CIRCULAR ECONOMY TRANSFORMATION IN MSMES: SUSTAINABLE BUSINESS MODEL INNOVATION TO ENHANCE ECONOMIC AND ENVIRONMENTAL PERFORMANCE

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This study analyzes the transformation of the circular economy in micro, small, and medium enterprises (MSMEs) through sustainable business model innovation and evaluates its impact on economic and environmental performance. The research aims to identify key factors influencing the successful implementation of circular economy principles and propose a theoretical framework relevant to developing countries. Employing a qualitative approach, this study utilizes a case study design and secondary data analysis, drawing from peer-reviewed journals, industry reports, and policy documents. Thematic analysis is applied to extract key patterns and relationships that support circular economy adoption in MSMEs. The findings reveal that integrating resource efficiency, waste reduction, and digital technologies enhances MSME competitiveness while promoting sustainability. Key success factors include leadership commitment, strategic partnerships, and access to technology and financing. This study contributes to the literature by offering a comprehensive framework that integrates circular economy principles with business model innovation in the MSME context. Practically, it provides strategic insights for policymakers, business leaders, and academics to accelerate the transition toward sustainable business models. Future research should focus on empirical validation and sector-specific applications to strengthen the framework's applicability. By adopting circular economy strategies, MSMEs can enhance their resilience, drive sustainable economic growth, and contribute to global environmental goals.

1. INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) serve as the backbone of the economy, particularly in developing countries (Khurana et al., 2021; Taiwo et al., 2022; Tumiwa & Nagy, 2021). According to data from the Ministry of Cooperatives and SMEs, MSMEs contribute more than 60% to the Gross Domestic Product (GDP) and provide over 90% of employment in Indonesia. This strategic role positions MSMEs as a key driver of national economic growth.

However, despite their economic significance, MSMEs face substantial sustainability challenges. These challenges include limited access to modern technology, inadequate financing, and a lack of awareness regarding the importance of sustainability in daily business practices (Singh et al., 2021; Vásquez et al., 2021). Furthermore, the traditional linear business model adopted by most MSMEs, which follows the "take-make-dispose" pattern, exacerbates resource depletion and environmental degradation (Naidoo et al., 2021; Namany et al., 2019). Given the increasing global pressure for environmental conservation and resource efficiency, a fundamental transformation toward a more sustainable and resilient business model is imperative (Nikolaou & Tsagarakis, 2021; Ruan et al., 2022; Velenturf & Purnell, 2021).

The circular economy (CE) has emerged as a novel paradigm that offers a viable solution to these challenges. By emphasizing resource efficiency, waste reduction, and material reuse, the circular economy presents a significant opportunity for MSMEs to enhance their competitiveness while contributing to environmental sustainability (Dey et al., 2020; Ormazabal et al., 2018; Sharma et al., 2021). The transition toward a circular economy not only helps MSMEs reduce operational costs through resource efficiency but also fosters innovation in high-value-added products (de Sousa Jabbour et al., 2019; Khurana et al., 2019). Despite these benefits, the adoption of the circular economy within MSMEs remains limited, particularly in developing countries such as Indonesia, where access to knowledge and resources often poses a significant barrier (Mishra et al., 2021; Ngan et al., 2019).

A more substantial transformation is required, particularly in the way MSMEs conceptualize and implement sustainable business models. The conventional business approaches adopted by MSMEs often lack long-term sustainability considerations, leading to inefficiencies in resource utilization and increased environmental impact. The integration of circular economy principles into MSMEs' business strategies is not merely an option but a necessity to ensure long-term business resilience and competitiveness (Jaeger & Upadhyay, 2020). Without this transformation, MSMEs risk being left behind in an increasingly sustainability-driven market, where consumers, investors, and regulatory bodies are demanding more environmentally responsible business practices. Moreover, adopting circular economy principles can provide MSMEs with a strategic advantage by differentiating their products and services, improving cost efficiency, and enhancing brand reputation in the marketplace (Jin et al., 2022). Therefore, understanding how sustainable business model innovation can facilitate the circular economy transformation in MSMEs is of paramount importance.

The novelty of this study lies in its effort to integrate the concept of the circular economy with sustainable business model innovation, a topic that has yet to be extensively explored within the MSME context. The originality of this research is reflected in its multidimensional perspective, combining economic and environmental sustainability as a foundation for designing MSME development strategies. Furthermore, this study has high practical relevance, as it focuses on the MSME sector, which plays a crucial role in the economy, particularly in developing nations. By providing both theoretical and practical insights, this research is expected to serve as a strategic foundation for stakeholders in accelerating the transition toward a circular economy within MSMEs. The circular economy transformation in MSMEs also makes a vital contribution to supporting the Sustainable Development Goals (SDGs), particularly Goal 8 on decent work and economic growth and Goal 12 on responsible consumption and production. Therefore, this study is not only academically relevant but also holds significant practical implications in advancing the global sustainability agenda through the empowerment of MSMEs.

This study is driven by several key questions that need to be addressed to understand the circular economy transformation in Micro, Small, and Medium Enterprises (MSMEs). First, how can the circular economy transformation be implemented in MSMEs through sustainable business model innovation? Second, what factors influence the successful implementation of sustainable business models in enhancing the economic and environmental performance of MSMEs? Third, what are the theoretical and practical implications of integrating the circular economy and business model innovation in MSMEs in developing countries?

