adopt to address the challenges they face in the context of digital innovation and technology adoption. This discussion draws on a range of academic sources from different researchers in the fields of economics, finance, and banking.

- *Digital Transformation and Innovation*: Adopting digital technologies plays a crucial role in the growth and sustainability of SMEs and Cooperatives. Research by Anim-Yeboah et al. (2020) highlights the significance of digital transformation processes and their implications for SMEs' capability and capacity.

- *Knowledge Management and Training*: Azevedo and Almeida (2021) suggest that providing training courses geared towards decision-makers can help SMEs grasp the challenges of digital transition effectively. This activity emphasizes the importance of knowledge management and capacity-building in navigating digitalization.
- *Government Policy and Support*: Government policies can play a pivotal role in facilitating digital transformation. The study by Mai et al. (2023) showcases the role of government policy and IT capabilities in fostering digital transformation and innovativeness among SMEs, especially in the post-Covid context.
- *Collaboration and Ecosystem*: Collaboration is identified as a critical enabler for SMEs implementing green ICT and digital technologies, as highlighted by Marmaridis and Unhelkar (2011). This approach emphasizes the importance of building a supportive ecosystem for technology adoption.
- *Industry-Based Strategies*: Understanding the industry-specific drivers and barriers of digitalization is crucial. Low et al. (2021) emphasize the need for industry-based strategies tailored to Malaysian SMEs' specific context and challenges.
- *Innovation Capability*: Foroudi et al. (2017) emphasize the connection between digital technology adoption and marketing management capability, underscoring that enhancing innovation capabilities through technology can drive growth for SMEs.
- *Overcoming Barriers*: Overcoming barriers is critical to technology adoption. Fanelli (2021) and Ongori (2008) discuss rural SMEs' barriers to adopting new technologies and how addressing these challenges can enhance digitalization efforts.
- *Entrepreneurial Orientation*: Vrontis et al. (2022) point out the moderating role of entrepreneurial orientation in adopting digital technologies for sustainability and value creation. This finding highlights the significance of aligning the organization's culture with technology initiatives.
- *Industry 4.0 Adoption*: Industry 4.0 technologies have gained attention for their transformative potential. Ghobakhloo et al. (2022) provide insights into the drivers and barriers of Industry 4.0 adoption among manufacturing SMEs, offering a systematic review and transformation roadmap.
- *Digital Recruitment and Talent*: Venkatesh and Jakka (2023) explore the implementation of digital recruitment technology, underlining the

role of technology in enhancing HR practices and talent acquisition for SMEs.

- *Sustainability and Value Creation*: The relationship between digital transformation and sustainability is discussed by Šimberová et al. (2022), emphasizing the need to view digitalization as an opportunity for growth and sustainability.
- *Knowledge Sharing and Case Studies*: Furjan et al. (2020) suggest that analyzing case studies can provide valuable insights into digital transformation initiatives. Such studies offer real-world examples and practical lessons that SMEs can learn.

These strategies underscore the multifaceted nature of digital transformation in SMEs and Cooperatives. Organizations must consider a combination of approaches that align with their specific contexts and goals.

1.4.2 Discussing Success Stories of Organizations That Have Effectively Tackled These Obstacles

Numerous studies have shed light on the successful strategies employed by organizations to overcome barriers to adopting digital technologies. For instance, Ahuja and Chan (2021) examined how small firms in rural Canada embraced digital innovation, enhancing their competitiveness and sustainability. Andjarwati and Wulan (2021) showcased the transformation of Indonesian MSMEs through digitalization, promoting sustainable growth. Anim-Yeboah et al. (2020) delved into the digital transformation process and its implications for SMEs, emphasizing capability and capacity development.

A key theme across these studies is the role of factors influencing technology adoption. Ardjouman (2014) explored factors affecting technology adoption among SMEs in Cote d'Ivoire, while Arsalan Nazir and Saleem Khan (2022) investigated the impact of information and communication technology adoption in Pakistani SMEs. Corr, Pejcic, and Volpe (2017) focused on enabling factors for digital technology adoption in manufacturing firms.

Education and training also play a significant role. Azevedo and Almeida (2021) proposed a training course aimed at decision-makers to tackle the challenges of digital transition in SMEs. Furjan, Tomičić-Pupek, and Pihir (2020) analyzed case studies to understand digital transformation initiatives, emphasizing the importance of knowledge dissemination.

Government policies and industry-specific insights are crucial. Low, Hengky Latan and Charbel J Chiappetta Jabbour (2021) highlighted drivers and industry-based heterogeneity in digitalization adoption among Malaysian SMEs. Mai et al. (2023) discussed the interplay of government policy, IT capabilities, and digital transformation in the context of Vietnamese SMEs post-Covid.

Collaboration and networking contribute to success. Marmaridis and Unhelkar (2011) emphasized collaboration as a critical enabler for SMEs implementing green ICT, while Sobolev et al. (2020) explored cooperative organizations and their adoption of digital technologies.

Furthermore, understanding barriers is crucial to finding practical solutions. Fanelli (2021) investigated barriers to adopting new technologies within rural SMEs, highlighting challenges that need addressing. Ongori (2008) examined barriers to ICT adoption in SMEs from a developing country perspective.

In addition to these success stories and strategies, it is essential to consider that every organization's context is unique. This list of references provides a comprehensive resource for understanding the landscape of digital technology adoption in SMEs, offering insights into overcoming obstacles and driving success. For a more in-depth analysis, feel free to explore the provided references.

1.5 Conclusion

1.5.1 Summarizing the Key Challenges Highlighted in the Chapter

The conclusion of the chapter highlights several key challenges in digital innovation and technology adoption among small and medium enterprises (SMEs). The extensive exploration of research literature showcases a range of obstacles that SMEs face as they attempt to embrace digital transformation.

One prevalent challenge is the barrier posed by limited resources in terms of financial constraints and access to technological infrastructure. Many SMEs struggle to allocate sufficient funds to adopt digital technologies and lack the hardware and software to fully leverage these innovations. This financial constraint often intersects with another challenge - the shortage of skilled personnel. The shortage of individuals

proficient in digital technologies hampers implementing and managing these technologies within SMEs.

Moreover, there needs to be more awareness and understanding of the potential benefits of digital transformation. SMEs often lack a comprehensive strategic plan for adopting digital technologies, leading to confusion and hesitance. This issue is closely related to the challenge of organizational resistance to change. Resistance from employees, especially among long-standing traditional businesses, can hinder the smooth integration of digital solutions into existing workflows.

Interoperability issues also emerge as a significant hurdle. The compatibility of new technologies with existing systems and processes within SMEs is crucial. Failure to address interoperability can lead to inefficiencies and disruptions in operations. Security concerns are another critical challenge. Due to their limited resources, SMEs might struggle to implement robust cybersecurity measures, making them vulnerable to cyber threats and data breaches.

Regulatory and policy challenges also play a role. The evolving landscape of data privacy and security regulations can be overwhelming for SMEs. Navigating these complex requirements demands time and expertise that many SMEs lack.

Furthermore, the pace of technological change itself is a challenge. Keeping up with the rapid developments in the digital realm requires continuous learning and adaptation, which can be daunting for SMEs with limited capacity for research and development.

Geographical location is an additional factor. Rural SMEs, for instance, might face unique challenges regarding access to high-speed internet and technological infrastructure.

In conclusion, the journey of SMEs toward digital transformation is riddled with multifaceted challenges, including financial limitations, skills shortages, resistance to change, interoperability issues, security concerns, regulatory complexities, and the dynamic nature of technological advancements. Addressing these challenges requires a comprehensive and well-structured approach encompassing financial support, training, strategic planning, and stakeholder collaboration.

1.5.2 Emphasizing the importance of overcoming these challenges for sustainable growth

In economics and business, the adoption of digital technology by small and medium-sized enterprises (SMEs) has become a critical determinant of

sustainable growth. The challenges and opportunities this digital transformation presents are extensively explored in academic literature. The studies conducted by various researchers shed light on different aspects of this phenomenon. For instance, Ahuja and Chan (2021) focus on digital innovation in small rural firms in Canada. They highlight the importance of technological advancements in fostering entrepreneurship in rural areas. Similarly, Andjarwati and Wulan (2021) emphasize the role of technology in promoting sustainability among Indonesian MSMEs and cooperatives.

In examining the digital transformation process, Anim-Yeboah et al. (2020) delve into the implications for SMEs' capability and capacity. This theme is echoed by Li et al. (2017), who view digital transformation from a capability perspective among SME entrepreneurs. On the other hand, Nazir and Khan (2022) explore the factors influencing ICT adoption in Pakistani SMEs, providing insights into the contextual dynamics.

Multiple studies focus on the challenges SMEs face in adopting digital technologies. Bond and Houston (2003) examine barriers to matching new technologies with market opportunities. Similarly, Fanelli (2021) examines barriers to adopting new technologies in rural SMEs, highlighting these enterprises' unique challenges. Ongori (2008) takes a developing country perspective, identifying barriers to ICT adoption in SMEs.

The drivers of technology adoption also come into play. Ghobakhloo et al. (2022) systematically review Industry 4.0 technology adoption among manufacturing SMEs, identifying key drivers and barriers. Vrontis et al. (2022) explore the role of entrepreneurial orientation in moderating the adoption of digital technologies for sustainability and value creation.

Moreover, the role of government policy and external factors is addressed. Mai et al. (2023) discussed the impact of government policy, IT capabilities, and digital transformation on innovativeness among Vietnamese SMEs in the post-COVID context. This finding aligns with the work of Montegut-Salla et al. (2013), who analyze the factors influencing ICT adoption in agricultural cooperatives.

Several researchers analyze digital transformation strategies and initiatives. Miharja and Muhammad (2023) offer insights into the digital transformation strategy of SMEs in a specific industry, while Ritchie and Brindley (2005) explore ICT adoption by SMEs and its implications for relationships and management.

The research landscape also reflects the need for collaboration and knowledge management. Marmaridis and Unhelkar (2011) discuss collaboration as a critical enabler for SMEs implementing green ICT.

Distanont and Khongmalai (2022) examine the adoption of digital technology in SMEs, emphasizing the collaborative aspect.

In conclusion, adopting digital technology in SMEs is a complex process with various challenges and opportunities. These studies highlight the role of technology in promoting sustainable growth, the barriers SMEs face in adopting digital technologies, the drivers that influence technology adoption, and the strategies and initiatives that can facilitate this transformation. As businesses navigate this digital landscape, these insights contribute to a comprehensive understanding of the factors shaping technology adoption in SMEs.

1.5.3 Conclude with a call for further research and innovation in aiding SMEs and Cooperatives in their digital transformation journey

In SMEs and Cooperatives, digital transformation has emerged as a critical driver of growth and sustainability. A wealth of research underscores the significance of this journey. For instance, Ahuja and Chan (2021) explore the digital innovation landscape within rural Canadian small firms. Similarly, Andjarwati and Wulan (2021) shed light on the transformative potential of technology for sustainable Indonesian MSMEs and cooperatives. This theme extends to the capability and capacity implications, with Anim-Yeboah et al. (2020) delving into the digital transformation process's ramifications for SMEs—Ardjouman (2014) elucidated factors affecting technology adoption in the context of SMEs in Cote d'Ivoire.

Moving forward, Arsalan Nazir and Saleem Khan (2022) examined the factors impacting ICT adoption in Pakistani SMEs, while Azevedo and Almeida (2021) proposed a training course aimed at facilitating digital transition. Barriers to technology-market alignment in established firms are explored by Bond and Houston (2003), emphasizing the challenges of harmonizing new technologies with market opportunities. The agricultural sector's adoption of the Internet and ICT is analyzed by Burke (2010).

Considering the enablers in firms' adoption of new digital technologies, Corr, Pejcic, and Volpe (2017) present an empirical inquiry, whereas Distanont and Khongmalai (2022) delve into digital technology adoption in SMEs. The potential of digital technology in rural SMEs is investigated by Fanelli (2021), while Foroudi et al. (2017) associate marketing management capability with growth in SMEs.

Furjan, Tomičić-Pupek, and Pihir (2020) provide insights into digital transformation initiatives via case studies. The review by Ghobakhloo et al. (2022) systematically outlines the drivers and barriers of Industry 4.0 technology adoption among manufacturing SMEs. The Indian context of IT adoption is addressed by Sridevi et al. (2019).

Li et al. (2017) explored entrepreneurial perspectives on digital transformation, and Low, Hengky Latan, and Chiappetta Jabbour (2021) investigate digitalization adoption's drivers and industry-based variations in Malaysian SMEs. The interplay between government policy, IT capabilities, and digital transformation for Vietnamese SMEs post-Covid is investigated by Mai et al. (2023).

Additionally, Miharja and Muhammad (2023) dissect the digital transformation strategy's role in SME development. From a cooperative standpoint, Molinillo and Japutra (2017) review the organizational adoption of digital information and technology, while Montegut-Salla, Cristóbal-Fransí, and Gómez-Adillón (2013) examine ICT adoption in agricultural cooperatives. Nurhidayati (2020) emphasizes knowledge management capability and the digital ecosystem's role in SME digital transformation.

Notably, the barriers to ICT adoption in SMEs are explored by Ongori (2008) in a developing country context. The potential of digital technology for achieving sustainable development in SMEs is reviewed by Philbin, Viswanathan, and Telukdarie (2022). The ladder adoption model's lessons in promoting ICT in small firms are presented by Martin and Matlay (2001).

In the Nigerian context, Mayowa et al. (2017) correlate technology acceptance and usage with improved SME performance. The evolution of the digital era prompts strategies for UKM digital development (Slamet et al., 2017). Cooperative organizations' engagement with digital technologies is addressed by Sobolev et al. (2020).

Regarding frameworks and guidance, Steyn and Leonard (2012) provide a conceptual framework for SMEs adopting technology. Regarding national and regional differences, Wielicki and Arendt (2010) examined shifts in ICT implementation barriers. The effective use of digital technology in SMEs is dissected by Zairis (2020, 2021).

Zamani (2022) reviewed the evolving technological era's impact on SMEs and the adoption of technologies. Overall, this literature underscores the imperative for further research and innovation to guide SMEs and Cooperatives on their digital transformation journey.

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Multi-dimension Waqf: Perpetuating Waqf Inclusiveness Through Digitalization

2

Asfi Manzilati and Muhammad Dandy Alif Wildana

Abstract

Waqf was once one of the most versatile and impactful institution in the Islamic society. However, over the past century waqf has been reduced and limited to only a fraction of its functions. The advancement of technology and digitalization has made its breakthrough to our daily life, and waqf may has the potential in utilizing it. The main ideas of waqf are inclusiveness and perpetuity of benefit that it gave, and technology can amplify it broader recipients regardless of any hindrance. With technology, the deficiency that waqf faced in its past can be remedied and it will increase its impact and benefit to all. Although the collaboration of waqf and technology may seem promising as it shows, there are some aspects in waqf, especially in the Islamic Law (Fiqh) that must be revisited and re-aligned to harmonize the perception among the Islamic Jurists to ensure sound, robust, and agile waqf institution that follows the development of society.

Keywords

Blockchain · Digitalization · Inclusiveness · Perpetuity · Waqf

A. Manzilati · M. D. A. Wildana
Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia
e-mail: asfi@ub.ac.id; dandyalif.feb.ub@ub.ac.id

© Future Science Press. 2023
F. Prasetyia (ed.), N. Mulachelah (ed.), *Digital Transformation and Inclusive Economic Development in Indonesia*, https://doi.org/10.11594/futscipress2

2.1 Introduction

Islamic economics serves as the alternative offered from the conventional mainstream economics that has become the backbone of society nowadays, centralized on the assumption of self-maximization, opportunistic behavior, and survival of the fittest have caused catastrophic economic failures since Adam Smith almost 300 years ago. The movement of Islamic Economics emerged during the decolonization of Asian-Muslim-dominant countries in Asia and Africa, where those countries strived to achieve independence from their European colonizers.

Since then, Islamic economics has developed rapidly and tremendously worldwide, with Islamic Banking and Finance spearheading the development. The development of digital technology in the 5.0 industry has expedited the world into the digitalization of almost everything. The COVID–19 pandemic has made colossal changes in human behavior and their dependencies on technology. With this drastic change, Islamic Economics and Finance must capture this opportunity to develop even further, especially Waqf or Awqaf (plural), as the unique proposition and solution to provide private and public properties available to the communities.

This chapter discusses the possibility of creating multi-dimensional Waqf by utilizing digital advancement to maintain its perpetuity aspects and spread its benefit across dimensions seamlessly while keeping low maintenance costs. The structure of this chapter is as follows: The historical timeline of Waqf; The exploration of the possibility of integrating Waqf with technology, mainly in its post options form while maintaining its perpetuity and benefit; The discussion on the Islamic Jurisprudence issues on the integration; and lastly the way forward for Waqf.

2.2 Waqf Characteristics and Its Development Overtime

The Waqf institution has been serving the Muslim community for centuries. The origin of Waqf came when Prophet Muhammad PBUH mandated a piece of land in Madinah to be held (of its ownership), but giving out the produce of the land to the people in need. Prophet Muhammad PBUH instructed that the land may not be sold, given, or

inherited by the descendants of the land owner. Hence, the land will continue to give benefits over time.

Such practice is considered the beginning of Waqf in Islam, which happened after Prophet Muhammad PBUH moved to Madinah from Mecca. This practice has stated that the produce of the land, aside from being distributed to people in need, may also be given to the owner's next of kin, enslaved people, travelers/wayfarers, and the caretaker of the land itself. The practice aims to distribute the benefit of an asset to the public but keep the ownership to Allah and handled by those appointed to manage it.

Besides the example of practice, which is considered the origin of Waqf, or awqaf in plural, other assets were categorized as waqf assets by Prophet Muhammad PBUH during His lifetime, such as the palm date spring in Mecca, after the Battle of Uhud. These lands produce quite a substantial. The Prophet PBUH and His family used a fraction of it for one year, and the rest is being used for spending on public properties, especially for armaments, horses, armor, and other Muslim benefits. The mixed-use of the benefit produced by waqf properties has shown the benefit distribution's versatility; further evidence will be shown in more examples.

Waqf itself can be defined as the effort to hold assets (usually tangible, non-perishable) to utilize the benefits that come out of it. The purpose of Waqf, in general, can be divided into three categories: religious, philanthropic (social), and family. The former two were established in the era of Prophet Muhammad PBUH. The latter was established in the era of the Second Caliph, Umar Ibn Al Khattab. The religious and social Waqf is intended to serve as a source of benefit for religious and social purposes. Meanwhile, family waqf is intended to give permanent income to the family and their descendants. In some cases, if any surplus comes from the family, Waqf is distributed to the people for religious and social purposes.

Waqf has characteristics distinct from its counterparts: the assets' perpetuity and the deeds' permanence for those who pledge the asset. The perpetuity aspect is that the asset must be able to maintain its usage and to give benefits continuously without being sold, pawned, inherited, and altered of its substance. The other characteristic is that once someone has already pledged the asset, he or she is unable to recall the asset. However, on one condition, some madzhab or Islamic school of thought allows the Waqf to be temporary, but most of the time, Waqf is permanent and irrevocable.

Waqf has proven to be adaptive and agile in the past, but not so in the modern era. Various studies reported the performance of Waqf in the past, especially in the era of Prophet Muhammad PBUH and the Four Early

Caliphs (Abu Bakr, Umar Ibn Khattab, Utsman Ibn Affan, Ali Ibn Abi Talib) and continued to the era of Islamic Sultanate in various dynasties (Umayyad, Abbasid, Ottoman). The dusk of the Waqf institution happened when colonizers from European countries annexed or occupied most areas once owned by the Sultanate. The total decimation of the Waqf institution was when the Ottoman Empire disintegrated in 1924 and transformed into the Turkish Republic.

After that, the advancement and utilization of waqf institutions and their assets are limited to those of only religious and social benefit, e.g., schools, mosques, graveyards, or other non-productive assets that at some points are abandoned and damaged over time because of lack of funds to maintain them. Thus, in modern times, Waqf has lost its shining, glorious days when it became the backbone of Islamic Economics to provide public and private interest. With the existence of Waqf, the government at that time, even though they had the ability to provide, was helped by the public goods or assets that Waqf provided so that the budget could be shifted to finance other areas that still needed financing.

2.3 Technological Advancement: Pushing the Boundaries of Waqf?

The exponential growth of technology has led to discoveries in every aspect of our lives, and Islamic Economics and Finance (IEF) is no stranger to such development. However, waqf seems distant to such technologies and neglected compared to other instruments in IEF. In contrast, waqf is a versatile instrument that can fit into almost every aspect, e.g., public, private, religious, social, and economical. Suppose waqf is integrated with the advanced technology of this time. This way will unlock its full potential, given that the system's administrator ensures that such a system aligns with the intention of the waqf institution itself.

Concerning the advancement of technology, one question has emerged: Is it pushing the boundaries of waqf to its limit? (Especially in terms of Islamic Law). It is worth remembering that all aspects and instruments of IEF are bound into two laws, namely Islamic Law (shariah) and positive law (lex loci). Technology and Islamic Law, most of the time, do not see eye to eye. Hence, it can cause conflict and cause unnecessary setbacks in the development of waqf itself. This condition is even worse when the literacy of waqf among Muslims today is at an all-time low. It is

understandable that since the end of colonial times, waqf has never been fully resuscitated and resurrected to its former glory and wholly utilized in the former Muslim countries that had been colonized.

In some research, there are efforts to integrate waqf with technology, for example, integrating waqf with financial technology to assist fund collection in terms of cash waqf. Cash waqf is a waqf that gathers cash to fund some project (economics, social, religious, or all of them together) for the benefit of people. Another effort that utilizes the financial technology and system is the creation of Sukuk (Islamic Bond) based on cash waqf that is used to finance projects, and the benefit is not in terms of monetary returns but social returns. In Indonesia, such an instrument is called Cash Waqf Linked Sukuk (CWLS), which is the product of the Indonesian Waqf Board (Badan Wakaf Indonesia/BWI) and Ministry of Finance of the Republic of Indonesia (Kementerian Keuangan/Kemenkeu).

CWLS, as intended and claimed by its issuer, would be the vehicle to spread the benefit of waqf and prevent leakage in the financing of the asset. CWLS provides financing for developing essential infrastructure, such as dams, bridges, schools, healthcare facilities, and other service buildings, to improve the livelihood of the people around the infrastructures. This Sukuk is also an initiative for people interested in putting their money together with other people to create waqf assets, which, from an Islamic point of view, is the source of rewards for the hereafter, as long as the asset is still in use.

Another effort to connect waqf to other financial instruments that utilize technology is the inception of waqf based on shares of companies. This initiative aims to generate income from the company activities based on dividends given every period (usually once yearly). The dividend received will then be utilized in two ways: first is to increase the primary investment in the companies, and the second is to channel it to the intended benefit, whether for social, economic, or religious purposes altogether. This approach is not without challenges. One of the most significant challenges is to ensure that the company waqf invests must be Shariah compliance companies.

Sharia-compliant companies must undergo rigorous screening in both qualitative (sectors and other non-financial) and quantitative (financial including financing source debt proportions) aspects. Various institutions in the world have issued six screening standards, such as DJIM Indices, FTSE Shariah Global Equity Index Series, MSCI Islamic Index Series, Russell-Ideal ratings Islamic Index, Shariah Advisory Council (SAC) of Securities Commission (SC) Malaysia, and Standard & Poor Shariah Indices. The screening is necessary to ensure the fulfillment of the sharia

compliance of the company and the return from the investment of the waqf institution.

The most recent initiative to integrate waqf with technology is the emergence of blockchain and the Internet of Things, especially with automated sensors connected to the Internet. In addition, in the last five years, artificial intelligence (AI) has pushed the boundaries of technology to uncharted territories. Historically, research on the utilization of Blockchain Technology is becoming more common these days, but the exploration of concepts that utilize it is still open for discussion.

It is possible that waqf, in one day, will be based on intangible assets in the form of digital systems or even using the world of META ®, a digital-based world developed by Mark Zuckerberg, who owns Meta (Inc), formerly known as Facebook (Inc). Such discussion will be explained further in the following subchapter, where the concept of integration of waqf into technology will be discussed further, deeper, and more into experimental-like and futuristic concepts proposed.

2.4 Waqf and Technology Integration: Multi-Dimensional Approach

At present, integrating waqf and technology has been attempted in various ways. One of the success stories was integrating waqf with financial technology by involving banking and other financial institutions in collecting, distributing, and creating financial instruments that can support waqf, such as CWLS in Indonesia. There are also attempts to integrate waqf with other technology, but implementing such a concept has yet to be realized. Nonetheless, the discussion regarding waqf integration with state-of-the-art technology has been rigorous. This section will attempt to take different approaches through a multidimensional perspective by integrating and involving assets or concepts that have yet to be explored.

One of the critical aspects that become the main concern is waqf assets. In the past, waqf assets were usually tangible assets with a perpetuity aspect, such as land and buildings, but not intangible assets. Meanwhile, as time passes, the modern world has considered assets not based on their form but on their economic value, such as Meta, Amazon, and other tech companies. Waqif can surrender its assets as a system, just like what those companies produced. However, the decision on whether waqf can be based on intangible assets such as the system has yet to exist. If we are moving

from the physical world to the digital world, systems must be built to ensure the soundness and robustness of the utilization of assets.

Another example of waqf-able assets is a patent, where the proceeds from the patent itself may be distributed among those who are needy or reinvested in place of the waqif to increase waqf assets and broaden its base. Suppose these kinds of assets are acceptable as waqf. In that case, almost every modern creation can become waqf, and those assets can generate a considerable amount of money to maintain the assets and distribute them as per needs. Through this scheme, perpetuity is preserved, and progressively, waqf assets become more diversified over time. If waqf assets vary, it will help waqf institutions to have greater survivability and may reach out even further.

Besides expanding the asset type that can be used as waqf, the technological development of waqf institutions may be rooted in integrating Blockchain, the Internet of Things (IoT), and Artificial Intelligence. Blockchain is not only the foundation for cryptocurrency but also for other technologies that are derived from it. Among the technologies are smart-self-executing contracts, the Internet of Things, colored-marked-access tokens, and currency (crypto). Those blockchain products have the potential for the development of waqf to expand and adapt to the development of the modern world.

However, the utilization of Blockchain-based technology requires enormous consumption of electricity. At this point, some developing or even developed countries still rely on non-renewable resources such as coal, oils, gas, and more. Assuming that generating electricity may come from more environmentally friendly sources in the future, it might be possible to mass-using blockchain technology, which is still being utilized only for cryptocurrency and yet to be developed into any other product. However, the main highlight of blockchain technology is its extreme transparency. That aspect is crucial to charitable-based organizations such as waqf to earn public trust and be part of good governance in managing the asset, utilization, and beneficiaries.

Another technology that is worth mentioning is artificial intelligence and machine learning. Both technologies are aimed at efficiently making difficult decisions based on the database and algorithm programmed in the machine. As far as waqf is concerned, AI and blockchain technology applications will assist primarily with supervision. It is not only limited to supervision, collection, and disbursement but also to become manifest for the assets or become background check tools or any other purposes set by the administrator. As mentioned, this ecosystem runs on huge energy capacity and a broadband internet connection because every single asset

(both physical and digital) is attached to sensors. The sensors can read the current condition and report it to the central backbone of the blockchain, where the decisions are made.

The final technology proposed is a token, a unique access key to certain assets and/or certain benefits as the consequence of both parties (Nadzir and the Beneficiary) agreeing through a smart-self-executing contract and IoT to utilize the waqf asset. This token represents the rights of asset usufruct based on the agreed terms and conditions concluded earlier. In practice, this colored-marked-access-token acts as an access key to the waqf assets, which provides access to and as a master control for every aspect of the asset (tangible and intangible asset). This token is helpful to prevent the waqf asset from being used by unauthorized persons and as the marker of idle or redundant assets. The integration of those technologies is illustrated below.

Suppose a waqf asset (Shopping complex) comprises five units in one single-building complex near busy roads in the city and is already equipped with the above-mentioned technologies. All units are to be leased to 5 different tenants, and the waqf manager uses the said technology at his/her disposal to operate those assets. Firstly, the waqf manager uses AI to analyze the information given by the potential tenants and structure intelligent contracts based on the criterion determined by the manager. Creating a smart-self-executing contract is required to ensure that both parties, especially tenants who take on the assets, are appropriately selected and honor the contract.

After carefully studying the contract, both parties agreed to seal the contract through payment. After that, the contract executes itself to present the tenant with a blockchain access token on the mobile device. The token represents usufruct and control access for the amenities that connect the building leased to the supervision system in the blockchain. The token itself will record data on the usage of the asset, and it will trigger a report in the case of malfunction and/or when equipment requires replacement. Furthermore, the token will ensure that the unit leased cannot be accessed after the lease period.

In terms of payment of the leased asset, the smart-self-executing contracts will act as the collector of the regular payment, which was agreed upon during the lease of the asset. The contract will deduct the amount from the lessee's purse and credit the same amount to the lessor's purse. This case can only be done if one assumes that the entire payment system for this scheme has already adopted blockchain-based payment. There is a possibility of using another system of payment. However, it will become alienated and inefficient because it will require harmonization and

determination of exchange rate every time, and this will also create more costs rather than reducing it.

In addition, the smart contract (from the perspective of the lessor or the waqf manager) can be extended to stipulated purposes. For example, a fraction of the lease payment received will be automatically distributed to the beneficiaries appointed and set by the waqf in the contract (or, in short, auto disbursement). This kind of distribution assures periodic payments to the beneficiaries of the waqf, maintaining low distribution costs and preventing moral hazard and/or fraud. This method is possible because blockchain has unique features of extreme transparency, where all activities (financial to non-financial) are recorded as part of governance requirements in managing public properties.

The illustration above is among many other conceptual settings when integrating technology (especially blockchain and AI) with waqf assets and institutions. With such technology, waqf managers can reduce redundancy and manage costs and other costs related to asset management. At the same time, the technology keeps the asset in use. Assuming it is an intelligent asset, the waqf manager can set the asset to advertise itself as a vacancy, so there will be a minimum idle asset. As futuristic and imaginative as this concept sounds, this concept may come to reality with the current development of technology. However, some fundamental issues require attention, which will be explained in the subchapter below.

2.5 *Fiqhi* Issues in Waqf- Technology Consolidation

When discussing Islamic Economics and Finance, the issue of fiqh or Islamic Jurisprudence will always become the center of attention. In discussing the attempt to integrate waqf with technology, researchers usually stumble upon several obstacles, namely experimentation and exploration of gray areas in fiqh, the void, and the reinterpretation of law. Those three obstacles are the most common issues in fiqh. Nevertheless, there are issues unique to each case, and various factors can influence it.

One of the most critical and debated issues is the experimentation and the exploration of Islamic Law. There are two strongholds of Islamic Scholars: one is a classics scholar, who has a rigid interpretation of Islamic Law, and on the other side is a contemporary scholar, who has a more flexible, forward-looking perspective. Although the latter has greater flexibility, the principle of Islamic Jurisprudence must also be complied with. However, to address the current issues in the modern world, greater

flexibility and agility of the decision (fatwa) in Islamic Jurisprudence is required, especially when discussing laws related to the fiqh of waqf, the waqf-able asset, and other technical aspects.

Another thing that must be addressed is the spirit to identify and derive laws in the event of a void of law. In some cases, there are occurrences where no law binds that, and this creates ambiguities where there is no assurance in the interpretation of the law. One example of the voidness of law is the launching of Bitcoin. A cryptocurrency acts as a medium of exchange based on blockchain technology. Most of the scholars initially had dissenting opinions regarding the usage of bitcoins. However, they already agree that Bitcoin is not permissible because there is no underlying asset, no guarantor, and the high speculation (gharar) aspect.

Bitcoin rulings in Shariah are only a few examples of integrating IEF aspects and technology. As part of IEF as of now, waqf has yet to make any of those rulings, and in the perspective of Shariah, as long as there are no activities that clearly state that it is prohibited. This case indicates that waqf has the opportunity to expand to various forms, benefits, and other purposes. However, to prevent misinterpretation and give legal assurance, it is necessary to create a clear and firm legal framework. This move ensures the waqf institution operates smoothly and protects the interest of stakeholders, including those who benefit from it. The assurance and the ascertaining of law in IEF (especially in Islamic (Sharia) Law) is of utmost importance because failing to do so will result in a void of contract. The transactions are deemed illegal and will result in huge losses, both financial and non-financial.

2.6 Way Forward for Waqf and Technology Integration

The way forward for waqf institutions is challenging. The ever-changing, dynamic world demands agile and adaptive institutions that can address the current problem. Three main issues require solutions immediately in order to bring waqf into the spotlight just like it did in the past. These identified issues are a few among many, and if it is not addressed correctly, waqf will lose momentum and sadly will be lost and left behind without ever having a chance to re-emerge again in the modern age.

The issues are the lack of comprehensive and integrated research between Islamic Jurisprudence, especially Muamalah (code of conduct)

law and other research; The lack of funding for research and development (R&D) that can support Waqf; Lastly, the political will that become the bedrock of every institution because the law is the source of legitimation for every institution and provide explicit instruction and pathway for litigation process if a dispute arises. Each of the mentioned problems will be discussed in detail in the following paragraph.

First, the challenge that encumber the development and experimental utilization of waqf is the lack of comprehensive studies that integrate the creation of concepts and models for waqf development with state-of-the-art research in Islamic Jurisprudence. Such comprehensive research is needed because, as aforementioned, Waqf institutions, such as other IEF institutions, are bound by Islamic Jurisprudence and Positive Law.

The difference in momentum and fortitude in pushing and experimenting in terms of research, if compared between technology, may become one of the greatest hindrances to the development of waqf. Other institutions may thrive and be agile because they must only apply and obey one law, while waqf must abide by two kinds of law. Also, there are different interpretations of Islamic Law based on the school adopted (Hanafi, Maliki, Hanbali, Syafi'i), which can directly influence the interpretation of the law—moreover, the Custom differs from one to the other countries and regions.

