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# Mapping Circular Economy Adoption in Multinational Enterprises: Industry-Wise Barriers and Future Directions

**Jay Bhanderi**

Wroclaw University of Economics and Business

E-mail: jbhanderi18@gmail.com

ORCID: 0009-0009-8935-4334

**Yash Chawla**

Wroclaw University of Science and Technology

E-mail: yash.chawla@pwr.edu.pl

ORCID: 0000-0002-7925-7532



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## Abstract

**Aim:** This article investigates the uneven adoption of circular economy practices across industrial sectors, with a focus on how and why some industries progress more rapidly than others. Special attention is given to the role of multinational enterprises as enablers of circular transitions, examining the systemic and organizational factors that influence implementation outcomes.

**Methodology:** A structured qualitative literature review was conducted, drawing on peer-reviewed academic sources published between 2015 and 2024. The analysis applied a multi-level framework, macro (industry and policy context), meso (supply chain and ecosystem coordination), and micro (firm-level strategies) to compare circular economy adoption across six major industries: automotive, electronics, manufacturing, food and beverage, construction, and textiles.

**Results:** The findings reveal three distinct tiers of circular economy maturity. High-adoption industries such as automotive and electronics, have embedded circularity through strategic leadership and supply chain integration. Medium-adoption sectors exhibit promising initiatives, even though progress remains fragmented. Low-adoption industries face persistent regulatory, infrastructural, and cultural barriers that inhibit systemic change. Across sectors, the interaction of regulatory, economic, technological, and organizational factors creates compounded challenges to circular economy implementation.

**Implications and recommendations:** Effective circular economy adoption requires coordinated efforts to overcome structural barriers and build enabling capabilities. Policymakers should design sector-specific support mechanisms and promote cross-sector learning. Organizations are encouraged to institutionalise a circular economy through dedicated leadership, capability development, and supply chain innovation. Future research should focus on developing a circular economy adoption maturity model that integrates industry-specific dynamics with actionable implementation pathways.

**Originality/value:** This review offers a novel synthesis of a circular economy adoption patterns across industries, advancing theoretical insight and practical guidance. By comparing divergent sectoral experiences, the paper contributes to a conceptual framework for understanding circular economy readiness and strategic levers for change.

**Keywords:** circular economy (CE), industry adoption patterns, multinational enterprises, implementation barriers, sustainability transition

## 1. Introduction

Amidst mounting environmental pressures and the growing resource constraints, the transition from linear to circular economic models has become a critical imperative for global industry (Gasparri et al., 2023). The world currently consumes resources at 1.75 times the planet's regenerative capacity while producing over 2 billion tons of municipal solid waste annually, a figure projected to reach 3.4 billion tons by 2050 (Di Stefano et al., 2023). This unsustainable trajectory coupled with increasing climate related disruptions and geopolitical tensions exposes the fundamental vulnerability of traditional linear business models (Di Stefano et al., 2023). While the transition toward circularity affects businesses of all sizes, this review focuses explicitly on multinational enterprises (MNEs) as the primary agents of changes. MNEs play a disproportionate role in shaping industrial sustainability because of their transnational supply chains, strategic influence, and access to capital (Dennison et al., 2024). Although most reviewed studies centre on European MNEs, the findings also draw lessons applicable to global contexts where similar industrial and policy conditions exist.

Within this context, MNEs stand at a crucial crossroads (Di Stefano et al., 2023) as they possess unique capabilities to catalyse system-wide transformation toward circular economy (CE) principles (Di Stefano et al., 2023). Yet the reality of CE adoption presents a paradox while some industries demonstrate remarkable progress in implementing circular practices, others remain entrenched in linear paradigms despite similar sustainability imperatives (Perotti et al., 2025).