The objective of this study is to examine how sustainable business model innovation can support the circular economy transformation in MSMEs. Additionally, this research aims to analyze the key factors contributing to the successful adoption of the circular economy in MSMEs. Finally, this study seeks to propose a new theoretical framework that integrates economic and environmental sustainability for MSME development.

The circular economy has become a focal point of research in the context of sustainability, particularly in the large manufacturing sector. However, its implementation in MSMEs remains underexplored. While the study by Jaeger & Upadhyay (2020) highlights the barriers to circular economy adoption at the firm level, its focus is primarily on large industries rather than MSMEs. In the context of business model innovation, Jin et al. (2022) introduced the Business Model Canvas as an innovation tool; however, its application in the circular economy and environmental sustainability within MSMEs has yet to be widely adapted. This study contributes to the literature by examining the interaction between business model innovation and the circular economy, specifically in the context of MSMEs. The research focus is to create an integration of economic and environmental sustainability, offering a novel perspective within the existing body of knowledge.

Previous research on the circular economy has highlighted various approaches and challenges in implementing this concept, particularly in the business and MSME sectors. de Sousa Jabbour et al. (2019) emphasize that circular economy business models require changes in operational management decision-making processes, necessitating the development of new skills among designers, operations managers, and supply chain professionals. Salvador et al., (2021) further argue that circular economy strategies, such as strategic partnerships and digital technologies, significantly influence key business model elements, including customer segments, customer relationships, and key partnerships.

The study by Prieto-Sandoval et al., (2021) developed the Ecopyme methodology, consisting of five steps designed to assist industrial SMEs in transitioning from a linear to a circular model, emphasizing value creation and organizational commitment from top management to staff. Similarly, Akinwale, (2024) found that the adoption of the circular economy in Saudi Arabia is driven by employee training, financial resources, top management commitment, digital technology, product/service improvements, and public pressure. However, it is not significantly influenced by incentives or regulatory pressure. Muafi, (2021) examined the impact of green culture and green strategy on circular economy implementation, revealing that green intellectual capital plays a moderating role in this relationship. Furthermore, Cantú et al., (2021) demonstrated that the successful implementation of the circular economy in SMEs in developing countries requires aligning business strategies with local market characteristics, such as infrastructure, regulations, and consumer behavior. Kravchenko et al., (2019) contributed by identifying key performance indicators related to sustainability for various circular economy strategies, enabling an initial assessment of sustainability performance potential in manufacturing firms.

While the existing literature has highlighted various approaches and strategies for circular economy implementation, several critical gaps remain unaddressed. First, most studies focus on large enterprises or specific industrial sectors, whereas the MSME context remains underexplored. Second, the relationship between business model innovation and economic and environmental sustainability is still not well-defined, particularly in the context of developing countries. Third, there is a lack of studies that provide a holistic methodology for integrating economic and environmental sustainability into MSME development through business model innovation.

This study aims to bridge these gaps in the literature by developing a framework that facilitates the circular economy transformation in MSMEs through sustainable business model innovation. The specific objectives of this research are as follows: First, to identify key factors influencing the successful implementation of the circular economy in MSMEs. Second, to analyze how sustainable business model innovation can enhance both the economic and environmental performance of MSMEs. Finally, to propose a new theoretical framework that integrates economic and environmental sustainability for MSME development, particularly in developing countries.

2. RESEARCH METHODS

This study employs a qualitative research approach with a case study design to explore the transformation of the circular economy in MSMEs through sustainable business model innovation and its impact on economic and environmental performance. The case study method was chosen because it allows for an in-depth examination of specific phenomena within real-world contexts, providing nuanced and contextualized insights that are particularly valuable for understanding complex organizational and economic dynamics.

The primary data source for this research is secondary data, which includes relevant literature such as peer-reviewed scientific journals, books, government reports, and corporate documents that discuss the circular economy, business model innovation, and MSME performance. The selection of secondary data as the primary source is justified by its ability to provide comprehensive and longitudinal insights, ensuring a robust understanding of trends, theoretical developments, and empirical findings in the field. Furthermore, secondary data allows for the integration of diverse perspectives, reducing biases that may arise from single-case observations.

Data collection was conducted through an extensive literature review, systematically analyzing various sources to obtain data that support the research objectives. A total of 47 references were utilized, encompassing both theoretical and empirical studies that contribute to the conceptual and analytical framework of this study.

The collected data were analyzed using thematic analysis, which involved several key stages. First, data reduction was performed to filter and extract relevant information aligned with the research focus. Next, the data were categorized into specific themes based on the conceptual framework, allowing for structured analysis. Thematic interpretation was then conducted to examine the relationship between sustainable business model innovation and the economic and environmental performance of MSMEs. Finally, the findings were presented through in-depth narratives, tables, and diagrams to enhance clarity and comprehensibility.

To ensure the validity and reliability of the research, triangulation was rigorously applied. Source triangulation was conducted by comparing multiple secondary data sources, including academic literature, government publications, and industry reports, to ensure consistency and accuracy. Additionally, theory triangulation was employed by incorporating multiple theoretical perspectives to enrich the analytical depth and provide a more holistic understanding of the circular economy transformation in MSMEs. These triangulation techniques enhance the credibility of the findings by mitigating potential biases and ensuring a well-rounded analysis.