Second, most waqf institutions and assets commonly reside in countries once colonized and considered as developing. The consequences of developing countries are the lack of funding for research and development, especially in the universities and other higher education institutions. Without proper funding, it will be challenging for waqf-based research to produce high-quality, high-impact research that can push the boundaries of what we know today. Not to mention the development of technology, where most sophisticated technology is based in non-Muslim countries, and the use of it will be obstructed either by the lack of funds or the capacity to adopt it.

Last but not least, the issues of political will and government support are as important as the previous two. Without government support, either in funding or mainly in the proper legal framework, it will be tough for waqf to survive. As one remembers, waqf is commonly related to assets in which the ownership is transferred to Allah under the stewardship of Nadzir (waqf manager). A proper, strong, and clear ownership law is essential to keep the waqf institution going.

Another thing that the government must provide is a pathway for litigation in the case of dispute, especially when the descendant of the Waqif (the waqf giver) demands and challenges the decision of the waqf

asset to be returned to the family. Although some practices allow temporary waqf, the most common practice is that once the asset is surrendered and transferred into the stewardship of Nadzir. It cannot be revoked to lock the perpetuity and permanence of the giver's benefit and commitment. Through relevant agencies, the government must adapt and have criteria on what kind of asset is classified as permanent assets and which ones are classified as temporary assets. Despite the discussion and the difference in opinions, the preparation for such events must be as early as possible. Because if waqf is held up, it will lose its driving force. In the future, it will be challenging to catch up, and it will stay stagnant, insignificant, and finally forgotten as the relic of the past.

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Future Perspective: The Role of Artificial Intelligence in Predicting Investor Behavior: Opportunities and Challenges

3

David Kaluge

Abstract

This document delves into the future prospects of Artificial Intelligence (AI) in predicting investor behavior, providing insights into both the potential advantages and the hurdles in its application. It highlights the development of AI in financial contexts, focusing on machine learning algorithms used for predicting investor behavior. Furthermore, it explores opportunities, including the transformative impact of AI on investor behavior prediction. The document also uncovers challenges, such as economic uncertainty, abrupt market changes, and emerging data-related issues when implementing AI. Additionally, it discusses AI's social and ethical implications, particularly concerning data bias. It examines how AI can reshape decision-making in the capital market by synergizing with Big Data and complete information. In summary, this document offers a comprehensive view of AI's role in predicting investor behavior, touching on various aspects, from potential benefits to challenges.

Keywords

Adaptive Portfolio Optimization · Cognitive Investor Profiling · Dynamic Risk Mitigation · Economic Resilience Modeling · Ethical Data De-biasing · Quantitative Market Sentiment Analysis · Strategic AI-Infused Capital Markets

D. Kaluge
Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia
e-mail: davidk@ub.ac.id

© Future Science Press. 2023
F. Prasetyia (ed.), N. Mulachelah (ed.), *Digital Transformation and Inclusive Economic Development in Indonesia*, https://doi.org/10.11594/futscipress3

3.1 Introduction

In the dynamic realm of finance, understanding investor behavior plays a pivotal role. This introduction delves into the significant role that predicting investor behavior holds within the financial world. Furthermore, we will explore the evolution of Artificial Intelligence (AI) in the context of the financial market and how it has transformed how we perceive and navigate this intricate landscape.

3.1.2 Background

Investor behavior is the cornerstone of financial markets. The ability to anticipate how investors react to various market conditions is paramount for making informed decisions. Al-Blooshi and Nobanee (2020) emphasize the crucial applications of AI in financial management decisions, underscoring how it aids in predicting investor behavior. This remark aligns with the sentiment that understanding the behavioral patterns of investors provides valuable insights into market movements (Hsu et al., 2016).

3.1.3 The Role of AI in Predicting Investor Behavior

Enter Artificial Intelligence (AI), a groundbreaking technology that has left an indelible mark on numerous industries, including finance. In recent years, AI has grown in prominence as it offers the capacity to analyze massive datasets and discern intricate patterns that might elude human analysis (Henrique et al., 2019). AI-driven algorithms have demonstrated remarkable prowess in forecasting financial market trends, thereby guiding investors and institutions in their decision-making processes (Pavon Perez, 2022).

3.1.4 Development of AI in the Financial Context

As elucidated by Almutairi and Nobanee (2020), AI has not just disrupted but revolutionized the financial industry. Traditional financial analysis methods have been supplemented and, in some cases, even replaced by AI-driven models. These models are designed to process an immense volume

of data, often at speeds unattainable by human analysts, enabling them to identify trends, correlations, and potential risks (L. Chen et al., 2018).

AI's journey into the financial sector was marked by milestones. Initial applications focused on utilizing artificial neural networks, expert systems, and hybrid intelligent systems (Bahrammirzaee, 2010). These early endeavors laid the foundation for more advanced techniques, such as machine learning and deep learning. These techniques have demonstrated exceptional predictive capabilities, especially when forecasting stock market trends (Le et al., 2020).

Artificial Intelligence (AI) has revolutionized various sectors, including finance and banking. In economics and financial markets, AI plays a crucial role in making predictions, analyzing data, and aiding decision-making processes. In this context, AI refers to the simulation of human intelligence processes by machines, particularly computer systems.

To understand the foundations of AI and its applications in predicting market trends, let's start by defining AI and its basic concepts. AI involves creating algorithms and models that enable computers to perform tasks that typically require human intelligence. This definition can range from analyzing vast amounts of data to making predictions based on historical trends. In the financial sector, AI's role is prominent due to its capability to handle complex data sets and derive meaningful insights from them.

AI's significance in the financial domain has been widely acknowledged by researchers such as Al-Blooshi and Nobanee (2020), who have emphasized its applications in financial management decisions. They highlight how AI techniques contribute to more accurate forecasts and better decision-making in financial markets (Al-Blooshi & Nobanee, 2020).

One essential application of AI in finance is predictive analysis. AI algorithms process historical market data to identify patterns and trends, enabling predictions about future market movements. This technique is particularly relevant in stock market forecasting, where the goal is to anticipate price changes. Researchers like Alice Zheng have explored the use of AI for predicting stock market movements (Alice Zheng, 2017.).

Several studies have conducted comprehensive reviews of AI techniques in financial markets. Bahrammirzaee (2010) conducted a comparative survey of AI applications, including artificial neural networks and expert systems, showcasing their efficacy in financial predictions. Similarly, Berradi et al. (2020) undertook a comprehensive review of AI techniques, demonstrating their significance in financial market analysis (Berradi et al., 2021).

News and sentiment analysis are also integrated into AI models for economic forecasting, as highlighted by Barbaglia, Consoli, and Manzan (2021). These models aim to leverage textual information from news articles and other sources to predict market trends (Barbaglia et al., 2021).

Machine learning models have been extensively employed in financial market predictions. L. Chen et al. (2018) compared various AI algorithms for predicting the Chinese stock market and explored which ones perform better (L. Chen et al., 2018). Additionally, machine learning techniques have been utilized to predict financial distress and identify opportunities for better financial planning (Duarte & Barboza, 2020).

The integration of AI in the financial sector is not without challenges. Ensuring the accuracy and reliability of AI-driven predictions remains a concern. Researchers like Eluwole and Akande (2022) have explored the possibilities and threats associated with AI adoption in finance (Eluwole & Akande, 2022).

Overall, AI's transformative impact on the financial sector is evident, with its ability to analyze vast datasets, predict market trends, and enhance decision-making processes. However, continuous research and development are essential to address challenges and refine AI techniques for more accurate predictions in financial markets.

3.2 Predicting Financial Markets, Specifically Focusing on Common Machine Learning Algorithms used for Predicting Investor Behavior

Artificial Intelligence has rapidly gained prominence in the financial sector due to its potential to enhance decision-making and improve market predictions. This mini-review draws insights from a variety of sources (Al-Blooshi & Nobanee, 2020; Bahrammirzaee, 2010; Berradi et al., 2020; Chen et al., 2018; Farimani et al., 2022) to provide an overview of AI's role in financial predictions.

AI encompasses the use of algorithms and computational models to simulate human intelligence. Its integration into finance has led to the development of innovative predictive tools. AI leverages Machine Learning (ML) algorithms, which allow computers to identify patterns and make predictions from data. ML algorithms are widely employed in predicting financial markets due to their ability to analyze complex

datasets. Some commonly used ML algorithms include regression, decision trees, and artificial neural networks (ANNs).

Regression, a fundamental ML technique, establishes relationships between variables. It is frequently used for market trend analysis (Hijazi et al., 2023; Tiwari et al., 2020). Decision trees, on the other hand, are flowchart-like structures that help to make decisions or predictions. They have been used in predicting stock market trends (Hsu et al., 2016; Green & Pearson, 1995).

Artificial Neural Networks (ANNs), inspired by the human brain's neural structure, have shown significant promise in financial prediction (Barbaglia et al., 2021; Henrique et al., 2019). ANNs can identify complex relationships in data and have been applied for forecasting stock market trends (Mondal et al., 2021; Vats & Samdani, 2019). Notably, they have demonstrated the capability to capture nonlinear patterns and relationships that other algorithms may miss.

Several researchers (S.-H. et al., 2004; Hsu et al., 2016; Kruse et al., 2019) emphasize the ongoing debate between the efficacy of AI algorithms and traditional financial models. Adopting AI techniques is driven by their potential to outperform traditional methods and improve prediction accuracy.

Regarding practical applications, AI and ML models have been employed for stock market forecasting, investment strategies, and risk assessment (Chen & Wang, 2004; Bhusari et al., 2022). These applications have gained popularity due to their ability to handle large datasets, identify hidden patterns, and adapt to changing market conditions (Kumar et al., 2020; Trivedi et al., 2018).

However, it is essential to acknowledge that while AI has shown promise, it is not without challenges. Issues like bias in AI models, data quality, and the interpretability of complex algorithms need careful consideration (Pavón Pérez, 2022; Hasan et al., 2023). Moreover, some experts emphasize that AI should be used as a complementary tool, supporting human decision-making rather than replacing it entirely (Green & Pearson, 1995.-a; Eluwole & Akande, 2022).

Eventually, the integration of AI and ML algorithms in financial predictions offers numerous opportunities to enhance decision-making and market forecasting. By leveraging algorithms like regression, decision trees, and artificial neural networks, financial institutions can gain insights from complex datasets and potentially achieve better predictive accuracy. However, the challenges of bias, data quality, and interpretability need to be addressed to harness AI's full potential in the financial sector.

3.3 Opportunities for the Application of AI in Investor Behavior Prediction

The use of AI in this field has opened up exciting possibilities for identifying intricate patterns that are difficult for humans to discern. One of the significant challenges in financial markets is recognizing complex patterns that may not be immediately evident to human analysts. However, AI has proven to be a valuable tool in this regard, offering the ability to uncover hidden patterns in market data and anticipate changes in market trends.

A prime example of AI's prowess lies in its capacity to identify complex patterns within market data that would be challenging for human analysts to detect. This capability stems from the inherent strength of AI algorithms to process vast amounts of data and recognize intricate relationships among various variables. By analyzing historical market data, AI algorithms can identify recurring trends, correlations, and anomalies that might escape human observation. This approach is well illustrated in studies like Al-Blooshi and Nobanee's research ("Applications of Artificial Intelligence in Financial Management Decisions"), emphasizing how AI's analytical power aids in unearthing these hidden patterns.

Imagine AI examining historical data on stock prices, trading volumes, macroeconomic indicators, news sentiment, and more. It can discern intricate interplays among these variables, identifying patterns that may precede market shifts. For instance, an AI system might spot a pattern in which particular combinations of news sentiment, trading volumes, and specific economic indicators tend to precede a rise or fall in stock prices. This knowledge can then be utilized to predict potential future price movements.

One of the most promising applications of AI in predicting investor behavior is its ability to anticipate changes in market trends. By learning from historical data, AI models can recognize patterns that suggest a shift in investor sentiment or behavior. This model has far-reaching implications for decision-making in finance and investing. Investors and financial institutions can leverage AI predictions to make more informed choices, whether adjusting investment portfolios, devising trading strategies, or hedging against potential risks.

Studies like Barbaglia, Consoli, and Manzan's research ("Exploring the Predictive Power of News and Neural Machine Learning Models for Economic Forecasting") showcase the role of AI models, particularly neural machine learning, in predicting economic trends. These models

incorporate news sentiment analysis and market data to anticipate economic fluctuations.

Immediately, we can conclude that integrating AI into financial and economic forecasting holds immense potential. AI's ability to unveil complex patterns in market data, which might elude human experts, makes it a valuable asset in predicting investor behavior. By leveraging AI's predictive capabilities, finance professionals and institutions can make more informed decisions and better navigate the complexities of financial markets.

In economics, finance, and banking, Artificial Intelligence (AI) has emerged as a transformative force, revolutionizing the way financial decisions are made and transforming traditional practices. One notable application of AI is in predicting investor behavior. By leveraging AI algorithms and techniques, analysts and researchers can gain insights into the complex and often unpredictable behaviors investors exhibit.

AI's potential in predicting investor behavior is particularly noteworthy. Al-Blooshi and Nobanee (2020) highlighted the applications of AI in financial management decisions, shedding light on how AI can aid in predicting and understanding investor behaviors. AI algorithms, equipped with the ability to analyze vast amounts of historical data, can discern patterns, correlations, and even hidden factors that influence investors' decisions. This predictive capability offers valuable insights into potential market trends and helps investors make more informed decisions.

Furthermore, AI contributes to more accurate risk assessment in investment. Traditionally, risk assessment has been based on historical data and statistical models. However, AI brings a new dimension by delving deeper into data analysis. It can process an extensive array of factors and variables that might not have been considered previously. For instance, Al-Blooshi and Nobanee (2020) emphasized how AI's analytical prowess can lead to more precise risk calculations for investment portfolios.

Consider the example of portfolio risk assessment. AI systems can analyze diverse data, including historical market performance, macroeconomic indicators, geopolitical events, news sentiment, and even social media trends. By assimilating such a vast array of information, AI algorithms can provide a more comprehensive and nuanced understanding of potential risks. Barbaglia, Consoli, and Manzan (2021) delve into the predictive power of news and neural machine learning models for economic forecasting, showcasing how AI can tap into unconventional data sources to refine risk evaluations.

Integrating AI in investment risk analysis aligns with Bahrammirzaee's observations (2010) on the benefits of artificial neural networks, expert systems, and hybrid intelligent systems in finance. These systems have the capacity to adapt, learn, and improve over time, making them well-suited for the dynamic nature of financial markets.

Incorporating AI into the realm of finance involves a range of AI techniques, from neural networks to expert systems, as explored by several scholars (Berradi et al., 2020; Henrique et al., 2019). These techniques enhance forecasting accuracy and provide a deeper understanding of market dynamics. For instance, Cohen (2022) discusses algorithmic trading and financial forecasting using advanced AI methodologies, underlining the potential of AI in identifying trading patterns and predicting market movements.

Moreover, AI's impact extends beyond traditional financial practices. It has the potential to address behavioral biases among financial planners (Hasan et al., 2023), enhance financial inclusion (How et al., 2020), and provide insights into the intricacies of investor sentiment (Green & Pearson, 1995). The transformative role of AI in finance is also explored by Hunt (2020), who emphasizes how financial companies leverage AI to their advantage.

Then, none can neglect that AI's applications in predicting investor behavior and refining risk assessment processes in finance are transformative. Analysts and researchers gain deeper insights into investor decisions and risk factors by harnessing AI's computational power and data analysis capabilities. This shift from traditional methods to AI-powered predictive models aligns with the evolving landscape of finance, offering the potential to revolutionize decision-making processes.

We will discuss how Artificial Intelligence (AI) is applied to predict investor behavior and analyze market sentiment through social media and news data. Relevant citations from the provided sources are also incorporated throughout this explanation.

In recent years, integrating Artificial Intelligence (AI) in the financial industry has led to significant advancements in predicting investor behavior and understanding market sentiment. One prominent application of AI in this context is the analysis of market sentiment through data collected from social media platforms and news sources. This approach leverages the vast data generated by individuals' interactions and opinions on various platforms. AI algorithms are employed to process and analyze this data, providing insights into investor sentiment and reactions to specific news events.

The utilization of AI in analyzing market sentiment offers several advantages. Traditional methods of gauging market sentiment often relied on surveys or expert opinions, which could be subjective and time-consuming. With AI, vast amounts of data can be processed quickly and objectively. For instance, sentiment analysis algorithms can automatically categorize social media posts and news articles as positive, negative, or neutral, providing a quantifiable measure of overall sentiment.

One example of AI's application in measuring market reactions to news events can be found in the work of Barbaglia, Consoli, and Manzan (2021). They explored the predictive power of news and neural machine learning models for economic forecasting, demonstrating the potential of AI techniques to contribute to accurate market predictions based on sentiment analysis.

Furthermore, research by Al-Blooshi and Nobanee (2020) highlights the growing interest in AI applications in financial management decisions. Their mini-review emphasizes how AI techniques, including sentiment analysis, are increasingly adopted to enhance decision-making processes within the financial sector.

Another case is the research conducted by Berradi et al. (2020) that comprehensively reviews the use of AI techniques in financial markets. This study provides insights into various AI methods to predict market behavior, showcasing the diversity and breadth of AI's influence on financial decision-making.

Moreover, Alice Zheng and Chen et al. (2018) also explore AI's role in predicting stock market behavior. Their research showcases the potential of AI algorithms, including neural networks, to make accurate predictions about stock market movements by analyzing historical data and market trends.

In summary, the integration of AI in predicting investor behavior and analyzing market sentiment has become increasingly prominent in the financial industry. Through sentiment analysis of social media and news data, AI algorithms provide valuable insights into market reactions and investor sentiment. The works of various researchers, as cited, underscore the multifaceted applications of AI in financial management decisions, particularly in analyzing market sentiment and predicting stock market behavior.

3.4 Challenges in Applying AI in Investor Behavior Prediction

3.4.1 Uncertainty in an Economy

In the realm of financial management and the application of artificial intelligence (AI), one of the notable challenges lies in predicting investor behavior. The interconnectedness of economic uncertainties and the accuracy of AI predictions form the core of this challenge. The fluctuations in the global economy can potentially impact the efficacy of AI predictions in this domain significantly.

As economic conditions shift, the ability of AI algorithms to forecast investor behavior can be affected. This phenomenon has been observed in various studies, including those by Al-Blooshi and Nobanee (2020), who highlighted the applications of AI in financial management decisions. Additionally, works by Chen and Qiao (2018) have delved into the comparison of AI algorithms for predicting stock markets in the context of the Chinese market. These studies collectively underline the intricate relationship between economic changes and the performance of AI-driven predictions in the financial landscape.

To illustrate the concept further, let's consider two real-life examples of significant economic events that have shaken the markets and demonstrated the challenges AI predictions may face:

- *The Global Financial Crisis (2007-2008)*: The economic downturn sparked by the collapse of Lehman Brothers in 2008 was a profound event that had far-reaching effects on financial markets worldwide. AI models designed based on historical data and trends might not have been adequately equipped to predict the unprecedented turmoil caused by the subprime mortgage crisis. The event exposed limitations in AI's ability to account for extreme market behaviors fueled by complex systemic factors (Bahrammirzaee, 2010; Berradi et al., 2020).
- *Brexit Referendum (2016)*: The referendum introduced high uncertainty into financial markets, particularly those related to the British Pound and European markets. AI models relying on historical patterns might have struggled to foresee the unique and immediate impact of this political event on investor sentiment and market dynamics. The event showcased the challenge of predicting market reactions to unexpected geopolitical events (Barbaglia et al., 2021; Farimani et al., 2022).

In a nutshell, the integration of AI into predicting investor behavior within the financial landscape presents both potential benefits and inherent challenges. The complex relationship between economic changes and the accuracy of AI predictions underscores the dynamic nature of financial markets. As the world economy evolves, the accuracy of AI predictions can be influenced by a multitude of factors, ranging from global economic events to geopolitical developments. Researchers and practitioners in the field continue to explore ways to enhance AI's predictive capabilities in the face of these challenges.

3.4.2 Sudden Market Condition Changes

There are significant challenges when applying artificial intelligence (AI) in predicting investor behavior, mainly when sudden changes occur in market conditions. One of AI's key hurdles is its ability to cope with unexpected shifts in the market. For instance, sudden market volatility can pose significant difficulties for AI algorithms to make predictions based on historical data and patterns. This issue is critical since abrupt changes can lead to unpredictable outcomes, and AI systems might struggle to adapt swiftly.

Take, for example, the concept of market volatility. Traditional market prediction models, including AI-based ones, often rely on historical data to identify patterns and trends. However, during times of unexpected market volatility, these patterns can be disrupted, leading to inaccurate predictions. The sudden fluctuations in stock prices and other financial instruments can result from various factors such as economic indicators, political events, or global crises. AI models that primarily depend on past data might not adequately capture these factors.

This challenge has been highlighted by several researchers in the field of finance and AI. Al-Blooshi and Nobanee (2020) emphasize that AI models might struggle to adapt quickly to sudden market changes, leading to prediction inaccuracies. Additionally, researchers such as Bahrammirzaee (2010) and Berradi et al. (2020) have conducted comprehensive reviews of AI applications in finance, highlighting the difficulty of AI systems in handling unexpected market volatility.

Furthermore, Alice Zheng's insights on using AI for stock market predictions underline the complexity of adapting AI models to rapid changes in market conditions. Similarly, studies by Eluwole and Akande (2022) explore the possibilities and threats of AI in finance, including the challenge of addressing sudden market shifts.

Researchers have explored various AI techniques and methods to improve predictions in such scenarios in a rapidly evolving landscape. Chen et al. (2018) and Hsu et al. (2016) have compared different AI algorithms to predict market trends, shedding light on the efficacy of these techniques under varying market conditions.

While AI has shown promise in financial prediction, it is vital to acknowledge its limitations when it comes to handling abrupt market changes. Despite advancements, AI models must evolve to swiftly adapt to unforeseen events to provide accurate and reliable predictions.

3.4.3 Data Focuses on the Challenges Associated with the Implementation of Artificial Intelligence (AI) in Predicting Investor Behavior

One of the significant challenges in this regard is the issue of data privacy. As AI algorithms require access to significant amounts of data to make accurate predictions, the use of personal data raises privacy concerns.

This challenge has been discussed extensively in various studies. For instance, Al-Blooshi and Nobanee (2020) highlighted the application of AI in financial management decisions, where data privacy emerged as a crucial concern. They emphasized that using personal data for AI analysis could violate individuals' privacy rights. In their mini-review, they explored how AI applications in financial decision-making could inadvertently compromise the privacy of sensitive information (Al-Blooshi & Nobanee, 2020).

In her work on using AI for stock market predictions, Alice Zheng noted that collecting and utilizing personal data for AI-based stock market predictions could lead to privacy breaches (Alice Zheng, 2017). Similarly, Almutairi and Nobanee (2020) emphasized the significance of addressing data privacy concerns when implementing AI in the financial industry, as AI-driven models heavily rely on sensitive data (Almutairi & Nobanee, 2020).

To provide more insight into the challenges, let's consider a couple of examples of privacy violations related to the use of personal data in AI analysis:

- *Unauthorized Data Sharing*: In the study by Berradi et al. (2020), the authors discussed cases where financial institutions might

unintentionally share customers' financial data with third parties without proper consent, potentially violating their privacy rights. Such unauthorized data sharing could lead to reputational damage for the financial institutions involved, as well as legal consequences for breaching data protection regulations (Berradi et al., 2020).

- *Data Leakage and Identity Theft*: Another concerning scenario was outlined by Ferreira et al. (2021), who highlighted that if financial data containing personal identifiers were not properly anonymized or protected, hackers could exploit vulnerabilities to gain unauthorized access to sensitive information. This situation could result in identity theft, financial fraud, and a loss of trust among investors and customers (Ferreira et al., 2021).

Thus, the challenge of data privacy is a critical aspect of applying AI to predict investor behavior. The concerns revolve around unauthorized data sharing, the potential for data leakage, and the risk of identity theft. These challenges underline the need for ethical and regulatory frameworks that ensure the responsible use of personal data in AI-driven financial analyses.

3.4.4 The Social and Ethical Impacts of Using Artificial Intelligence (AI)

The social and ethical impacts of using Artificial Intelligence (AI) in finance, specifically focusing on the influence on employment and job roles. AI has rapidly advanced in recent years, transforming various industries, including the financial sector. One significant area of AI application in finance is predicting investor behavior. This activity has both positive and negative effects on the job landscape within the financial sector.

The use of AI in predicting investor behavior, driven by sophisticated algorithms and machine learning techniques, can significantly impact employment in the financial industry. For instance, AI can analyze vast amounts of data from various sources, including news, market trends, and historical data, to predict how investors might behave in certain situations. This can lead to more informed decision-making and potentially higher profits for financial institutions.

However, the implementation of AI also raises concerns about job displacement. With the ability to process data at unprecedented speeds and accuracy, AI systems can perform tasks traditionally handled by human

analysts, traders, and advisors. This case could potentially lead to a reduction in the demand for human labor in these roles. As AI continues to improve its prediction accuracy, financial firms might opt to replace certain positions with AI systems to save costs and increase efficiency.

One example of this shift can be observed in reducing the human workforce in tasks such as data analysis, trading execution, and even customer service. As AI systems become more sophisticated in analyzing market trends and predicting investment outcomes, there is a possibility that roles involving routine and data-heavy tasks could be automated. This matter might lead to downsizing or reorganization within financial institutions, affecting various job roles.

The concern about job loss due to AI in the finance sector is not unprecedented. Similar worries have been raised across other industries that have adopted automation and advanced technologies. However, it is essential to note that while AI can replace specific tasks, it also creates new opportunities. The development, maintenance, and oversight of AI systems require skilled professionals. Jobs related to AI programming, algorithm design, data management, and ethical oversight will likely emerge and grow as AI becomes more integral to the financial industry.

In summary, the integration of AI in predicting investor behavior within the financial sector can potentially transform the job landscape. While AI can automate specific tasks and reduce the demand for roles involving routine activities, it also creates opportunities for specialized roles related to AI development and oversight. To navigate these changes, financial institutions need to strike a balance between leveraging AI's benefits and ensuring that human workers continue to play a meaningful role in the industry.

3.4.5 Social Impact and Ethics of Overcoming Data Bias in AI

Artificial Intelligence (AI) has gained substantial traction in financial management, particularly in decision-making processes. The utilization of AI in financial settings has showcased its potential to enhance various aspects of the industry, from predicting market trends to optimizing investment strategies (Al-Blooshi & Nobanee, 2020; Gadre-Patwardhan et al., 2016).

However, it is crucial to address the issue of bias in data used for training AI algorithms, especially given the financial implications of AI decisions. Bias can emerge in data due to historical patterns, unequal representation, and systemic inequalities (Pavón Pérez, 2022). This bias

can inadvertently lead to biased predictions and decisions, thus perpetuating discrimination and inequality.

Meticulously tackling bias in data is a paramount concern when developing AI models for financial decision-making. Ensuring diverse and representative datasets, mitigating algorithmic biases, and continuously monitoring AI systems are steps toward addressing this issue (Bahrammirzaee, 2010; Farooq & Chawla, 2021). Initiatives must encompass both technical measures and ethical considerations to safeguard against unfair practices.

The repercussions of biased predictions are evident in financial domains. For instance, biased AI algorithms may perpetuate gender or racial inequalities in lending decisions, thus reinforcing societal disparities (Hasan et al., 2023). Bias can impact stock market predictions and economic forecasts, potentially leading to financial instability (Barbaglia et al., 2021; Goodell et al., 2021).

To illustrate, the application of AI in stock market predictions showcases how bias can influence outcomes. If a dataset for training an AI model is skewed towards specific market segments, the model's predictions may inaccurately favor those segments, neglecting others (Alice Zheng, 2017; Chen et al., 2018). This issue can result in inaccurate forecasts, misleading investors, and affecting market stability.

Finally, AI's integration into financial management has proven advantageous, but it is imperative to consider the ethical implications of data bias. Addressing bias in AI algorithms is vital to ensure fair and unbiased decision-making in the financial sector. By adopting strategies to mitigate bias and implementing ethical guidelines, the finance industry can harness the potential of AI while fostering inclusivity and fairness in decision-making.

3.4.6 Reshaping Investor Decision-Making in the Capital Market: The Synergy of AI, Big Data, and Complete Information

The convergence of artificial intelligence (AI), big data, and complete information has captivated the financial world, opening new horizons for investor decision-making. This amalgamation holds the potential to reshape strategies and outcomes in the capital market. By merging AI's predictive prowess, big data's expansive processing capabilities, and

complete information transparency, investors can use a profound blend of tools to elevate their choices.

Exploring the applications of AI in finance, Al-Blooshi and Nobanee (2020, 2020) delve into the capacity of AI to enhance financial management decisions. They accentuate AI's ability to decipher intricate market dynamics and predict future trends. Correspondingly, Barbaglia, Consoli, and Manzan (2021) spotlight the potency of news and neural machine learning models in economic forecasting. Their illustration of sentiment analysis from news articles underscores AI's influence on market sentiment and resultant investment decisions.

A deeper dive into AI's advantages emerges from Bhusari et al. (2022), Gadre-Patwardhan, Katdare, and Joshi (2016), and Cohen (2022a, 2022). Bhusari et al. (2022) vividly detail AI's impact on trading strategies, risk management, and investment recommendations. Gadre-Patwardhan, Katdare, and Joshi (2016) extend this narrative by spotlighting AI's roles in algorithmic trading and credit risk assessment. Cohen (2022a, 2022) introduces advanced AI methodologies for algorithmic trading and financial forecasting, enriching investors' responses to market dynamics.

Parallel to AI's ascendancy, big data emerges as a game-changer. Go, Moon, and Kim (2020) investigate AI's present and future in finance, focusing on big data. This symbiosis enhances risk assessment, customer experiences, and personalized advice. Big data and AI blend empowers investors with personalized insights and data-driven guidance.

Complete information, advocated by Zhang (2020), is the bedrock of practical decisions. Transparent and accurate data dissemination empowers investors. Integrating AI in this sphere refines its value, rendering information timely and actionable.

Navigating these themes, Farooq and Chawla (2021) furnish a panoramic view of AI in finance. They explore its applications in portfolio optimization, risk assessment, and fraud detection. This broad vista reinforces AI's transformative influence.

However, amidst optimism, challenges emerge—Eluwole and Akande (2022a, 2022) spotlight AI's dual nature—possibilities and threats. Ethical concerns, regulatory hurdles, and algorithmic biases necessitate vigilance for ethical and equitable integration.

In the future, several areas within the capital market and investor behavior are likely to undergo significant revolutionary changes due to advancements in AI, big data, complete information, and robotic technologies:

- *Personalized Investment Strategies*: AI-driven platforms will offer highly personalized investment strategies based on individual risk

tolerance, financial goals, and market trends. Investors can access sophisticated robo-advisors that consider their preferences and continuously adjust portfolios for optimal returns.

- *Behavioral Finance Insights*: AI algorithms will analyze investor behavior and sentiment to provide insights into market trends and potential shifts. This information will help investors make more informed decisions by understanding the collective sentiment of the market.
- *Predictive Analysis*: Advanced predictive analytics will enable investors to anticipate market movements identifying opportunities and risks before they become evident to traditional analysis methods. This proactive approach will give investors a competitive edge.
- *Real-time Decision Making*: AI-powered trading algorithms will make real-time decisions based on complex market data, reacting to changes with minimal human intervention. This tool will lead to faster execution and improved risk management.
- *Alternative Data Integration*: Investors will increasingly incorporate alternative data sources, such as satellite imagery, social media trends, and even weather patterns, into their analysis. AI will help process and extract valuable insights from these diverse datasets.
- *Quantitative Trading Strategies*: Quantitative trading will become more sophisticated as AI algorithms generate high-frequency trading strategies, leveraging real-time market data to execute trades precisely.
- *Risk Assessment and Management*: AI will revolutionize risk assessment by analyzing vast historical data to identify potential risks and vulnerabilities in investment portfolios. This action will enable investors to implement proactive risk management strategies.
- *Evolving Regulatory Landscape*: Regulators will adopt AI-driven tools to monitor market activities and detect anomalies, enhancing market integrity and investor protection.
- *Ethical and Socially Responsible Investing*: AI will enable investors to align their portfolios with ethical and socially responsible criteria. Algorithms will screen investments for environmental, social, and governance (ESG) factors to help investors make choices that reflect their values.
- *Market Transparency and Fairness*: Blockchain technology, combined with AI, will enhance transparency in trading processes, ensuring fair and efficient market operations while reducing the potential for fraud.

- *Global Market Accessibility*: AI-powered translation tools and market analysis platforms will make international markets more accessible to investors, regardless of language barriers or geographical locations.
- *Crisis Preparedness*: AI systems will help investors better navigate market crises by providing real-time insights and predictions, enabling more effective decision-making during turbulent times.

Overall, integrating AI, big data, complete information, and robotic technologies will empower investors with unprecedented tools and insights. This transformation will lead to more personalized, informed, and strategic investment decisions, ultimately reshaping the capital market landscape and investor behavior. However, ensuring ethical, responsible, and transparent use of these technologies is crucial to maximize their positive impact.

If all investors universally adopt advanced technologies such as integrated AI, big data analysis, perfect information, and robotic trading, it would lead to significant changes in the financial markets across various aspects, including market volatility, stability, efficiency, and overall dynamics. Here is a deep analysis of the potential outcomes:

- Market Volatility and Stability:
  - *Reduced Short-Term Volatility*: Advanced AI algorithms would identify trends and patterns quickly, reducing knee-jerk reactions and irrational trading behavior. This action could lead to a reduction in short-term volatility by minimizing impulsive trades driven by emotions.
  - *Potential for Enhanced Long-Term Volatility*: AI-driven trading systems could respond to subtle signals and contribute to more pronounced long-term trends despite reduced short-term volatility. As a result, long-term volatility could increase due to collective actions based on similar AI algorithms.

