Circular Economy in Practice: Barriers, Challenges, and Strategic Implications

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ABSTRACT

The circular economy has emerged as a transformative model for achieving sustainable development by decoupling economic growth from resource consumption. However, its practical implementation remains constrained by multiple and interrelated barriers. This study conducts a narrative review to synthesize current knowledge on the barriers, challenges, and strategic implications of circular economy implementation. The analysis reveals six dominant and interdependent themes: institutional and regulatory limitations, economic and financial constraints, technological and infrastructural readiness, organizational and collaborative capabilities, consumer and behavioral dynamics, and business model and design for circularity. The study contributes by integrating fragmented insights into a comprehensive conceptual understanding that highlights the systemic nature of these barriers. Strategically, the review underscores the need for coherent policies, financial mechanisms, technological innovation, and behavioral change to accelerate adoption. Future research directions are proposed to explore policy synergies, digital enablers, cross-country comparisons, and the long-term performance of circular business models.

Keywords: Circular Economy, Barriers, Challenges, Sustainability. Narrative Review

INTRODUCTION

The concept of a circular economy has emerged as a central paradigm in the pursuit of sustainable development, offering a transformative alternative to the traditional linear model of "take–make–dispose." By promoting resource efficiency and minimizing waste, circular economy seeks to decouple economic growth from the depletion of natural resources, fostering an economy that thrives on regeneration and closed-loop systems. In recent years, the circular economy model has gained traction among scholars, policymakers, and industry practitioners as a strategy to achieve environmental sustainability while sustaining economic competitiveness. However, despite its growing relevance, the implementation of circular economy principles remains fraught with barriers, challenges, and strategic complexities that vary across industries and regions.

Barriers to adopting a circular economy are complex and often stem from a limited understanding of its concepts and economic potential. Many companies still find it challenging to recognize the systemic value of circular strategies, viewing them mainly as environmental obligations rather than as catalysts for innovation and efficiency. As Risteska and Gveroski (2022) highlight, transitioning to a circular economy can offer numerous benefits, such as reducing environmental impacts and enhancing competitiveness, yet misinterpretations of its value proposition frequently delay implementation. This issue is further exacerbated by a general lack of

awareness and education among key stakeholders, which restricts behavioral change and impedes the spread of circular practices (Gonella et al., 2024). Additionally, Kapoor et al. (2021) argues that incorporating biological and ecological frameworks into the circular economy can enhance resource efficiency and resilience, but such integration is often neglected when organizations prioritize short-term financial gains over long-term sustainability goals.

Technological readiness adds another layer of complexity to the shift towards a circular economy. Although the progress of Industry 4.0 technologies such as automation, digitalization, and smart manufacturing provides tools to facilitate circular processes, their implementation requires substantial financial investment and a fundamental change in organizational culture. Awan et al. (2021) emphasize that these technologies can help address major obstacles in adopting a circular economy, yet companies often lack clear strategic frameworks to guide the transformation. In developing regions, these challenges are even more pronounced. Khan and Mihaisi (2023) note that small and medium-sized enterprises (SMEs) in resource-limited settings face restricted access to technology, finance, and knowledge, which exacerbates inequality and limits their involvement in circular transitions.

At the strategic level, transitioning successfully from linear to circular systems demands more than just incremental operational changes; it requires a comprehensive organizational transformation. As Scholtysik et al. (2023) point out, designing circular business models involves reconfiguring value chains, processes, and stakeholder relationships to align economic goals with environmental sustainability. Government intervention and regulatory frameworks are also crucial enablers. Tashtamirov (2023) emphasizes that policy coherence and institutional support are essential for accelerating the adoption of circular economies at regional and national levels, particularly through fiscal incentives and governance mechanisms that promote sustainable practices. Additionally, consumer engagement and stakeholder collaboration are vital in fostering an ecosystem conducive to circularity (Camacho-Otero et al., 2020). Aligning business models with circular economy principles not only boosts operational efficiency but also enhances resilience by reducing reliance on virgin resources and stabilizing supply chains (Fraccascia et al., 2019).