Ethical considerations were strictly adhered to throughout the study. All data sources utilized were publicly accessible and legally obtained, ensuring transparency and academic integrity. By systematically justifying the use of secondary data and reinforcing the triangulation approach, this study provides a rigorous and credible examination of circular economy transformation in MSMEs.

3. RESULTS AND DISCUSSION

Circular Economy Transformation in MSMEs through Sustainability-Based Business Model Innovation

This study finds that the transformation of the circular economy in MSMEs can be achieved through three key elements of business model innovation: value proposition, operational structure, and revenue mechanism (Santa-Maria et al., 2021; Bigliardi & Filippelli, 2021; Centobelli et al., 2020). The value proposition in a circular economy-based MSME business model focuses on value creation through waste reduction, raw material reuse, and sustainable product design (Awan & Sroufe, 2022). For instance, literature studies indicate that MSMEs in the textile sector have adopted circular economy models by repurposing fabric waste into new products such as bags and accessories. This approach not only enhances resource efficiency but also generates added value that appeals to sustainability-conscious consumers (Salvador et al., 2021).

Integration of Digital Technology in Circular Economy Transformation

The operational structure of MSMEs in circular economy transformation involves integrating digital technologies to improve production process efficiency and waste management (Sarc et al., 2019). Technologies such as the Internet of Things (IoT) enable waste tracking and optimization of raw material usage (Pardini et al., 2020). Figure 1 illustrates a framework comprising five stages of the operational structure of MSMEs in circular economy transformation, integrating digital technologies to enhance efficiency and sustainability.
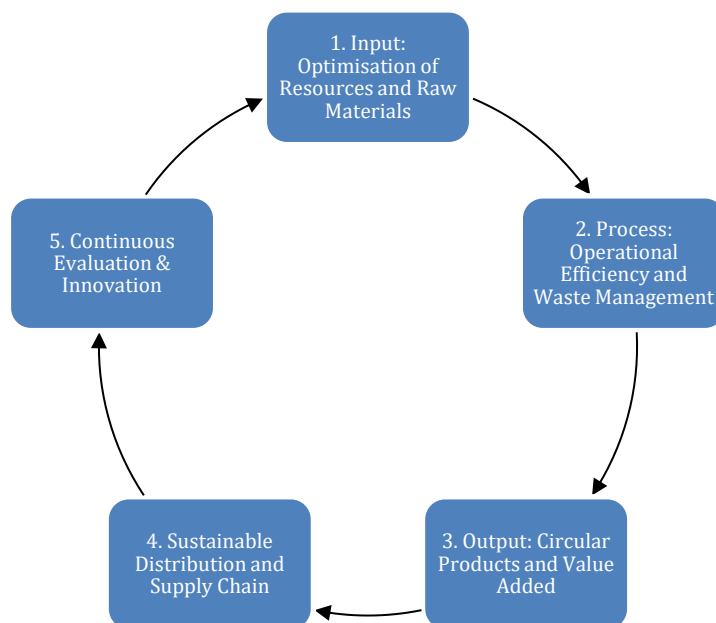

Figure 1. Stages of MSME Operational Structure in Circular Economic Transformation
Source: Processed Data (2025)

At the initial stage, MSMEs must ensure that raw materials are sourced from sustainable practices, including recycled materials. By implementing IoT, business owners can monitor real-time material usage, reducing waste and improving efficiency. Digitalization also enhances process automation, enabling businesses to optimize production cycles and minimize energy consumption (Silva & Azevedo, 2020). Additionally, AI-powered analytics can provide strategic recommendations to improve sustainability performance, while blockchain technology ensures transparency in supply chain management, allowing businesses to track and verify the sustainability credentials of suppliers (Modgil et al., 2021).

Real-time waste management strategies using digital tools allow MSMEs to minimize environmental impact while creating new revenue opportunities from processed waste. For example, IoT-based waste monitoring systems can identify material consumption patterns and optimize resource allocation. Big data analytics can further support decision-making by providing insights into resource efficiency trends, helping MSMEs adopt lean manufacturing concepts that minimize material loss and optimize production outputs (Ghahramani et al., 2022). Table 1 presents a comparative analysis of digital technology adoption in MSMEs implementing circular economy practices. The table highlights the extent to which IoT, AI, and blockchain influence operational efficiency, cost reduction, and sustainability performance. From Table 1, it is evident that IoT plays a crucial role in enabling MSMEs to achieve operational efficiency by monitoring energy and material consumption. AI enhances decision-making through predictive analysis, allowing businesses to identify areas where waste reduction strategies can be implemented effectively. Meanwhile, blockchain ensures transparency in sustainable sourcing, addressing challenges related to verifying the environmental impact of supply chains.

Table 1. Impact of Digital Technologies on Circular Economy Implementation in MSMEs

Digital Technology	Function	Expected Benefits in Circular Economy
IoT	Real-time monitoring of resource usage and waste management	Reduced waste, optimized production efficiency
AI	Predictive analytics for process optimization	Improved decision-making, enhanced sustainability
Blockchain	Supply chain transparency and verification	Strengthened trust in sustainable sourcing

Source: Processed Data (2025)

These insights emphasize the need for MSMEs to leverage digital tools to facilitate circular economy transformation. By adopting these technologies, MSMEs can not only enhance their competitiveness but also contribute to broader sustainability goals by reducing environmental footprints and improving resource efficiency.