- Market Efficiency:
  - *Increased Efficiency*: With perfect information and AI-driven analysis, inefficiencies in the market would be rapidly identified and exploited, leading to quicker price adjustments and improved market efficiency.
  - *Arbitrage Opportunities Diminished*: As AI-driven strategies quickly capitalize on pricing disparities, traditional arbitrage opportunities would be less accessible, limiting the potential for short-term profit through price discrepancies.

- Investor Behavior
  - *Reduced Herding Behavior*: AI's ability to process vast amounts of information and consider a wide array of factors could reduce herding behavior. Investors might make more independent decisions, which could lead to a moderation of extreme market movements.
  - *Algorithmic Herding*: Paradoxically, if many investors use similar AI models, a new form of herding behavior could be driven by algorithms following similar patterns.

- Market Manipulation and Fraud
  - *Improved Detection and Prevention*: AI algorithms could better detect and prevent market manipulation and fraudulent activities by analyzing unusual patterns and behaviors. This advantage could enhance market integrity and investor confidence.

- Liquidity and Trading Volume
  - *Higher Liquidity*: AI-driven algorithms can respond quickly to market changes, increasing liquidity by facilitating more trades. This could lead to reduced bid-ask spreads and more efficient order execution.
  - *Potential for Excessive Trading*: Increased liquidity might lead to more frequent trading as algorithms respond to even minor fluctuations. This could lead to higher trading volumes and potentially exacerbate volatility.

- Market Predictability
  - *Higher Predictability*: AI's data-driven nature could lead to more predictable market behavior, as algorithms incorporate historical data and trend analysis. However, this could also make markets vulnerable to "self-fulfilling prophecies" if many algorithms follow the same patterns.

- Systemic Risks
  - *Reduced Systemic Risks*: AI's ability to quickly identify risks and anomalies could reduce systemic risks by enabling prompt responses to potential market crises.
  - *New Forms of Systemic Risks*: If many AI algorithms make similar decisions based on similar data sets, a systemic risk might emerge if the data or the algorithms contain inherent biases or incorrect assumptions.

- Market Innovation
  - *Accelerated Innovation*: The adoption of advanced technologies would likely lead to rapid innovation in financial products, services, and trading strategies, further reshaping the financial landscape.

- Regulatory Challenges
  - *New Regulatory Frameworks*: Regulators might need to develop new frameworks to oversee and regulate the behavior of AI-driven trading systems to ensure fair competition, transparency, and market stability.

In summary, the widespread adoption of advanced technologies in the financial markets would likely result in a complex interplay of reduced short-term volatility, increased market efficiency, changed investor behaviors, and potential challenges related to systemic risks and regulatory oversight. While these technologies offer opportunities for enhanced decision-making and efficiency, they also introduce new dynamics that must be carefully managed to maintain the integrity and stability of the financial markets.

3.5 Conclusion and Future Directions

In the dynamic landscape of financial markets, the convergence of artificial intelligence (AI), big data, and complete information has sparked transformative waves, offering profound opportunities and challenges for investors. Implementing AI to predict investor behavior within the financial sector carries various benefits and risks, as drawn from diverse research studies.

AI's ascension into financial management decisions has been illuminated by Al-Blooshi and Nobanee (2020), underscoring AI's potential to decode intricate market dynamics and forecast future trends. This predictive prowess is amplified by the ability of AI-powered models to analyze voluminous data, yielding invaluable insights into market trajectories (Chen et al., 2018). Moreover, AI's facets, such as machine learning and neural networks, demonstrate promise in augmenting the accuracy of economic forecasting (Barbaglia et al., 2021).

Nevertheless, as the landscape evolves, so do the potential risks. The interplay between AI and behavioral biases among investors adds

complexity to AI predictions (Hasan et al., 2023). Algorithmic bias and interpretability challenges are inherent pitfalls that demand careful mitigation (Pavón Pérez, 2022). Thus, safeguarding ethical and responsible AI applications emerges as an essential pivot.

The tapestry of AI's applications across finance is rich and vibrant. It extends from stock market prediction (Kumar et al., 2020) to financial distress forecasting (Duarte & Barboza, 2020) and sentiment analysis of news data (Khadjeh Nassirtoussi et al., 2014). Machine learning algorithms, particularly neural networks, exhibit a remarkable capacity to unearth intricate patterns in financial data (Hsu et al., 2016).

Nonetheless, the journey is not devoid of challenges. The quality of data and efficacy of model training were ongoing concerns. AI's effectiveness is intertwined with external factors like economic shifts and market volatility (Farimani et al., 2022). While the promise of AI in financial markets is undeniable, its limitations necessitate judicious evaluation and application.

The equilibrium between harnessing AI's prowess and navigating its risks is pivotal in the path forward. Adapting regulatory frameworks must ensure accountability, transparency, and equitable AI-driven financial decision-making (Eluwole & Akande, 2022). Collaboration among academia, industry, and policymakers will sculpt the trajectory of AI's role in the financial sector.

As the curtain falls, the chapter on AI's influence on investor decision-making within the financial realm remains wide open. The amalgamation of research studies showcases the multifaceted potential of AI to revolutionize financial management. While the landscape is marked by optimism, it mandates persistent research to harness its potential and navigate its complexities fully. In this ever-evolving dynamic, AI is poised to continue redefining investor decision-making as we journey into a future where innovation and responsibility walk hand in hand.

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The Integration of Artificial Intelligence (AI) in Assisting with the Mitigation Process for Environmental Issues

4

Shofwan

Abstract

Climate change has significant implications for human existence, particularly economic activity. Community economic activity positively impacts welfare; nonetheless, it concurrently engenders a deterioration in environmental quality. Numerous mitigating endeavors have been undertaken to reduce the magnitude of this impact, among which artificial intelligence (AI) has been employed for this purpose. There are several domains in which artificial intelligence can play a part in overcoming environmental difficulties, including the design of buildings that are more energy efficient, the monitoring of deforestation, and the optimization of the use of renewable energy. Significant issues of social and environmental concern include the lessening of pollution in the environment, the preservation of natural resources, and the recycling of used materials. Both reducing one's impact on the environment and minimizing that impact continue to be appealing as pollution control methods. These processes are interactive, dynamic, and uncertain, making managing and controlling difficult. The following is a list of some of the ways that artificial intelligence technology can be used to help alleviate environmental problems. The way of AI for doing that is for example reducing technology industry emissions, real time data collection and analysis, measuring carbon footprints, wildlife conservation, monitoring environmental indicators, and improving energy efficiency.

Keywords

Environmental Issues · Integration and Implemented · Artificial Intelligence Mitigation Process

Shofwan
Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia
e-mail: shofwan.fe@ub.ac.id

© Future Science Press. 2023
F. Prasetyia (ed.), N. Mulachelah (ed.), *Digital Transformation and Inclusive Economic Development in Indonesia*, https://doi.org/10.11594/futscipress4

4.1 Introduction

The current climate change phenomenon affects all aspects of life, particularly people's economic activities. Artificial intelligence (AI) has significantly contributed to various domains across multiple industries. As computers undertake jobs that typically necessitate human ability, artificial intelligence (AI) can progressively enhance cognitive abilities via time and leveraging the data it accumulates. Artificial intelligence (AI) and robots are distinct entities. Robotic systems execute predetermined tasks following programming instructions provided by human programmers, but artificial intelligence (AI) systems enhance their capabilities through iterative learning processes. This involves assimilating and analyzing acquired data and leveraging this information to refine their future decision-making or operational performance. The recent advancements in artificial intelligence (AI) technology are expected to find applications in diverse domains. The utilization above represents a progressive advancement stemming from artificial intelligence, made possible by recent technological advances, and is primarily employed for highly specialized objectives.

The application of artificial intelligence (AI) in addressing environmental challenges is a notable domain. The field of study expresses optimism over the potential of artificial intelligence (AI) to mitigate risks and minimize harm, particularly in the context of conservation and rehabilitation efforts necessitated by the consequences of climate change. The utilization of artificial intelligence has promise for enhancing the collection, analysis, and utilization of data about environmental degradation and its consequential effects. This technology has the potential to facilitate precise monitoring and measurement, hence enabling informed decision-making processes for policy formulation. However, it is worth noting that the primary consumers of AI technology were predominantly from the academic and industrial sectors rather than the environmental sector. The observation can be made by referring to Figure 1 below:

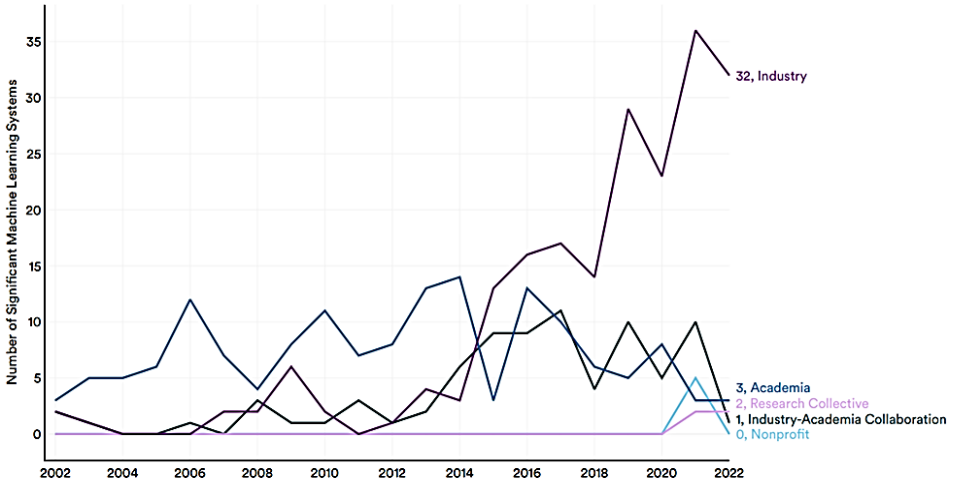

Fig. 4.1 The use of AI technology throughout many sectors and its associated advantages from 2002 to 2022. Ref: AI Index Report (2023)

It is evident in Figure 4.1 that the majority of people who utilized AI technology were academics during the years 2002 and 2014. On the other hand, the industrial sector became the sector with the most significant number of consumers. This finding is backed by artificial intelligence systems requiring considerable data, computer power, and significant expenditures. Therefore, industry participants are better positioned in this scenario than academia and non-profit organizations. Increased productivity and a speedier pace of invention are both benefits that come from the existence of AI. The most recent application of AI has brought about these benefits, which include the following:

- Robotic vehicles, also known as autonomous automobiles, are the subject of this innovation, which can go 132 miles at 22 miles per hour. This technology includes a steering and acceleration system designed to comply with traffic regulations.
- Speech recognition, namely improving the effectiveness of booking guides for airplane tickets. Application of technology in areas such as automatic speech recognition and management of dialogue systems.
- Autonomous planning and scheduling refers to the development of this technology to automate spacecraft operation schedules. In addition, detection, diagnosis, and problem-solving are included as part of the automated process that is carried out.

- During gameplay, this progression occurred during a computer-controlled chess game. This form of AI has successfully defeated some of the world's best chess players.
- The use of artificial intelligence in the fight against spam, namely to highlight the categorization of messages as spam. It takes the form of a message filter that may classify incoming messages automatically based on a predetermined set of rules.
- The planning of logistics and the advancement of technology within the field of logistics. The planning and scheduling of logistics transportation are automated due to technological advances. To determine the factors affecting the parameters that will be used to determine the answer.
- Robotics: applying this technology in creating an unconventional vacuum cleaner. This robot vacuum cleaner is so advanced that it can handle bombs and other potentially dangerous substances.
- Machine translation refers to the growth of this technology in the effectiveness of word translation of more than two trillion words—automation of language translation to understand the desired language to be translated directly.
- The Methane Emissions Observatory Reading Machine is a piece of equipment that will revolutionize the application of artificial intelligence to monitor and reduce emissions from significant sources.

Following the consideration of a select group of earlier AI implementation examples, an investigation into the industries that make the most use of the technology is carried out. The application of artificial intelligence (AI) in the business world is a significant step forward in today's world. Still, it has drawbacks, particularly those that affect the natural world. This is a substantial worry regarding how artificial intelligence may be used in the industrial sector and how AI can be used in the environmental sector, particularly when reducing the damages resulting from industrial activity. It emphasizes making use of AI to manage the negative externalities that are associated with economic progress. Efforts are being made to employ AI to regenerate energy and the environment. The impact of applying AI in the business world is a topic that is frequently brought up in conjunction with the advancement of AI; however, the possibilities for the rise of AI, when seen from its potential, are not brought up after this discussion, which is something that draws much attention. In the subject of determining environmental harm caused by the negative externalities caused by industrial activity, artificial intelligence technology is applied.

There are several domains in which artificial intelligence can play a part in overcoming environmental difficulties, including the design of buildings that are more energy efficient, the monitoring of deforestation, and the optimization of the use of renewable energy. Significant issues of social and environmental concern include the lessening of pollution in the environment, the preservation of natural resources, and the recycling of used materials. Both reducing one's impact on the environment and minimizing that impact continue to be appealing as pollution control methods. These processes are interactive, dynamic, and uncertain, making managing and controlling difficult. As a result, managing and maintaining these processes can be challenging. The use of artificial intelligence (AI) is one method that is useful for tackling problems of this complexity. In the course of this research, the most recent developments in AI-based technologies for the management and control of pollution reduction and mitigation procedures are put into practice.

4.2 How Artificial intelligence (AI) Mitigate Environmental Problems

The following is a list of some of the ways that artificial intelligence technology can be used to help alleviate environmental problems:

4.2.1 Reducing Technology Industry Emissions

Artificial intelligence (AI) has the potential to provide a technology-based answer to the problem of environmentally sustainable industrial development. This technology has the potential to be exploited in the management of emissions of greenhouse gases. In this instance, controlling carbon dioxide (CO2) is a byproduct of power plants, factories, and other enterprises. When implemented, this strategy might be called Carbon Capture and Storage (CCS). The CCS idea emphasizes capturing emissions from industries to reduce CO2 emissions released into the atmosphere (Haszeldine, 2009). This procedure, which includes both capture and storage steps, has the potential to cut global emissions by as much as 20%.

It will require the considerable cooperation of hundreds of CCS factories worldwide to achieve its goals for climate change mitigation. Without CCS, the burning of fossil fuels will exceed 85 percent, making it

the primary contributor to greenhouse gases. During this time, coal was responsible for up to 57% of the total rise in emissions. As CCS deployment becomes more widespread, it has also been anticipated to become more cost-efficient. It finds use in significant industries such as refining, steel manufacturing, fertilizer production, ethanol fermentation, and even cement manufacturing. The image that follows illustrates the CCS scheme:

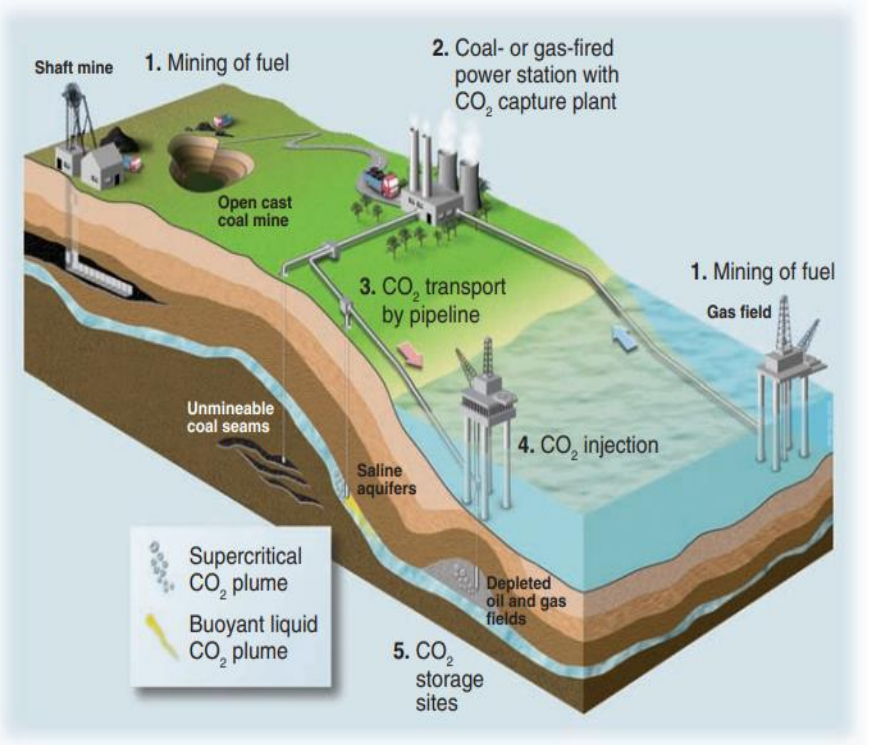

Fig. 4.2 Diagrammatic Representation of The Life-Cycle Capture Carbon. Ref: Haszeldine (2009)

Figure 4.2 illustrates the primary role of CCS, which is to eliminate, refine, and concentrate emissions effectively. Emission capture is conducted by utilizing various chemical solvents, such as carbonates, liquid ammonia, membranes, CO2 capture sorbents, metal-organic frameworks, enzyme-based systems, and ionic liquids, which can effectively eliminate carbon. In the process described, the combustion of oxyfuel in the presence of air results in the denitrification of nitrogen compounds, leading to the conversion of nitrogen into carbon dioxide and

water. These byproducts are subsequently stored at depths exceeding 800 meters below the Earth's surface. Artificial intelligence (AI) advancement aligns with the pressing need for electric power, escalating with global economic expansion. Figueroa et al. (2008) emphasized the necessity for optimizing CO2 capture technology has been emphasized. Engaging in deliberate learning activities can enhance a process's dependability and cost efficiency. The learning cycle is visually represented in the temporal chart as follows:

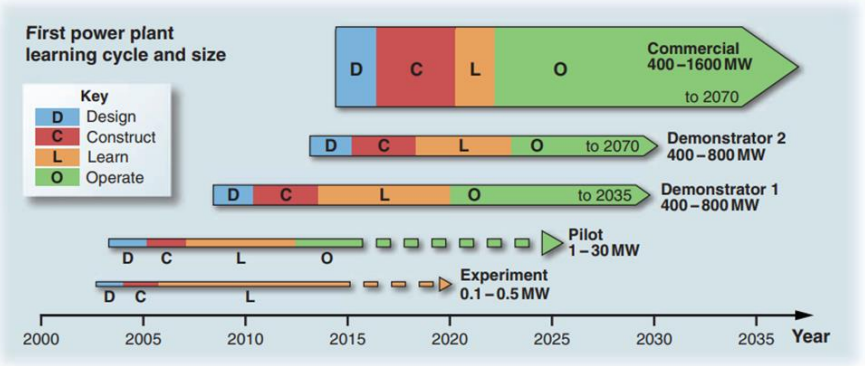

Fig 4.3 Time Chart Capture Carbon and Sequestration. Ref: Haszeldine (2009)

According to Figure 4.3, the commercialization and cost-effectiveness of power generation by CCS can be attained by 2020. The success of carbon capture and storage (CCS) demonstrations relies on the backing of developed nations, which can be demonstrated by the provision of progressively larger experimental equipment. The data afterward underscores the imperative for the widespread implementation of CCS across different regions globally. This is done to achieve significant outcomes in the mitigation of emissions, particularly in the process of CO2 injection. The storage mechanism within the microscopic pore spaces of sedimentary rocks necessitates appropriate formation conditions in terms of both temporal and spatial factors. The advancement of artificial intelligence (AI) technology entails the utilization of computational algorithms to address the intricate nature of emission networks, hence offering potential solutions to global challenges.

As an illustration, artificial intelligence (AI) algorithms can forecast the most favorable operational parameters for refinery equipment, diminishing the necessity for energy-intensive modifications. This phenomenon results in a decrease in the release of greenhouse gases, which plays a crucial role

in mitigating the impacts of climate change. Furthermore, artificial intelligence (AI) can potentially reduce flaring, a practice that substantially adds to carbon dioxide (CO2) emissions within the industrial sector. Artificial intelligence (AI) can reduce the frequency of unforeseen shutdowns, which commonly lead to gas flaring, by accurately forecasting equipment malfunctions and enhancing maintenance planning.

4.2.2 Real Time Data Collection and Analysis

Numerous professional domains, particularly the business sector, are increasingly relying on the practice of data analysis. In this instance, the corporation benefits from a competitive edge in terms of time efficiency. The process of data analysis enables the real-time accessibility and assessment of data. This expeditious procedure necessitates a rapid processing time for data without the requirement of undergoing the storage and retrieval process at a subsequent time. Data analysis is characterized by its dynamic nature, commencing with the collection and integration of data, followed by automated analysis and subsequent reporting. The origins of real-time technology can be traced back to earlier advancements in aviation, defense, and robotics. The work system utilizes real-time data responsively to facilitate its operations.

Fig. 4.4 Real-Time Big Data Analytics. Ref: Bekker (2018)

As depicted in Figure 4.4, Artificial intelligence (AI) exhibits a level of complexity that surpasses simplicity. With its myriad advantages, the utilization of AI cognitive computing technology promises to augment usage levels. One of the benefits associated with real-time analysis pertains to data management. In the realm of business, the process of decision-making holds significant importance due to its requisite for meticulous deliberation. Planning, forecasting, and testing processes utilize preexisting data, commonly called Big Data. Big Data is a comprehensive and intricate data collection encompassing several aspects of business operations. Undoubtedly, velocity is a crucial factor in facilitating the examination and projection of data from a comprehensive and anticipatory standpoint. Real-time analysis possesses a distinct benefit in this context.

In addition, the analysis of large-scale data or Big Data, which undergoes constant updates, presents complexities when approached by typical analytical methods. Instantaneous data collecting is vital for businesses since it encompasses comprehensive consumer preferences, market analysis, and data acquisition across many business sectors surrounding financial reports. Real-time analysis is the optimal solution in this scenario to address impromptu data requirements promptly. These advantages have the potential to optimize performance and minimize expenses. According to Vora (2022), the Internet of Things (IoT) can autonomously make real-time intelligent decisions.

Real-time analysis has multifaceted benefits, encompassing immediate advantages such as enhanced performance and cost reduction, as well as long-term implications for corporate sustainability due to its ability to systematically access data over extended periods. Various factors influence business resilience, including weblogs, social media content, census figures, customer service records, and real-time analytical results. Massive Parallel Programming (MPP) facilitates the transformation of Big Data into viable commercial solutions by implementing intuitive decision-making processes. Using validated data by filtering out extraneous information further substantiates the advantages of real-time analysis. The primary benefits of real-time analysis include enhanced temporal efficiency, decreased expenditures, and heightened accuracy. In a broader context, real-time analysis encompasses the sequential stages of data preparation, research, and evaluation to transform the available data into valuable insights for individuals involved in company operations. Establishing teamwork between support people and IT workers can effectively address difficulties and yield favorable outcomes. In market dynamics, organizations are poised to attain a prominent market position by their adeptness in decision-making facilitated by real-time analysis.

According to Orchestrate (2018), artificial intelligence, data analysis, and the Internet of Things (IoT) have emerged as valuable resources for enhancing and incorporating business models within organizations.

One of the benefits associated with using artificial intelligence (AI) in the context of actual data collecting pertains to enhancements in the realm of data management. This enhancement relates to decision-making as a fundamental component of company operations, with data assuming a significant role. One aspect of the procedure involves planning, forecasting, and testing, essential for obtaining the required data. The utilization of real-time analytics is a significant factor in the adoption and advancement of the Big Data life cycle, which is now in its early stages. Artificial intelligence (AI) has the potential to significantly contribute to the real-time analysis phase, which is a crucial component of the Big Data life cycle during the transition period.

Many organizations and businesses maintain extensive data repositories for extended periods. The current proliferation of data encompasses various sources such as weblogs, social media content, census statistics, and customer service records. Unlike in the past, where data was typically organized in tabular form, a significant portion of today's data is unstructured or semi-structured. Artificial intelligence (AI) technology makes it feasible to securely store large volumes of data, commonly referred to as big data, for extended durations.

4.2.3 Measuring Carbon Footprints

The ever-evolving economy has posed an escalating challenge to resource constraints. The phenomenon above can be attributed to the persistent utilization of resources to foster community growth and enhance societal well-being. Artificial intelligence (AI) is a potential answer to this dilemma. During the 1990s, Mathis Wackernagel and William Rees introduced a set of indicators aimed at monitoring the extent to which human activities exert pressure on the Earth's ecosystem, commonly referred to as the ecological footprint. The initiation of the development of this technology was announced by the National Footprint Accounts in the year 2010. The objective is to measure the effective utilization of natural resources in response to demand for their utilization (Mancini et al., 2016).

The Ecological Footprint (EF) concept can be observed and represented through many stages or elements. The initial phase of the EF process entails identifying and compiling traces, followed by measuring activities conducted in developed and developing nations. The planning and

creating solutions to mitigate the footprint are conducted based on the measurement outcomes. Adopting the legislative framework mandates the adoption of programs aimed at reducing carbon footprints. Furthermore, the efficacy of programs to reduce carbon footprints is systematically monitored and assessed.

In addressing the pressing issue of climate change, a more focused area of study pertains to the carbon footprint. The influence of climate change resulting from human activities on the global carbon cycle of emerging nations is significant. The prioritization of carbon identification should be emphasized on the political agenda. Currently, the land utilization advantages derived from carbon credits do not exhibit a substantial increase compared to including biomass, namely forests. However, it is worth noting that agricultural land also presents noteworthy potential for carbon storage. Based on the findings of the Food and Agriculture Organization (FAO), it is evident that a significant proportion, around 90%, of the potential for climate protection in the agricultural sector can be effectively harnessed through carbon sequestration within the soil. It can be conceptualized in the following manner to fulfill its objective of serving as a benchmark for effectively utilizing natural resources.

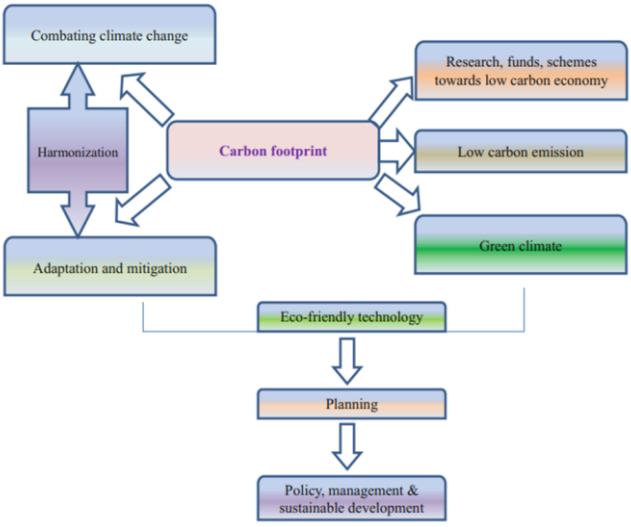

Fig. 4.5 Policy for Regulating Carbon Footprint. Ref: Banerjee et al. (2021)

Figure 4.5 illustrates the relationship between the carbon footprint flow and the formulation of policies promoting sustainable, environmentally-

oriented development. The formation of a green economic strategy can be achieved by the professional harmonization of adaptation and mitigation strategies for climate change, specifically by cutting emissions. The role of the government is crucial in facilitating sustainable manufacturing processes and advocating for a conservative approach to enhance human resource management. Participatory management is a significant facet of cultivating community consciousness regarding sustainable agroecosystems. The mitigation of carbon emissions, energy consumption reduction, and food waste minimization are critical obstacles that must be overcome to attain sustainability within agroecosystems.

4.2.4 Wildlife Conservation

There are following advancements in addressing a range of environmental issues. Artificial intelligence (AI) also facilitates enhanced and streamlined conservation practices, increasing effectiveness and efficiency and commencing from intricate hardware encompassing uncrewed aerial vehicles and mobile devices. Currently, the surveillance of conservation areas mainly relies on web-based platforms that offer cataloging functionalities and predictive problem-solving skills. In this scenario, artificial intelligence (AI) emerges as a viable alternative for specialists seeking to implement conservation efforts by utilizing high-resolution imagery and Big Data obtained from satellites, complemented by integrating various sensor devices. These sensors encompass the monitoring of several environmental phenomena, including but not limited to climate change, deforestation, and biodiversity loss. The foreign collaborations undertaken also contribute to the advancement of AI Guardian, aiming to attain boundless achievements. The development of AI Guardian is presently underway in partnership with esteemed organizations such as NASA, National Geographic, Global North Universities, the World Bank, the International Union for Conservation of Nature (IUCN), and The Nature Conservancy (TNC) or BINGO. The construction of planetary computers, aimed at tackling the difficulties related to biodiversity protection and sustainable development, involves the participation of over 200 countries and 400 global datasets.

Implementing the PALAWEEN network on Palama Island has facilitated the integration of Geographic Information System (GIS) technology. The Rapid Enforcement Support, Planning, Operation, and Network System Enhancement (RESPONSE) facilitates the real-time exchange of information among collaborating entities. Additionally, the

course of action will encompass the strategic development of law enforcement routes, identification of target locations, and determination of entry and exit points for the unlawful extraction of plant and animal resources. According to Parris-Piper et al. (2023), forest rangers are provided with the Protect Animals tracking application on their mobile devices, which facilitates the monitoring of animals. An illustrative instance of the utilization of artificial intelligence (AI) technology in the realm of animal conservation can be depicted as follows:

Fig. 4.6 Major Protected Areas on Palawan and Protect Wildlife Initiatives. Ref: Parris-Piper et al. (2023)

Figure 4.6 demonstrates that Wildlife Insights also supports monitoring. The support provided encompasses data sharing and managing wildlife, further enhanced by advanced analytical techniques. The advancements include the deployment of camera traps, the establishment of law enforcement networks, and the integration of mobile weaponry as standard practice. An innovative initiative known as Rainforest Connection has emerged in the floating forest region. Artificial intelligence (AI) is employed in wildlife conservation to perform many tasks, including species identification, habitat monitoring, and data analysis. Utilizing this technology facilitates the efficient handling of extensive datasets and the automation of crucial operations about conservation endeavors. Through cooperation with the Department of Environmental and Natural Resources (DENR), illicit activities can be effectively curtailed through surveillance equipment that captures, monitors, and forecasts acoustic emissions associated with wildlife poaching. This illegal behavior may serve as a proactive measure.

The potential of artificial intelligence (AI) in animal conservation holds excellent promise. The technology above will significantly enhance surveillance, predictive analysis, and the mitigation of illegal hunting activities. The expeditious advancement of artificial intelligence (AI) is poised to dramatically propel innovation within conservation methods, assuming an increasingly prominent position. The primary function of artificial intelligence (AI) is to enhance the capacity for data analysis, streamline monitoring processes, and forecast ecological patterns. This approach will facilitate decision-making processes and improve the efficiency of resource allocation for conservation efforts. The subject matter at hand pertains to the field of logic. This process facilitates decision-making and enhances the efficient allocation of resources for conservation.

4.2.5 Monitoring Environmental Indicators

The unsustainability of development has led to a range of ecological pressures, including ozone depletion, global warming, aquifer depletion, species extinction, erosion, and pollution. Fuzzy Logic is a viable approach to address the inherent uncertainty associated with sustainability evaluation. The inception of fuzzy Logic can be attributed to Lotfi A. Zadeh in 1965, who sought to provide a computational framework for effectively describing information within uncertain contexts. Fuzzy Logic, as elucidated by Yager and Zadeh (1992), holds significant relevance

in information-based systems, serving as a crucial tool for decision-making and control. In contrast to alternative logic systems, fuzzy Logic offers decision outcomes characterized by a greater degree of fairness and humaneness. Particularly in this study, which used non-binary and non-linear data. According to Yudanto et al. (2013), fuzzy Logic enables the capability of linguistic and non-linear evaluation. Fuzzy Logic encompasses a set of functions utilized to construct expert knowledge systems. These functions include fuzzification, knowledge base construction, decision-making logic, and defuzzification.

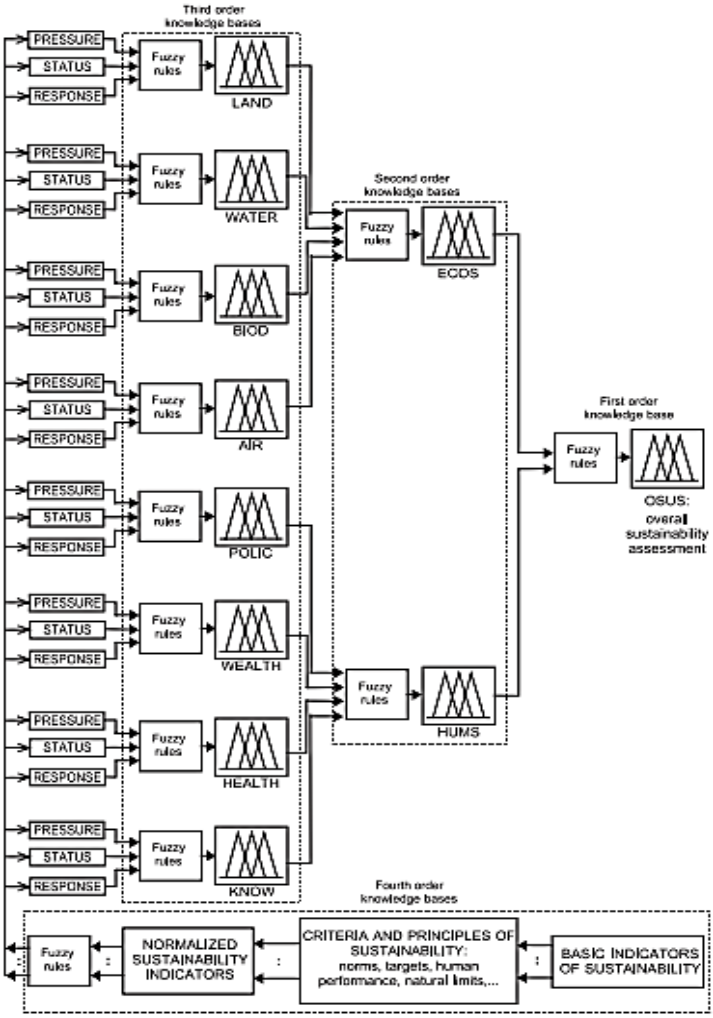

Fig. 4.7. Configuration of the SAFE model. Ref: Andriantiatsaholiniaina et al. (2004)

The fuzzy Logic process entails the assessment and conversion of data into fuzzy theorems, which are subsequently implemented by constructing a decision model that simulates the controller's behavior. The defuzzification step represents the ultimate logical control phase wherein transforming unprocessed data culminates in generating a singular numerical value. The number in question serves as the fundamental determinant for the execution of actions resulting from the Fuzzy Logic process (Pancawati & Yulianto, 2016).