From an economic standpoint, transitioning to a circular economy offers significant potential for reducing costs and creating value. By minimizing waste disposal and raw material procurement expenses, companies can achieve both environmental and financial benefits. Empirical evidence indicates that circular economy practices open up new revenue opportunities and provide social benefits through inclusive financial systems and community engagement (Idrus et al., 2024). Fraccascia et al. (2019) further argue that successful circular economy models drive innovation, enhance competitiveness, and spur economic growth, making their integration into business strategy essential for long-term sustainability. However, the shift toward circularity is a complex endeavor that requires collaboration, adaptability, and a shared commitment among businesses, governments, and consumers to overcome ongoing challenges and fully realize the potential of sustainable economic development.

The aim of this paper is to synthesize the existing literature on the key barriers, challenges, and strategic implications of implementing circular economy principles across various industries. By integrating insights from a range of empirical and conceptual studies, this paper seeks to deepen the understanding of the systemic factors influencing circular economy implementation and to identify strategic pathways for enhancing its adoption.

The structure of this paper is organized as follows. The next section reviews the literature on the circular economy, while Section 3 details the methodology. Section 4 presents and discusses the main findings, and finally, Section 5 concludes the paper by summarizing key insights and highlighting future research directions.

LITERATURE REVIEW

The growing body of research on the circular economy underscores both its transformative potential and the persistent barriers that hinder its practical implementation. Across industries and regions, the transition toward a circular economy is hampered by a mix of institutional, economic, technological, and behavioral challenges that hinder firms and societies from moving beyond linear production and consumption models. A widely acknowledged barrier is the lack of collaboration and stakeholder coordination across value chains. Studies

reveal that fragmented supply chains, isolated decision-making, and insufficient cooperation among actors limit the development of circular strategies. In the construction industry, for instance, the absence of cross-sectoral partnerships and the complexity of procurement processes undermine material recovery and reuse initiatives. Similarly, coordination issues in the toy industry illustrate how a lack of stakeholder alignment can stall progress (Joshi & Khandekar, 2025; Durdyev et al., 2025). Weak collaboration also affects eco-industrial park governance, where limited commitment from participating firms and unclear performance targets restricts resource exchange and the creation of industrial symbiosis (Nguyen & Le, 2025).

Economic and financial constraints further limit the widespread adoption of circular economy practices. Many organizations face uncertainty about the profitability of circular models due to high initial investment costs, limited access to finance, and unclear market demand for secondary materials. Research indicates that firms often encounter additional costs related to recycling, transportation, and product take-back systems, especially in the built environment where linear public procurement practices prevail (Griffiths et al., 2025). In developing economies, the financial gap is even more pronounced as SMEs struggle to secure long-term funding for innovation and infrastructure upgrades (Bourdin et al., 2025). This lack of economic viability discourages experimentation with new business models and reinforces reliance on traditional, resource-intensive operations (Rizos et al., 2016).

Governmental and regulatory frameworks also play a decisive role in shaping the pace of circular economy transitions. The absence of coherent policy direction, weak enforcement mechanisms, and inconsistent regulations across agencies often lead to institutional uncertainty. In emerging and developing economies such as Morocco, Kazakhstan, and Malaysia, these inconsistencies undermine the ability of firms to invest in long-term circular solutions (Bourdin et al., 2025). Sector-specific studies, such as those on the fashion industry and waste management systems in Brazil, indicate that regulatory pressure without supportive incentives can generate compliance burdens rather than foster innovation (Abdelmeguid et al., 2024; Souza Piao et al., 2024). Similarly, in the Gulf Cooperation Council region, the lack of standardized policies and green procurement mechanisms has slowed market creation for circular products and services (Zighan et al., 2025).

Technological readiness and infrastructure continue to be key factors in the successful implementation of a circular economy. The integration of digital technologies, such as automation, data analytics, and blockchain, presents opportunities to improve traceability, product lifecycle management, and resource optimization. However, these technologies also introduce new challenges. Research on digital manufacturing highlights concerns about data security, information privacy, and system interoperability, which cause firms to hesitate in adopting advanced technological tools (Bag et al., 2022). In many developing regions, inadequate waste management infrastructure, limited access to digital tools, and a lack of technical expertise further hinder firms from leveraging technological innovations (Pittri et al., 2025). Despite these challenges, researchers have pointed out that digital solutions like blockchain and smart contracts can foster trust and transparency in supply chains, laying the groundwork for circular business models to thrive (Kumar & Chopra, 2022).