The adoption of CE is far from uniform as different industries face unique economic, technical, and institutional contexts that shape their implementation trajectories (Korhonen et al., 2018). The automotive sector, for instance, has witnessed transformative initiatives, with companies such as Stellantis establishing dedicated CE business units (see Table 1) and implementing comprehensive circularity strategies (Di Stefano et al., 2023). Similarly, electronics manufacturers have developed sophisticated reverse logistics systems and remanufacturing capabilities (Zils et al., 2025). In stark contrast, sectors such as construction and textiles continue to struggle with basic circular principles despite their significant environmental footprint (Gasparri et al., 2023).

The persistence of these adoption gaps raises critical questions for both research and practice – why do some industries successfully operationalise CE principles whereas others lag behind? What combinations of barriers – regulatory, economic, technological, and cultural – explain these divergent patterns? Most importantly, how can insights from high-adoption sectors inform strategies for accelerating CE implementation across industries?

Whilst the literature examined CE barriers and enablers (Kirchherr et al., 2017), there remains a notable gap in understanding industry-specific adoption patterns and their underlying dynamics.

Current research tends to focus either on individual sectors or on general implementation challenges, without systematically comparing cross-industry differences or exploring the transferability of successful practices (Gasparri et al., 2023).

This study addressed these research gaps by comprehensively reviewing CE adoption patterns across industries, proposing a framework for future research, specifically aiming to analyse current CE adoption patterns across industries while also laying the theoretical groundwork for a CE adoption maturity model. The author outlined the conceptual basis for a future CE adoption maturity model, yet the primary goal was to identify and analyse the key barriers shaping CE adoption across industries with different levels of circular progress. The intention was not to develop or validate the given model, but rather to provide an evidence-based foundation for such work in subsequent research, identify industry-specific constellations of barriers that inhibit progress, extract lessons from high-adoption sectors that can inform lagging industries, and finally propose tailored policy and business recommendations to support its adoption. This integrated approach is in line with recent papers by Acerbi & Taisch (2020) and Di Stefano et al. (2023), who emphasised the need for comparative industry insights to advance CE implementation.

## 2. State of the Art

### 2.1. Understanding CE Implementation in MNEs

The transition to a CE represents a fundamental shift from traditional linear business models, requiring organizations to reimagine their entire value chains (Assmann et al., 2023). The Ellen MacArthur Foundation (2015, p. 2) defines CE as “one that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times”. This definition emphasises the paradigm shift required across all stages of the value chain from raw material sourcing to end-of-life product recovery and aligns with conceptual models that integrate CE into design, logistics, and consumption behaviour (Kirchherr et al., 2017; Korhonen et al., 2018).

Recent studies highlight that MNEs, due to their scale and transnational reach, are uniquely positioned to advance CE adoption. These companies act as orchestrators of complex supply chains, often engaging in capacity building with suppliers and partners to enable circular practices (Aryee & Kanda, 2024). Many MNEs also invest heavily in dedicated infrastructure and emerging circular technologies, enabling a shift from product ownership to performance-based business models (Assmann et al., 2023). Moreover, their global footprint allows them to transfer knowledge across markets, replicate successful practices, and foster the development of new markets for refurbished goods and secondary materials (Calzolari et al., 2021).

However, the complexity of implementing CE principles varies significantly across MNEs, often due to organizational legacy systems, global coordination challenges, and the lack of harmonised CE metrics (cf. Drofenik et al., 2025). The latter argued that aligning national policy ambitions with corporate execution requires adaptive strategies that respond to institutional and operational realities. Furthermore, MNEs often struggle to embed circular principles in diverse cultural and regulatory environments, especially where local infrastructure and consumer awareness are underdeveloped. Di Stefano et al. (2023, p. 2) noted that “CE transition cannot be implemented through scattered actions; the far-reaching scale of the compulsory changes necessitates the support and coordination of lead actors of the global economy”.

### 2.2. Industry-Wise Adoption Patterns

The automotive and electronics industries are widely recognised as leading sectors in the adoption of CE practices (Montemayor & Chanda, 2023). In the automotive industry, Stellantis exemplifies this leadership by establishing a dedicated CE Business Unit, fundamentally redesigning how vehicles and components are produced, recovered, and reused (Stellantis, 2024). This initiative aims to significantly expand revenue streams from remanufactured and reused parts over the next decade (Stellantis, 2024). The strategy is emblematic of a broader sectoral shift toward lifecycle thinking, wherein materials are retained in closed loops through localised recovery systems and remanufacturing hubs.