An instance of AI Fuzzy Logic employed in the environmental domain is the Sustainability Assessment by Fuzzy Evaluation (SAFE) application. The SAFE technique incorporates two distinct components: ecological sustainability (ECOS) and human sustainability (HUMS). The environmental dimension encompasses various features, including water quality, land integrity, air quality, and biodiversity. In human size, the elements enclosed include political factors, economic well-being, healthcare, and education.

Figure 4.7 shows the utilization of fuzzy logic and IF-THEN rules to amalgamate the input and generate a composite indicator, which is subsequently transmitted to the subsequent database. The concept of total sustainability is achieved by integrating composite indicators of essential components, drawing upon a foundational knowledge base.

Artificial intelligence (AI)--enabled sensors are employed in aquatic environments such as rivers, lakes, and seas to quantify water temperature, pH levels, and other water quality indicators. The utilization of artificial intelligence (AI)-)-Enabled cameras are employed to monitor the air quality within urban areas and identify instances of air pollution originating from industrial sources. Artificial intelligence (AI) systems are also employed to monitor and safeguard wildlife populations, including those of endangered species. In addition to its applications, as mentioned above, it is also utilized to identify and address illicit logging and fishing activities. Cameras are deployed to surveil woods and oceans to detect any indications of illegal behavior.

Artificial intelligence (AI) systems are employed to analyze satellite imagery to identify illegal logging and fishing activities. In addition, artificial intelligence (AI) technology is employed to identify and mitigate environmental catastrophes. Artificial intelligence (AI) systems are used to place and monitor occurrences of forest fires, floods, and other natural disasters. Artificial intelligence (AI) technologies are currently employed to identify and address incidents involving the release of oil and other substances that pose a risk to the environment and human health. Subsequently, the data obtained from different sensors is examined

to identify alterations in the background, such as climate variations, water levels, and indicators of environmental conditions, as well as changes in the behavior of animal and plant species.

4.2.6 Improving Energy Efficiency

Artificial intelligence (AI) functions as a power controller in the context of energy efficiency optimization. One example is the deployment of the Smart Grid. The method's development encompasses several efficiencies that effectively address the intricacies inherent in the electricity system. Implementing an automated transmission line has eliminated the need for regular supervision in this development. Additionally, this system facilitates the development of specialized protection controllers designed to address issues such as cascading outages, network loads, and other types of disturbances. According to Massoud Amin, an electrical engineer affiliated with the University of Minnesota in Minneapolis, intelligent grids can operate autonomously and effectively address issues without human intervention.

The subsequent assertion made by the individual was that electricity has a velocity nearly equivalent to that of light, hence allowing for a limited timeframe of a few milliseconds within which proactive measures can be undertaken. The Smart Grid system has been used to govern the configuration of uncontrollable disturbances, such as lightning or typhoons, by effectively interrupting the flow of disasters. The implementation of Smart Grid technology has significantly improved cost efficiency, reducing the expenses associated with addressing electrical interruptions by up to one-eighth of the prior yearly costs. The sequential progression of the scheme can be observed as follows:

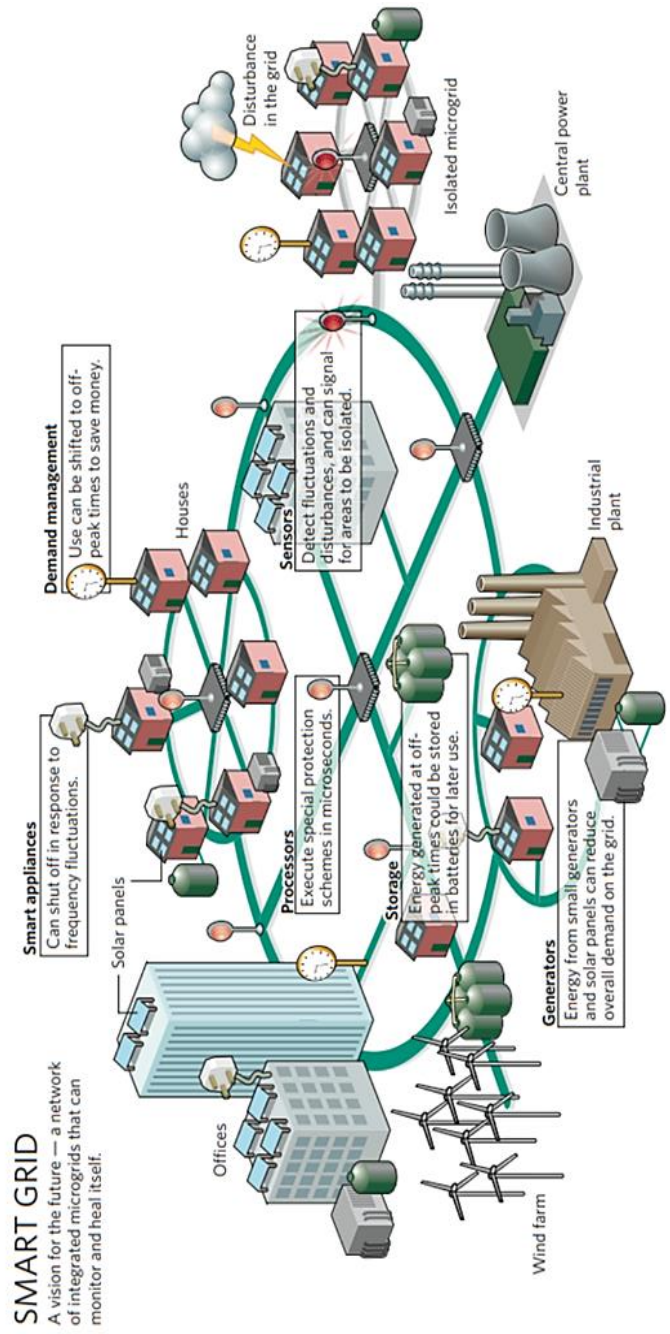

Fig. 4.8 Smart Grid Flow. Ref: Marris (2008)

Figure 4.8 portrays the transformation of the electric power infrastructure into a technologically advanced digital framework. Natural energy management and distribution are facilitated by utilizing two-way information systems, which aim to enhance efficiency, dependability, and safety. Implementing the Smart Grid represents a significant advancement in the modernization of the electric power infrastructure, incorporating technological automation and disaster mitigation measures. Microgrids, diversified distributed energy resources (DER), and energy storage systems (ESS) have inherent self-healing capabilities to address the symptoms that arise. In its evolution, the facilitation of electricity consumption exhibits self-healing properties through its capacity to anticipate, detect, and react to system-related issues. Additionally, consumer involvement plays a crucial role in utilizing solar panel assets.

Furthermore, the system ensures high-quality power by maintaining stability and minimizing losses. Lastly, the system is designed to accommodate various generation options, such as wind, sunlight, and micro-hydro, expanding the range of available electricity sources (Susilo et al., 2018). The visibility of AI's implementation in enhancing energy efficiency is growing, according to the remark above.

The utilization of artificial intelligence (AI) is revolutionizing the strategies employed by organizations in addressing energy efficiency concerns. This technology facilitates optimizing energy consumption, resulting in cost reduction and the mitigation of carbon emissions. Artificial intelligence (AI) has several notable applications in energy efficiency.

Intelligent buildings utilize artificial intelligence (AI) to enhance energy efficiency inside their premises. This is achieved by analyzing sensor data, which enables the automation of heating, cooling, and lighting systems.

Transportation systems can benefit from the integration of artificial intelligence (AI) as it has the potential to enhance their efficiency through the optimization of route planning, traffic management, and energy consumption.

Sustainable product design can be facilitated by integrating artificial intelligence (AI) technologies, which enable organizations to find materials and production processes with little environmental impact.

4.3 Conclusion

The latest technological findings in artificial intelligence (AI) technology can be utilized to help overcome and reduce the risk of environmental damage due to climate change industrialization. This use is a further development of AI due to the latest technology for particular purposes based on the story of previous information. AI's primary function is mitigating environmental issues and problems such as industrial emission reduction technology, measuring carbon footprints, preserving wildlife, monitoring ecological indicators, and increasing energy efficiency. AI's ability to store previous information in memory is the basis for analyzing this matter.

AI technology in the environmental sector can help the industrial sector manage its waste before it is disposed of into the environment. On the other hand, community groups and stakeholders involved in environmental conservation should not hesitate to utilize AI technology to support performance in creating a healthy environment and minimizing potential interference from factors that cause damage. Technology can help preserve the environment and make government programs successful in implementing sustainable development.

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Foreign Direct Investment and the Digital Economy: Concepts, Challenges and Policies

5

Al Muizzuddin Fazaalloh

Abstract

As a result of economic expansion and technical advancement, digitalization is unavoidable. Multinational corporations, often known as Foreign Direct Investment (FDI), play an important and vital role in spreading digitalization throughout the global economy. However, not all developing countries have equal access to the benefits of digital technological advancements brought forth by FDI. This can be attributed to limited human resources in underdeveloped countries, which continue to struggle to assimilate new technologies brought in by FDI. As a result, an in-depth investigation of the determinants of FDI that transfers digital technology to developing nations must be communicated in a straightforward and quantitative manner. Furthermore, it is critical to assess the influence of FDI in the digital technology industry on sustainable development in developing nations. Finally, this article will address how effective policies may be developed to attract FDI in the digital technology sector in developing nations in order to contribute to long-term development.

Keywords

Developing countries · Digital economy · FDI · Indonesia

A. M. Fazaalloh
Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia
e-mail: almuiz.wang@ub.ac.id

© Future Science Press. 2023
F. Prasetyia (ed.), N. Mulachelah (ed.), *Digital Transformation and Inclusive Economic Development in Indonesia*, https://doi.org/10.11594/futscipress5

5.1 Background

The COVID-19 pandemic has decimated the economics of nearly every country worldwide, including Indonesia, since the beginning of 2020. With the devastation of the economy in numerous countries throughout the world, people's economic activities have changed, one of which is economic digitalization. Social distancing restrictions have indirectly influenced the business environment of numerous corporate operators and consumers. They have unconsciously been compelled to convert all economic activity, production, and consumption to digital formats. If people used to buy and sell in traditional markets or shopping centers face to-face before the epidemic, they moved to online shopping afterward. Economic digitization is a sporadic development that developed due to the consequences of the COVID-19 pandemic.

Nonetheless, economic digitization has great potential to boost economic growth. One of the most important potentials of digitalization is the development of artificial intelligence, which is particularly effective in assisting humans in solving many life difficulties, including economic ones. Furthermore, one of the benefits of digitalization is the use of big data as a source of information for economic and business policy analysis, which is highly beneficial to both public policymakers and businesses. This advantage will eventually drive technical development innovation, leading to progressively explosive economic expansion.

Economic digitization has become a massive force that alters the global economy's roadmap and evolution. Foreign direct investment (FDI) is important in fostering fast digitization. FDI is characterized as an economic driving force because of its two leading roles: directly injecting cash into the domestic economy and transferring technology and expertise to the host country. The presence of FDI in recipient nations frequently delivers enormous positive effects, such as the ability to absorb many workers, improve workers' abilities, and drive salary and welfare improvements. Thus, in the current period of Industrial Revolution 4.0, FDI can be viewed as a critical approach for generating long-term economic growth in host countries.

Using FDI to drive quicker economic growth through digitalization is difficult for developing countries such as Indonesia. Various impediments, such as relatively poor human capital capabilities and issues with the quality of institutions, such as licensing processes and corrupt conduct from the bureaucracy, imply that Indonesia continues to struggle to attract FDI to engage in the digital economy.

Another difficulty is that the unequal distribution of infrastructure in the telecommunications sector impedes FDI investment significantly. Nonetheless, the government's continued efforts to roll out the red carpet for foreign companies looking to invest in the digital economy are intensifying. This action opens up significant opportunities for Indonesia to develop its economy toward long-term economic growth through digitalization.

This chapter will explore several barriers to recruiting FDI to invest in the digital economy sector, as well as how to assess the impact of FDI in this area on the economy as a whole. Aside from that, policy recommendations to attract FDI in the digital economy sector will be actively and comprehensively debated.

5.2 Comprehending the Digital Economy

The digital economy can be defined as the economic usage of information technology, including hardware, software, applications, and telecommunications (Malecki & Moriset, 2007). In this setting, the digital economy is the primary motivator for business players to digitalize upstream to downstream activities across all business phases. Similarly, customers use the sophistication of digital technology to meet various demands, from basic needs like daily food intake to non-basic, secondary, and even tertiary wants, like the need for luxury items.

According to the IMF (2018), the digital economy can be understood in two ways. The first is straightforward: digital economy refers to an online platform. This move indicates that the digital economy serves as an intermediary channel for buyers and sellers while engaging in economic activities such as acquiring or selling products or services on an online platform such as a marketplace (for example, Tokopedia, Shopee, and others in Indonesia). Second, the digital economy can have a broader definition. This indicates that the digital economy uses digital data in various economic activities requiring modern technology.

The OECD (2020) refined the most recent definition of the digital economy into three more complete categories:

The digital economy encompasses all economic activity for creating Information and Communication Technology (ICT) commodities and digital services.

The digital economy includes any economic activity that relies on digital input as a critical concept. The narrow definition is the name given to the second definition.

There is a definition of the digital economy, which includes a narrow definition and all economic activities fueled swiftly by digital input.

IMF (2018) provides additional definitions of the digital sector in the economy. At least three conditions for economic activity can be classified as digital. First, the digital economy is inextricably linked to how transactions are carried out, whether through digital orders or digitally ordered commodities. Second, the digital economy necessitates the exchange of commodities or services, as well as the exchange of data. Third, digital economic activities are performed by those in the government, private sector, individuals, households, or non-profit organizations. These three conditions can serve as distinguishing features between digital and non-digital economic sectors.

In addition to the explanations provided by the IMF (2018), UNCTAD (2019) explains three fundamental components of the digital economy. The first is the primary dimension. This dimension has various aspects, including fundamental inventions such as semiconductors and processors, basic technology such as computers and telecommunications equipment, and linking infrastructure such as the internet and telecommunications networks.

The second is the information technology sector's dimension. This dimension covers core commodities and services that rely on essential digital technologies, such as digital platforms, mobile phone apps, and payment services. Through spillover effects, this dimension provides complete color to various sectors of the economy.

The third component of the digital sector is the broader dimension of digital products and services consumed by society as a whole. E-commerce is one example of this dimension. This dimension also focuses on new firms that have emerged as a result of digitization, such as digitalized economic operations in the banking, tourism, media, and transportation sectors.

5.3 Types of FDI in the Digital Economy Sector

According to UNCTAD (2017), FDI in the digital economy is divided into two categories: FDI in the digital sector and FDI in the ICT sector. The

first group explained that FDI in the digital industry has unique characteristics, such as making the Internet the focal point of its company operations. In this industry, FDI is separated into two categories: FDI that only utilizes digital as its primary business and mixed FDI. FDI uses the Internet as part of its business operations but also uses activities outside the Internet or physically as part of its business activities.

FDI in the digital sector can be classified into four categories. The first is FDI on digital platforms such as social networks, search engines, and so on. The second type of FDI is in digital solutions, such as digital payment operators and other digital service providers. The third type of FDI is FDI in the e-commerce sector, where FDI operates on online platforms that conduct commercial transactions. Recent FDI examples include FDI in the tourism services sector and trade that sells things over the Internet. Fourth, FDI is focused on digital content such as digital media, games, and data analytics.

Then, FDI in the ICT sector can be classified into two groups. The first is FDI in the Information Technologies (IT) sector, such as FDI in the hardware and software development sectors. The second type of FDI is FDI in the telecommunications sector, such as providing telecommunications infrastructure and connectivity services.

5.4 FDI Determinants in the Digital Economy Sector

Attracting FDI in the digital economy sector may be the best strategy for boosting economic growth. This action is not without reason. For starters, foreign direct investment in the digital economy would immediately create jobs and absorb labor. Because the absorbed workforce is highly skilled, the wages will also be high. This indicates that encouraging FDI in the digital economy sector is critical to boosting societal welfare. Second, FDI can boost technology transfer from industrialized to developing countries, resulting in technology transfer in the digital sector, which can ultimately catapult economic growth.

Given the importance of attracting FDI in the digital economy sector, it is also critical to understand the strategy. According to a previous study, there are three strategic variables to attract FDI, which are based on the motivations of FDI in making investments. Market-seeking, resource/asset-seeking, and efficiency-seeking are among these incentives (UNCTAD, 1998).

In the context of market-seeking, various aspects merit consideration in attracting FDI in the digital economy. First, with globalization, international corporations can digitally expand their operations. Globalization can potentially reduce the distance between producers and consumers across borders.

Second, the rapid growth of digital media in numerous nations has the potential to attract significant FDI in the digital sector. For example, Li et al. (2021) discovered that digital media independence in China could attract FDI from emerging countries positively.

Third, there is no denying that a vast population equates to a significant market share. As a result, attracting FDI in the digital sector will be positively associated with a large population. The larger the population, the higher the possibility for digital equipment users, such as using social networking apps via digital platforms.

Fourth, the amount of per capita income in the host country; the higher the income earned by the host country's population, the more appealing FDI will be. In truth, it is clear that high wealth is matched by high consumption in some groups. As a result, FDI in the digital sector will be more attractive to nations with high per capita income.

In terms of the resource/asset-seeking incentive, it is intimately tied to the availability of resources possessed by the host country. These include raw materials, natural resources, inexpensive labor, skilled labor, and physical infrastructure such as roads, ports, airports, telecommunications, and electricity or energy. The availability of energy and telecommunications networks can be the foundation for luring FDI into the digital economy sector. Multinational corporations will choose areas with enough electricity infrastructure, making it easier to grow or start new operations in the area.

Finally, the efficiency-seeking incentive seeks advantages from differences in costs between endowment components and economic scale and scope in different countries. In general, this motive seeks to reduce the company's production costs. Multinational corporations will reduce input costs as part of this effort. Since the 1990s, FDI with this purpose has concentrated on skilled labor, rivalry from similar companies, infrastructure quality, and economic agglomeration usage, and is more inclined toward knowledge-intensive sectors and R&D (Dunning, 1998). Aside from that, variables such as industrial parks have an impact on attracting FDI with this goal.

Efficiency-seeking motives indeed play a significant influence in attracting FDI in the digital economy sector. For example, FDI in the

digital economy sector will be interested in investing in areas with a high concentration of qualified workers, such as software developers. Another example is that when there is economic agglomeration in a region, FDI in the digital sector can use this agglomeration to synergize and work with other enterprises, both domestic and foreign, in expanding the digital economy.

5.5 Challenges in Luring FDI in the Indonesian Digital Economy Sector

FDI in the digital economy sector, notably in the telecommunications and transportation industries, has expanded dramatically since the 1990s, peaking in 2008 (see Figure 1). Two possible explanations exist for the high growth in FDI in this area. First, in 2006, the Ministry of Communication and Information issued a policy on implementing cellular mobile networks. This policy ushers in a new age in which Indonesia is beginning to recognize modern communications technologies. Second, the general population overwhelmingly supported this program. According to BPS-Statistics Indonesia (from now on referred to as BPS), the percentage of families that own/control cell phones has increased rapidly, from 37% in 2007 to 52% in 2008.

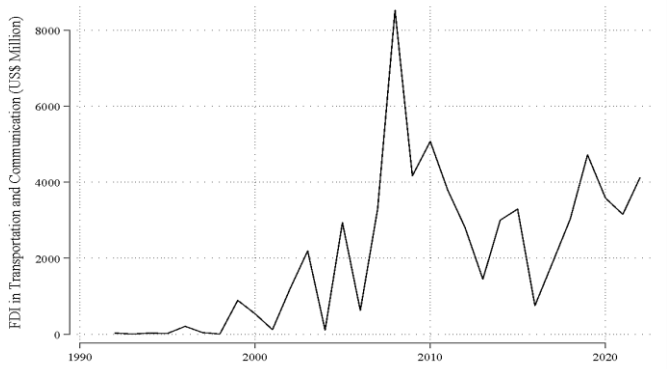

Fig. 5.1 Development of Foreign Direct Investment in Indonesia's Telecommunications and Transportation Sectors (1992-2022). Ref: Ministry of Investment, accessed September 2023

However, this positive trend did not continue sustainably. As shown in Figure 5.1, FDI flows have experienced a drastic decline since 2009 and fluctuated in movement until the end of the period. This Figure conveys the message that attracting FDI in the telecommunications and transportation sectors is becoming more challenging.

Indonesia is a vast archipelagic country with diverse economic resources that are not uniformly dispersed throughout each island. This fact creates a particular difficulty for Indonesia in attracting FDI effectively and sustainably. For example, the primary economic infrastructure on the island of Java differs significantly from places on other islands, particularly on distant islands. As a result, attracting FDI in the digital industry requires a unique approach tailored to each island.

Infrastructure development on the island of Java is well advanced, with power plants, ports, airports, railways, toll roads, and high-speed trains available, making it more straightforward to attract FDI. In contrast to the islands outside of Java, a lack of infrastructure is a significant barrier to FDI investment.

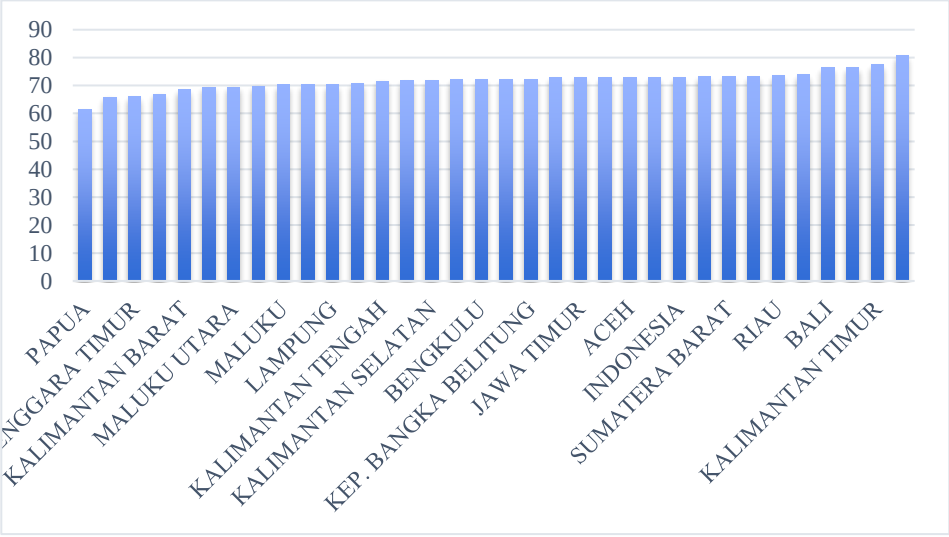

Fig. 5.2 Human Development Index by Province in Indonesia, 2022. Ref: BPS (2023), accessed September 2023

Another significant issue is the disparity in human development between provinces. Java has demonstrated its ability to develop high-

quality human resources once again. This is aided by the presence of a very appropriate educational infrastructure. School facilities ranging from the fundamental level (primary school) to the highest degree of education, namely postsecondary institutions, are practically evenly distributed around the island. This situation presents an excellent opportunity for the Javanese community to become highly educated. Figure 5.2 depicts statistics on the Human Development Index (HDI) in 2022, with provinces in Java, such as Jakarta and Yogyakarta, ranking first and second in Indonesia.

Therefore, the population tends to gather on the island of Java, making FDI in the digital economy sector more inclined to invest on this island. The larger the population of an island, the greater the potential for the target market. According to the results of the 2020 population census conducted by BPS, the island of Java has 151.6 million people or 56.10 percent of Indonesia's population. Meanwhile, Sumatra has the largest remaining population at 21.68 percent, followed by Sulawesi at 7.36 percent, Kalimantan at 6.15 percent, Bali-Nusa Tenggara at 5.54 percent, and Maluku-Papua at 3.17 percent.

Corruption as a measure of institutional quality is also a significant impediment to attracting FDI in the digital economy sector. According to data from the Corruption Eradication Commission (KPK), there were 48 criminal acts of corruption in regional administrations on the island of Java in 2022 (out of 120 cases). This finding shows that the potential for attracting FDI on the island of Java is still relatively high if the corruption problem can be resolved. Unfortunately, the pervasive corruption that never appears to go away makes FDI appear hesitant to invest in the island of Java.

Furthermore, labor wages are still a significant concern in Indonesia. Based on JETRO's survey report on Japanese companies investing in Indonesia in 2022, they found that the issue of increasing wages was ranked as the main issue perceived by Japanese companies for investment problems. As many as 82.8 percent of companies surveyed stated that increasing wages was the most challenging problem for investors to choose Indonesia as an investment destination. Moreover, procurement expenses rank second in terms of difficulty for Japanese investors, with 80.9 percent viewing this as an investment issue. Apart from these issues, Japanese investors are concerned about the relatively high corporate tax burden, currency rate fluctuations, and procedures for imported goods.

5.6 The role of FDI in the Digital Economy Sector in Sustainable Development

Regarding theory and empirical evidence, it is impossible to deny that FDI is vital in promoting economic growth. In the context of the digital economy, FDI in the digital industry contributes significantly to economic growth via numerous avenues. There are at least two typical ways for FDI to affect economic growth: increased capital in the economy and technology transfer to indigenous firms (Aitken & Harrison, 1999).

FDI in the digital sector contributes significantly to rising per capita income, mainly by improving digital infrastructure, such as establishing broadband networks and cloud infrastructure. These two types of infrastructure can potentially become a driving force in the economy, as their presence can speed connectivity between corporate players and consumers in economic activities such as production, consumption, and distribution.

Furthermore, FDI in the digital sector can spur economic growth by transferring technology to indigenous firms. The presence of technology transfer from FDI can assist indigenous firms in absorbing the most recent technology brought by FDI from industrialized countries. Domestic enterprises can develop goods of comparable quality or at least competitive with FDI products by mastering sophisticated technology. Not only that, but technology transfer can help domestic enterprises in other areas grow faster and more productively.

Apart from these two avenues, FDI in the digital industry directly impacts the economy by absorbing workers and improving wages. When the digital FDI sector runs in Indonesia, it will absorb many workers. Many IT workers will be hired, and the potential for job creation in other areas is also substantial. For example, Micro Small Medium Enterprise (MSME) players use the digital sector to develop and distribute their products and services.

Furthermore, raising wages favorably impacts FDI in the digital sector. Foreign direct investment in the digital sector will generally pay more excellent wages than domestic firms. This is understandable, given that FDI typically requires employees with advanced skills and education. As a result, they will pay more to workers in the digital sector.

From a regional economic standpoint, FDI in the digital sector in Indonesia is still unevenly distributed. In general, the digital FDI sector remains concentrated on the Indonesian island of Java. For example, the

value of foreign investment in Java in 2022 was $3.6 billion (Ministry of Investment, 2023)[1]. This percentage is the highest among the islands, accounting for 88.8 percent of total foreign investment in the transportation and communications sector. Of course, this reduces the leverage for growth engines outside of Java.

5.7 Investment Policy to Encourage FDI in the Digital Economy

Investment policies to attract FDI in Indonesia's digital economy sector can primarily be implemented by considering the numerous issues raised in the previous section's discussion. Various barriers to attracting FDI in the digital economy include uneven infrastructure development among islands, disparities in human capital, a more concentrated population on Java Island, corruption, and the problem of high labor wages. These challenges must be addressed if policymakers want to increase the attractiveness of FDI in the digital economy sector.

As a result, infrastructure development should be more equitably dispersed rather than relying solely on the economy of Java. A fresh breakthrough is required to create a more equal and strategic infrastructure. However, restricted government finances can make more fair infrastructure development difficult. In response, infrastructure development outside of Java should be carried out through collaboration with the private sector under a framework of symbiotic mutualism. This means that the private and public sectors must benefit from each other and be held to the same standards.

More equitable infrastructure development can indirectly improve human capital and demographic equality in various parts of Indonesia. Physical infrastructure development, such as roads, airports, ports, railroads, and toll roads, can be a binding anchor for foreign investment in the digital economy sector. This is because infrastructure is crucial for a corporation to expand or start a business for both foreign and local investment, particularly FDI in the digital economy sector. Meanwhile, residents will be more interested in places with complete or adequate

[1] The author derives FDI numbers from the Ministry of Investment, which are available at https://nswi.bkpm.go.id/data_statistik.

infrastructure, resulting in a population shift from densely populated areas to sparsely populated areas with superior-quality infrastructure.

Corruption prevention is a policy step that should be implemented promptly and utilized as the primary guideline in combating corruption, which is becoming increasingly prevalent in Indonesia. If regulations like this are efficiently executed, international investors will have more trust in Indonesia's bureaucracy, which will ultimately attract more FDI in the digital economy and general sectors. In this scenario, the government can provide guarantees for FDI in the digital economy sector to place their investments without interference from the complexities of central and regional government bureaucracy.

Wage policy is also critical to more effectively attracting FDI in the digital economy sector. Various aspects explain the significance of this wage policy: First, wages that are not excessively high and competitive can encourage FDI in the digital economy sector to place investments. This competitive compensation will impact the recruitment of digital sector workers such as programmers, IT experts, and other digital sector workers to become more efficient and provide the finest talent for FDI.

Second, too high wages will discourage FDI in the digital industry from investing in the host country; instead, they will prefer to relocate their factories to other countries without difficulty. As a result, international investors have shown less interest in participating in the digital sector. Third, the wage increase can expand the wage gap between high-skilled and low-skilled workers. As a result, wage disparities between high-skilled and low-skilled workers will emerge, threatening the long-term viability of foreign investment in the digital sector.

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From Disruption to Inclusion: The Role of Digitalization and Artificial Intelligence (AI) in Ensuring an Inclusive Economy

6

Laila Masruroh Pimada and Ferry Prasetyia

Abstract

The concept of an inclusive economy has emerged as a critical issue in global development discussions, aiming for a more equitable and sustainable society. It focuses on four main characteristics: education and training, access to resources, sustainable growth, and quality employment. Digital transformation and artificial intelligence (AI) have significantly impacted economic inclusion, enabling equal access to and opportunities for all individuals, regardless of their socio-economic background. To implement an inclusive economy, cross-sector collaboration, appropriate policies, and innovation are needed. Challenges include digital access gaps, skills and education gaps, data diversity, job loss, security and privacy issues, investment gaps, and technological dependence. Policy recommendations include education investment, technology regulation, support for SMEs, and international cooperation to establish global standards and policies that promote equitable growth.

Keywords

Artificial intelligence · Digital transformation · Inclusive economy

L. M. Pimada · F. Prasetyia
Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia
e-mail: ferry.p@ub.ac.id

© Future Science Press. 2023
F. Prasetyia (ed.), N. Mulachelah (ed.), *Digital Transformation and Inclusive Economic Development in Indonesia*, https://doi.org/10.11594/futscipress6

6.1 Introduction

Rapid technological progress has resulted in a phenomenon known as disruption, in which traditional business models and time-honored practices have been replaced by new ideas (Christensen, 1997). This disruption is being driven by digitalization and artificial intelligence (AI). However, beyond the constraints of disruption, there is a great chance to promote social and economic inclusion by harnessing new technologies to close existing gaps.

Digitalization has improved global access to information, communication, and transactions. Digital technology has connected marginalized communities to the global economy in many developing countries, allowing them to participate in the digital economy (McKinsey Global Institute, 2017). People who do not have access to traditional banking, for example, can now enjoy digital financial services thanks to fintech (Zhou et al., 2019). Meanwhile, AI, with its capability to process vast amounts of data, provides a more detailed insight into economic disparities and potential solutions that can be implemented. AI enables a deeper understanding of disparity patterns and offers means to devise more tailored policies (Zhang et al., 2020). However, as O'Neil (2016) pointed out, AI might exacerbate these disparities without proper application. The key is how to use AI to benefit all strata of society, not just a particular group.

For stakeholders, it is essential to understand that disruption does not necessarily mean destruction. If managed correctly, the disruption from digitalization and AI can catalyze more extensive inclusion (World Economic Forum, 2018). Active government involvement in regulating and supporting technological development and ensuring equal access for all is a crucial step towards a more inclusive economy (OECD, 2019). However, achieving an inclusive economy is a challenging task. Challenges, from data privacy issues to disparities in technological access, can hinder this process. Therefore, collaboration across sectors—government, industry, and civil society—becomes paramount. With the right innovations and policies, we can ensure that the benefits of digitalization and AI are enjoyed by everyone, not just a select few individuals or groups (OECD, 2019).