Cultural and behavioral barriers also play a significant role in shaping circular economy transitions. Entrenched consumer habits, resistance to change within organizations, and a general lack of awareness about the environmental and economic benefits of circular practices limit participation in reuse, recycling, and remanufacturing programs. Research conducted in the Gulf Cooperation Council region found that social norms and organizational inertia prevent the adoption of sustainable consumption patterns (Zighan et al., 2025). Similar challenges were observed in Vietnam's eco-industrial parks, where low managerial commitment and insufficient community engagement limited long-term success despite supportive infrastructure (Nguyen & Le, 2025). These findings indicate that behavioral change must accompany policy and technological interventions for circular economy initiatives to be effective and sustainable.

While barriers are well documented, the literature also highlights several strategic implications and responses that can expedite the adoption of a circular economy. Policy development and enforcement are among the most crucial levers, as governments can influence market conditions through incentives, standards, and public procurement that favor circular practices (Durdyev et al., 2025; Bourdin et al., 2025). Collaborative governance structures that unite firms, consumers, and public institutions are also essential in overcoming fragmentation and fostering innovation (Souza Piao et al., 2024). Technological advancements, when supported by adequate

capacity building and infrastructure development, can significantly enhance the efficiency and scalability of circular systems (Bag et al., 2022; Pittri et al., 2025). Equally important is cultivating market and consumer awareness, as changing consumption preferences and encouraging participation in return and reuse systems strengthen the demand base for circular products and services (Rizos et al., 2016).

Beyond addressing barriers, several studies emphasize the environmental, economic, and social benefits that a circular economy can deliver when properly implemented. Shifting to circular production systems reduces material consumption, minimizes waste, and fosters resource regeneration, thereby contributing to environmental sustainability (Ma et al., 2021; Hynni et al., 2025). Economically, circular business models boost competitiveness, drive innovation, and create employment opportunities throughout supply chains (Holly et al., 2023; Laubinger et al., 2020). On the social front, circular practices enhances inclusion and community resilience by creating new types of work and integrating social enterprises into sustainable value chains (Van Opstal et al., 2024). Collectively, these benefits demonstrate that adopting a circular economy is not just an environmental necessity but also a strategic catalyst for long-term social and economic development.

In conclusion, the literature depicts the implementation of the circular economy as a complex process shaped by collaboration gaps, financial and institutional constraints, technological limitations, and behavioral inertia. Despite these challenges, the accumulated evidence indicates that targeted interventions, such as coherent policy design, technological innovation, stakeholder engagement, and public awareness initiatives, can significantly propel the transition toward a circular and sustainable economy.

METHODOLOGY

This study employs a narrative review methodology to synthesize existing knowledge on the barriers, challenges, and strategic implications of implementing the circular economy across various sectors and contexts. The narrative review approach was selected for its ability to provide a comprehensive and interpretive examination of diverse findings, integrating conceptual, empirical, and theoretical insights from the existing literature. Articles were retrieved from the Scopus database, chosen for its extensive coverage of peer-reviewed and high-impact scholarly publications. The search strategy utilized the keywords “circular economy” AND “barrier” OR “challenges” OR “implication” to ensure the inclusion of studies that explicitly address implementation issues and strategic considerations within the circular economy framework. The selected studies were analyzed to identify recurring patterns, emerging themes, and cross-sectoral linkages that collectively contribute to understanding the systemic factors influencing circular economy adoption.

FINDINGS AND DISCUSSION

An analysis of the top thirty most-cited peer-reviewed journal articles reported in Table 1 reveals six interrelated thematic dimensions that collectively shape the barriers, challenges, and strategic implications of implementing the circular economy: institutional and regulatory conditions, economic and financial constraints, technological and infrastructural readiness, organizational and collaborative capabilities, consumer and behavioral dynamics, and business model and design for circularity. These themes consistently emerge across the literature, indicating that transitions to a circular economy are not hindered by a single factor but rather by a complex web of interrelated conditions spanning policy, markets, technology, and society.