The findings of this study suggest that integrating digital technology into circular economy models enables MSMEs to enhance their operational resilience and adapt to changing market demands. Furthermore, governments and policymakers should support MSMEs in accessing digital infrastructure and training programs to accelerate this transformation. This alignment between digital innovation and sustainability presents a strategic opportunity for MSMEs to strengthen their position in an increasingly eco-conscious global market.

The operational structure of MSMEs in circular economy transformation relies on resource optimization and production process efficiency through digital technology integration (Arroyabe et al., 2024). In the initial stage, MSMEs must ensure that raw materials are sourced from sustainable practices, including the use of recycled materials. By implementing Internet of Things (IoT) technology, business owners can monitor raw material usage in real-time, thereby reducing waste and improving production efficiency. In operational processes, efficiency is a key factor supporting sustainability (Silva & Azevedo, 2020). Digital technology-based automation enables production process optimization, while IoT-based waste monitoring systems help identify material consumption patterns and waste generation levels. Through this data analysis, MSMEs can develop more efficient production strategies by adopting lean manufacturing concepts to minimize waste at every stage of production (Ghahramani et al., 2022). Additionally, the implementation of real-time waste management strategies allows small and medium enterprises to minimize environmental impact while creating new revenue opportunities from processed waste that can be resold or repurposed as alternative raw materials (Tereshchenko et al., 2023).

Products developed within the circular economy ecosystem must be designed for durability, reparability, or easier recyclability (Leal et al., 2020). Modular design is one of the viable solutions, ensuring longer product lifespans while reducing the need for new material consumption. Furthermore, eco-friendly certifications serve as an added value that enhances the competitiveness of MSME products in a market increasingly concerned with sustainability. In the distribution stage, adopting a sustainable supply chain is a strategic approach to reducing environmental impact (Wojnarowska et al., 2021). The use of green logistics systems and optimized delivery routes can significantly lower the carbon footprint generated during distribution. Meanwhile, leveraging circular economy-based e-commerce platforms facilitates easier access to sustainable products for environmentally conscious consumers (Arman & Mark-Herbert, 2021).

To ensure the continuous development of this transformation, evaluation and innovation are integral components of the operational structure of circular economy-based MSMEs (Suchek et al., 2021). The utilization of big data enables comprehensive analysis of operational performance, while artificial intelligence (AI) can provide strategic recommendations that are more adaptive to market changes and sustainability policies (Modgil et al., 2021). By implementing this technology- and sustainability-driven approach, MSMEs not only enhance operational efficiency but also contribute to a more environmentally friendly economy while strengthening their competitiveness in the global market. The analysis results indicate that employee training in the use of these technologies is a key success factor, as identified by Akinwale (2024).

The revenue mechanism in sustainability-driven business model innovation involves diversifying income streams through products and services that support the circular economy (Centobelli et al., 2020). For instance, MSMEs can offer product repair services or product take-back programs, where used products are reprocessed into new items. Additionally, MSMEs can adopt a subscription model for circular products, in which customers pay a subscription fee to use the product, accompanied by maintenance services and environmentally friendly spare part replacements (Rosa et al., 2019). This approach not only extends product lifespan but also generates sustainable revenue for businesses.

Revenue can also be obtained through the sale of recycled or upcycled products, where industrial waste or production residues are repurposed into high-value items (Balu et al., 2022). For example, textile waste from the garment industry can be transformed into fashion accessories or decorative products with significant market appeal. In this way, MSMEs not only reduce waste but also create new market opportunities driven by sustainability-conscious consumers.

Furthermore, the concept of the sharing economy and product leasing has emerged as an effective strategy for increasing revenue (Abrate & Viglia, 2019). Instead of selling products outright, MSMEs can offer rental services for tools or production equipment that are infrequently used, such as machinery or agricultural tools, allowing broader access to equipment at a lower cost. This business model optimizes resource utilization, reduces new product consumption, and creates a more stable revenue stream for business owners. Through these various mechanisms, MSMEs can enhance their competitiveness while actively contributing to a more sustainable and efficient economy.

Key Factors for Successful Implementation of Circular Economy in MSMEs

The successful implementation of the circular economy in MSMEs is highly dependent on several interrelated key factors. One of the primary factors is the commitment of management and leadership within the organization. Leaders with a strong sustainability vision can drive organizational cultural change and facilitate the adoption of circular business practices. A study by Cantú et al., (2021) indicates that MSMEs led by individuals with a sustainability-oriented mindset tend to have higher levels of circular economy adoption. With strong leadership, the transformation toward a more sustainable business model can be executed more effectively and consistently.

In addition, strategic partnerships with various stakeholders play a crucial supporting role. Governments can contribute by providing fiscal incentives and regulatory frameworks that facilitate circular economy adoption. Non-governmental organizations (NGOs) also play a vital role in educating and raising awareness among MSME actors, helping them understand the benefits and opportunities associated with circular business models. Meanwhile, large corporations can serve as supply chain partners by supporting the implementation of circular principles, whether through the provision of recycled raw materials or the procurement of products from MSMEs that adopt sustainable practices.