Though technological disruption brings challenges, with collaboration, innovation, and the right policies, we can utilize digitalization and AI as essential instruments in realizing an inclusive economy. The world we face now demands transformation, and technology can be the bridge to achieving economic inclusion.

6.2 The Concept of an Inclusive Economy

The inclusive economy has emerged as a critical issue in global development discussions. With a growing awareness of wealth gaps and severe inequities around the globe, this notion provides viable answers for a more equitable and sustainable society. This is not only about social justice but also vital for a country's long-term progress and stability. Rapid economic expansion benefits a chosen few in many locations while the mass of the population has yet to gain. When only a tiny proportion of the population benefits from economic progress, social tensions rise, and public trust in national institutions falls.

The inclusive economy challenges the traditional idea that growth helps all groups of society automatically. On the other hand, this notion underlines the importance of progress that empowers every individual, ensuring everyone has equal opportunity to contribute to and profit from economic advancements. This action includes prioritizing excellent education, health care, and equal work opportunities. We can attain a vision of a society that is not only rich but also just and sustainable through encouraging an inclusive economy. It is now up to governments, businesses, and civil society to collaborate to ensure that economic progress results in equitable and long-term benefits for all parts of society.

An inclusive economy is a development strategy to ensure everyone has equal opportunities to participate, contribute, and benefit from economic growth (UNDP, 2019). This showcases an economy prioritizes empowering vulnerable and marginalized communities, such as women, youth, minority groups, and the impoverished. An inclusive economy refers to a development strategy with similar aims. This concept encourages human-centered development, where individual well-being is at the forefront of every development initiative.

The inclusive economy has become a development strategy in an increasingly connected world. However, even though technology and globalization potentially bring broader opportunities, the growing disparities and inequalities often pose challenges many countries face when implementing this development model. As reported by the World Bank in 2017, income disparities and inequalities in many developing and developed countries have deepened social divides, threatened social cohesion, and slowed economic growth (World Bank, 2017).

A hallmark of the inclusive economy approach is its focus on vulnerable and often marginalized groups. Women, for instance, representing half of the global population, frequently face structural barriers preventing them from accessing the same economic resources,

education, and employment opportunities as men. The International Labour Organisation's (ILO) 2018 report indicates that women still earn lower wages compared to men for the same jobs in many countries (ILO, 2018). Moreover, youth, especially those living in conflict or post-conflict regions, are often left behind by economic developments. According to UNESCO in 2019, limited educational and job opportunities for the youth can contribute to instability and conflicts (UNESCO, 2019). Minority groups, whether based on ethnicity, religion, or other identities, are also frequently overlooked in development. Discrimination against these minority groups can prevent them from accessing equal health services, education, and job opportunities, deepening inequalities and escalating social tensions.

Discussing an inclusive economy necessitates mentioning the impoverished population. Despite significant progress in reducing global poverty, hundreds of millions still live below the poverty line. According to the UNDP's Human Development Report in 2017, non-inclusive development can deepen poverty and isolate certain groups from the benefits of economic growth (UNDP, 2017). The inclusive economy offers a holistic, human-centered approach to facing these challenges. Through appropriate policies and interventions, coupled with international cooperation among nations and institutions, we can promote even growth and ensure that economic benefits are felt across all societal layers.

As explained above, an inclusive economy prioritizes an approach that ensures that every individual has an equal opportunity to benefit from economic growth. There are four main characteristics of an inclusive economy that reflect the fundamental principles of inclusivity:

- Education and Training

  Quality education and training serve as pivotal pillars in preparing individuals to face the escalating global competition. Equal education not only asserts every individual's right to access knowledge but also ensures that everyone, regardless of their social or economic background, is equipped with competencies enabling them to effectively and adaptively contribute in an ever-evolving economy. On the other hand, quality training ensures that these skills remain relevant, facilitates smooth transitions into the workforce, and anticipates future industrial needs. According to the World Bank (2017), education and training focused on real-world needs can enhance individual and collective productivity and foster innovation. With heightened productivity and innovation, a country's economy can grow sustainably, creating an environment conducive to the entire

community's progress. Therefore, investment in education and training is not just a moral obligation but a strategic necessity for inclusive and sustainable national growth.

- Access to Resources

Access to resources is vital for the growth and development of individuals and businesses, especially smaller ones. The intricate global economic landscape has much untapped potential and wasted opportunity without adequate access to resources like finance, technology, and infrastructure. This is about more than just having capital. It is also about having the capacity to innovate, adapt, and compete globally. The OECD (2019) has emphasized the importance of providing equal access to these resources, especially for vulnerable groups. Equal access bridges more significant opportunities, allowing them to shift from passive roles to active agents of change in the economy. Both innovation and entrepreneurship, which drive economies, depend on the ability of individuals and businesses to utilize available resources effectively. Thus, efforts to ensure equal access not only manifest fairness principles but also drive inclusive growth strategies where every community member has an opportunity to contribute and benefit from economic progress.

- Sustainable Growth

Economic growth is a primary indicator of a country's development. However, if such growth benefits only a small group or specific sectors of society, the nation's economic foundation may become unstable. In situations where only a few individuals or groups enjoy the fruits of economic growth, inequality rises, leading to social tensions and potential instability. The International Monetary Fund (IMF) report 2017 highlighted the importance of ensuring economic growth is robust but also inclusive and sustainable. Focusing on equitable growth ensures that not just the elites benefit but every societal layer gets a fair share of the economic pie. Such balanced and sustained growth is more than an economic goal. It is a means to foster a fairer, more peaceful, and more stable society. In essence, when economic benefits are widely felt across society, there is an increase in socio-economic stability and, importantly, resilience against potential future crises. A strong economy is one that embraces all, ultimately building robust collective resilience (IMF, 2017).

- Quality Employment

Within modern society, employment has evolved to be more than just a means to earn a living. It is a central aspect of life where individuals seek recognition, self-realization, and job satisfaction. Quality employment parameters are not limited to wage scales but also extend to the extent of job growth opportunities, reinforcement of self-worth, and social security assurance. This aligns with the International Labour Organisation's (ILO, 2018) emphasis on the importance of quality employment. Moreover, the ILO stresses that jobs meeting quality standards should be accessible to all, especially vulnerable groups, ensuring even economic growth distribution. Systematic and integrated collaboration from various stakeholders is essential to realize the availability of quality jobs. Firstly, the government needs to implement policies to create high-quality job opportunities. Secondly, the education sector must be strengthened to ensure the availability of skilled labor. Lastly, clear regulations should be applied to safeguard worker rights. Through this approach, we can anticipate the manifestation of an inclusive, high-quality employment ecosystem for all.

6.3 Digital Transformation and AI in Building an Inclusive Economy

The advancement of technology in this modern era is inseparable from the significant role of digitalization and artificial intelligence (AI). Digitalization and AI have become two primary pillars that define the direction of development across many economic sectors worldwide. Furthermore, these two technologies have played a pivotal role in driving economic inclusion, ensuring that all individuals, regardless of their socio-economic background, have equal access to and opportunities to participate in the global economy.

Digitalization has reduced barriers to accessing various services and information. Someone in rural Africa can now access educational courses from a renowned European university via their mobile device. At the same time, a small trader in Southeast Asia can sell their products to consumers in America or Europe with the aid of e-commerce platforms. This ease of access has created a wave of democratization of information and opportunities unparalleled in history. Meanwhile, AI has transformed how humans comprehend and use information. AI's ability to analyze, analyze,

and understand massive volumes of data enables it to make more accurate decisions, build better-customized products to user wants, and even forecast future trends.

Regarding economic inclusion, AI can aid in identifying economic gaps, forecasting regions that require intervention, and developing more tailored solutions. Not only that but AI and digitalization make it easier for more inclusive business models to arise. Shared economy systems, such as ride-sharing or home-sharing, enable individuals to participate in the global economic ecosystem with relatively little cash.

Despite the tremendous potential of digitalization and AI, ensuring this transformation does not leave segments of the population behind is vital. Awareness of the potential bias in AI or the disparity in access to digital technology must be part of the global agenda. Along with this, AI, with its ability to handle massive quantities of data and make judgments based on data analysis, has ushered in a change in how we do business, learn, and even communicate with one another. The use of AI in data analysis, forecasting, and automation allows for higher productivity, creativity, and the development of solutions that are more suited to individual needs. Examples of how digital technology and artificial intelligence (AI) are being used to promote inclusiveness in many economic sectors include:

- Financial Sector

  Fintech (financial technology) has changed the face of banking and finance. This advancement, fueled by digitalization and artificial intelligence, has transformed how we access and use financial services. Once thought to be exclusive and rigid, the financial sector is now more inclusive and dynamic, providing unprecedented benefits to the general public. One of the most visible aspects of this transformation is the ease with which credit can be obtained. In traditional banking traditions, obtaining a loan frequently necessitates a strong credit history, which many people, particularly in developing countries, may lack. However, the credit-granting process has dramatically transformed thanks to AI-powered microcredit apps. These applications utilize artificial intelligence to analyze user transaction patterns, purchasing behaviors, and even social interactions to make a more holistic credit decision. Rather than solely relying on traditional credit history, AI-based systems consider many data points to evaluate an individual's creditworthiness. This enables individuals previously without access to formal financial services, such as informal workers or those in remote areas, to obtain loans. The impact of this innovation is far-reaching. For individuals, it means access to financial resources

for investment, education, or emergencies. For the economy at large, it creates new capital flows and spurs economic growth from a broader base. With the adoption of digitalization and AI, Fintech is not only changing the way we transact but also redefining what inclusion means in a modern financial context.

- Education

The digital era has made a significant contribution to the world of education. The emergence of online learning platforms and MOOCs (Massive Open Online Courses) has set a new benchmark for comprehending and accessing education. Quality education is now at our fingertips, no longer limited by geography, economic status, or physical institution constraints. One of the most exciting advancements in digital education is integrating artificial intelligence. AI-based recommendation systems on online learning platforms offer unparalleled personalization. Based on user behavior analysis, preferences, and learning history, AI can suggest courses or materials best suited to an individual's needs and aspirations. This makes the learning process more flexible and relevant. With MOOCs, globally, knowledge from renowned universities can be accessed by anyone, anywhere. This ensures that quality education is no longer the privilege of those who can attend elite institutions but a right for all who wish to learn and grow.

- Health

The health sector has become one of the fields where the impact of digital transformation and artificial intelligence is keenly felt. With technological advancements, many challenges previously deemed daunting now have innovative solutions, broadening access and enhancing the quality of healthcare services. AI-based health applications have made remarkable strides in diagnosis and treatment. Through intricate and detailed patient data analysis, AI can identify disease patterns and offer high-quality treatment recommendations. This not only boosts care efficiency and effectiveness but also minimizes medical errors. The most significant benefit of AI-driven applications is how this technology facilitates access to healthcare services in remote areas. Patients in these regions can now receive preliminary diagnoses via apps without having to travel far to health centers. This is invaluable, especially for communities in isolated locations or with limited healthcare facilities. Furthermore, with advancements in AI-supported telemedicine, consultations with

specialists in major cities or even abroad have become feasible. This shifts the paradigm that quality healthcare is solely accessed by traveling to major medical centers. Thanks to technology, quality healthcare is at our fingertips, ensuring every individual, wherever they may be, has an equal opportunity for a healthy life.

- Agriculture

The agricultural sector has experienced an exhilarating technological transformation over the past decade. A significant player in this revolution is artificial intelligence (AI). With AI integration, farming is no longer just a traditional activity; it has evolved into a tangible representation of precision agriculture. One of the most beneficial applications of AI in farming is its ability to predict weather patterns with high precision. With this information, farmers can prepare their land and crops according to anticipated weather conditions, maximizing harvest potential while minimizing loss risks. Pest detection through AI provides farmers with an edge in protecting their crops. AI-based cameras and sensors can detect pest presence early, enabling farmers to take preventive or controlling measures before widespread infestation. Equally important, AI also offers recommendations on optimal planting times. By considering various factors like soil conditions, seasonality, and historical weather patterns, AI guides farmers on the best times to commence planting. Thus, AI not only facilitates enhanced crop yields but also supports agricultural sustainability. This marks a significant step in meeting rising global food needs while ensuring farming practices remain eco-friendly and sustainable.

- Employment Sector

Technological evolution and digitalization have profoundly impacted the way we work and job hunt. A standout phenomenon in today's digital era is the emergence of digital-based gig platforms. These platforms depict a working-world revolution, offering unprecedented flexibility and breaking down traditional geographical barriers. Digital gig platforms, such as Upwork, Freelancer, and Fiverr, enable individuals to provide services based on their expertise to clients worldwide. Thus, a graphic designer in Indonesia, for instance, can now work for a client in Europe or America without leaving home. Another advantage of these platforms is their inclusivity. Individuals from diverse educational, social, or economic backgrounds can effortlessly register and find work matching their expertise. This is particularly

beneficial for those facing obstacles in traditional job markets, such as disabled individuals, homemakers, or those residing in remote areas. However, it is undeniable that with such flexibility come new challenges like income instability and worker protection absence. Nonetheless, with appropriate regulations and awareness from both workers and employers, digital-based gig platforms can be an inclusive solution for many individuals aiming for economic independence.

Digitalization and AI have paved the way for broader economic inclusion worldwide. By eliminating geographical, social, and economic barriers, this technology ensures that every individual, regardless of their background, can access equal opportunities on the global stage. However, ensuring these technologies are ethically applied and considering potential social impacts is vital. With the right approach, we can ascertain that digitalization and AI serve not only as tools for growth but also as instruments to build a fairer and more inclusive society.

6.4 Challenges and Strategies for Implementing an Inclusive Economy based Digitalization and AI

As previously described, an inclusive economy is a concept where everyone, regardless of their socio-economic background, is given an equal opportunity to participate in the economic wheel actively. In today's digital era, digital technology and AI offer enormous potential to strengthen the principles of an inclusive economy. They provide innovative solutions to expand access to resources, education, and business opportunities for previously unreachable communities. Although the prospects are promising, a series of challenges must be addressed. Integrating AI and digital technology into the economy necessitates considering issues such as the digital divide, data security, and algorithmic bias risks. However, with every challenge comes an opportunity. We can harness the digital revolution to create a more equitable and inclusive society through innovation, cross-sector collaboration, and appropriate policies.

The challenges in implementing a digital and AI-based inclusive economy are as follows:

- Digital Access Gap

Access to the internet and digital technology remains uneven worldwide. According to the World Bank (2018), although internet penetration is increasing, a significant portion of the population remains unconnected to the internet, especially in developing countries.

- Skills and Education

The increasingly digital world requires different skills. However, not every individual has access to adequate education to prepare them for the digital age. The World Economic Forum (2018) notes an urgent need for retraining and skill enhancement to prevent communities from being left behind.

- Data Diversity

AI needs diverse data to ensure its decisions are unbiased. However, Buolamwini and Gebru (2018) show that many AI models are trained with data that does not reflect society's diversity, resulting in potentially discriminatory decisions.

- Job Loss

While AI might create new jobs, there is concern that it could also lead to significant job losses, especially for low-skilled workers. Research by Arntz, Gregory, and Zierahn (2016) indicates that many jobs in OECD countries are at risk of automation.

- Security and Privacy Issues

Data has become an invaluable asset. However, this comes with associated risks concerning security and privacy. Pasquale (2015) argues that societies could be threatened by the "black box" of algorithms controlling information and finances without adequate transparency and regulations.

- Investment Gap

Investment in new technologies is often concentrated in the hands of a few companies or countries. Florida and Mellander (2017) found that wealth and technology investments tend to concentrate on specific areas, potentially deepening global economic inequality.

- Technological Dependence

As most business operations and daily activities transition to digital platforms, there is a risk of increased reliance on technology.

Disruptions, such as cyberattacks or system failures, could severely affect the economy and society (Clark, 2017).

Appropriate strategies are required in line with the challenges of implementing an inclusive economy based on digitalization and AI. Some strategies to support this implementation include:

- Enhancing Digital Infrastructure

  Addressing the digital divide is about providing access and ensuring the quality and speed of adequate internet services. Remote areas, often overlooked in terms of digital access, require special attention in building internet infrastructure. With good-quality internet access, communities in these areas can capitalize on various opportunities, ranging from education and health to business ventures. Additionally, with adequate internet access, local innovation and creativity can flourish and contribute to the global economy. The World Economic Forum (2016) emphasizes that investments in digital infrastructure serve not only to expand network coverage but also to ensure the sustainability and inclusivity of the economy. Therefore, a total commitment from the government, private sector, and civil society is essential to realizing a digital economy that includes all layers of society.

- Continuing Education and Training

  Ongoing education and training are increasingly vital to ensuring that the workforce remains relevant and competitive. As technology evolves, the skills required in the workplace change. According to the McKinsey Global Institute (2017), digital skill training and technological literacy are not just necessities but integral parts of today's education. This does not only apply to those working in tech fields but also to workers across various sectors, from healthcare to manufacturing. Adapting educational curricula to the most recent technology developments and offering platforms and resources for lifelong learning guarantees that individuals have access to the information and skills required to prosper in a digitally enhanced environment. This strategy will encourage long-term economic growth and provide job possibilities.

- Robust Data Regulation

  Many firms now see data as a valuable asset, raising customer privacy and security issues. According to the Harvard Business

Review (2018), trust is the core of the consumer-digital company connection. If consumers feel their data is safe, they are more inclined to utilize digital services or goods. In contrast, data breaches or privacy violations can affect a company's brand and weaken consumer trust. As a result, robust and targeted data rules are essential to guarantee that organizations uphold the highest data security standards and hold themselves accountable for it. These regulations do not only protect consumers but also provide guidance to companies on how to handle data appropriately. Ultimately, a secure and trusted digital ecosystem will support growth and innovation in the digital economy.

- Partnership between the public and private sectors

In the transition to an inclusive digital economy, cooperation between the public and private sectors is essential. It was stressed in a report released by the International Telecommunication Union (2019) that combining these two organizations' resources, knowledge, and influence may accelerate digitization more effectively and equitably. The government has a part to play in encouraging technological innovation and adoption through supporting policies, suitable laws, and financial incentives. On the other hand, the private sector can provide real-world, workable solutions because of its technical know-how and creative capacity. Additionally, by working together, digital efforts can include the most disadvantaged segments of society. When the public and private sectors work together effectively, they can hasten the adoption of new technologies, spur economic expansion, and guarantee that everyone benefits from digitalization.

- The development of moral AI

The development of artificial intelligence (AI) technology has opened up countless prospects for innovation in a variety of fields. However, this exponential increase presents moral dilemmas that have never been encountered before. The significance of an ethical approach was emphasized in a 2020 issue of Nature Electronics. From the content recommendations we follow to the essential medical choices we make. this technology has the potential to have a profound impact on human life. Therefore, developers and decision-makers must ensure that AI respects personal liberties and rights. Transparency, responsibility, and awareness of potential social repercussions are requirements for ethical AI development. Building a solid ethical foundation would not only increase public trust but also

guarantee that AI serves society as much as possible while upholding human values.

- Smart Use of Technology

  Technology dependence concerns call for significant, staged interventions. When utilizing digital gadgets, it is essential to establish limits and give priority to tasks that call for intense concentration, according to Newport (2016). Twenge and Campbell (2018) recommend limiting social media use to combat reliance. Additionally, Turkle (2015) underlines the value of quality time away from technology and implores us to engage in face-to-face communication more frequently than through screens. We can move towards healthier and more purposeful technology use by fusing all these strategies with awareness and discipline.

6.5 Conclusion

Rapid digitization and artificial intelligence advancements have led to fundamental changes in the functioning of various economic sectors. Digitization has accelerated business transformation and opened up new growth opportunities. However, these uneven changes have left parts of society behind. From the explanation above, we can draw several key conclusions:

- Digitization and AI have the potential to enhance productivity, innovation, and economic growth.
- There is a risk of income and job polarization, where specific sectors benefit more from the new technologies while others lag.
- Relevant skills and education are paramount to competing in the digital job market.

According to the key findings above, building an inclusive economy in the age of digitization and AI is no longer an option but a must. It is critical to guarantee that the benefits of technology are dispersed relatively throughout society and not only to a chosen few. We can ensure that everyone has the access, opportunities, and skills needed to adapt and succeed in an inclusive economy. In addition to promoting long-term growth, this inclusive approach protects against severe inequality, which, if left uncontrolled, threatens our social and economic stability.

The following policy recommendations should be considered:

- *Education Investment*: The country should invest in education, focusing on digital skills and critical thinking to ensure graduates succeed in an AI-driven industry.
- *Technology Regulation*: Governments must impose reasonable controls on emerging technologies to ensure that they are not abused and that everybody sees their advantages.
- *Support for SMEs*: Governments and communities must help micro, small, and medium-sized businesses expand by providing access to digital technology and suitable training.
- *International Cooperation*: Governments must work with other countries to establish global standards and policies that promote equitable growth.

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Observing the Digitalization of Digital Banking Ecosystem in Asia

7

Farah Wulandari Pangestuty and Ignatius Kuncoro Krisnugroho

Abstract

The significant development of digital technology has brought changes to all economic sectors, especially banking. The massive use of digital technology has also encouraged changes in lifestyle in society, requiring financial services from banks that are appropriate to the current era. Many digital services are offered by banks in order to increase competitiveness and cost efficiency. Technological disruption in banking also provides opportunities for large consumers in the Asian region but also has challenges and risks that need to mitigated.

Keywords

Bank · Financial Services · Risk · Technology

F. W. Pangestuty · I. K. Krisnugroho
Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia
e-mail: farah.wp@ub.ac.id

© Future Science Press. 2023
F. Prasetyia (ed.), N. Mulachelah (ed.), *Digital Transformation and Inclusive Economic Development in Indonesia*, https://doi.org/10.11594/futscipress7

7.1 Introduction

The rapid advancement of technology has undeniably led to an enormous change in people's lifestyles (Goldfarb & Tucker, 2019; ITU, 2022; UN. High-Level Panel on Digital Cooperation, 2019; Verhoef et al., 2021; World Bank, 2016). Things that were once challenging and complex have now been simplified and expedited, resulting in enhanced convenience and efficiency in daily life. This transformation certainly applies to the fulfillment of banking needs, where the existence of digital-based banking facilities now serves people. The banking sector has experienced significant transformation, transitioning from the conventional brick-and-mortar model to the more convenient and technologically advanced options of mobile applications and online platforms (Alkhowaiter, 2020; Alnemer, 2022; Rodrigues et al., 2023; Yusgiantoro et al., 2018).

The virus not only accelerated the adoption of digital financial services but also highlighted their significance during periods of crisis (Pierri & Timmer, 2021; Riza, 2021). Amidst the implementation of lockdowns and the enforcement of social distancing measures, individuals resorted to utilizing digital banking platforms as a means to conduct their financial transactions, facilitate payments, and engage in investment activities (Ahmed & Sur, 2023; Aniqoh et al., 2022; Septianurmayanti & Prasetyo, 2023; Sun et al., 2021). The outbreak of the pandemic has functioned as a catalyst for fostering innovation within the digital banking sector, compelling financial institutions to modify their strategies in order to sustain competitiveness within a rapidly evolving environment (Aniqoh et al., 2022; Baturante et al., 2022; Musyaffi et al., 2022; Rahmawati & Sagita, 2022; Schmidt-Jessa, 2022).

Within the dynamic digital economy, especially in the banking sector in Asia, competition is fierce as numerous players vie for a share of the sizable market (Li et al., 2020). The existence of a varied and expanding population within the region offers significant potential for expansion to digital banking institutions. Furthermore, there has been a notable shift in the buying behavior of consumers, with a growing tendency to embrace and incorporate user-friendly features (Aniqoh et al., 2022; Grabner-Kräuter & Faullant, 2008; Mi Alnaser et al., 2023). Nevertheless, pursuing these opportunities requires a cautious approach to effectively managing the associated risks and obstacles. In order to prosper in the current landscape, digital banks must effectively tackle crucial matters such as regulatory frameworks, security concerns, and trust among consumers (Aghdam et al., 2022; Damenshie-Brown & Ofosu-Ampong, 2022; Kaur & Arora, 2021; Revathi P., 2019; Wijaya & Halim, 2022). This book

chapter aims to examine the digital banking landscape in Asia, focusing on the opportunities, risks, prospects, and challenges encountered by developing countries as they endeavor to leverage the digital banking revolution.

7.2 Transformation of The Banking Sector Through Digital Technology

Digital banking refers to providing banking services through digital or online channels using mobile applications, websites, and other online platforms. In simple terms, the definition of digital banking is a form of banking that allows customers to carry out financial transactions, access account information, and manage finances via smartphone, tablet, or desktop.

The initial stage of digital banking can be traced back to the beginning of the 20th century when the computerized process was first applied. Here are some brief overviews of each milestone:

- *Early Origins (1950s-1970s)*: Early Origins (1950s-1970s): The roots of digital banking can be traced back to the mid-20th century when banks first began experimenting with electronic data processing and computers (Osei et al., 2023). In the 1950s and 1960s, they used these early computers to automate processes like ledger balancing and check processing. As they found that the slow and expensive computers of that era were more cost-effective compared to employing a large number of clerks to carry out those processes manually, they decided to embrace computer technology to automate many aspects of their operations during the 1960s and 1970s. (Anderson, 2001).
- *Emergence of ATMs (1970s)*: The 1970s witnessed a significant milestone with the introduction of Automated Teller Machines (ATMs). These machines initially served as cash dispensers, and by the 1970s, ATM technology had evolved into the system we are familiar with today (Chorafas & Steinmann, 1988; Hayashi et al., 2017). These machines allowed customers to withdraw cash and perform basic transactions without visiting a physical bank branch. It marked the first step toward digital self-service banking.

- *Advent of Telephone Banking (1980s)*: During the 1980s, telephone banking gained prominence as banks began to offer telephone-based services (Dermine, 2016). Customers could access their accounts and perform transactions using touch-tone keypads over the phone. This represented another early form of remote digital banking.
- *Rise of Online Banking (1990s)*: The 1990s brought about the advent of the internet, which transformed banking significantly. Online banking history can be traced back to the mid-1990s, when internet usage was unpopular (Fang & Zhan, 2010). Banks launched websites, enabling customers to check balances, transfer funds, and pay bills online. Online banking paved the way for a more user-friendly and convenient banking experience.
- *The 2000s: Mobile Banking and Fintech*: In the 2000s, mobile phones became increasingly prevalent. Banks developed mobile banking apps, allowing customers to manage their accounts and conduct transactions on-the-go. Simultaneously, the fintech (financial technology) revolution began, introducing innovations such as peer-to-peer lending, digital wallets, and robo-advisors.
- *2010s: Fintech Disruption and Regulatory Response*: The 2010s saw the fintech industry disrupt traditional banking models (IMF, 2022). Fintech startups offered consumers alternative banking services and challenged established institutions. Banks responded by enhancing their digital offerings, and regulatory bodies introduced new rules and guidelines to oversee the fintech and digital banking sector.
- *The COVID-19 Acceleration (2020s)*: The COVID-19 pandemic accelerated the adoption of digital banking (OJK, 2021). Lockdowns and social distancing measures made digital banking services a necessity. Consumers increasingly turned to mobile apps and online platforms for their financial needs, including contactless payments and digital wallets.
- *Modern setting*: In the current digital banking environment, mobile banking apps, electronic wallets, and online payment platforms have become basic needs for everyday financial activities. Massive technological inventions like blockchain and cryptocurrencies have also introduced new possibilities, although they have regulatory challenges. Additionally, digital identity verification and biometric authentication methods are enhancing security and user convenience.

Banking technology has had a significant impact on the industry, revolutionizing the way we manage our finances. It has made banking more convenient and accessible, with online and mobile banking features.

Adopting financial technology has also contributed to banks' profitability rather than being a distraction. Investment in information technologies by banks has improved their ability to produce and transmit soft information and enhanced their complex information processing capacity. The rise of digital transformation and innovative financial technology applications has posed challenges to traditional banks, leading to the need for strategies such as customer retention, customer acquisition, banking as a service, and social media payment platforms. Electronic banking services have become increasingly important, providing customers convenience, efficiency, and improved banker-customer relationships. Banking technology has transformed the industry, making banking services more accessible, efficient, and customer-centric. Digitalization in the banking sector has become increasingly important due to the modern problems and opportunities faced by the industry. Banks are transforming their services by incorporating digital channels, new data warehouses, and advanced analytics. This digital transformation allows for improved customer service, increased transparency, and faster and more reliable transactions. The development of e-banking services has had a significant positive impact on bank performance, particularly in terms of cashless payments and mobile transactions. However, the digitalization of banking services has also presented challenges, such as the reluctance of customers to fully embrace digital transactions and the need for improved network support. Despite these challenges, financial institutions have recognized the potential of social media as a tool for customer service and revenue generation. Banks can expand their reach, improve customer knowledge, and establish dynamic communication with their clients using social media platforms.

7.3 Competition and Challenges of Digital Banking in Asian

Digital banking has experienced significant growth and transformation in recent years, especially in the Asian region, driven by technological advancements and the increasing use of smartphones and the Internet. It has become vital for creating customer value and enabling cashless transactions, especially during the COVID-19 pandemic. Digital banking has posed challenges for traditional retail banks, leading to the emergence of digital banking firms and Fintech companies. Established banks have

forced these new players to adopt digital technologies quickly to remain relevant and retain customers. The adoption of artificial intelligence (AI) has been particularly prominent in the banking sector, providing various benefits and improving customer satisfaction. Overall, digital banking has revolutionized the way financial transactions are conducted, offering customers convenience, efficiency, and a wide range of services as technology develops.

The rapid development of technology in the Asian region has also adjusted people's lifestyle patterns. Changes in lifestyles in accommodating technological developments can be seen from the increased penetration of digital technology, which also encourages high online transactions. The high growth of internet users can be seen from more than 20% of internet users in the Southeast Asia region of 460 million users who have become online in the last three years. The Covid-19 pandemic that hit the world has also increased and accelerated internet user penetration. The high level of online transactions and penetration of digital technology bring auspicious opportunities for developing digital technology. The high penetration of technology and the growth of internet users in Asia has made digital banking grow significantly. Digital banking is considered to meet customer needs for technological changes that make transaction needs faster without being limited by space. BCG data (2021) shows that the Asia Pacific region is home to many digital banks. Around 50 of 249 digital banks worldwide are in the Asia Pacific region. However, only 13 digital banks are making profits, with ten digital banks in the Asia Pacific region. The dominance of digital banks with significant income levels in the Asia Pacific region shows that the Asia Pacific region has great potential for the digital banking ecosystem. The growth of digital banks in the Asia Pacific region is classified as very fast, showing that, apart from the Asia Pacific region having great economic potential, it can also face market competition.

Digital banks are facing increasing competition in the market. The rise of Information Communication Technology (ICT) and Fintech challenger banks has disrupted traditional banking models and transformed the industry. While financial factors still significantly influence market share, ICT factors, such as IT center operations and IT scandals, play an essential role in determining bank competitiveness. The existence of digital currency, especially cryptocurrency, issued by companies that are not banks can also impact competition between banks, affecting interest rates on loans and fees charged by banks. Cryptocurrency investors do not view central bank digital currencies (CBDCs) as a threat and positive stances on CBDCs are seen as favorable signals for other digital currencies. Non-

banking financial technology services also increase competition in the financial services sector. Fintech has significantly impacted the banking industry, leading to changes in how financial services are provided and increasing competition from non-financial institutions. Banks have started to invest in fintech and explore innovative solutions to stay competitive. The relationship between fintech firms and banks has evolved, with collaboration and competition observed. The rise of fintech has prompted banks to rethink their service distribution channels and increase investment in technology. However, there are also risks associated with fintech development, which regulators and banks must address. The academic literature has focused on understanding the benefits and pitfalls of fintech lending, including the interplay between technology and bank regulations, the role of fintech firms as competitors or complements to traditional bank lending, and investors' behavior in fintech lenders. Digital banking and fintech have revolutionized the financial industry by providing convenient, accessible, and cost-effective solutions to users. However, along with its benefits, there are concerns regarding privacy, security, consumer protection, ethical considerations, and regulatory compliance. Fintech has given rise to various segments, such as online payments, P2P lending, robo-advice, and blockchain, which have revolutionized traditional finance but also come with limitations. Fintech startups with cutting-edge technologies have disrupted traditional banking models and provided benefits such as enhanced accessibility, convenience, and personalized experiences. The concept of "Fintech in the Metaverse Banking" allows individuals to carry out financial transactions in virtual settings, providing a digital replica of a bank's assets and automated processes. The growth of fintech startups globally and in Ukraine has led to positive dynamics in the digital transformation of the banking sector, with cooperation between banks and fintechs enabling the use of innovative products and the development of a fintech ecosystem.

According to BCG (2021), three essential keys play an important role in the success of digital banks: leveraging assets, building and scaling the bank, and sustaining progress. Leveraging assets is strongly influenced by how consumers recognize digital bank branding and the advantages of a digital ecosystem that synergizes to expand the scope of services and develop available financial services. Building and scaling the bank affects the performance of digital banking with a value that reflects being able to meet consumer expectations according to technological developments, the use of technology that increases flexibility and expansion of services, and a dynamic organization. Sustainable business development triggered by data-driven to improve the quality of decision-making analysis, risk

management, and product structure that supports operating profit. The high development of the digital economy, especially in developing countries with high levels of digital consumption and adoption, creates opportunities for developing digital financial services, especially digital banks. The massive development of technology and changes in people's consumption patterns have made banks continue to innovate by digitalizing. The demand for technology adoption is something that must be met in order to remain able to survive in financial services competition. Competition in the financial services sector due to technological developments takes work. Very rapid technological disruption also puts pressure on the financial services sector, primarily through financial technology companies, which offer various advantages compared to financial services companies, especially conventional banking. Financial technology companies oriented toward digital technology make it easier for these companies to penetrate the market by taking advantage of the momentum of digitalization in society. The large number of financial services companies in the financial services sector amidst changes in consumption patterns and technology means that banks not only compete with other banks but also have to focus on competition with digital banks and financial technology companies. In general, banking continues to focus on technology development.