Table 1: Summary of Key Themes

Theme	Representative Studies	Key Findings	Strategic Implications
Institutional and Regulatory Conditions	Kirchherr et al. (2018); De Jesus & Mendonça (2018); Adams et al. (2017)	Fragmented regulations and inconsistent policies generate uncertainty and discourage investment.	Develop coherent and harmonized regulatory frameworks, integrate circular criteria into public procurement.

Economic and Financial Constraints	Rizos et al. (2016); Govindan & Hasanagic (2018); Adams et al. (2017)	High initial costs, limited financing access, and uncertain market demand impede adoption.	Introduce fiscal incentives, circular investment funds, and risk-sharing mechanisms.
Technological and Infrastructural Readiness	Kirchherr et al. (2018); Bag et al. (2022); Govindan & Hasanagic (2018)	Technological immaturity and inadequate recycling infrastructure constrain implementation.	Invest in digital infrastructure, capacity building, and technological innovation for traceability and recovery.
Organizational and Collaborative Capabilities	Rizos et al. (2016); De Jesus & Mendonça (2018)	Weak inter-firm coordination and limited knowledge sharing hinder systemic change.	Promote collaborative platforms, industrial symbiosis networks, and multi-stakeholder governance.
Consumer and Behavioral Dynamics	Kirchherr et al. (2018); De Jesus & Mendonça (2018); Govindan & Hasanagic (2018)	Low awareness and risk aversion among consumers and managers slow circular adoption.	Conduct education campaigns, promote eco-labeling, and foster sustainability-oriented cultures.
Business Model and Design for Circularity	Rizos et al. (2016); Adams et al. (2017); Kirchherr et al. (2018)	Lack of design-for-circularity and limited service-based innovation restrict value retention.	Embed circularity at the design stage and shift toward performance-based and service-oriented models.

The primary and most prevalent theme identified in the literature pertains to institutional and regulatory conditions. Kirchherr et al. (2018) and De Jesus and Mendonça (2018) argue that fragmented policies, weak enforcement mechanisms, and the absence of harmonized standards contribute to institutional uncertainty that deters long-term investments in circular initiatives. Adams et al. (2017) emphasize that linear-oriented procurement rules and unclear waste classification laws further impede circularity in the construction sector. These studies collectively underscore the importance of coherent regulatory frameworks, fiscal incentives, and regionally coordinated strategies that can provide consistent signals to firms and investors.

The second theme, economic and financial constraints, is often identified as a fundamental obstacle to implementing a circular economy. Rizos et al. (2016) emphasize that SMEs face challenges such as limited access to finance, high transaction costs, and uncertain profitability linked to circular business models. Similarly, Govindan and Hasanagic (2018) point out that the high capital intensity and unpredictable demand for secondary materials discourage firms from adopting reuse or remanufacturing strategies. Adams et al. (2017) further observe that additional insurance and certification costs in construction diminish the viability of circular practices. The literature indicates that targeted fiscal policies, public-private financing mechanisms, and green investment funds can be crucial in overcoming these financial hurdles.

A third significant theme revolves around technological and infrastructural readiness. Numerous scholars highlight that the technological infrastructure essential for the circular economy, including traceability systems, digital manufacturing, and reverse logistics, remains underdeveloped (Kirchherr et al., 2018; Govindan & Hasanagic, 2018). Adams et al. (2017) point out that recycling and material recovery infrastructures are still inadequate in many countries, while Bag et al. (2022) emphasize that concerns related to data security and interoperability impede the widespread adoption of digital technologies in circular systems. These findings underscore the necessity for integrated digital solutions, capacity-building initiatives, and infrastructural investment to fortify the technological foundation of circular transitions.

The fourth theme pertains to organizational and collaborative capabilities. Rizos et al. (2016) and Kirchherr et al. (2018) highlight limited coordination across supply chains and inadequate information sharing as significant barriers to effective circular practices. De Jesus and Mendonça (2018) argue that weak institutional connections and the lack of collaborative governance models hinder the expansion of circular business ecosystems. To address these structural shortcomings, establishing cross-sectoral partnerships, developing collaborative platforms, and building shared knowledge repositories are often suggested as effective strategies.