Access to technology and green financing is also a key element in accelerating the transition to a circular economy within the MSME sector. The adoption of modern technologies, such as digitalization in production processes and more efficient recycling methods, enables MSMEs to reduce waste and enhance productivity. On the other hand, the availability of green financing instruments, such as green bonds and impact investing, provides financial support for MSMEs seeking to adopt sustainability-driven business models. A study by Prieto-Sandoval et al., (2021) emphasizes that access to environmentally oriented financing is one of the critical determinants of the sustainability of this transformation. Through a combination of visionary leadership, robust strategic partnerships, and adequate access to technology and funding, MSMEs can more effectively implement circular economy principles and enhance their competitiveness within an increasingly dynamic business ecosystem.

Theoretical and Practical Implications

This study makes a theoretical contribution by developing an integrated framework that combines business model innovation and the circular economy for MSMEs. This framework offers a multidimensional approach encompassing economic, environmental, and social sustainability. Furthermore, this study extends the application of the Business Model Canvas (Jin et al., 2022) by incorporating sustainability elements as a core component in business model design for MSMEs. The proposed framework integrates circular economy theory (Jaeger & Upadhyay, 2020) with business model innovation concepts, providing a holistic perspective on how MSMEs can effectively transform under global sustainability pressures.

This study also provides practical guidance for MSMEs, stakeholders, and policymakers to accelerate the transition toward a circular economy. The practical recommendations include the following: First, providing training and mentoring programs to enhance the technical and managerial capacities of MSMEs in implementing circular economy principles. Second, developing fiscal policies that incentivize circular economy adoption, such as tax incentives for MSMEs implementing circular practices. Lastly, facilitating access to green technologies through subsidies or partnerships with technology institutions. This study introduces the Sustainable Circular Business Model Framework (SCBMF), designed to help MSMEs integrate economic and environmental sustainability into their business models. This framework focuses on three interdependent key elements: Circular Value Proposition, Sustainable Operational Structure, and Resilient Revenue Mechanism, as illustrated in Figure 2.
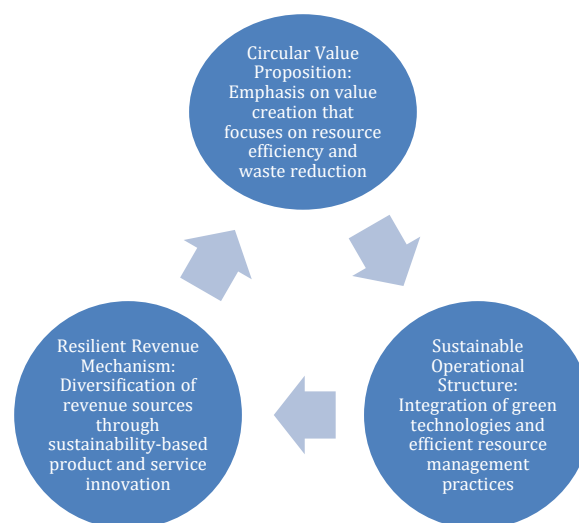

Figure 2. Sustainable Circular Business Model Framework (SCBMF)
Source: Data processed, 2025

The circular value proposition emphasizes value creation that focuses on resource efficiency and waste reduction (Whalen, 2019). Within the circular economy framework, MSMEs must transform how they design, manufacture, and distribute products to enhance sustainability. The value offered to customers extends beyond quality and price to include positive environmental impacts, such as the use of eco-friendly raw materials, durable product designs, and recycling options. MSMEs can implement product design strategies that consider the product lifecycle, including the use of recycled or biodegradable materials and the provision of maintenance services to extend product longevity. Additionally, they can adopt a take-back system, where customers return used products for repair, recycling, or repurposing. For instance, an MSME specializing in bag production could utilize recycled fabric from industrial textile waste and offer a trade-in program for customers seeking to exchange old products for new ones. Through this approach, the value provided to customers is not merely the product itself but also their contribution to reducing textile waste.

The Sustainable Operational Structure refers to the integration of green technologies and more efficient resource management practices (de Oliveira Santos et al., 2019). To achieve operational efficiency, MSMEs must adopt technologies that support emission reduction, renewable energy utilization, and the optimization of raw material usage through low-waste production systems. MSMEs can leverage digital technologies to optimize supply chain and inventory management, such as utilizing the Internet of Things (IoT) to monitor energy consumption and waste generation throughout the production process. Additionally, implementing lean manufacturing practices that minimize material and water waste can significantly enhance production efficiency. For example, MSMEs in the food and beverage industry can employ organic waste processing technologies to generate compost or biogas, which can then be reused as an energy source or fertilizer for agriculture. This approach not only reduces waste but also fosters a more sustainable and cost-effective production system.