Digital bank technology has become a significant focus in the banking industry, with financial institutions leveraging digital technologies to offer more convenient services to their clients. The rapid development of technology, especially during the Covid-19 pandemic, has accelerated the adoption of digital banking services. Digital transformation in the banking sector has opened up new development opportunities and has allowed banks to offer a broader range of payment methods. Implementing digital technologies in banking has improved performance management by providing real-time data, increasing the number of data sources, and reducing the risk of data manipulation. Digital banks are characterized by integrated big data, agile teams, automation processes, cloud computing, machine learning, and artificial intelligence. These technologies could enhance the efficiency and productivity of banking activities. Overall, digital bank technology is revolutionizing the banking industry and providing customers with more convenient and efficient banking services.

7.4 Opportunities and Risk of Digital Banking in Asia

There are two characteristics of digital banks according to the type of formation: digital banks that have adopted technology ultimately since their inception, and digital banks that were formed from the development of conventional banks by establishing new business units or developing digital aspects in the bank's business lines. The business model for establishing a digital bank is significant for the performance opportunities and potential risks that can occur. Digital banks (the development of conventional banks) were later strengthened by digital technology. This advancement can result in forming new business units with advantages in capital and branding aspects they already have.

Digital banks originating from conventional banks' development have a good reputation and branding which consumers know about the parent company. Branding that is close to consumers means that digital banks, which are the result of the development of conventional banks, will be able to acquire customers more efficiently so that the costs required for carrying out promotions can be reduced more efficiently. The ease of consumers accepting digital banks resulting from the development of conventional banks will make it easier for consumers to accept digital bank products. Another advantage obtained is that digital banks formed from conventional banks or have a parent company tend to have a more stable capital capacity, making it possible for them to be better able to survive in the face of competition. The formation of a digital bank that originates from the development of a conventional bank generally requires a significant investment in developing human resources and the use of initial digital technology, so the formation of a digital bank resulting from the development of a conventional bank may require a more significant investment when compared to a digital bank that focuses on the use of technology. Massively digital since its inception.

Digital banks that have focused on the massive use of digital technology since their inception have the advantage of using resources as efficiently as possible, reducing the investment costs required. Having a comprehensive plan for the use of technology from the start means that a bank that has been planned to be fully digital will have business process efficiency, for example, minimizing the need for branch offices and employees, so that it has the benefit of minimizing operational costs and initial investment. Newly formed digital banks have problems attracting customer interest or increasing public interest in using the products offered by the digital bank, so there is a tendency to use discount strategies or provide higher interest rates compared to other digital banks to get

consumers interested in using these product services. Digital banks carrying out aggressive promotions will provide very high deposit interest rates, even exceeding the guaranteed interest rates set by deposit insurance institutions. Several digital banks have also implemented daily interest rates to increase people's interest in placing their funds in the bank.

Digital banking carries various security, credit, and operational risks. These risks arise due to cyber security threats, fraud, transaction interruptions, and unauthorized account access. Third-party funds (TPF) negatively affect credit risk and profitability in digital banking, while credit risk partially mediates between TPF and profitability. To combat these threats, digital banks need to implement efficient security systems involving multiple verifications, authentication processes, and data encryption. Risk management is crucial for digital banks to address potential risks and ensure the success of digital banking expansion. The challenges in digital banking can be addressed by applying innovative products, such as voluntary insurance, which can boost customer confidence and promote the growth of digital banking.

The development of digital banks is inseparable from potential risks. Digital banks have used several approaches. Bank risk is a topic explored in several of the abstracts provided. According to Biswas et al. (2006), there is a theoretical nexus between bank sustainability and bank risk, with sustainability having a risk-mitigating effect. Dick-Nielsen et al. (2023) argued that increased capital requirements do not necessarily lead to decreased bank equity risk, as banks may shrink their excess capitalization in response. Puspitasari and Rachmawati (2023) analyzed the health of national private foreign exchange banks and found that these banks exhibited a healthy condition overall. Hui's research showed that banking competition and agglomeration impacted bank credit risk. Macroprudential regulatory policies should consider these factors. Chen, Lee, and Liu investigate the relationship between macroeconomic risk, bank liquidity, and bank risk, finding that risk and liquidity are positively related in high-risk environments. One approach is to prioritize risk management in the use of information technology. It involves implementing security controls and measures to protect against fraud, processing errors, system disruptions, and other unanticipated events.

Additionally, digital banks can leverage the resources of other companies as part of their value chain without having to own them, which can help mitigate risk by spreading it across multiple entities. Furthermore, banks can address security concerns by swiftly and sophisticatedly dealing with digital banking crimes, thereby maintaining the credibility of digital banking services. By adopting these measures, digital banks can minimize

the risks associated with digital banking and provide their customers with a secure and reliable banking experience.

The development of financial technology (fintech) significantly impacts bank risk-taking and risk management. Fintech innovations, such as off-balance-sheet business innovations and fintech services adopted by banks, can improve bank risk management processes and reduce the willingness to transfer risks, thereby reducing bank risk-taking behavior. Additionally, fintech can effectively reduce banks' risk, mainly operational efficiency, financial innovation, and risk management. The adoption of fintech services and the growth of fintech firms have been found to reduce risk-taking behavior and increase bank stability. These findings highlight the complementary relationship between fintech development and traditional banking, emphasizing the importance of financial supervision and risk control in the banking industry.

The tight competition between banks and other financial service institutions, which also makes digital banks provide interest rates, may cause difficulties for digital banks in disbursing credit because interest rates are higher than other financial service institutions. In general, deposits in banking are guaranteed by deposit insurance institutions, which will increase customer confidence as long as the guaranteed deposits comply with the requirements guaranteed by the savings insurance institution. The guaranteed requirements include, among other things, that the interest rate on deposits provided by banks to customers is under the interest rate set by the deposit insurance agency. The interest rate and nominal amount guaranteed by the deposit insurance institution are determined to avoid the high risks banks take to gain profits through their business. Deposit insurance and other institutional and economic variables can affect the interest rate spread in the banking system, which may indicate inefficiency or market power in this sector. The introduction of deposit insurance can increase the lending-deposit spread in banking, mainly due to an increase in the lending rate, suggesting the presence of moral hazard problems related to this instrument.

Additionally, the ability of the public sector as the guarantor of last resort (GLR) to help banks or guarantee their liabilities can impact the sensitivity of interest costs to bank fundamentals. Increased levels of GLR risk may foster market monitoring by depositors. The interest rate risk exposure of banks and deposit insuring agents is poorly understood, but empirical results suggest a link between the two. Overall, deposit insurance and the role of the public sector as a guarantor can influence deposit interest rates and the spread of the banking system. Deposit insurance

institutions are essential in increasing customer confidence and reducing systemic risks from digital bank business activities.

Just like various factors influence conventional banks, digital bank lending. One crucial factor is the return on assets, net interest margin, and bank liquidity. Another factor is the introduction of the SME Supporting Factor (SF), which allows banks to reduce capital requirements for credit risk on exposures to SMEs. This policy measure has been found to alleviate credit rationing for medium-sized firms rather than for micro/small firms. Additionally, changes in credit supply and demand for loans are reported by banks and play a role in new credit developments. The size of the bank also affects loan growth, with larger banks having a positive impact on loan growth, but the interaction between bank size and interest rates is insignificant. Bank credit distribution plays a vital role in bank revenues. Various factors influence bank profitability. These factors include poor loan quality and the inability to leverage rising deposit volumes effectively. Other factors that affect profitability include banking ratios, funds interest rate, interest spread, fee-based income ratio, and inefficiency ratio. Internal factors such as bank size, capital adequacy ratio, management efficiency, income diversification, liquidity risk, and credit risk also play a role in determining profitability.

Additionally, macroeconomic variables like GDP growth and inflation impact bank profitability. In the case of Islamic commercial banks, internal factors such as BOPO, NPF, and FDR significantly affect profitability, while external factors such as inflation do not have a significant effect. Understanding and managing these factors is crucial for banks to maintain and improve their profitability. Massive digitalization has forced economic actors to adjust their business forms, forcing banks to adjust their business activities.

7.5 Key to Success for Digital Banks

Digitalization results in significant banking changes and encourages economic ecosystem changes, thereby creating opportunities for economic actors, primarily digital banks. Digitalization has a significant impact on household consumption. The digital economy is changing the traditional understanding and essence of consumption, and it is necessary to modernize the current theoretical approach to personal consumption to account for the many factors that affect it. Digital financial inclusion (DFI) in China has positive and negative effects on household consumption

smoothing. While households can smooth approximately 70 percent of transitory income shocks, DFI still needs to improve its ability to insure against these shocks. Online purchases may lead to oversensitivity of consumption to income, and traditional financial sector development contributes to better household consumption smoothing. Digitalization also affects household energy consumption. The results of panel regressions show an inverse relation between the popularity of certain internet activities and energy consumption. Internet activities such as internet calling, reading online newspapers, and activities on social media networks lead to lower energy consumption.

In contrast, other activities, such as reading emails and online purchases, do not significantly impact. Digitalization has both positive and negative effects on household consumption and energy consumption. The high penetration of digital technology influences the development of digital transactions, which can be seen from the size of e-commerce in a country. Banks and financial firms can learn from e-commerce to develop and market their products to customers. They can also offer new products and services to meet emerging e-commerce needs. However, banks are finding that new opportunities in e-commerce bring new operational and strategic risks. Alongside the growth in online shopping, card fraud continues to climb, and it is suggested that best practice techniques developed for online banking security should be extended to online shopping. The banking industry is responding to the rapid development of online commerce by delivering credit and deposit products electronically and developing products exclusively for e-commerce. However, they need to catch up in seizing the emerging opportunities in this area. Some financial institutions have started numerous e-commerce initiatives to expand their business and explore new revenue sources beyond traditional banking.

The banking industry is responding to the development of online commerce by delivering credit and deposit products electronically. Some banks are even developing products exclusively for e-commerce. However, as banks enter the electronic arena, they face new operational and strategic risks. On the other hand, the invention of an e-commerce-oriented online credit method and system aims to provide a light asset, no pledge, high efficiency, and an automatic credit processing system for clients. The system evaluates credit applications based on store and historical sale information to determine whether to loan and calculates the credit ceiling for approved applications. A credit rating index system has also been established for loan enterprises in online supply chain finance. This system uses a multi-level gray evaluation model to comprehensively

evaluate loan enterprises' credit and enable banks to take specific risk control measures. Emerging protocols and technologies are also being developed to eliminate card fraud and provide alternative Internet payment methods to compete with credit cards.

7.6 Conclusion

Massive digitalization creates significant new opportunities for digital banks through the growth of the digital economic ecosystem, which can be seen from the fast growth of e-commerce. The swift growth of e-commerce shows that the level of consumption is very high. The digital financial ecosystem is developing in Asia, especially digital banking. The large number of digital banks in the Asia Pacific region making profits, compared to digital banks in other regions, shows that the Asia Pacific region has high potential for digital financial development because it is supported by massive digital penetration, which can increase household consumption. Increasing household consumption, primarily through encouraging e-commerce, will create opportunities to provide credit facilities and other financial services to generate profits for digital banking. Digital banking is the party that benefits from the development of e-commerce because it has a different orientation that supports digital transactions, different from conventional banks. The adaptation of digital banks in providing technology-based microfinance services and supporting financial services for e-commerce transactions allows digital banks to penetrate the market in line with the development of digital technology and e-commerce users. The high opportunities for digital banking also increase potential risks, especially in facing competition between banks and other financial service institutions. The openness of digital banks in minimizing possible risks must be done with open communication with consumers to increase customer trust. In summary, the ongoing evolution of digital banking has implications for increasing convenience, efficiency, and inclusiveness within the financial sector. This finding is expected to drive further development as the industry continues to evolve and adapt in response to technological advances and changing consumer preferences.

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Building a Sustainable Future: AI-Driven Economic Governance for Development

8

Faishal Fadli and Vietha Devia SS

Abstract

The 21st century is marked by interconnected global challenges, with climate change taking center stage. In this context, economic governance plays a pivotal role in promoting sustainability. The integration of artificial intelligence (AI) offers the promise of data-driven insights and predictive capabilities to guide informed policy decisions, ultimately steering societies toward resilience and sustainable development. While these technological advancements hold great promise, they also exacerbate economic inequality. However, AI-powered economic governance has the potential to act as an equalizer by enabling targeted interventions and inclusive social safety nets. It empowers governments to design progressive tax policies and innovative job training initiatives. Furthermore, AI-driven economic governance facilitates agile policymaking, ensuring timely responses to emerging economic trends. Ethical considerations are essential in this transformative journey. Responsible and inclusive AI deployment requires transparency, fairness, and accountability. This book delves into these ethical complexities, offering insights into the delicate balance between technological progress and societal well-being. AI technologies have revolutionized various industries, but their potential in economic governance remains largely untapped. AI offers an opportunity for a paradigm shift in economic governance, providing data-informed, agile, and forward-thinking approaches. Its strength lies in its ability to swiftly and accurately analyze vast datasets, enabling proactive measures to mitigate risks and real-time policy adjustments.

F. Fadli · V. D. SS
Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia
e-mail: faishalfadli@ub.ac.id; vietha.devia@ub.ac.id

© Future Science Press. 2023
F. Prasetyia (ed.), N. Mulachelah (ed.), *Digital Transformation and Inclusive Economic Development in Indonesia*, https://doi.org/10.11594/futscipress8

AI-driven governance can optimize resource allocation and tailor interventions to address specific challenges, such as economic inequality, while minimizing human biases in decision-making, promoting fairness and transparency. "Building a Sustainable Future: AI-Driven Economic Governance for Development" explores AI's role in economic governance through case studies and expert insights. Sustainable development, which seeks to harmonize economic progress, social equity, and environmental preservation, can benefit significantly from AI's data-driven approach. By embracing AI as a catalyst for equilibrium, we can work toward a future where economic growth, social inclusion, and environmental stewardship coexist. AI excels in economic governance by addressing inequalities and social exclusion, while ensuring responsible and equitable AI adoption remains a priority. This book envisions a future where AI maximizes benefits while minimizing adverse consequences, shaping a better world for future generations.

Keywords

AI-driven economic governance · Climate change · Data-driven insights · Ethical considerations · Sustainable development

8.1 The Imperative for Change

The 21st century confronts us with interconnected global challenges, with climate change standing out as a pressing concern. The devastating impacts, including rising temperatures and extreme weather events, necessitate immediate action. Economic governance becomes pivotal in promoting sustainability, and the integration of AI offers hope by providing data-driven insights and predictive capabilities for informed policy decisions. This can guide societies toward resilience-building measures and sustainable development (Cheng & Zeng, 2023)

Simultaneously, economic inequality persists, exacerbated by technological advancements and automation. Job displacement and wealth concentration are prominent issues. AI-powered economic governance can be an equalizer, enabling policymakers to craft targeted interventions and inclusive social safety nets. AI's data analysis capabilities empower governments to design progressive tax policies, focused social programs,

and innovative job training initiatives to foster inclusive economic growth. Additionally, as rapid technological changes reshape industries, AI-driven economic governance facilitates agile policymaking, ensuring timely responses to emerging economic trends. Governments can leverage AI algorithms to forecast economic scenarios, optimize resource allocation, and adapt regulatory frameworks to the dynamic economic landscape (Fitzgibbon, 2012).

However, ethical considerations must guide this transformative journey. Responsible and inclusive AI deployment necessitates transparency, fairness, and accountability in decision-making processes. Safeguarding data privacy and preventing AI systems from perpetuating bias or discrimination is crucial for building trust and public support. This book explores these ethical complexities, offering insights into the delicate balance between technological progress and societal well-being. Ultimately, "Building a Sustainable Future: AI-Driven Economic Governance for Development" aims to explore how AI can shape a better world. The book seeks to inspire collaboration and collective action through knowledge sharing, case studies, and expert perspectives, envisioning a future where economic development aligns with social progress and environmental stewardship. By embracing AI-driven economic governance, we can pave the way for a future marked by innovation, equity, and sustainability for all.

8.2 The Dawn of AI in Economic Governance

AI technologies have profoundly impacted various industries, from finance to healthcare, revolutionizing operations and possibilities. However, their potential in economic governance remains untapped mainly as traditional models struggle with the complexities of modern global challenges, including climate change, inequality, and technological disruptions. AI offers an opportunity for a paradigm shift in economic governance, providing data-informed, agile, and forward-thinking approaches (Slosser, 2021).

AI's strength lies in its ability to swiftly and accurately analyze vast datasets, offering policymakers a deeper understanding of economic trends and potential crises. It enables proactive measures to mitigate risks and real-time policy adjustments in response to changing economic conditions, enhancing resilience. AI-driven governance can optimize resource allocation and tailor interventions to address specific challenges, such as

economic inequality, leading to more effective poverty alleviation and reduced disparities.

Moreover, AI's impartial data processing minimizes human biases in decision-making, promoting fairness and transparency (Nissim & Simon, 2021). Ethical considerations are paramount, ensuring responsible AI implementation in alignment with societal values. In "Building a Sustainable Future: AI-Driven Economic Governance for Development," we explore AI's role in economic governance through case studies and expert insights, aiming to empower readers with a profound understanding of its potential. Together, we strive to contribute to a sustainable, inclusive, and prosperous future where AI aids economic governance for the benefit of all.

8.2.1 Case Study

8.2.1.1 Case Study 1: AI-Driven Energy Management for Sustainability

Country: Germany

Known globally for its dedication to renewable energy and combating climate change, Germany faced intricate challenges in managing its increasingly complex energy grid due to integrating renewable sources like solar and wind. These sources brought unprecedented variability, stressing the need for efficient energy supply and demand coordination. Traditional energy management systems were ill-equipped for this new paradigm, hindering Germany's transition to a more sustainable energy landscape.

In a significant step forward, the German government initiated a collaboration between leading AI researchers and energy companies to develop and implement an AI-driven energy management system (Ossewaarde & Gulenc, 2020). This innovative system utilized machine learning algorithms and real-time data from diverse sources to predict energy demand accurately and optimize the utilization of renewable sources. The result was a more stable and sustainable energy grid, reducing reliance on fossil fuels and greenhouse gas emissions. This achievement solidified Germany's position as a global leader in renewable energy adoption and climate-conscious initiatives, highlighting the transformative potential of AI and interdisciplinary collaborations in overcoming complex challenges and fostering harmony between civilization and nature.

8.2.1.2 Case Study 2: AI-Powered Agricultural Innovation for Sustainable Farming

Country: India

In India, a nation grappling with the dual challenge of feeding its growing population while mitigating the environmental impact of traditional farming methods, a transformative agricultural revolution was set in motion. Climate change and resource limitations threatened food security, prompting the Indian government to forge a pioneering partnership between agricultural experts and technology firms, resulting in a groundbreaking AI-infused agricultural initiative (Doshi & Varghese, 2022). This visionary endeavor leveraged AI-driven analytics, satellite imagery, and real-time weather data to provide farmers with personalized insights and recommendations covering crop planning, irrigation management, and pest control. By harnessing the power of AI precision agriculture, farmers gained the ability to optimize resource allocation, minimize water wastage, reduce chemical inputs, and significantly increase crop yields. This shift towards sustainable land management and enhanced productivity marked a transformative milestone in India's journey towards ecological balance and agricultural efficiency.

At the heart of this AI-powered agricultural revolution was the profound empowerment of farmers, particularly those at the grassroots level. The democratization of knowledge and technology ensured that even smallholders, who often faced the precarious balance between agricultural sustenance and vulnerability, could access data-driven insights. With this information, farmers could adapt their cultivation strategies, optimize resource utilization, and proactively address pest-related challenges. This initiative became a beacon of hope, heralding increased crop yields and fostering empowerment, resilience, and sustainable progress among farmers. Beyond revolutionizing farming practices, it symbolized India's unwavering commitment to bridging the gap between technology and tradition, innovation and conservation. It showcased the nation's proactive approach to environmental challenges, highlighting its determination to create a future where human sustenance harmoniously coexists with the planet's well-being. As the AI-powered agricultural innovation program continued to yield impressive results, its impact resonated far beyond the fields, inspiring a paradigm shift in how societies perceive the interplay between technology, nature, and progress.

8.2.1.3 Case Study 3: AI-Enabled Financial Inclusion for Economic Growth

Country: Kenya

In the intricate socio-economic landscape of Kenya, the pervasive challenge of economic disparities and limited banking access hindered progress and left marginalized communities on the fringes of prosperity. Traditional banking systems struggled to reach remote areas and underserved populations, casting a shadow over Kenya's quest for holistic development. In a remarkable partnership between fintech companies and AI experts, the Kenyan government initiated an AI-driven financial inclusion revolution (Mhlanga, 2020). This groundbreaking endeavor leveraged mobile phone data and advanced AI algorithms to assess individuals' creditworthiness. Utilizing insights from mobile data, this AI-driven innovation created alternative credit scores for those excluded from traditional credit systems. This empowerment led to the emergence of mobile-based banking channels and tailored microloan programs, providing previously unbanked individuals access to financial services.

The impact of this AI-powered financial inclusion initiative extended beyond economic growth, reshaping society's fabric. It fostered a thriving entrepreneurial ecosystem and supported small businesses by providing accessible credit. Additionally, it fortified societal resilience through access to savings and insurance services, breaking the cycle of poverty for many families. This venture highlighted the essential link between economic empowerment and societal equity, offering hope for a more just and compassionate world. As Kenya continued to embrace this AI-driven initiative, it served as a beacon of hope, illustrating the power of technology and empathy in bridging divides and nurturing prosperity for all.

8.2.1.4 Case Study 4: AI- Analysis of policy, ethics, and regulation

Country: China

In July 2017, China unveiled its 'New Generation Artificial Intelligence Development Plan,' a pivotal moment in its technological journey, aiming for global AI leadership by 2030 and catalyzing a trillion yuan AI industry transformation (Roberts et al., 2021). This blueprint not only emphasized technological advancement but also China's role in shaping global AI ethics and standards. This article delves into the socio-political landscape

and policy discourses behind China's AI strategy, offering a unique perspective on its narrative.

Our focus revolves around two key aspects: strategic sectors where China invests in AI and the concurrent ethical discussions surrounding its adoption. AI's transformative impact spans sectors like education, healthcare, manufacturing, and surveillance, redefining human interaction, economic landscapes, and governance paradigms. Amid this transformation, ethical debates emerge, questioning AI's responsible use in areas such as privacy, security, algorithmic bias, and accountability. As China positions itself as an AI leader, it carries the responsibility of establishing a global ethical framework.

Scrutinizing China's AI policy within its socio-political context reveals a complex and ambitious tapestry. It is not just about technological prowess but also a nation's vision, deliberations, and aspirations defining its role in the technological era. By exploring the threads connecting AI innovation, ethical responsibility, and societal transformation, we gain insights that transcend analysis, offering a glimpse into the essence of China's AI journey.

These case studies exemplify the transformative power of AI in driving sustainable economic governance. These countries have paved the way for a more inclusive, equitable, and prosperous future by harnessing AI technologies to address complex challenges and promote sustainable practices. These real-world examples showcase how AI-driven economic governance can unlock new possibilities, enabling nations to build a sustainable future for their citizens and the global community.

8.2.2 Expert Insight

8.2.2.1 Expert Insight 1: Philippe Aghion, Benjamin F. Jones, and Charles I. Jones, AI Ethicist and Economist

The emergence of artificial intelligence (AI) in the evolving economic landscape has profound implications for economic growth (Aghion et al., 2019). AI's ability to replicate human intelligence and automate tasks raises questions about the future of human labor and income distribution, fundamentally altering the essence of economic growth. Furthermore, AI's impact extends beyond automation, transforming innovation processes and potentially leading to rapid self-improvement, known as "singularities." These ideas, explored by visionaries such as Good, Vinge, and Kurzweil and later elaborated by Nordhaus, delve into their economic foundations, guiding future research.

Central to this exploration are questions that transcend the ordinary: How does the integration of AI and automation align with historical growth patterns and capital allocation? Can these patterns endure in the twenty-first century? The interplay of AI and automation also profoundly influences market structures and enterprise incentive systems, shaping internal organization and innovation. This narrative unfolds on two fronts: AI as a contemporary form of automation, tracing its lineage from historical instances to modern applications, and the concept of Baumol's "cost disease," highlighting the changing contributions of sectors with varying productivity growth rates to the national economy (Zeira, 1998; Acemoglu & Restrepo, 2018). Together, these aspects present a complex picture of growth and the distribution of economic benefits, inviting researchers, visionaries, and economists to explore the intersection of mechanization and creativity, where machines shape future economies and craft resonant harmonies through time.

8.2.2.2 Expert Insight 2: Rohit Nishant, Mike Kennedy, and Jacqueline Corbett, AI Economist and Environmental Policy Specialist

In the expansive realm of technological evolution, artificial intelligence (AI) emerges as a transformative force with vast implications, especially in addressing pressing environmental sustainability challenges. AI offers a promising solution in an era marked by ecosystem degradation and the looming climate crisis. This discourse focuses on advancing research and practical applications of AI for environmental sustainability, from optimizing processes to influencing behaviors and shaping an overarching framework for environmental governance.

Despite its potential, the fusion of AI and sustainability presents challenges, including reliance on historical data in machine learning models, the unpredictable nature of human responses to AI interventions, and amplified cybersecurity risks. These challenges open avenues for future research and innovation, requiring a multi-dimensional approach encompassing systems dynamics, design thinking, psychology, sociology, and economic considerations (Nishant et al., 2020). The fusion of AI and environmental sustainability represents a frontier of both promise and challenge.

8.2.2.3 Expert Insight 3: Anton Korinek and Joseph E. Stiglitz, AI Economist and Development Economist

In the grand tapestry of technological advancement, artificial intelligence and automation technologies hold both promise and shadow for global development (Korinek & Stiglitz, 2021). These swift technological strides have the potential to reverse the progress painstakingly etched by developing countries and emerging markets over the past five decades, leading to exacerbated poverty and deepening inequality. This juncture, where technological innovation intersects with equitable progress, demands our scrutiny.

These innovative technologies, while conserving labor and resources, can also exacerbate "winner-takes-all" dynamics, favoring developed nations. The bridge between prosperity and adversity hangs in the balance, threatening the well-trodden pathways to global economic integration for developing economies. Our mission is to understand the economic levers driving these developments and illuminate pragmatic policies that can navigate away from inequality's jagged shoals.

Mitigating the shadows cast by technological advancements requires economic policies that acknowledge the challenges developing and emerging economies face. This approach seeks to counterbalance innovations' labor and resource-saving nature by enabling these nations to harness the benefits. Beyond individual economies, global economic governance calls for reform, fostering an ethos of equitable prosperity. This moment challenges us to stand at the crossroads of innovation and equity, shaping progress into an instrument that harmonizes prosperity for diverse nations united in their aspirations.

These expert insights offer valuable perspectives on the transformative role of AI in economic governance for sustainable development. The experts emphasize the need for ethical considerations, interdisciplinary collaboration, inclusivity, and a balanced approach that integrates AI technologies responsibly to address the complex challenges of building a sustainable future. By learning from their wisdom and expertise, we can harness the full potential of AI-driven economic governance to create a more equitable, just, and prosperous world for generations to come.

8.3 Holistic Approach to Sustainable Development

Sustainable development, the core aspiration of humanity, seeks to harmonize economic progress, social equity, and environmental preservation. AI emerges as a potent tool in this quest, offering the potential to optimize resource allocation, minimize waste, and drive efficiency in economic governance, thereby advancing sustainable development.

AI excels in economic governance by uncovering hidden patterns within vast datasets, enabling the identification and rectification of inequalities and social exclusion. This insight informs targeted interventions and social programs, promoting social inclusion and reducing disparities. Furthermore, AI's capacity to foster innovation in emerging industries supports sustainable economic growth, shaping environmentally conscious sectors and technologies (Taeihagh, 2021).

AI's data-driven approach empowers evidence-based policymaking, enabling governments to craft adaptive, responsive, and future-oriented policies considering both short-term economic goals and long-term sustainability (Siau & Wang, 2018). As nations embrace AI in economic governance, they pave the way for a more inclusive, equitable, and environmentally conscious future. However, this journey entails challenges, including ethical considerations, data privacy, and bias mitigation.

In the forthcoming chapters of "Building a Sustainable Future: AI-Driven Economic Governance for Development," we delve into case studies and expert analyses, highlighting AI's potential and challenges in promoting sustainable development. This exploration aims to equip readers with a nuanced understanding of AI's transformative role, inspiring collaboration among policymakers, businesses, and individuals to craft a more sustainable and prosperous world. Embracing AI as a catalyst for equilibrium can lead to a future where economic growth, social inclusion, and environmental stewardship thrive together, forging a path toward genuine sustainability.

8.3.1 Best Practice 1: Multi-Stakeholder Collaboration

Building a sustainable future through AI-driven economic governance necessitates the active collaboration of multiple stakeholders. Policymakers, technologists, academics, civil society, and businesses must collaborate to co-create and implement AI-driven governance initiatives.

Multi-stakeholder collaboration ensures that diverse perspectives are considered, ethical concerns are addressed, and the benefits of AI technologies are shared equitably among all segments of society (Neupane & Echaiz, 2019). By fostering an inclusive and participatory approach, countries can develop AI-driven policies that resonate with the aspirations of their citizens, promote sustainable development, and create a sense of collective ownership in shaping the future.

8.3.2 Best Practice 2: Ethical AI Design and Oversight

At the core of AI-driven economic governance for sustainable development lies a commitment to ethical AI design and oversight. Governments and organizations must establish clear guidelines and standards for the responsible use of AI technologies (Dara et al., 2022). This includes ensuring transparency in AI decision-making processes, safeguarding data privacy, and implementing mechanisms to detect and rectify biases in AI algorithms. Regular audits and independent evaluations of AI systems can help identify and address potential ethical risks. Countries prioritizing ethics can build public trust in AI technologies, enabling responsible and sustainable integration into economic governance.

8.3.3 Best Practice 3: Data-Driven Decision-Making

AI-driven economic governance thrives on data-driven decision-making (Marda, 2018). Governments should invest in data infrastructure to enable evidence-based policymaking, including data collection, storage, and analysis capabilities. Data sharing and collaboration between government agencies and private entities can facilitate comprehensive insights and inform policy formulation. By harnessing the power of data analytics and AI algorithms, policymakers can predict economic trends, identify areas of intervention, and optimize resource allocation for sustainable development. Data-driven decision-making ensures that policies are adaptive, responsive, and tailored to specific socio-economic challenges, leading to more effective and impactful governance.

8.3.4 Best Practice 4: Investing in AI Education and Capacity Building

To fully leverage the potential of AI-driven economic governance, countries must invest in AI education and capacity building (Sey & Mudongo, 2021). Governments should prioritize equipping their workforce with the necessary skills to develop, implement, and regulate AI technologies. This includes AI literacy programs for policymakers and public servants and technical training for data scientists and AI experts. By fostering a culture of AI literacy and competence, countries can effectively navigate the complexities of AI integration, promote innovation, and adapt to the changing economic landscape. Investing in AI education and capacity building ensures nations can harness AI technologies as strategic tools for sustainable development and economic growth.

Building a sustainable future through AI-driven economic governance requires embracing best practices that foster collaboration, ethics, data-driven decision-making, and capacity building. By adopting these principles, countries can unlock the full potential of AI technologies to create an economically prosperous, socially inclusive, and environmentally responsible future. By embracing these best practices, nations can pave the way toward a more sustainable and equitable future for the betterment of humanity and the planet.

8.4 Empowering All Stakeholders

Sustainable development, encompassing economic progress, social equity, and environmental preservation, is humanity's core pursuit. AI emerges as a potent tool to synergize these dimensions for a balanced society. By leveraging AI in economic governance, resource allocation can be optimized, minimizing waste and enhancing efficiency, contributing significantly to sustainable development.

AI excels in economic governance by uncovering hidden patterns in vast datasets, addressing areas of inequality and social exclusion often overlooked by traditional models. This insight empowers policymakers to design targeted interventions, fostering social inclusion and reducing disparities. AI also drives innovation in emerging industries, guiding investments towards sustainable practices and green technologies, aligning industries with environmental goals for a resilient future.

Furthermore, AI's data-driven approach enables evidence-based policymaking, allowing governments to craft adaptive, responsive, and future-oriented policies. As nations embrace AI in economic governance, they set the stage for a more inclusive, equitable, and environmentally conscious future. Ethical considerations, data privacy safeguards, and bias mitigation are essential in this journey. "Building a Sustainable Future: AI-Driven Economic Governance for Development" explores concrete case studies and expert analyses, providing a nuanced understanding of AI's role in promoting sustainability. By embracing AI as a catalyst for equilibrium, we can forge a path toward a sustainable future where economic growth, social inclusion, and environmental stewardship thrive together.

This book, "Building a Sustainable Future: AI-Driven Economic Governance for Development," highlights the importance of collaboration and inclusivity in AI adoption. Through case studies and comprehensive analysis, we explore best practices and lessons learned from diverse contexts, showcasing how inclusive AI-driven economic governance can pave the way for a more equitable and sustainable future.

8.4.1 Case Study 1: Ghana's Inclusive AI for Agricultural Development

In Ghana, a pioneering initiative sought to leverage AI technologies to promote inclusive economic growth in the agricultural sector (Kugbe et al., 2019). Recognizing the importance of collaboration and inclusivity, the government partnered with local farmers, agricultural experts, AI researchers, and technology companies to develop an AI-driven platform. This platform gave smallholder farmers real-time weather data, market information, and agricultural best practices. By integrating the expertise of farmers and empowering them with AI insights, the initiative ensured that technology adoption was tailored to the specific needs and challenges farmers face. As a result, crop yields increased, income levels rose, and rural communities experienced sustainable development. The inclusive approach empowered farmers and strengthened collaboration between various stakeholders, showcasing the transformative potential of AI in economic governance when driven by inclusive decision-making.