Similarly, the electronics industry represented by companies such as Schneider Electric has integrated CE principles throughout its operations (Schneider Electric, 2024). Schneider Electric's circular initiatives encompass product design for disassembly, reverse logistics, and global take-back programmes, demonstrating the power of digital technologies in tracking product lifecycles and enabling resource recovery (Rizos & Bryhn, 2022; Schneider Electric, 2024).

The manufacturing and agri-food sectors present a more varied picture, where localised innovations coexist with structural limitations (Gu et al., 2021; Mancini et al., 2019). In the dairy sector, for example, Arla Foods Ingredients has initiated bioeconomic projects that valorise by-products, e.g. acid whey, converting them into protein beverages and other value-added outputs (Arla Foods Ingredients, 2004). These isolated initiatives demonstrate technical feasibility but remain exceptions rather than norms. In the broader food and beverage industry, progress is evident in packaging redesigns and closed-loop systems, but the scalability of these solutions is constrained by fragmented supply chains and insufficient cross-industry coordination (Espinoza-Orias & Lundquist, 2025).

The food and beverage industry similarly shows promising developments but uneven implementation (Espinoza-Orias & Lundquist, 2025). While some companies have successfully established closed loop packaging systems and waste reduction programmes (see Table 1), others struggle with the complexity of implementing comprehensive CE strategies across their operations (Circle Economy, 2018). Such "pockets of excellence" (Chhimwal et al., 2022) reflect an emergent stage of circular maturity where capabilities are growing, but remain unevenly distributed due to gaps in funding, knowledge diffusion, and policy support.

Despite their significant environmental impact, the construction and textile industries remain among the least advanced in CE implementation. The construction sector faces deeply embedded structural barriers, including project-based operations, diverse stakeholder involvement, and long lifecycle assets that resist rapid innovation (Christensen, 2021). In addition, regulatory ambiguity and traditional cost-centric mindsets continue to hinder CE alignment (Gasparri et al., 2023). These conditions create fragmented and reactive responses to CE rather than cohesive strategic transformation.

The textile industry, particularly the fast fashion segment, also struggles with systemic issues such as low recycling rates, insufficient infrastructure for fibre recovery, and the dominance of cost-efficient linear models (De Felice et al., 2024). Despite increased awareness, circular innovation in textiles remains largely experimental and often disconnected from supply chain realities. These disparities also highlight the role of business model design in facilitating or impeding CE integration across sectors (Lewandowski, 2016).

## 2.3. Barriers to CE Implementation

This synthesis of the existing literature revealed a complex interplay of barriers that influence CE adoption rates across industries. These barriers, while distinct in their manifestations, often interact and reinforce each other creating compound challenges for organizations pursuing a circular transformation.

### Regulatory Barriers

Regulatory fragmentation is one of the most frequently cited barriers to CE implementation, particularly for MNEs operating across multiple jurisdictions (Kirchherr et al., 2017). Key issues include inconsistencies between national regulations, overlaps and/or contradictions between environmental and trade policies, and weak enforcement of existing CE directives (Calzolari et al., 2021). For instance, MNEs in the electronics industry must navigate a maze of end-of-life policies, eco-design requirements, and waste shipment regulations across the EU (European Court of Auditors, 2021; Hoffmann et al., 2025). These inconsistencies force companies to design parallel compliance processes, significantly raising administrative and operational costs. Some studies, e.g. Kirchherr et al. (2017) and Calzolari et al. (2021), stressed that regulatory uncertainty not only hampers investment but also slows the scaling of innovative circular models.