The Resilient Revenue Mechanism focuses on diversifying income streams through sustainability-driven product and service innovation (de Jesus Pacheco et al., 2019). In the circular economy, revenue is not solely derived from one-time product sales but also from various complementary services that support the product lifecycle, such as leasing, repair services, or recycling programs. MSMEs can develop a Product-as-a-Service model, where products are not sold outright but leased through subscription or pay-per-use schemes. Additionally, they can offer repair and refurbishment services to extend product lifespan and create new products from used materials (upcycling). For example, an MSME operating in the electronics industry could introduce a laptop and electronic device rental service for business customers or educational institutions. At the end of the rental period, the products could be upgraded, repaired, and re-leased or recycled into new components. This model enables MSMEs to establish a sustainable revenue stream without relying solely on continuous new product manufacturing.

The Sustainable Circular Business Model Framework (SCBMF) provides a strategic approach for MSMEs to effectively adopt the circular economy. By implementing the Circular Value Proposition, MSMEs can create sustainability-oriented value. Through the Sustainable Operational Structure, they can optimize resource utilization and minimize waste. Meanwhile, the Resilient Revenue Mechanism enables revenue diversification through more adaptive business model innovations. By integrating these three key elements, MSMEs can enhance their market competitiveness while contributing to the development of a more sustainable and inclusive economy.

4. CONCLUSION

This study examines how sustainable business model innovation facilitates circular economy transformation in MSMEs, addressing economic and environmental challenges. The findings highlight that integrating resource efficiency, waste reduction, and digital technologies significantly enhances MSME performance. Unlike previous studies, this research presents a comprehensive framework that combines business model innovation with circular economy principles, providing a novel perspective on how MSMEs can achieve long-term sustainability. The study advances the literature by identifying key success factors, including leadership commitment, technological adoption, and strategic partnerships, which are essential for fostering resilience and competitiveness in an increasingly sustainability-driven market.

To accelerate circular economy adoption in MSMEs, policymakers should implement supportive regulations, financial incentives, and capacity-building programs tailored to sustainability-oriented business practices. Digital infrastructure and access to green financing must be expanded to ensure MSMEs can integrate advanced technologies such as IoT, AI, and blockchain in their operations. Furthermore, collaboration between government, industry, and academia is crucial in fostering innovation ecosystems that promote circular business models. Future research should focus on empirical validation of the proposed framework and explore sector-specific challenges to develop more targeted policy interventions. By implementing these measures, MSMEs can play a pivotal role in driving sustainable economic growth while contributing to global environmental objectives.

5. REFERENCES

Abrate, G., & Viglia, G. (2019). Personal or Product Reputation? Optimizing Revenues in the Sharing Economy. *Journal of Travel Research*, *58*, 136–148. https://doi.org/10.1177/0047287517741998

Akinwale, Y. O. (2024). Circular economy awareness, adoption, and its effects on business performance in Saudi Arabia. *Problems and Perspectives in Management*, *22*(3), 119–133. https://doi.org/10.21511/ppm.22(3).2024.10

Arman, S. M., & Mark-Herbert, C. (2021). Re-Commerce to Ensure Circular Economy from Consumer Perspective. *Sustainability*, *13*(18), 10242. https://doi.org/10.3390/su131810242

Arroyabe, M. F., Arranz, C. F. A., & de Arroyabe, J. C. F. (2024). The integration of circular economy and digital transformation as a catalyst for small and medium enterprise innovation. *Business Strategy and the Environment*, *33*(7), 7162–7181. https://doi.org/10.1002/bse.3858

Awan, U., & Sroufe, R. (2022). Sustainability in the Circular Economy: Insights and Dynamics of Designing Circular Business Models. *Applied Sciences*, *12*(3), 1521. https://doi.org/10.3390/app12031521

Balu, R., Dutta, N. K., & Choudhury, N. R. (2022). Plastic Waste Upcycling: A Sustainable Solution for Waste Management, Product Development, and Circular Economy. *Polymers*, *14*(22), 4788. https://doi.org/10.3390/polym14224788

Bigliardi, B., & Filippelli, S. (2021). Investigating Circular Business Model Innovation through Keywords Analysis. *Sustainability*, *13*(9), 5036. https://doi.org/10.3390/su13095036

Cantú, A., Aguiñaga, E., & Scheel, C. (2021). Learning from Failure and Success: The Challenges for Circular Economy Implementation in SMEs in an Emerging Economy. *Sustainability*, *13*(3), 1529. https://doi.org/10.3390/su13031529

Centobelli, P., Cerchione, R., Chiaroni, D., Vecchio, P. Del, & Urbinati, A. (2020). Designing business models in circular economy: A systematic literature review and research agenda. *Business Strategy and The Environment*, *29*(4), 1734–1749. https://doi.org/10.1002/bse.2466

de Jesus Pacheco, D. A., ten Caten, C. S., Jung, C. F., Sassanelli, C., & Terzi, S. (2019). Overcoming barriers towards Sustainable Product-Service Systems in Small and Medium-sized enterprises: State of the art and a novel Decision Matrix. *Journal of Cleaner Production*, *222*, 903–921. https://doi.org/10.1016/j.jclepro.2019.01.152

de Oliveira Santos, H., Lannelongue, G., & González-Benito, J. (2019). Integrating Green Practices into Operational Performance: Evidence from Brazilian Manufacturers. *Sustainability*, *11*(10), 2956. https://doi.org/10.3390/su11102956

de Sousa Jabbour, A. B. L., Rojas Luiz, J. V., Rojas Luiz, O., Jabbour, C. J. C., Ndubisi, N. O., Caldeira de Oliveira, J. H., & Junior, F. H. (2019). Circular economy business models and operations management. *Journal of Cleaner Production*, *235*, 1525–1539. https://doi.org/https://doi.org/10.1016/j.jclepro.2019.06.349