8.4.2 Case Study 2: Kenya's AI-Driven Financial Inclusion for Empowerment

In Kenya, financial inclusion has been a critical driver of economic development and poverty reduction (Tiwari et al., 2019). The Kenyan government launched an inclusive AI-driven financial inclusion initiative to address the challenge of limited access to financial services in underserved communities. Policymakers collaborated with fintech companies, financial institutions, and civil society organizations to develop AI algorithms that assessed creditworthiness using alternative data sources, such as mobile phone usage patterns. This enabled previously unbanked individuals to access credit and other financial services, fostering economic empowerment and entrepreneurship. The collaboration ensured that the AI solution incorporated feedback from marginalized communities, leading to a more inclusive financial system that catered to their unique needs and circumstances. The success of this initiative exemplifies the transformative power of AI-driven economic governance when grounded in inclusive practices that prioritize the welfare of all citizens.

8.4.3 Case Study 3: Brazil's AI-Enabled Social Safety Net for Inclusive Development

In Brazil, where economic inequality has been a persistent challenge, AI-driven economic governance plays a crucial role in fostering inclusive development (Strusani & Houngbonon, 2019). The Brazilian government partnered with AI researchers, economists, and social welfare experts to design an AI-enabled social safety net. Using AI algorithms, the system identified vulnerable populations, assessed their needs, and delivered targeted social benefits and support. This collaborative approach ensured that the safety net reached those most in need, providing assistance to marginalized communities and improving overall socio-economic outcomes. By incorporating diverse perspectives and expertise, the initiative created a responsive and efficient social safety net, mitigating the impacts of poverty and enhancing social mobility. The collaborative and inclusive nature of the project showcased how AI technologies, when deployed with a focus on inclusivity, can drive transformative change in economic governance and foster sustainable development for all.

These case studies highlight the importance of collaboration and inclusivity in AI adoption for economic governance and development. By involving diverse stakeholders, including policymakers, experts, local communities, and technology innovators, these initiatives demonstrated how AI technologies can be tailored to specific contexts and address the unique challenges faced by different populations. Through collaborative and inclusive decision-making processes, AI-driven economic governance can unlock innovative solutions that promote sustainable development, reduce inequalities, and uplift marginalized communities, ultimately leading to a more equitable and prosperous future.

The integration of AI in economic governance is not a one-dimensional task. It requires the engagement of all stakeholders, who must work together to ensure that AI technologies are designed and deployed ethically. Transparency, accountability, and inclusivity serve as guiding principles that underpin AI-driven governance initiatives, enabling the benefits of AI to be shared equitably across society. By embracing this collective endeavor, we can harness AI's transformative potential to build a more inclusive, just, and sustainable future for all.

8.5 Addressing Challenges and Risks

AI-driven economic governance presents exciting opportunities for revolutionizing policymaking and advancing sustainable development. However, it also comes with a set of challenges and ethical considerations. Ensuring responsible and equitable AI adoption is paramount, requiring a delicate balance between innovation and ethics through collaboration among policymakers, businesses, and civil society (Goralski & Tan, 2020).

One critical ethical concern centers on bias and fairness in AI algorithms, as biased datasets can perpetuate inequalities in economic governance. Diversity in training data and ongoing bias detection and rectification are essential to be addressed, involving diverse stakeholders and rigorous testing to promote equity and inclusivity. Data privacy poses another significant challenge, with AI relying on vast data. Policymakers and businesses must prioritize data protection measures to respect privacy rights and comply with data security regulations while harnessing AI's potential effectively. Additionally, the potential for job displacement due to AI automation necessitates proactive strategies, such as reskilling and upskilling programs, to equip the workforce for the evolving economic landscape.

"Building a Sustainable Future: AI-Driven Economic Governance for Development" addresses these challenges by offering in-depth analyses,

expert insights, and case studies to foster a comprehensive understanding of AI's risks and mitigation practices. It envisions a future where responsible and collaborative AI adoption maximizes benefits while minimizing adverse consequences, enabling a sustainable, inclusive, and innovative future for all.

8.6 Navigating the Journey Ahead

In this book, we embark on a captivating journey to explore the dynamic interplay between artificial intelligence (AI) and economic governance. Through real-world case studies, expert insights, and thoughtful analyses, we comprehensively understand how AI can shape a sustainable and prosperous future within economic governance.

We highlight how AI is already driving positive change by examining concrete examples of AI applications. From optimizing resource allocation to addressing inequality and environmental challenges, AI acts as a catalyst for sustainable development. Expert perspectives add depth and context, offering insights into the opportunities and challenges ahead.

As we navigate the complexities of AI-driven economic governance, we recognize that today's decisions have far-reaching implications. Embracing AI's transformative potential opens unprecedented opportunities to build a future that economically thrives while preserving the environment. Through innovative economic policies, we envision sustainable growth, social equity, and ecological preservation.

This book aims to inspire policymakers, business leaders, and individuals to harness AI technologies for positive change. Our collective actions today can shape a future where economic prosperity coexists with social progress and environmental responsibility. By empowering readers with a deep understanding of AI's potential, we aim to spark meaningful discussions and drive collaborative efforts toward a sustainable future that benefits future generations. Let us embrace the profound potential of AI in shaping a better world for the future.

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Blockchain-based Digital Information Systems for Social Funds, Zakat, Infaq Alms, and Waqf Transparency

9

Dwi Retno Widiyanti

Abstract

Blockchain-based digital information systems can increase social fund, Zakat, Infaq alms, and Waqf transparency and accountability. Blockchain can boost philanthropy transparency. Blockchain records decentralized and transparent social fund, Zakat, Infaq alms, and Waqf transactions in an immutable and auditable chain. An immutable and auditable chain is created by linking transactions in blocks. This transparency lets stakeholders verify finances and resource allocation. Traceability and Accountability: Blockchain tracks funds from origin to destination. All contributors, recipients, and regulators can witness blockchain transactions. Transparency makes money allocation straightforward and prevents misappropriation and corruption. Automated Compliance Smart Contracts: Blockchain smart contracts automate Shariah and regulatory compliance. Smart contracts allocate funds depending on predefined criteria and automatically act when conditions are met. Human mistake and manipulation decrease, promoting openness and justice. Blockchain platforms can show contributors and beneficiaries financial flow in real time. Donations are tracked for openness and accountability. Beneficiaries can verify fund receipt and allocation, boosting system trust. Donor and receiver engagement and social impact grow with transparency. Blockchain facilitates audits and reporting. The blockchain records all transactions, simplifying and verifying financial reporting. Auditors can rapidly and

D. R. Widiyanti
Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia
e-mail: dr_wdy@ub.ac.id

© Future Science Press. 2023
F. Prasetyia (ed.), N. Mulachelah (ed.), *Digital Transformation and Inclusive Economic Development in Indonesia*, https://doi.org/10.11594/futscipress9

completely audit visible transaction history. Reduces time and improves financial reporting. Openness, immutability, and auditability of blockchain boost trust in social funds, Zakat, Infaq alms, and Waqf institutions. Transparent and responsible fund management with blockchain technology can boost donations, involvement, and charity efficacy. Strategy, cooperation, and legal and regulatory compliance are needed to implement blockchain technology. Data privacy and protection ensure confidentiality and openness. If applied effectively, blockchain technology can make social funds, Zakat, Infaq alms, and Waqf institutions more effective and sustainable.

Keywords

Blockchain · Islamic Social Funds · Transparency

9.1 Introduction

Islamic Social Funds, which encompass Social Funds, Zakat, Infaq, Alms, and Waqf, represent a charitable endeavor operating under the Islamic paradigm that possesses the capacity to exert a significant impact on the economy. Here is a closer look at these practices and their economic contributions, including three aspects of Zakat, Alms, and Waqf.

Zakat is a mandatory charitable giving within the Islamic faith (Omar & Khairi, 2021). The practice of giving a specified part, typically 2.5%, of an individual's income annually to designated beneficiaries, including the impoverished, those in need, creditors, and other groups outlined in Islamic jurisprudence. The collection and distribution of zakat have been identified as contributing to economic growth through many mechanisms, including poverty alleviation, income redistribution, increased consumption and demand within the economy, and subsequent job creation and entrepreneurship (Sarea, 2012; Putri, 2021). Zakat plays a crucial role in combating poverty by offering direct financial assistance to individuals in need, as highlighted by Zulfikri et al. (2021). Assisting individuals in meeting their fundamental necessities, enhancing their quality of life, and alleviating them from impoverished circumstances can be beneficial. Zakat serves as a mechanism for wealth redistribution, facilitating the transfer of

resources from individuals of higher socioeconomic status to those who are less fortunate. This practice aims to foster a more balanced and equal distribution of wealth within a given society. According to Khatiman et al. (2021), this intervention can potentially mitigate income inequalities and foster social equity.

Furthermore, the provision of zakat augments consumption and demand as the beneficiaries utilize the money they receive to fulfill their immediate need, thereby fostering consumption and demand within the economy. The potential effects of this phenomenon on enterprises and economic growth are likely to be favorable. According to Khasandy and Badrudin (2016), zakat, as a social welfare program, can be allocated towards providing social welfare services, including but not limited to healthcare, education, and housing. These activities not only enhance the welfare of individuals but also significantly contribute to the holistic advancement of society. The favorable environment created by the social-justice-oriented mechanism of zakat can be effectively utilized to bolster job creation and entrepreneurship initiatives. Such endeavors offer individuals the chance to generate income and attain self-sufficiency. This initiative fosters economic empowerment and facilitates the achievement of sustainable development goals.

Alms, often called Sadaqah in the Islamic faith, encompass voluntary acts of philanthropy and benevolence. Although Sadaqah is not considered a mandatory obligation like zakat, it is widely recommended and carries significant spiritual importance (Al-Manawi, 1990). Sadaqah has the potential to exert a positive influence on the economy through the following mechanisms. Emergency relief refers to the immediate assistance provided to individuals or communities in the aftermath of a disaster or crisis. It encompasses various forms of Sadaqah and has the potential to offer prompt aid during periods of emergency or occurrences of natural calamities. This intervention facilitates the recovery and reconstruction efforts of individuals and communities impacted by adverse events, thereby significantly contributing to broader economic resilience. Additionally, Sadaqah money can be employed for Community Development, encompassing various projects like vocational training, support for small businesses, and programs to enhance community capacity. These endeavors enhance the agency of individuals, facilitate self-reliance, and cultivate economic development at the local level.

The term "waqf" pertains to the Islamic custom of establishing an endowment, whereby a particular item, such as land, buildings, or finances, is allocated for charity objectives and maintained indefinitely. The administration of Waqf assets is entrusted to specifically appointed

trustees, who oversee the utilization of the generated income from these assets for diverse philanthropic initiatives. Waqf significantly bolsters the economy through several means, including infrastructure development, education and research, economic projects, and social services. According to Walaa (2021), the utilization of waqf assets can be directed towards the development and upkeep of vital infrastructure, including educational institutions, healthcare facilities, places of worship, and communal gathering spaces. This phenomenon leads to the stimulation of economic growth through the generation of employment opportunities and the enhancement of public infrastructure. Waqf monies can be allocated to assist educational institutions and research efforts. Investing in human capital development strengthens individuals' skills, knowledge, and ingenuity, thereby making a significant contribution to economic progress. The utilization of waqf has the potential to begin business ventures that yield financial returns and facilitate the creation of employment prospects. One instance of using Waqf land involves leasing to commercial enterprises, producing financial proceeds that can afterward be allocated towards philanthropic endeavors. The utilization of income generated by Waqf assets can be directed towards providing social services to marginalized populations, encompassing essential areas like healthcare, housing, and welfare initiatives. This phenomenon positively impacts the overall well-being of society and enhances the standard of living within localities.

The following analysis comprehensively explores the activities mentioned earlier and their implementation of digital information through blockchain technology in standard operations. Islamic Social Funds specifically concentrate on three dimensions: Zakat, Alms, and Waqf. Transparency and decentralization are necessary to facilitate and optimize Islamic Social Funds' economic contribution. There is a pressing need to introduce digital information systems in Islamic Social Funds Institutions in this modern era.

9.2 Digitalization in Zakat, Infaq, Alms, and Waqf

According to Oseni and Ali (2019), using technology in Islamic finance is not deemed problematic from a shariah standpoint. This is because *Fiqh Al-Muamalat* permits its usage unless there is clear evidence of its ban. Nevertheless, the management of Islamic Social Funds encounters particular challenges, such as inadequate transparency and accountability

in fund management, as well as a limited understanding among the general public regarding the need for this type of management (Ramadhan et al., 2023). Hence, the implementation of strategies and innovations is vital. In light of the advent of the digital era, it is imperative to introduce technological advancements to enhance the efficacy and efficiency of managing Islamic Social Funds. The effective administration of Islamic Social Funds plays a crucial role in attaining sustainable growth over an extended period. Therefore, implementing a digital system for managing social funds' finances emerges as an imperative necessity with far-reaching implications for the economic well-being of society (Amrial, 2021).

The advent of digital technologies has provided zakat organizations with opportunities to enhance the efficacy of their money management processes. Marzuki (2018) suggests that there are potential avenues for utilizing digital media in order to enhance zakat fundraising and effectively manage funds within Islamic Social Funds. According to Pramono et al. (2019), financial technology (fintech) platforms have the capability to facilitate the management of zakat, infaq, alms, and waqf monies through web-based interfaces and Android applications. One potential approach is to enhance the contribution process through digital platforms (Syarifudin, 2021). Digital donation platforms enable individuals to contribute funds promptly and efficiently, irrespective of their geographical location or time constraints, hence physically obviating the need to visit a contribution collection center. In addition, the utilization of digital technology enables the dissemination of donation information through various digital platforms, hence increasing accessibility to a larger audience (Rizky, 2023). According to Mediatama (2020), digital platforms can play a crucial role in facilitating, expediting, and broadening the circulation and utilization of money. Zakat institutions can potentially promote the adoption of digital platforms to facilitate zakat payments, hence enhancing individuals' economic empowerment. The increasing utilization of the internet and digital technologies has the potential to augment public engagement in philanthropic contributions and charity donations (Rizky, 2023).

The concept of waqf entails a contribution given by a follower of Islam in adherence to the principles of Islamic jurisprudence. This contribution is directed towards a designated fund manager, known as a nazhir, who assumes the responsibility of generating enduring advantages to foster a specific community's socioeconomic progress (Sukmana, 2020). The management of waqf necessitates a high level of openness due to its classification as a religiously motivated and publicly beneficial act.

Consequently, waqf administrators must be responsible not only to the waqif (the donor of the waqf) but also to Allah SWT.

According to Slamet Rusydiana and Devi (2018), enhancing the trust factor is of utmost importance in advancing cash waqf in Indonesia. Trust plays a significant role in determining consumer satisfaction within Islamic financial institutions, particularly in waqf organizations. Ab Shatar et al. (2021) underscore the importance of trust in the context of nazhir waqf. The results of their study suggest that having trust and faith in Nazhir has a favorable impact on the level of cash waqf contributions at Bank Islam Malaysia. The present findings are inherently interconnected with the findings of Ahmed et al. (2015), wherein it was seen that participants in their survey expressed a lack of trust towards the Islamic Religious Boards in Uganda. This lack of trust was primarily attributed to the perceived absence of transparency and accountability among the leaders of these institutions.

The establishment of accountability in the waqf sector in Indonesia has several challenges, such as the absence of an integrated waqf system and a dearth of transparency among nazhir (Astuti & Tanjung, 2019). Furthermore, it has been noted by Mansor et al. (2017) that Malaysian waqf institutions are confronted with the potential challenges of insufficient governance and accountability. Johan et al. (2016) assert that higher institutions in Malaysia have a mandate to examine the obstacles associated with openness in managing waqf. Various methodologies have been proposed to enhance the transparency of endowments, such as the establishment of waqf accounting (Hairul-Suhaimi et al., 2018), the implementation of effective governance practices in waqf institutions (Awaludin et al., 2018), the assessment of performance indicators for waqf institutions (Masruki et al., 2019), and the adoption of digital information systems (Rahmawati et al., 2021). These approaches aim to promote greater transparency in the management and administration of endowments.

The literature recognizes that implementing accounting practices, disclosure mechanisms, reporting procedures, and management strategies in the context of waqf institutions can contribute to improving their accountability. However, it is essential to note that there is currently a lack of accounting standards that align with waqf institutions' unique characteristics and operations (Hairul-Suhaimi et al., 2018). According to Awaludin et al. (2018), the presence of governance and the implementation of legislation pertaining to accountability in waqf institutions ensure that these institutions pay attention to legal and shariah compliance. However, it is necessary to establish a more efficient framework for accountability.

Performance assessment is a critical determinant in evaluating the responsibility of waqf institutions. However, it is worth noting that a considerable proportion of waqf institutions have yet to establish a formal system for measuring their performance. This can be attributed to their underwhelming financial performance, which suggests a lack of accountability within these waqf institutions (Masruki et al., 2019).

The digitalization of information systems within the waqf ecosystem encompasses various aspects, such as the digitization of waqf pledge records, the streamlining of nazhir registration procedures, and the implementation of digital financial management reporting. Additionally, digital technology has recently been integrated into the certification process for waqf land, utilizing the Geographical Information System and Regional Spatial Master Map. This integration serves to mitigate the occurrence of waqf contract fraud and promote efficient management of waqf assets by waqf institutions and nazhir. Nevertheless, the current Indonesian National Waqf Information System has encountered limitations in furnishing comprehensive data pertaining to the potential for enhancing waqf assets, the progress in developing such assets, and the equitable distribution of their benefits. This deficiency arises from the lack of integration between national waqf data and diverse sectors. Furthermore, the digitalization initiatives of waqf in Indonesia have primarily prioritized fundraising activities rather than the reporting of waqf assets (Rahmawati et al., 2021). The vulnerability of waqf assets to potential misappropriation for particular reasons undermines the trust of the general people in the custodians of waqf, hence weakening their faith.

9.3 Blockchain-based Digital Information Systems

According to Galen et al. (2018), blockchain technology is capable of offering financial accounting data that is transparent, reliable, and updated in real time. The enhancement of accountability and transparency is achieved by utilizing database sharing and the automated implementation of audits (Bitfury, 2016). The impact of blockchain technology on the global information technology sector has been significant, mostly attributed to its remarkable decentralization and security qualities (Wang et al., 2020). Consequently, the immutability of blockchain technology renders it resistant to manipulation, enabling the prevention of transactions

that deviate from their intended purpose as determined by the consensus of the blockchain network community.

Combining information system digitization with blockchain technology can overcome prior restrictions to promote waqf transparency. The effective digitization of information systems is expected to enhance the waqf system's openness and accountability, potentially leading to an increase in public confidence.

The healthcare sector has also adopted blockchain technology to manage patient data (Adere, 2022). Furthermore, utilizing blockchain technology enables the efficient segregation, aggregation, and monitoring of recyclable commodities and industrial waste in the supply chain (Khadke et al., 2021; Gong et al., 2022). Di Vaio et al. (2023) conducted a study. Implementing an intelligent contract system based on blockchain technology enhances transparency and mitigates instances of corruption within the financial and logistical sectors. A study conducted by Khan et al. (2022) showed that blockchain technology has a beneficial influence on the circular economy. The factors mentioned above contributing to this phenomenon include the transparency and visibility offered by blockchain technology, the utilization of smart contracts, and the establishment of efficient relationship management practices across many sectors.

Integrating blockchain technology in the context of precise Islamic Social Funds management information systems facilitates enhanced transparency in management processes. Despite the advancements in blockchain technology's impact across multiple industries, there is a notable absence of literature reviews exploring the correlation between blockchain technology and Islamic Social Funds.

9.3.1 Blockchain-based Digital Information Systems for Islamic Social Funds Transparency

Blockchain is an effective instrument for ensuring the transparency and integrity that Islam promotes in all transactions. Blockchain technology has the potential to offer participants and recipients immediate access to information regarding the movement of funds. Implementing a system to monitor and record donations promotes openness and accountability. The verification of receipt and allocation of funds by beneficiaries serves to enhance trust in the system. The implementation of transparency practices has been found to enhance the level of involvement between donors and

recipients, hence leading to a more significant social impact (Unal & Aysan, 2022).

According to Bernstein (2012), transparency encompasses the highest degree of openness and clarity regarding an organization's rules, practices, and actions. In accordance with Ball's (2009) definition, transparency is characterized as the capacity to access and comprehend information readily.

Numerous esteemed organizations, including the United Nations and the World Bank, have acknowledged the significance of transparency in diverse domains of human existence. As an illustration, the World Bank has advocated for enhanced transparency in procurement procedures by implementing the Open Contracting Initiative. This initiative aims to facilitate public access to comprehensive and readily available information pertaining to public contracts (World Bank, 2020).

Numerous scholarly investigations have demonstrated that transparency holds significant potential to enhance the accountability and efficacy of an organization. According to the study conducted by Chan et al. (2012), it was discovered that enhanced information disclosure has the potential to enhance the efficacy of supervision while simultaneously mitigating instances of fraud and economic crime. In a study conducted by Bertot et al. (2012), it was shown that implementing transparency measures in public services has the potential to enhance public confidence and foster greater public engagement in the decision-making process.

Hence, the utilization of Blockchain technology in digital information systems has significant promise in augmenting openness and accountability within the administration of Islamic Social Funds. There is a scarcity of research pertaining to the utilization of blockchain technology as a means to address the obstacles associated with accountability and transparency. Hence, it is worth noting that a considerable portion of individuals remain unaware of the potential of this technology to enhance accountability and transparency in the administration of Islamic Social Funds, as highlighted by Mohaiyadin et al. (2022). This paper explores the potential application of blockchain technology to enhance transparency in philanthropy operations:

- *Immutable and Transparent Transactions*: Blockchain offers a decentralized ledger with no interference, thereby reducing the possibility of human error (Fischer, 2018; Rabbani et al., 2020). Additionally, it provides a transparent ledger that facilitates the recording, tracing, and verifying all transactions associated with Islamic Social Funds by relevant stakeholders. According to Chong

(2021), every transaction is recorded within a block and interconnected with preceding blocks. Consequently, any modification to a single block will alter the hashes or unique identifiers of all preceding transactions (blocks) and their corresponding cryptographic validations. Therefore, it is establishing a permanent and verifiable sequence of transactions.

- *Traceability and Accountability*: Blockchain technology enables tracking funds throughout the process, from collection to distribution, regardless of location. This technology allows for the seamless tracking of funds throughout the entire process, encompassing collecting and distribution stages, irrespective of their geographical location (Elghaish et al., 2020; Zulfikri et al., 2021). All transactions that are documented on the blockchain are characterized by transparency and accessibility to all involved parties, encompassing donors, beneficiaries, and regulatory entities. According to Taufiq (2015), transparency is an essential requirement for the effective implementation of accountability. The increased transparency contributes to the promotion of accountability by facilitating the verification of the appropriate allocation of money in accordance with their intended goals, hence reducing the likelihood of misappropriation or corruption.
- *Streamlined Reporting and Auditing*: Blockchain-based systems ease the reporting and auditing procedures (Zulakiha, 2018; Muneeza & Nadwi, 2019). Due to the comprehensive recording of all transactions on the blockchain, financial reporting processes may be optimized and rendered responsible in real time. This facilitates a reduction in administrative complexities and enhances precision. According to Millatina et al. (2022), auditors possess convenient access to the transparent transaction history, facilitating efficient and thorough audits for assessing the management of zakat funds based on blockchain technology. Not only does this practice result in time and resource conservation, but it also enhances the dependability and ethical soundness of financial reporting.
- *Establishing Trust and Confidence*: The blockchain's traceability, immutability, and auditability contribute to establishing trust and confidence in Islamic Social Funds institutions (Zulfikri et al., 2022). The novelty of blockchain technology resides in its validation process, as it operates without the involvement of any third party (Chong, 2021). Implementing transparent and accountable fund management through blockchain-based systems can enhance donor attraction

(Mohaiyadin et al., 2022), foster more engagement, and bolster the overall efficacy of philanthropic endeavors (Millatina et al., 2022).

It is essential to acknowledge that the implementation of blockchain-based systems necessitates meticulous strategic planning, collaborative efforts, and strict adherence to legal and regulatory frameworks. In addition, maintaining data privacy and protection is crucial for upholding confidentiality while promoting openness. Nevertheless, via appropriate implementation, blockchain technology has the potential to significantly transform the transparency and efficiency of Islamic social funding institutions, thereby fostering more impactful and sustainable charitable activities.

9.3.2 Blockchain-based Digital Information Systems for Islamic Social Funds Decentralization

The transactions of Islamic Social Funds are tracked in a decentralized and open database by an immutable and auditable chain utilizing the blockchain. The blockchain system comprises decentralized ledgers containing all transactions distributed across peer-to-peer networks (Rabbani et al., 2020). This decentralized structure allows for transaction processing without intermediaries, potentially improving efficiency (Millatina et al., 2022). The decentralized structure of the blockchain network not only reduces transaction costs by eliminating intermediaries but also ensures openness, reliability, and precise and detailed fund tracking (Rejeb, 2020). The process of promoting blockchain transactions commences with the generation of a digital security code via encryption. In the subsequent stage, consumers endeavor to verify the transaction's authenticity while safeguarding their personal information. According to Changa et al. (2020), the transaction is permanently recorded without the possibility of alteration and will be automatically distributed to all users.

Decentralization is a fundamental aspect of blockchain technology, and it synergistically complements the functionality of *smart contracts*. Decentralization and *smart contracts* are considered fundamental principles closely linked to blockchain technology, exerting a substantial influence on the transformation of numerous sectors, particularly the financial domain. *Smart contracts* can be implemented on decentralized blockchain networks, guaranteeing their functionality within an environment that lacks the need for trust, is highly safe, and offers

transparency. One illustrative instance is Ethereum, a decentralized blockchain platform renowned for facilitating *smart contracts*. According to Rejeb (2020), developers can construct *Decentralized Applications* (DApps) that use smart contracts to automate procedures and establish interactions that do not rely on trust.

The systematic use of *smart contracts* within blockchain technology enables the automation of compliance processes. The term "*smart contracts*" was introduced by Nick Szabo, who elucidated the concept of securing contracts between two parties on computer systems without needing a third-party intermediary. These protocols are commonly implemented through software on a computer network or other forms of digital electronics (Sillaber & Waltl, 2017). *Smart contracts* have the potential to serve as self-executing contracts on the blockchain, incorporating predetermined rules and circumstances to facilitate adherence to Shariah principles and standards. According to Zulfikri et al. (2021), *smart contracts* can enforce the payment and distribution of funds per the predetermined criteria of Islamic Social Funds.

Additionally, these contracts can autonomously initiate actions or disbursements once certain circumstances are satisfied. Decentralization and *smart contracts* are integral elements of blockchain technology that synergistically contribute to establishing a secure, transparent, and efficient ecosystem. Additionally, they augment the underlying infrastructure's velocity, cost-efficiency, security, and reliability (Jayasinghe et al., 2018).

Adopting blockchain technology into the Islamic Social Funds institution establishes a direct connection between the donor and recipient through a unified decentralized network, hence facilitating interaction. According to Beik et al. (2019), utilizing decentralized databases in blockchain-based systems offers a means for donors and recipients to access real-time information regarding the movement of funds. This implementation serves as a secure and transparent model for charitable activities. According to Zulfikri et al. (2021), donors have the ability to monitor and verify the allocation of their charitable contributions, providing transparency and accountability regarding the recipients, timing, and locations of their cash. In contrast, beneficiaries may experience heightened levels of trust in the system due to their ability to independently check the receipt and allocation of cash. The system mentioned above functions as a comprehensive property management system that facilitates the involvement of all relevant parties and enables informed decision-making within a specific context (Walaa, 2021).

The concepts of blockchain decentralization and stakeholders in social funds are closely connected and can collaborate to improve social funds' transparency, efficiency, and accountability, especially those that adhere to Islamic principles. The stakeholders in this context encompass a range of individuals and entities, namely donors, recipients, fund administration personnel, regulators, auditors, local communities, Non-Governmental Organizations (NGOs), and Shariah Scholars. According to Chong (2021), The transparency of blockchain technology enables stakeholders to access real-time information regarding fund-related transactions and activities, hence promoting trust among donors, beneficiaries, and other relevant parties. According to Zulfikri et al. (2022), auditors possess the capability to authenticate fund operations readily. Decentralized social fund models afford contributors and beneficiaries a heightened level of involvement in decision-making processes, project selection, and governance. This is achieved by utilizing blockchain-based voting or consensus methods, as highlighted by Hamdan et al. (2019).

The integration of blockchain technology into social funds has the potential to augment decentralization, transparency, and accountability, rendering it a compelling choice for fund management across diverse industries, including Islamic social finance. Nevertheless, the effective execution of blockchain-driven solutions necessitates meticulous strategizing, comprehensive stakeholder enlightenment, and thorough evaluation of legal and regulatory structures to guarantee adherence to pertinent legislation and benchmarks. Furthermore, it is imperative to customize the technology following the particular requirements and objectives of the social fund.

9.3.3 Blockchain-based Digital Information Systems for Institutions of Zakat and Waqf

In a study conducted by Ahmed and Zakaria (2021), the implementation of blockchain technology has the potential to enhance the systematicity and efficiency of Zakat and Waqf organizations in fulfilling their responsibilities of collecting and distributing funds per Islamic principles. The data-gathering process, namely in relation to the collecting and distributing zakat and waqf-cash, continues to exhibit inefficiencies due to the lack of integration among different records maintained by individual Amils. According to Omar and Khairi (2021), a segment of the Asnaf population remains excluded from receiving the zakat fund due to

deficiencies in the data collection process. Yaacob and Nahar (2017) suggest that price errors and miscounting of waqf assets could occur due to administrative factors. Utilizing blockchain technology in the management of zakat and waqf serves as a transparent and unalterable ledger of transactions, verifying the destination of donations and fostering faith in the organization. The automation of Zakat and Waqf fund distribution can be achieved through the implementation of *smart contracts,* which establish established criteria and norms for transactions between muzakees or waqif and zakat institutions (Zulaikha & Rusmita, 2018; Rejeb, 2020).

As Noordin (2018) stated, recording zakat payments on a blockchain node occurs when the payment is made in line with various initiatives. Confirmation of payment acceptance will be provided to the individuals making the payment. The project has now secured its funding. The contributors will be notified through the application upon depletion of the funds. Utilizing blockchain technology has instilled a heightened sense of confidence among payers over the successful delivery of their zakat to the intended beneficiaries, owing to its enhanced transparency.

Blockchain technology can potentially uphold a comprehensive and transparent log of transactions involving Waqf assets on the blockchain. This includes properties, investments, and other assets contributed to the institution. According to Zulaikha and Rusmita (2018), In addition to fulfilling particular criteria, including the waqf assessor's signature is necessary when acquiring a waqf asset. The blockchain has the potential to offer verification in transactions involving assets. Blockchain technology facilitates secure and confidential money transfers between two parties, ensuring that sensitive information remains undisclosed to any third party. This feature effectively mitigates disputes, as the beneficiaries can exclusively access the asset in question, known only to the involved parties. Blockchain technology facilitates the exact and transparent recording of each transaction, as it necessitates converting waqf cash into an asset. Each partner involved in the transaction will be awarded the right to transfer the assets. The traceability of transactions is facilitated by blockchain technology, which effectively preserves precise and comprehensive records. In addition, it should be noted that blockchain technology exhibits a high degree of precision, whereby any attempts to manipulate or alter data will lead to the outright dismissal of the pertinent application. Consequently, the implementation of blockchain technology enables the prompt detection of any instances of corruption within waqf centers.

Incorporating accountability and transparency elements inside a blockchain system protects the integrity of the recorded data (Mancini & Lamboglia, 2017) while safeguarding against unauthorized modifications or corruption (Brusca et al., 2018; Walaa, 2021). According to Abojeib and Habib (2019), implementing blockchain technology can potentially decrease operational expenses for institutions by streamlining administrative processes and minimizing reliance on middlemen. Blockchain technology enables auditors and regulators to conduct efficient audits of an institution's financial records (Farooq et al., 2020), reducing the probability of financial fraud. The stakeholders, comprising of funders and institutional leaders, can retrieve real-time reports (Ihsan & Septriani, 2016; Zulaikha & Rusmita, 2018). Furthermore, utilizing blockchain technology can streamline cross-border donations and payments, enhancing the operational efficiency of Zakat and Waqf organizations on a global level (Zulaikha & Rusmita, 2018).

Although blockchain technology presents considerable advantages, it is imperative to consider various aspects, including scalability, adherence to legal requirements, and the preparedness of stakeholders for implementation. It is imperative to offer education and training programs on blockchain systems to the institution's personnel and the wider community. This measure is crucial in facilitating a seamless transition and optimizing the benefits of utilizing blockchain technology for the management of Zakat and Waqf resources.

9.4 Best Practices of Blockchain-based Waqf Institution

The following discourse analyzes the success story of a Waqf institution that has effectively implemented a blockchain-based system. A demonstration of the possibilities of a blockchain platform in the context of Islamic Social Funds was recently showcased at the "International Waqf and Blockchain Forum 2018" held in Kuala Lumpur, Malaysia. Referred to as the "Finterra Project" as its whole.