These regulatory challenges create particular friction in global value chains (Kirchherr et al., 2017). For instance, European MNEs in the electronics sector face a complex patchwork of end-of-life policies, eco-design directives (European Court of Auditors, 2021; Hoffmann et al., 2025), and cross-border waste trade restrictions (European Commission, 2006) that complicate operationalisation and suppress economies of scale. The lack of harmonised standards across regions often forces companies to maintain parallel compliance systems, increasing cost and complexity.

## Economic Barriers

From an economic perspective, CE initiatives often require substantial upfront investment in new technologies, process redesigns, and staff training (Kirchherr et al., 2017), which are the costs that many companies are hesitant to incur without immediate returns. The financial risk is especially pronounced for smaller supply chain partners and regional subsidiaries that collaborate with MNEs. These actors often lack access to dedicated funding streams or favourable credit terms for sustainability transitions (Grafström & Aasma, 2021). Whilst this study centres on MNEs, it also acknowledges that their circular performance often depends on the readiness and capacity of smaller actors embedded within their global supply chains. Furthermore, the underdevelopment of secondary material markets means that demand for refurbished or recycled inputs remains uncertain, further weakening the economic case for CE (Kirchherr et al., 2017). These barriers collectively contribute to a ‘value gap’ in CE economics, where firms recognise long-term benefits yet remain constrained by short-term financial pressures.

These economic challenges are particularly acute for organizations attempting to scale circular initiatives (Grafström & Aasma, 2021). As Kirchherr et al. (2017) noted, even when companies identify clear circular opportunities, the financial risk and uncertainty often prevent full-scale implementation. The situation is further complicated by market structures that inadequately reward resource efficiency or secondary material use.

## Technological Barriers

Technological limitations also impede CE implementation, especially in sectors where infrastructure for recycling or reverse logistics is underdeveloped (Kudrenko et al., 2025). Industries such as construction face persistent difficulties in recycling composite materials, while textiles lack scalable technologies for fibre separation and reprocessing (De Felice et al., 2024; Gasparri et al., 2023). The lack of standardised metrics or interoperable tracking systems further hinders cross-industry comparisons and best practice sharing (Drofenik et al., 2025). These technological gaps are magnified, which often cannot afford R&D or lack the internal capabilities to integrate emerging digital or material innovations (Assmann et al., 2023). Rizos and Bryhn (2022) stressed that overcoming these barriers will require a concerted effort to align innovation funding, regulatory support, and market readiness.

Beyond these specific challenges, organizations also face a broader technological transformation imperative. The construction sector for example, grapples with limited recyclability of composite materials and an absence of standardized best practice for material recovery (Gasparri et al., 2023). Smaller actors within MNE supply networks disproportionately experience these barriers due to limited investment capital and in-house expertise (Gasparri et al., 2023).

Beyond these structural barriers, CE initiatives can also produce unintended or counterproductive outcomes, commonly referred to as rebound effects (Zink & Geyer, 2017). These occur when efficiency gains or material recovery lead to increased overall consumption, shifting rather than reducing environmental burdens (Korhonen et al., 2018). For instance, improvements in recycling technologies may encourage larger production volumes, while the promotion of repair or reuse markets can extend product lifespans without necessarily reducing total material throughput (Kudrenko et al., 2025). Such effects highlight the need to approach CE implementation with a systems perspective, ensuring that circular strategies are addressed through full life-cycle analysis rather than isolated efficiency metrics (Espinoza-Orias & Lundquist, 2025). Addressing rebound effects early in CE planning helps prevent well-intentioned initiatives from reinforcing linear patterns of growth.

Taken together, these regulatory, economic, and technological barriers often reinforce each other, producing what has been termed a "circular inertia" (Korhonen et al., 2018), where companies are aware of sustainability imperatives but remain stuck in linear operating models due to systemic constraints.

## 2.4. Success Factors in High-Adoption Industries

Analysing high performing sectors revealed several critical success factors that enable effective implementation. These factors demonstrate how organizations can overcome barriers through strategic approach and systematic execution.