Dey, P. K., Malesios, C., De, D., Budhwar, P., Chowdhury, S., & Cheffi, W. (2020). Circular economy to enhance sustainability of small and medium-sized enterprises. *Business Strategy and the Environment*, *29*(6), 2145–2169. https://doi.org/https://doi.org/10.1002/bse.2492

Ghahramani, M., Zhou, M., Molter, A., & Pilla, F. (2022). IoT-Based Route Recommendation for an Intelligent Waste Management System. *IEEE Internet of Things Journal*, *9*(14), 11883–11892. https://doi.org/10.1109/JIOT.2021.3132126

Jaeger, B., & Upadhyay, A. (2020). Understanding barriers to circular economy: cases from the manufacturing industry. *Journal of Enterprise Information Management*, *33*(4), 729–745. https://doi.org/10.1108/JEIM-02-2019-0047

Jin, Y., Ji, S., Liu, L., & Wang, W. (2022). Business model innovation canvas: a visual business model innovation model. *European Journal of Innovation Management*, *25*(5), 1469–1493. https://doi.org/10.1108/EJIM-02-2021-0079

Khurana, S., Haleem, A., Luthra, S., & Mannan, B. (2021). Evaluating critical factors to implement sustainable oriented innovation practices: An analysis of micro, small, and medium manufacturing enterprises. *Journal of Cleaner Production*, *285*, 125377. https://doi.org/10.1016/j.jclepro.2020.125377

Khurana, S., Haleem, A., & Mannan, B. (2019). Determinants for integration of sustainability with innovation for Indian manufacturing enterprises: Empirical evidence in MSMEs. *Journal of Cleaner Production*, *229*, 374–386. https://doi.org/https://doi.org/10.1016/j.jclepro.2019.04.022

Kravchenko, M., Pigosso, D. C. A., & McAloone, T. C. (2019). Towards the ex-ante sustainability screening of circular economy initiatives in manufacturing companies: Consolidation of leading sustainability-related performance indicators. *Journal of Cleaner Production*, *241*, 118318. https://doi.org/10.1016/j.jclepro.2019.118318

Leal, J. M., Pompidou, S., Charbuillet, C., & Perry, N. (2020). Design for and from Recycling: A Circular Ecodesign Approach to Improve the Circular Economy. *Sustainability*, *12*(23), 9861. https://doi.org/10.3390/su12239861

Mishra, J. L., Chiwenga, K. D., & Ali, K. (2021). Collaboration as an enabler for circular economy: a case study of a developing country. *Management Decision*, *59*(8), 1784–1800. https://doi.org/10.1108/MD-10-2018-1111

Modgil, S., Gupta, S., Sivarajah, U., & Bhushan, B. (2021). Big data-enabled large-scale group decision making for circular economy: An emerging market context. *Technological Forecasting and Social Change*, *166*, 120607. https://doi.org/10.1016/j.techfore.2021.120607

Muafi. (2021). The Influence of Green Culture and Green Strategy on the Circular Economy Implementation: The Moderating Role of Green Intellectual Capital. *International Journal of Sustainable Development and Planning*, *16*(6), 1101–1108. https://doi.org/10.18280/ijsdp.160611

Naidoo, D., Nhamo, L., Lottering, S., Mpandeli, S., Liphadzi, S., Modi, A. T., Trois, C., & Mabhaudhi, T. (2021). Transitional Pathways towards Achieving a Circular Economy in the Water, Energy, and Food Sectors. *Sustainability*, *13*(17). https://doi.org/10.3390/su13179978

Namany, S., Al-Ansari, T., & Govindan, R. (2019). Sustainable energy, water and food nexus systems: A focused review of decision-making tools for efficient resource management and governance. *Journal of Cleaner Production*, *225*, 610–626. https://doi.org/https://doi.org/10.1016/j.jclepro.2019.03.304

Ngan, S. L., How, B. S., Teng, S. Y., Promentilla, M. A. B., Yatim, P., Er, A. C., & Lam, H. L. (2019). Prioritization of sustainability indicators for promoting the circular economy: The case of developing countries. *Renewable and Sustainable Energy Reviews*, *111*, 314–331. https://doi.org/https://doi.org/10.1016/j.rser.2019.05.001

Nikolaou, I. E., & Tsagarakis, K. P. (2021). An introduction to circular economy and sustainability: Some existing lessons and future directions. *Sustainable Production and Consumption*, *28*, 600–609. https://doi.org/https://doi.org/10.1016/j.spc.2021.06.017

Ormazabal, M., Prieto-Sandoval, V., Puga-Leal, R., & Jaca, C. (2018). Circular Economy in Spanish SMEs: Challenges and opportunities. *Journal of Cleaner Production*, *185*, 157–167. https://doi.org/https://doi.org/10.1016/j.jclepro.2018.03.031