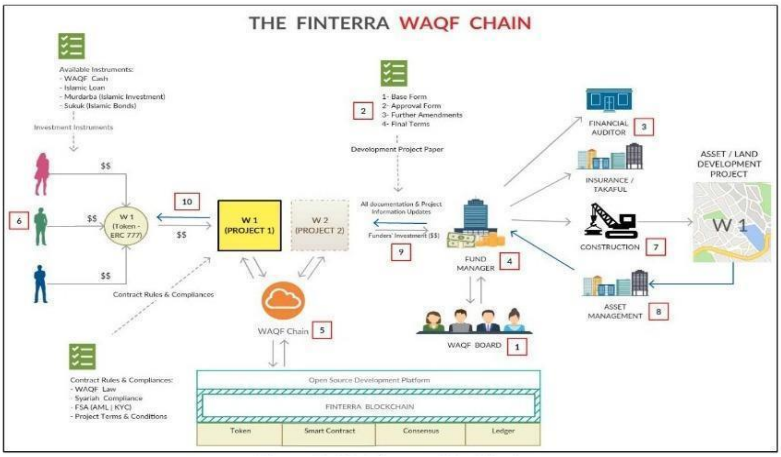

Fig. 9.1 The Finterra Waqf Chain. Ref: Rashid and Centre, 2018

This initiative emphasizes conducting research and development activities that have the potential to bring about a groundbreaking approach to crowd-funding. Simultaneously, it aims to ensure compliance with regulatory obligations such as Anti-Money Laundering (AML) and Know Your Customer (KYC) regulations. One specific component within this project is the Finterra Waqf Chain Use Case. The following section presents a comprehensive overview of The Finterra Waqf Chain concept, accompanied by relevant graphics (Figure 9.1) for visual representation (Rashid & Centre, 2018).

The Finterra Waqf Chain encompasses a series of operational standards, which are outlined as follows

- The waqf board is responsible for identifying and facilitating a land asset for development.
- The development project document encompasses components such as land title, feasibility study, building architecture, project plan, project costing and loss-profit analysis, and recommended financing instruments.
- The document undergoes a thorough evaluation and is then approved by an independent auditor.
- A certified fund manager is then engaged to facilitate an Initial Coin Offering (ICO) for the purpose of financing the designated waqf development initiative. This process entails the issuance of cryptographic tokens to eligible investors on a global scale.
- The "waqf chain," constructed on top of the Finterra blockchain, launches *the tokens* against the requisite capital. Pre-qualified

investors from various regions globally acquire the tokens, and the funds collected are held in escrow by the appointed fund manager. When investors acquire the token, they are provided with the choice (a. Cash waqf; b. Islamic loan; c. Muḍārabah; and d. Ṣukūk) of the funding mechanism they can employ.

- Once the maximum limit for the capital raising has been reached, the fund management proceeds to select a construction business for the purpose of commencing the construction and development of a physical structure.
- Once the building phase has concluded, the fund management entity proceeds to engage the services of an asset manager who will be responsible for the ongoing operation and maintenance of the asset.
- The fund manager is responsible for collecting any revenue or income the asset generates.

Earned revenues or income are subsequently allocated to investors based on the investment instrument employed and the associated terms and conditions.

9.5 Conclusion

In summary, it may be argued that implementing blockchain technology in digital information systems holds promise for significantly enhancing the transparency, decentralization, and efficiency of Islamic Social Funds, such as Zakat and Waqf institutions. These systems present numerous significant benefits, including but not limited to transparency and accountability, decentralization facilitated by Smart Contracts, efficient asset management, decrease in costs and time, enhanced auditability, seamless cross-border operations, real-time reporting, and heightened levels of trust and confidence.

Nevertheless, achieving effective execution necessitates meticulous strategic preparation, comprehensive stakeholder enlightenment, and strict adherence to pertinent legal and regulatory structures. In order to uphold confidentiality and promote openness, it is imperative to address privacy and data protection concerns. In general, the utilization of blockchain technology exhibits significant potential in transforming the administration of Islamic Social Funds, thereby facilitating philanthropic activities that are more effective and transparent while adhering to Islamic values.

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Halal Cosmetics Consumption Experiences in the Digital Marketing Era: A Phenomenological Analysis of Muslim Customers

10

Indri Supriani and Sri Iswati

Abstract

The digital marketing phenomenon—the increase of online advertisements—is significantly changing consumption behaviors. However, Muslim consumption activities have certain limitations based on Islamic principles, such as consuming halal products only. Aiming to explore Muslim customer experiences with halal cosmetics consumption in the digital marketing era. This study conducted 16 phenomenological semi-structured interviews to capture themes from an individual perspective. The data were analyzed within the framework of three main themes and presented by combining direct citations from the participant's statements with the literature on three types of digital marketing—content, social media, and influencer marketing. The result highlights religiosity as a prominent factor Muslim consumers consider despite the attractiveness of digital marketing strategies. The participants also confirmed that digital is more effective than conventional marketing. It influences their knowledge and awareness regarding halal cosmetics products and prompts them to consumptive behavior as they gain broader product recommendations through online interactions. Influencer marketing is the most persuasive tool in strengthening a brand's position. This study is a pioneer attempt to offer insight into marketing practice and a

I. Supriyani
Department of Economics, Faculty of Economics and Business, Brawijaya University, Malang, Indonesia
e-mail: indri.supriani@ub.ac.id

S. Iswati
Department of Accounting, Faculty of Economics & Business, Universitas Airlangga, Surabaya, Indonesia
e-mail: iswati@feb.unair.ac.id

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F. Prasetyia (ed.), N. Mulachelah (ed.), *Digital Transformation and Inclusive Economic Development in Indonesia*, https://doi.org/10.11594/futscipress10

comprehensive understanding of the Muslim consumption behavior of halal cosmetic products in the digital marketing era.

Keywords

Digital marketing · Halal cosmetics · Muslim consumption · Phenomenological approach

10.1 Introduction

The Muslim population in Muslim-majority countries has grown over recent years. This growth has caused a global increase in the demand for halal products (Putri & Abdinagoro, 2018). Muslim consumers have become a unique market for analysis due to their activities, namely, their consumption activities under Sharia principles (Karoui & Khemakhem, 2019). Muslims consume halal products only; the term "halal" means lawful, permissible, legal, and allowed (Garg & Joshi, 2018; Shahid et al., 2018).

The increase in the Muslim population has led to an escalation in the demand for halal cosmetics globally. Indonesia is the second-largest country in terms of cosmetics consumption after India (BAPPENAS, 2018). Moreover, Indonesia is the second-largest contributor to the growth of cosmetics globally (EU-Indonesia Business Network, 2019). Thus, with an 87% Muslim population, Indonesia has great potential to become the halal industry leader, aligned with the Indonesian Sharia Economics Master Plan's objective, which is to become a leading producer in the global halal sector by 2024 (BAPPENAS, 2018), including in the halal cosmetic industry.

Aside from issues concerning the growth of the Muslim population and halal cosmetics awareness, another phenomenon that has an enormous impact on human behavior is the digital era. This phenomenon has become a new cultural repertoire in every aspect of a person's life globally (Busca & Bertrandias, 2020). The digital era has also affected the relationship between customers and brands vis-à-vis digital marketing. Melović et al. (2020) demonstrated that the key benefit of digital marketing is that it enables customers to provide feedback and interact with a brand as well as obtain more detailed information that ultimately determines their purchasing decision. These strategies help brands connect with customers

and analyze their honest opinions about products or services. As a result, online information can easily influence and drive customer consumption behavior in many ways.

Interestingly, the Dinar Standard and Salam Gateway (2018) revealed that technological development and the era of digitalization have contributed to increased demand for halal cosmetics. Numerous studies have proven that digital marketing, including halal cosmetics consumption, significantly affects customer behavior. Previous studies such as Shahid et al. (2018), Adiba (2019), and Muhsin (2019) mentioned that technology has transformed marketing strategies digitally, changing halal cosmetics demand patterns among customers. Similarly, (Ishak et al., 2019) found that 83% of respondents tended to search for halal cosmetics information on the Internet before buying products.

Using evidence from Indonesia, Handriana et al. (2020) determined that customers are easily exposed to massive amounts of information in the digital era, influencing their expectations of halal cosmetics products. Specifically accessing the impact of a beauty blogger, Putri and Abdinagoro (2018) suggested that halal cosmetics companies should inspect digital marketing changes that predispose their customer's purchasing behavior. Thus, the rise of digital marketing has dramatically changed customer behavior and marketing strategies around the globe, including in Indonesia (Rangaswamy et al., 2020). Due to these facts regarding the digital marketing era, it has become a concern that current Indonesian customer behavior might differ from their behavior over the past several decades.

Against this background, it is worth exploring the Muslim perspective about what and how they experience the digital marketing phenomenon and their halal cosmetics consumption behavior. This area is still under-researched. No academic research focused on the impact of digital marketing on halal cosmetics consumption that adopts a phenomenological approach, to the best of our knowledge. Prior studies have mentioned that the digital era affects customer consumption behavior and that further research is required to capture the impact on Muslim consumer behavior. Therefore, this study aims to reveal how digital marketing influences Indonesian halal cosmetics consumption behavior regarding religiosity, awareness, and knowledge. Thus, this study's results contribute to marketers' understanding of Muslim consumption behavior and enable them to design strategies that fit their potential customers' needs in the digital marketing era.

10.2 Literature Review

10.2.1 Halal Cosmetics

Halal is a crucial factor that Muslims should consider in their activities. Halal means that a product has satisfied Islamic law and is allowed to be consumed (Handriana et al., 2020). According to (Sugibayashi et al., 2019), Muslims should consume halal and *tayyib* products. This means that the product's ingredients should not induce any health risks. On the other hand, cosmetics are defined as treatments intended to enhance a person's appearance or the human body and to clean, beautify, and change one's appearance (Yeo et al., 2016). Thus, halal cosmetics can be considered safe to enhance one's physical appearance and meet the requirements of Islamic law.

10.2.3 Digital Marketing

The Internet is primarily used to establish online product promotions, well-known as digital marketing. The Internet allows customers to share their experiences with goods and services on social networks and sharing platforms, which are digital marketing tools (Barbosa & Fonseca, 2019). Digital technology enables brands to build their value and image among existing and potential customers by easily interacting with them online (Kannan & Li, 2017). With this advantage, the number of digital users increases by more than 20% every year as more offline customers switch to digital technology, making shopping more accessible for consumers (Bughin, 2015). (Ryan, 2014) divided digital marketing into several forms, including content, social media, and influencer marketing.

10.3 Methodology

This study adopted a phenomenological technique. Fennell (1985) explained that phenomenological analysis is used by marketing researchers to comprehend consumer behavior better. The phenomenological approach allows the researcher to understand what makes the customer want to buy or consume a product/service (Fennell, 1985). In this study, we analyze how Muslim consumers construe the digital marketing phenomenon, how

consumers live with and adjust to digital marketing, and how it generally changes consumer culture regarding halal cosmetics over time.

This study used a purposive sampling technique based on the goal of this study. This study was conducted with Muslim females who used halal cosmetics over the last year. The participant should have accessed information about halal cosmetics products on the Internet, either from search engines or social media sites, and have read/watched an online review about halal cosmetics products by an influencer. The researchers explained the study's objectives, and once the participants agreed to participate, they digitally signed a written consent form.

In terms of the number of participants, this study satisfied the recommendations of Morse (1994) and Creswell (1998), who suggested that the minimum number of participants in a phenomenological study should be six and between 5 and 25 participants, respectively (Guest et al., 2006). This study achieved data saturation in Interview 9, ensuring an adequate sample size. According to Guest et al. (2006), saturation will occur sooner if the participants have some common criteria.

This study involved 16 participants ranging from 20–27 years of age. According to the EU-Indonesia Business Network (2019) survey covering a population of nearly 250,000 people, the average age of the cosmetics consumer is under 28 years, which aligns with market segmentation in the digital transformation era. Thus, the participants engaged in this study will portray the digital marketing phenomenon regarding halal cosmetics consumption. Further information on the participants' demographics is presented in Table 10.1.

Table 10.1 Characterization of the study participants

No.	Age	Study Program	Degree	Experience with halal cosmetics (*in years*)
1.	20	Islamic Elementary School Teacher	Bachelor	3
2.	27	Nursing	Post-Graduate	5
3.	21	Accounting	Post-Graduate	4
4.	27	Veterinary Health and Disease Science	Post-Graduate	10
5.	25	Basic Education	Post-Graduate	5
6.	25	International Relations	Post-Graduate	7
7.	25	Islamic Economic Science	Post-Graduate	8
8.	22	Economics	Bachelor	1
9.	22	Economics	Bachelor	5

10.	25	Notary	Post-Graduate	5
11.	22	Economics Education	Bachelor	4
12.	26	Technology and Vocational Education	Post-Graduate	3
13.	21	Islamic Economics	Bachelor	3
14.	21	Religious Study	Bachelor	5
15.	20	Elementary School Teacher	Bachelor	9
16.	20	Early Childhood Islamic Education	Bachelor	8

Note: The number of years of experience using halal cosmetics is indicated in parentheses throughout the following discussion.

A semi-structured interview (SSI) was conducted to gain insight into Muslim consumers' personal experiences. The SSI methodology enabled researchers to expand the questions to thoroughly understand participants' answers (DiCicco-Bloom & Crabtree, 2006). The SSIs were held in October 2020, and the interview process was conducted in Bahasa (an English-language version of the interview questions is available in the Appendix). Using content analysis, the researchers analyzed the results individually according to their importance and centrality (Sanders, 1982).

10.4 Results and Discussion

This study identified three main themes from the data analyzed, described in Table 10.2. The participants explained their opinions about and experiences with halal cosmetics, digital marketing influences on the Muslim perspective on halal cosmetics, and their views and experiences with each type of digital marketing.

Table 10.2 The determining themes are according to the data collected in interviews

Theme	Subtheme	Quote
Opinions and experiences using halal cosmetics	Halal criterion	"As long as I know, cosmetics are said to be halal if the cosmetics product has a logo or halal certification given by the Indonesian Ulama Council" - Interviewee 8 (1 year).

	Halal cosmetics consumption	"[…] I feel safer when I am using halal cosmetics because I can affirm that there is no such a haram ingredient that invalidates worship […]" -Interviewee 2 (5 years).
Digital marketing influences the Muslim perspective on Halal Cosmetics	Religiosity	"Digital marketing has no impact on my religiosity; I used the halal product only because it is an obligation in my religion" -Interviewee 9 (5 years).
	Knowledge	"By watching a review of certain products, I gained some knowledge about the halal and haram ingredients. I know more scientific names of non-halal materials" (Interviewee 1, 3 years).
	Awareness	"[…] Back then, people usually focused on halal food and drink. They are less concerned about halal cosmetics… an explanation of halal cosmetics is fundamental to me because it opens up insights that we can be more aware of" -Interviewee 4 (10 years).
	Consumerism	"Digital marketing significantly changes my halal cosmetics consumption. In the past, we can only get recommendations from our close friends. However, in this era, we can get more detailed information from online reviews and other customer's comments. Thus, it changes the quantity and variation of my consumption" -Interviewee 4 (10 years).
	Challenges	"[…] It is difficult to determine a reliable source […]" -Interviewee 13 (3 years).
Views and experiences about digital marketing in halal cosmetics	Content marketing	"[…] I usually use a search engine to find more detailed information about the specific product that I used by typing the brand name to affirm that it is halal […]" -Interviewee 5 (5 years).
	Social media marketing	"[…] on social media, people can leave comments there […] I can get the additional information and find the

		products that match my skin type." - Interviewee 6 (7 years)
	Influencer marketing	"[…] Influencer explained the product's information frankly and told us it is what it is. Influencer tells us an honest review without making the product sounds good […]. Personality is the main thing that I consider, not from the influencer beauties" - Interviewee 3 (4 years).

Note: The number of years of experience using halal cosmetics is indicated in parentheses in this table and throughout the following discussion.

10.4.1 Opinions about and Experiences with Halal Cosmetics

10.4.1.1 Halal Criteria

All informants describe halal cosmetics as cosmetics that do not contain ingredients that contradict Islamic law. They also agreed that the Indonesian Ulama Councils' (MUI) halal logo is one of the main factors determining a cosmetics product's "halalness." As stated by Interviewee 4 (10 years): "There must be a halal label [...]. There are no ingredients that contain haram ingredients like pork and also use other ingredients that will be harmful."

This study confirmed that the informants agreed that halal cosmetics' ingredients are safe for consumption, indicated by the availability of code numbers from Indonesia's Food and Drug Monitoring Agency (IFDA) on the product packaging. For example, Interviewee 11 (4 years) described the criteria determining cosmetics as halal: "First, halal cosmetics should be safe to use. It does not contain haram elements that the Qur'an and Hadith prohibit. It should have been declared safe by BPOM and has halal certification from MUI […]."

The previous statements confirm that certification by MUI and IFDA are critical factors for consumers to identify halal cosmetics. This result is supported by Muhsin (2019), who discovered that 95.5% of his study's participants were convinced that cosmetics are classified as halal if the products bear the halal logo from MUI. Thus, the halal logo on the packaging significantly influences consumer perspectives regarding halal products (Ambali & Bakar, 2014).

The participants also agreed that halal cosmetics should use only healthy ingredients. "[…] The quality of halal cosmetics is so much better for my skin compared to the products which I do not know about it is

halalness […]" (Interviewee 10, 5 years). This result is also consistent with a prior study by Kurniawati and Savitri (2019), who ascertained that health reasons are the second-highest factor consumers consider when assessing halalness. In sum, this study confirmed that the halal logo, the IFDA code number, and the product ingredients were crucial factors shaping Indonesian Muslim consumers' decisions regarding whether a cosmetics product is halal.

10.4.1.2 Halal Cosmetics Perspective

Participants explained their experiences with using halal cosmetics. Participants stated that halal cosmetics offered a convenient feeling because they could conduct prayer and any other worship without fearing that the cosmetic's ingredients would invalidate their activities. Participants said they would only consume halal products because this reflects their identity as Muslims and their faith in their religion. The participants would not compromise the halalness of a product that they consume. As highlighted by Interviewee 6 (5 years):

> "[…] We also understand, right? From a religious perspective, we must ascertain the clarity of our products. Friends of the Prophet, when they discover that the eaten product is not clear about its halalness, he will regurgitate the food. So, I have to make sure that the product is halal."

This study revealed that participants were experiencing convenience in using halal cosmetics because it is part of their beliefs in their religion. This finding is consistent with (Shahid et al., 2018) and (Ishak et al., 2019), who found that participants preferred to avoid a cosmetics product if they were doubtful of its halal status because it is against their religion.

10.4.2 Changing Halal Cosmetics Consumption with Digital Marketing

10.4.2.1 Religiosity

The participants discussed their experiences in facing digital marketing. They revealed that it does not influence their religiosity, meaning they will choose halal products instead of non-halal products even though the products have been impressively advertised with digital marketing. As affirmed by Interviewee 15 (9 years):

> "[…] There are many verses in the Quran that explain the urge to consume halal products, not only food and drinks, right? The Ustaz often reminds us that we have to use halal products according to Allah's orders in Al-Baqarah' what verse is that […] which says that we must consume halal and tayyib (healthy) goods."

This result was supported by (Shahid et al., 2018), who noted that religiosity is considered a key factor controlling individual behavior and an essential element influencing consumer attitudes toward consumption. Thus, the consumer with intense religiosity would obey their obligation as a Muslim.

Those statements clarify that religiosity is the primary factor considered by the Muslim consumer. Precisely, this finding reflects consumers attention to the religious factors associated with halal cosmetics. This result also follows what has been postulated by the literature, which assures that religiosity is a significant factor shaping Muslim consumption decisions regarding halal cosmetics (Abd Rahman et al., 2015; Khalid et al., 2020; Shahid et al., 2018; Tournois, 2015; Yeo et al., 2016). A similar result was reported by the EU-Indonesia Business Network (2019), which determined that 50% of Indonesian women prefer to purchase halal cosmetics because of religious matters through a survey.

In summary, this study confirms that digital marketing does not influence Muslims to consume non-halal products because it is against Islamic principles. At the same time, digital marketing has tremendous potential to lead customers to be more religious by using halal products. This result indicates that to build a great relationship, marketers should design marketing strategies that fit their customers' religious needs, as suggested by prior studies by Garg & Joshi (2018), Karoui & Khemakhem (2019), and Suparno (2020).

10.4.2.2 Knowledge

The collected data also show that digital marketing has increased knowledge regarding halal cosmetics. According to Interviewee 5 (5 years), the digital marketing phenomenon has played a prominent role in upgrading her knowledge about cosmetic ingredients. She said: "It helps me discover more information about halal products. Back then, I did not know the terms or names of cosmetic ingredients. However, now I know […]. It is beneficial, especially for me who lack knowledge about cosmetics."

The data analysis also discovered that the participants are well-informed due to the information that they obtain online. Digital marketing helps customers discover more information about the usefulness and price of halal cosmetics. Hence, this study confirms that the customer can quickly find information about halal cosmetics products during this digital era, thereby increasing their knowledge.

Previous research using the quantitative method, including a study by (Said et al., 2014), demonstrated that product knowledge is a significant factor in consumer decision-making. Evidence from Malaysia from a study by (Ishak et al., 2019) determined that the level of knowledge about the usefulness, materials, and after-effects of products drives distinct purchase decisions for halal cosmetics among educated female millennial Muslims. Therefore, this study corroborates the literature that points to the importance of digital marketing strategies to enrich the customer's knowledge, which, in turn, will lead to increasing demand for halal products.

10.4.2.3 Awareness and Halal Cosmetics

Several participants emphasized that digital marketing has intensified their awareness of halal cosmetics. As said in Interviewee 7 (8 years): "Digital marketing influencing my awareness about halal cosmetics, because by reading online articles, I become more aware and concerned that the halalness of the cosmetics product is important." In the same vein, Interviewee 9 (5 years) declared that she gained additional information through online searching, which affected her awareness:

> "[…] Information about halal cosmetics that I found on the Internet made me realize that using halal ones is our obligation as Muslim women. […] To look beautiful but still meet the Islamic principles."

This study affirmed that the digital marketing phenomenon has impacted the customer's awareness. Melović et al. (2020) revealed that digital marketing has profoundly affected customer awareness of a product or service. Empirical research conducted by (Handriana et al., 2020) revealed that Indonesian Muslim millennials generally acquire halal product information digitally, which is considered the reason underlying the heightened awareness about halal products in Indonesia.

In short, this study affirmed that digital marketing affects the consumption of halal cosmetics, particularly for those consumers who lack awareness about halal products. Digital marketing will increase their awareness of the importance of halal cosmetics. Thus, this study

emphasizes that companies should utilize digital marketing to increase customer awareness of halal cosmetics products.

10.4.2.4 Consumerism

The participants emphasized that digital marketing significantly affected their consumption, both in terms of quantity and variation. Interviewee 1 (3 years) declared: "Before digital marketing growing such as this moment, I only used the same products. There were not many variations. However, now I have a lot of numerous information. Thus, I try to use serum, essence, mask, and other product variations. […]." In addition, Interviewee 2 (5 years) described that digital marketing triggered her to become more consumptive. As declared by one of the participants:

> "[…] We are usually exposed to online advertisements, making me more consumptive. We can easily find the online reviews. […] At any time from our mobile phone […]"

Moreover, in this digital marketing era, consumers can easily interact with other customers on various online platforms, contributing to their purchasing decisions and leading to consumerism activities. As mentioned by Interviewee 6 (7 years): "[…] We can see other customer's comments […] Which about 70% influencing my usage decision. If many people said that the product is great, I definitely would buy the product." This finding is supported by a previous study, which established that customers' use of sharing platforms plays a crucial factor in forming consumer behavior (Barbosa & Fonseca, 2019). Fazira & Chan (2018) demonstrated that digital marketing is one of three factors that drives the positive trend of halal industry demand, reflecting consumer's consumptive behavior.

According to these statements, this study established that digital marketing has dramatically influenced consumer consumption. This study reveals that digital marketing has triggered Muslim consumers to become more consumptive, although Muslim consumption should occur according to Islamic principles, and consumerist behavior should be avoided.

10.4.2.5 Challenges

The data collected in this study reveal that digital marketing has dramatically offered a plethora of information regarding halal cosmetics, leading to confusion in purchasing decisions due to the overwhelming amount of information. Interviewee 4 (10 years) conveyed, "I feel dizzy when there are too many choices, so I decide not to see online ads that very often."

Levy & Gvili (2015) explained that today, everyone can easily share information through a dozen online platforms, which prompts the amount of electronic word-of-mouth (e-WOM) information to increase. In turn, it is causing a decline in e-WOM quality. This study result indicates that despite the increasing awareness of halal cosmetics among the participants due to easiness in discovering the information online, the participants also faced difficulties picking credible information, which resulted in doubtfulness. Furthermore, this study also discovered one interesting fact.

The preceding declaration aligns with a survey conducted by EU-Indonesia Business Network (2019) that reported that despite the massive promotion and marketing domestic brands have conducted over the years, imported cosmetics from non-Muslim countries have dominated Indonesian cosmetics sales, and most of the products do not bear the halal logo on the packaging. As a result, online promotions about cosmetics products that do not have halal certification are easier to find than halal-labeled cosmetics.

10.4.3 Views of and Experiences with the Digital Marketing of Halal Cosmetics Products

10.4.3.1 Content Marketing

This study's collected data reveal that participants used to find more information about halal cosmetics by reading online content using search engines. According to Interviewee 11 (4 years), with the help of content marketing, she was able to ensure that a halal cosmetics product was registered at BPOM. "I usually search on Google to find the BPOM number and the ingredients of the cosmetics product." On a similar note, Interviewee 4 (10 years) explained that content marketing helps her find more detailed information about the products she intends to buy. She declared: "I found it from Google searching. I used specific keywords such as 'halal cosmetics review' or just typed the product's brand name if I already have a preferred product."

This description reveals that content marketing has enabled customers to gain more detailed and relevant information to solve their problems rather than simply promote a company's products (Järvinen & Taiminen, 2016). Additionally, (Wang et al., 2019) described content marketing as a strategic way to establish a brand's value. In short, this phenomenon has changed consumer consumption behavior as they become more concerned about product value.

10.4.3.2 Social Media Marketing

Online interaction on social media sites among customers was cited as a contributing factor influencing the customer's experiences in purchasing halal cosmetics products. Social media has widened customers' connections, as they can interact with other customers globally. This interaction allows customers to obtain additional information by reading and replying to comments, which increases their sense of belonging to a product community. As stated by Interviewee 4 (10 years):

> "[…] In the past, we only knew to get product recommendations from our friends. [...] But now, we can also see reviews and comments from fellow users so that you know more."

Kannan & Li (2017) also determined that customers sharing opinions and experiences about using products online in social media comments will affect other potential buyers both before and after purchase. This result indicates that massive comments on halal cosmetics' social media would increase the customer's trust in the products.

In this era, customer's voices have become more potent as many people are hearing them through social media. Interviewee 5 (5 years) emphasized:

> "Instagram and YouTube are the most popular social media marketing tools. […], but nowadays, TikTok also has great potential (as a marketing tool)."

This result is in line with prior studies that stated that Twitter, Instagram, Facebook, and TikTok are the most effective social media platforms to increase a brand's awareness and interact with customers (Haenlein et al., 2020; Ishak et al., 2019; Shahid et al., 2018). Besides, the EU-Indonesia Business Network (2019) has reported that social media has a significant impact on increasing cosmetic market share in Indonesia. This study corroborates the suggestion that brands should utilize exchanging information and experiences among customers on social media to improve their product's quality and evaluate their market strategies to satisfy their customers.

10.4.3.3 Influencer Marketing

More than half of the participants highlighted that influencer marketing has become the most prominent marketing method that affects their consumption behavior and perspective of halal cosmetics. The participants

defined an influencer as an expert who has many followers on his/her social media and actively shares their experiences with certain products with their followers. As mentioned by Interviewee 10 (5 years):

> "[…] I only trust reviews from the influencer if they are experts in this area (cosmetics), I trust if the influencer is a doctor. Influencers should have the proper knowledge and be familiar with the product's usability […]."

This study has demonstrated that a high number of followers in an influencer's social media and a high intensity of interaction among customers in their comments section positively shape the customer's purchasing behavior. The finding is in accordance with Berne-Manero and Marzo-Navarro (2020), who explained that customers engage easily with macro-influencers with between 100,000 and 1,000,000 followers because they have a manageable professional image that creates admirability and credibility.

However, Lin et al. (2019) stated that an influencer should not automatically be a celebrity, blogger, or journalist with a vast following; they might be a micro-influencer who intensively utilizes their knowledge, powerful position, and relationships to affect their followers. Another important factor the participants consider in following an influencer is their personality. This study finds that nearly all the participants agreed that the influencer's personality is a crucial factor that they consider in following the influencer. The influencer's personality reflects how she/he explains the reviews and should reflect qualities such as humbleness, approachability, honesty, friendliness, and good humor. As pointed out by Interviewee 15 (9 years):

Influencers use trending words or make jokes during the reviews. It makes me feel like my closest friend talks to me and gives me warm advice.

This finding is in line with Ki et al. (2020), who stated that customers quickly build a sense of intimacy with funny and hilarious influencers, who have a higher possibility of interaction between micro-influencers and their customers. Berne-Manero and Marzo-Navarro (2020) stated that micro-influencers could provide a higher value of interaction with their followers. They offer more feedback on their customers' comments on their social media. Therefore, this study further clarifies that marketers should choose influencers carefully, not only based on their number of followers but also on their competencies/knowledge about halal cosmetics and their ability to build a customer's trust through their personality. This study suggests that marketers should provide freedom for influencers to offer honest reviews

and share their experiences using products without pushing them to discuss only the positive aspects of their products. Additionally, it is suggested that companies should collaborate with micro-influencers, as they target specific potential customers.

10.5 Managerial Implications

This study presents customers' perspectives and experiences regarding halal cosmetics products in the digital marketing era and provides several managerial implications based on its findings. First, marketers should focus on customers' religious beliefs by bearing the halal logo on the product packaging, as it has become the most prominent factor that customers consider. Second, advertising through digital marketing is more effective for attracting the customer's attention and building a solid emotional connection. However, advertising on linear TV is still needed to trigger the customer's intention to seek further information about the products in online articles. Thus, marketers should design an effective balance between offline and online advertisements. This study suggests that the percentage of online ads for digital marketing should be higher than that for offline.

Moreover, this study's most crucial suggestion is that marketers must pay more attention to influencer marketing. It is portrayed as a more effective marketing tool than content and social media marketing. Influencers' online video reviews on social media have become very attractive and provide comprehensive information. They explain detailed steps for applying the products, the influencer's skin condition before and after using the product, and describe the product's negative aspects. Thus, companies should design influencer marketing strategies that enable the influencer to demonstrate honest reviews about the company's products and ascertain that the influencers have used the products for a certain period.

This study also suggests that marketers should be selective in collaborating with influencers since they become the product's representative. The influencer's total number of followers on their social media accounts should not become the primary benchmark for hiring an influencer. This study reveals that the influencer should have certain knowledge and expertise in halal cosmetics products, be humorous, and offer gentle feedback to their followers in the comments section. Thus,

marketers should find influencers that suit their brand values and have similar preferences to their potential customers. Furthermore, this study also emphasizes that the company should not have to work with macro-influencers to promote their products. In contrast, micro-influencers have significant potential to improve the customer's engagement with products because they can build strong relationships, closeness, and friendships with their followers by responding to followers' comments on their social media.

10.6 Conclusion

This study's findings shed light on the customer's perspective and experience with halal cosmetics in the digital marketing era in the Indonesian context. This study ascertained that religiosity had become the foremost factor considered by Indonesian Muslim customers in deciding their cosmetics consumption. This result indicates that no matter how attractive and promising a product's advertisements are in digital marketing, they will not sacrifice their religion to consume products, which remains doubtful regarding halalness. On the other hand, digital marketing has significantly increased the customer's knowledge and awareness of halal cosmetics due to the ease with which they can discover detailed information online. However, digital marketing has dramatically led customers into consumptive behavior because today, they can get product recommendations from relatives and other customers on a large scale by sharing online information. Moreover, this study also emphasizes that customers face challenges in filtering credible information about halal cosmetics due to the massive spread of information on the Internet.

Future research may replicate the conceptual model used in this study and apply it to describe the Muslim perspective toward non-halal cosmetics products and vice versa. The result will enhance understanding of digital marketing's influence on consumer consumption behavior. Therefore, extensive research on halal cosmetics consumption behavior in the digital marketing era is required.

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Appendix

Participant Questionnaire

1. Can you introduce yourself?
    a) Age
    b) Study Program
    c) Study Degree
2. Can you explain your perspective about halal cosmetics consumption?
    a) The importance of using halal cosmetics
    b) Halal cosmetics indicator
    c) Experience using halal cosmetics
3. What do you think about the digital marketing phenomenon in terms of halal cosmetics products?
    a) Can you explain the comparison between digital and conventional marketing?
    b) How has digital marketing influenced your halal cosmetics consumption?
4. How much time do you spend online finding halal cosmetics information?
5. What do you think about content marketing?

a) How often do you look for halal cosmetics information using a search engine?

b) How has content marketing specifically influenced your halal cosmetics consumption?

6. What do you think about social media marketing?

a) How often do you look for halal cosmetics information through social media?

b) Are there any specific social media sites where you prefer to find the information that you need? If your answer is yes, can you please talk about why you choose this specific one?

c) How has social media marketing specifically influenced your halal cosmetics consumption?

7. What do you think about influencer marketing?
    a) How often do you look for halal cosmetics information from a beauty influencer?
    b) Do you have a favorite beauty influencer that you always look up? If your answer is yes, can you please talk about her/his/them?
    c) How has influencer marketing specifically influenced your halal cosmetics consumption?

8. Among the three types of digital marketing (i.e., content marketing, social media marketing, and influencer marketing), what is the most convenient type for you to discover the halal cosmetics information you need?
9. What are the challenges of halal cosmetics consumption in the digital marketing era?
10. Do you have any suggestions to solve the challenges encountered?

ISBN 978-621-96812-7-8