### Strategic Leadership and Organizational Commitment

A consistent theme across high-adoption industries is the presence of strategic leadership and deep organizational commitment to CE. Companies such as Stellantis and Schneider Electric have embedded CE into their core business strategies, often through dedicated business units with board-level oversight (Schneider Electric, 2024; Stellantis, 2024). This commitment is reflected in clear internal targets for material recovery and reuse, backed by robust governance structures. These organizational setups facilitate long-term planning and ensure CE goals are not sidelined during short-term financial fluctuations. As suggested by De Pascale et al. (2023), sustained CE progress depends on aligning circular objectives with executive-level incentives and strategic roadmaps.

Companies demonstrating success in this area, e.g. Stellantis and Schneider Electric, have established dedicated CE business units with direct reporting lines to senior management (Schneider Electric, 2024). This structural commitment ensures that circular initiatives receive the necessary resources and attention while facilitating cross-functional coordination.

### Supply Chain Integration and Collaboration

Supply chain coordination is another cornerstone of successful CE implementation. High-performing companies adopt what Autio (2022) described as "orchestrated ecosystems," where they invest in supplier training, shared infrastructure, and digital technologies to enable closed-loop systems. For instance, in the automotive sector companies have developed sophisticated reverse logistics systems to recover, remanufacture, and reintegrate components efficiently (Abbas et al., 2024). Such supply chains are characterised by transparency, long-term partnerships, and real-time tracking enabled by digital platforms (Zils et al., 2025). These integrative approaches reduce transaction costs and increase the resilience of circular business models.

Beyond structural changes, cultural and human capital investments also play a crucial role. Leading companies foster circular mindsets through internal training programmes, while externally they engage in consumer education and industry-wide knowledge sharing (Türkeli & Schophuizen, 2019). Participation in multi-stakeholder coalitions and cross-sector alliances allows businesses to influence policy, co-develop standards, and accelerate innovation diffusion. These efforts create what Kumar et al. (2024) called “circular acceleration loops”, namely virtuous cycles where each successful initiative reinforces the organization's capacity and motivation to scale further.

## 3. Methodology

This study employed a structured qualitative literature review to examine how six industries, i.e. automotive, electronics, manufacturing, food and beverage, construction, and textiles, adopt and implement circular economy (CE) principles. Peer-reviewed publications from 2015 to 2024 were retrieved from Scopus, Web of Science, and EBSCO, focusing on CE drivers, barriers, and implementation strategies (Acerbi & Taisch, 2020; Korhonen et al., 2018).

The heart of this analytical process involved an in-depth examination of the subject literature, applying a modified version of Gioia methodology, commonly used in qualitative research to build conceptual insight from rich textual data. This approach involves three key stages: (1) identifying first-order concepts directly from the reviewed literature, (2) grouping them into second-order themes that capture recurring ideas or relationships, and (3) abstracting aggregate dimensions that represent overarching patterns across industries. By adapting this framework to a literature review context, the analysis maintained transparency and traceability between data, interpretation, and theory development. This method allowed to identify patterns while maintaining the rich context of each industry's unique journey, helping to move beyond simple categorisation to understand the intricate relationship between different factors affecting CE adoption.

To ensure the quality and relevance of the literature included in this review, the author applied clear inclusion parameters. First, only peer-reviewed academic publications were considered to maintain scholarly rigour. Selected works had to demonstrate either a clear empirical foundation or a substantive theoretical contribution related to CE. Furthermore, each study needed to directly address industrial CE implementation, with a particular emphasis on the identification and analysis of adoption barriers or enabling mechanisms. This approach ensured that the reviewed materials offered both conceptual depth and practical relevance across sectors.

The study findings were organised using a three-level framework macro, meso, and micro, commonly used in CE research (Drofenik et al., 2025), where macro level considered industry-wide and regulatory trends, meso level examined the supply chain configurations and inter-firm collaboration. Finally, micro level focused on company-specific practices, leadership, and resource capabilities. This multi-level view enabled to analyse adoption holistically, reflecting the systemic nature of CE transformations.