Pardini, K., Rodrigues, J. J. P. C., Diallo, O., Das, A. K., Albuquerque, V. H. C., & Kozlov, S. A. (2020). A Smart Waste Management Solution Geared towards Citizens. *Sensors (Basel, Switzerland)*, *20*(8), 2380. https://doi.org/10.3390/s20082380

Prieto-Sandoval, V., Torres-Guevara, L. E., Ormazábal, M., & Jaca, C. (2021). Beyond the circular economy theory: Implementation methodology for industrial SMEs. *Journal of Industrial Engineering and Management*, *14*(3), 425–438. https://doi.org/10.3926/jiem.3413

Rosa, P., Sassanelli, C., & Terzi, S. (2019). Towards Circular Business Models: A systematic literature review on classification frameworks and archetypes. *Journal of Cleaner Production*, *236*(1), 117696. https://doi.org/10.1016/j.jclepro.2019.117696

Ruan, T., Gu, Y., Li, X., & Qu, R. (2022). Research on the Practical Path of Resource-Based Enterprises to Improve Environmental Efficiency in Digital Transformation. *Sustainability*, *14*(21). https://doi.org/10.3390/su142113974

Salvador, R., Barros, M. V., Freire, F., Halog, A. B., Piekarski, C. M., & de Francisco, A. C. (2021). Circular economy strategies on business modelling: Identifying the greatest influences. *Journal of Cleaner Production*, *299*, 126918. https://doi.org/10.1016/j.jclepro.2021.126918

Santa-Maria, T., Vermeulen, W. J. V, & Baumgartner, R. J. (2021). How do incumbent firms innovate their business models for the circular economy? Identifying micro-foundations of dynamic capabilities. *Business Strategy and the Environment*, *31*(4), 1308–1333. https://doi.org/10.1002/bse.2956

Sarc, R., Curtis, A., Kandlbauer, L., Khodier, K., Lorber, K. E., & Pomberger, R. (2019). Digitalisation and intelligent robotics in value chain of circular economy oriented waste management - A review. *Waste Management*, *95*, 476–492. https://doi.org/10.1016/j.wasman.2019.06.035

Sharma, N. K., Govindan, K., Lai, K. K., Chen, W. K., & Kumar, V. (2021). The transition from linear economy to circular economy for sustainability among SMEs: A study on prospects, impediments, and prerequisites. *Business Strategy and the Environment*, *30*(4), 1803–1822. https://doi.org/https://doi.org/10.1002/bse.2717

Silva, D., & Azevedo, A. L. (2020). Sustainability as a driver of operational excellence - the relevance of variability in process operations. *International Journal of Integrated Supply Management*, *13*(2–3), 210–233. https://doi.org/10.1504/IJISM.2020.107850

Singh, M., Rathi, R., & Garza-Reyes, J. A. (2021). Analysis and prioritization of Lean Six Sigma enablers with environmental facets using best worst method: A case of Indian MSMEs. *Journal of Cleaner Production*, *279*, 123592. https://doi.org/https://doi.org/10.1016/j.jclepro.2020.123592

Suchek, N., Fernandes, C. I., Kraus, S., Filser, M., & Sjögrén, H. (2021). Innovation and the circular economy: A systematic literature review. *Business Strategy and the Environment*, *30*(8), 3686–3702. https://doi.org/10.1002/bse.2834

Taiwo, O. S., Hakan, A., & Savaş, Ç. (2022). Modeling the Impacts of MSMEs' Contributions to GDP and their Constraints on Unemployment: The Case of African's Most Populous Country. *Studies in Business and Economics*, *17*(1), 154–170. https://doi.org/10.2478/sbe-2022-0011

Tereshchenko, E., Happonen, A., Porras, J., & Vaithilingam, C. A. (2023). Green Growth, Waste Management, and Environmental Impact Reduction Success Cases From Small and Medium Enterprises Context: A Systematic Mapping Study. *IEEE Access*, *11*, 56900–56920. https://doi.org/10.1109/ACCESS.2023.3271972

Tumiwa, J., & Nagy, A. (2021). Micro, small, and medium enterprises in emerging economies and economic transition: a comparative study between Indonesia and Hungary. *International Journal of Entrepreneurship and Small Business*, *43*(1), 22–38. https://doi.org/10.1504/IJESB.2021.115312

Vásquez, J., Aguirre, S., Puertas, E., Bruno, G., Priarone, P. C., & Settineri, L. (2021). A sustainability maturity model for micro, small and medium-sized enterprises (MSMEs) based on a data analytics evaluation approach. *Journal of Cleaner Production*, *311*, 127692. https://doi.org/https://doi.org/10.1016/j.jclepro.2021.127692

Velenturf, A. P. M., & Purnell, P. (2021). Principles for a sustainable circular economy. *Sustainable Production and Consumption*, *27*, 1437–1457. https://doi.org/https://doi.org/10.1016/j.spc.2021.02.018

Whalen, K. (2019). Three circular business models that extend product value and their contribution to resource efficiency. *Journal of Cleaner Production*, *226*, 1128–1137. https://doi.org/10.1016/j.jclepro.2019.03.128

Wojnarowska, M., Sołtysik, M., & Prusak, A. (2021). Impact of eco-labelling on the implementation of sustainable production and consumption. *Environmental Impact Assessment Review*, *86*, 106505. https://doi.org/10.1016/j.eiar.2020.106505