The fifth theme, consumer and behavioral dynamics, highlights the socio-cultural aspect of transitions to a circular economy. According to Kirchherr et al. (2018), public awareness is still low, with consumers often viewing recycled or refurbished products as inferior. Similarly, De Jesus and Mendonça (2018) and Govindan and Hasanagic (2018) note that managerial risk aversion and a lack of a sustainability-oriented corporate culture hinder organizational change. This behavioral inertia slows the adoption of circular practices on both the consumption and production sides. The literature suggests that educational campaigns, eco-labeling, and consumer engagement programs could boost participation in circular initiatives.

Finally, business model and design for circularity represents a cross-cutting theme that connects operational strategy with systemic transformation. Scholars emphasize that durability, modularity, and design for disassembly are crucial in enabling resource recovery and extending product lifecycles (Kirchherr et al., 2018; Adams et al., 2017). Rizos et al. (2016) demonstrate that firms that integrate circular design with service-based business models achieve higher resilience and value retention. Such findings point to the strategic imperative of embedding circularity at the design stage, supported by data-driven monitoring and performance metrics that capture the economic and environmental value of circular practices.

Ultimately, the business model and design for circularity serve as a unifying theme that bridges operational strategy with systemic transformation. Scholars highlight the importance of durability, modularity, and design for disassembly in facilitating resource recovery and prolonging product lifecycles (Kirchherr et al., 2018; Adams et al., 2017). Rizos et al. (2016) illustrate that companies integrating circular design with service-based business models achieve greater resilience and value retention. These findings underscore the strategic necessity of embedding circularity at the design stage, bolstered by data-driven monitoring and performance metrics that capture the economic and environmental benefits of circular practices.

Across these six themes, a clear pattern emerges: institutional and financial uncertainty intensifies technological and behavioral inertia, while limited collaboration and inadequate design integration further hinder progress. In contrast, coordinated efforts that blend policy coherence, financial incentives, digital innovation, and stakeholder engagement are shown to accelerate adoption. The convergence of evidence from highly cited works such as Kirchherr et al. (2018), Govindan and Hasanagic (2018), Rizos et al. (2016), and De Jesus and Mendonça (2018) supports the argument that circular economy transitions require systemic rather than incremental transformation, anchored in collaboration, innovation, and shared accountability among governments, industries, and consumers.

CONCLUSION AND FUTURE RESEARCH DIRECTIONS

This conceptual review reveals that implementing the circular economy is a complex, multi-dimensional process that goes beyond environmental concerns to include institutional, financial, technological, behavioral, and organizational dynamics. By examining insights from the thirty most-cited peer-reviewed studies, this paper concludes that the barriers to adopting a circular economy are deeply interconnected and systemic in nature.

The evidence indicates that fragmented policy frameworks, inconsistent regulatory enforcement, and inadequate institutional coordination continue to impede the effectiveness of circular initiatives (Kirchherr et al., 2018; De Jesus & Mendonça, 2018). Financial barriers, such as high investment costs, along with technological limitations like underdeveloped recycling infrastructure and limited digital integration, further exacerbate these challenges (Rizos et al., 2016; Govindan & Hasanagic, 2018; Bag et al., 2022). Additionally, organizational inertia and the absence of collaborative mechanisms remain significant obstacles (Rizos et al., 2016). Moreover, behavioral resistance among consumers and managers, driven by low awareness and risk aversion, restricts the demand for circular products and services (Kirchherr et al., 2018). Despite these challenges, the review finds a strong consensus in the literature that adopting a circular economy can promote long-term sustainability when supported

by coherent policies, targeted incentives, and cross-sectoral collaboration.

Based on the insights from this review, several future research directions are suggested. Firstly, empirical studies should investigate how combinations of policy instruments, such as green public procurement, fiscal incentives, and extended producer responsibility, interact to accelerate circular adoption across various sectors. Secondly, future research should explore the role of digital technologies, including blockchain, artificial intelligence, and Internet of Things applications, in enhancing traceability, transparency, and collaboration within circular value chains. Thirdly, comparative analyses between developed and developing countries could reveal context-specific enablers and constraints, thereby informing more inclusive transition pathways. Fourthly, greater attention should be paid to behavioral and cultural dimensions, particularly how consumer values, education, and organizational culture influence the success of circular initiatives. Finally, longitudinal and mixed-method studies are necessary to evaluate the long-term performance and resilience of circular business models and to understand how they evolve under changing environmental, economic, and regulatory conditions.

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