Over 200 peer-reviewed studies were examined based on their empirical depth, theoretical contribution, and relevance to industrial CE adoption. Thematic synthesis facilitated a comparison across sectors and the identification of common and divergent adoption dynamics. Whilst the predominance of European and North American literature could introduce geographic bias, this was mitigated through careful source triangulation and contextual cross-validation.

## 4. Results

The literature reveals a stratified pattern of CE adoption maturity across industries, highlighting considerable divergence in implementation pace and strategy. Table 1 summarises the industry-wise patterns of CE adoption, highlighting the key barriers, success factors, and providing evidence that enables a comparison of adoption maturity across sectors.

Table 1. Comparative overview of CE adoption maturity, key barriers, and enabling practices across industries

| Industry | Adoption Tier | Key Barriers | Key Success Factors | Evidence from Literature | References |
|---|---|---|---|---|---|
| Automotive | High | Regulatory, Economic | CE Business Unit, Value Chain Integration | Advanced CE integration through remanufacturing, extended product life cycles, and closed-loop supply chains aligned with EU directives | (Acerbi & Taisch, 2020) (Calzolari et al., 2021) |
| Electronics | High | Technical, Cultural | Design for Circularity, Take-Back Schemes | Lead in eco-design and take-back systems, leveraging digital traceability and producer responsibility regulations to close material loops | (Kumar et al., 2024) (Corvellec et al., 2021) |
| Manufacturing | Medium | Economic, Regulatory | Resource Valorization, Process Innovation | Progress via localised CE initiatives that valorize waste streams and foster incremental innovation within supply chains | (De Pascale et al., 2023) (Korhonen et al., 2018) |
| Food & Beverage | Medium | Cultural, Economic | Waste Reduction, Collaborative Initiative | CE adoption relies on stakeholder collaboration, packaging innovation, and partnerships reducing food waste | (Drofenik et al., 2025) (Gasparri et al., 2023) |
| Construction | Low | Fragmentation, Regulation | Pilot Projects, Digital Platforms | In early stages, with scattered CE pilots focusing on secondary material reuse and BIM-based circular design | (Calzolari et al., 2021) (De Pascale et al., 2023) |
| Textiles | Low | Technical, Economic | Early-Stage Recycling, Stakeholder Action | Exploring recycling technologies and collaborative take-back models, but systemic CE integration is limited by cost and policy gaps | (Gasparri et al., 2023) (Corvellec et al., 2021) |

Source: author's elaboration based on the reviewed literature.

## 4.1. The Three Tiers of CE Adoption

The automotive and electronics sectors emerged as clear leaders in CE implementation, demonstrating what might be called 'circular maturity'. In the automotive sector, companies such as Stellantis have undergone strategic transformations by embedding CE into core operations, establishing specialised business units, and achieving substantial returns from remanufactured and reused parts (Stellantis, 2024). This reflects what Kumar et al. (2024) described as "integrated circular leadership" where CE goals are institutionalised within supply chains and performance targets. Similarly, electronics manufacturers like Schneider Electric have shown advanced maturity through design-for-disassembly practices, global take-back schemes, and digital lifecycle tracking systems (Rizos & Bryhn, 2022; Schneider Electric, 2024).

In the middle tier, industries such as manufacturing and agri-food display characteristics of emergent circularity, marked by isolated innovations amid systemic inertia (Chhimwal et al., 2022). Initiatives, including Arla's bioeconomic valorisation of whey by-products are technically promising but remain exceptions rather than being sector-wide norms (Arla Foods Ingredients, 2004). Broader uptake is often impeded by fragmented value chains, inconsistent incentives, and low absorptive capacity among smaller actors (Espinoza-Orias & Lundquist, 2025).

At the lower end of the adoption spectrum, the construction and textile sectors face deeply embedded structural and cultural challenges. In construction, traditional contracting practices, project fragmentation, and long asset lifespans create resistance to CE integration (Christensen, 2021; Gasparri et al., 2023). The textile sector, especially fast fashion, is constrained by cost-driven global supply chains, weak post-consumer infrastructure, and minimal regulatory pressure for material recovery (De Felice et al., 2024). These sectors exemplify what Lewandowski (2016) called "CE-incompatible business models," which requires rethinking at a systemic level.

## 4.2. The Barrier Landscape

Perhaps the most compelling finding of this research was how barriers to CE adoption interact and reinforce each other. The relationship between regulatory requirements and economic constraints results in a structural lock-in, where organizations are constrained by overlapping regulatory, technical, and market failures that perpetuate the linear model. Calzolari et al. (2021) described this as an “institutional paradox”, where businesses operate within systems that rhetorically support CE but functionally inhibit its realization.

Consider the case of cross-border material flows: companies often find themselves caught between conflicting regulatory requirements, market uncertainties and technical challenges. This complex interplay of barriers requires a sophisticated, multi-level response that few organizations are currently equipped to deliver (Calzolari et al., 2021).

In several sectors, barriers exist not in isolation but as interdependent systems. For instance, regulatory fragmentation often discourages investment in secondary material infrastructure, which in turn limits economies of scale and technological advancement (Kudrenko et al., 2025). This creates a feedback loop that reinforces economic uncertainty and slows innovation diffusion. Moreover, the lack of standardised CE indicators across jurisdictions prevents companies from benchmarking progress or reporting results consistently, adding to operational ambiguity. The analysis also highlighted that information asymmetry, due to limited data on material flows and end-of-life recovery, acts as a hidden barrier, particularly for global MNEs coordinating multi-country supply chains. Addressing these intertwined constraints will require not just sectoral regulation also but cross-border policy coherence and unified CE metrics.

## 4.3. Pathways to Success

However, amidst these challenges, this study uncovered clear patterns of successful CE implementation. Successful businesses invest in integrated capabilities that combine operational redesign, strategic alignment, and ecosystem collaboration to scale CE practices (see Corvellec et al., 2022; Kumar et al., 2024), which include internal learning systems, supplier engagement protocols, digital material tracking, and incentive structures aligned with CE goals. Rather than treating CE adoption as a set of isolated projects, leading organizations approach it as a long-term strategic transformation that embeds circular principles across operations.

A consistent pattern across high-performing sectors is that successful CE implementation depends on the institutionalisation of learning and feedback loops. Companies that scale CE initiatives treat experimentation as an ongoing process (Perotti et al., 2025), applying evaluation metrics and feedback into every operational layer (Dennison et al., 2024). For example, digital platforms used for material tracking are increasingly repurposed to monitor supplier compliance and environmental outcomes, reinforcing accountability throughout the value chain. Another emerging pathway involves inter-industry alliances such as joint innovation hubs or shared material databases that allow MNEs to pool risk and accelerate technological diffusion. These collaborative infrastructures appear to be crucial in translating pilot projects into lasting circular ecosystems.

# 5. Discussion and Conclusion

This study set out to address how and why CE adoption differs across industries, with particular attention to the role of MNEs as enablers of circular transformation. The author identified three tiers of CE maturity, high (automotive, electronics), medium (manufacturing, agri-food), and low (construction, textiles) each shaped by the interaction of regulatory, economic, and technological constraints, with strategic leadership, supply chain collaboration, and digital integration being common success factors. By comparing these dynamics, it was demonstrated that the pace of CE adoption depends not only on industry characteristics but also on the institutional and organization capabilities embedded within MNEs.

The results reinforce the view that effective CE implementation depends on aligning firm-level capabilities with supportive institutional frameworks (Geels, 2011; Korhonen et al., 2018; Lewandowski, 2016). In other words, circular transformation is not simply a technical shift but a systemic reconfiguration of governance, business models, and industrial ecosystems.

For practitioners, this study stresses the importance of sector-specific approaches to CE. Companies in low-adoption industries must prioritise regulatory engagement, cross-sector learning, and incremental capability-building, whereas high-adoption businesses can play a mentoring role, sharing practices and scaling technologies. CE transformation should be viewed not as a single-stage project but as a maturity continuum, requiring strategic alignment, investment, and governance at each phase.

While CE holds promise for decoupling growth from resource use, it may also create rebound and social effects that complicate its outcomes (Zink & Geyer, 2017). At the same time, circular transitions reshape labour markets by creating new opportunities in repair and recycling while risking job displacement or inequities along global supply chains. Thus MNEs have an ethical responsibility to ensure that circular strategies promote fairness, decent work, and transparency rather than transferring risk to vulnerable workers or regions. Implementing fair transition principles and conducting full-cycle assessments can help align environmental ambitions with social equity and long-term sustainability (Espinoza-Orias & Lundquist, 2025).

In general, CE adoption among MNEs remains uneven yet is visibly advancing. Accelerating this transition requires policy coherence, cross-sector collaboration, and institutional learning that convert pilot initiatives into systemic change. Future research should develop an empirically grounded CE adoption maturity model, integrating sector-specific capabilities with global comparative insights. Building such frameworks will bridge the gap between research and practice, as well as support fair and inclusive circular transitions worldwide.

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# Mapowanie wdrażania gospodarki o obiegu zamkniętym w przedsiębiorstwach międzynarodowych: bariery branżowe i przyszłe kierunki

## Streszczenie

**Cel:** W niniejszym artykule zbadano nierównomierne przyjęcie praktyk gospodarki o obiegu zamkniętym (CE) w różnych sektorach przemysłu, ze szczególnym uwzględnieniem tego, jak i dlaczego niektóre branże rozwijają się szybciej niż inne. Szczególną uwagę poświęcono roli przedsiębiorstw wielonarodowych (MNE) jako czynników umożliwiających przejście na gospodarkę o obiegu zamkniętym, badając czynniki systemowe i organizacyjne, które wpływają na wyniki wdrażania.

**Metodyka:** Przeprowadzono ustrukturyzowany jakościowy przegląd literatury, korzystając z recenzowanych źródeł akademickich opublikowanych w latach 2015-2025. W analizie zastosowano wielopoziomowe ramy: makro (kontekst branżowy i polityczny), mezo (koordynacja łańcucha dostaw i ekosystemu) i mikro (strategie na poziomie firmy), aby porównać wdrażanie gospodarki o obiegu zamkniętym w sześciu głównych branżach: motoryzacyjnej, elektronicznej, produkcyjnej, spożywczej i napojów, budowlanej i tekstylnej.

**Wyniki:** Wyniki ujawniają trzy różne poziomy dojrzałości CE. Branże o wysokim stopniu adaptacji, takie jak motoryzacja i elektronika, wdrożyły gospodarkę o obiegu zamkniętym dzięki strategicznemu przywództwu i integracji łańcucha dostaw. Sektory o średnim stopniu adaptacji wykazują obiecujące inicjatywy, chociaż postęp jest powolny. Branże o niskim stopniu adaptacji borykają się z uporczywymi barierami regulacyjnymi, infrastrukturalnymi i kulturowymi, które hamują zmiany systemowe. W różnych sektorach interakcja czynników regulacyjnych, ekonomicznych, technologicznych i organizacyjnych stwarza złożone wyzwania dla wdrażania CE.

**Implikacje i rekomendacje:** Skuteczne przyjęcie CE wymaga skoordynowanych wysiłków w celu pokonania barier strukturalnych i zbudowania zdolności umożliwiających jej wdrożenie. Decydenci powinni tworzyć sektorowe mechanizmy wsparcia i promować naukę międzysektorową. Organizacje są zachęcane do instytucjonalizacji CE poprzez zaangażowane przywództwo, rozwój zdolności i innowacje w łańcuchu dostaw. Przyszłe badania powinny koncentrować się na opracowaniu modelu dojrzałości przyjęcia CE, który integruje dynamikę specyficzną dla branży z możliwymi do zastosowania ścieżkami jej wdrażania.

**Oryginalność/wartość:** Niniejszy artykuł przedstawia nową syntezę wzorców przyjmowania CE w różnych branżach, zarówno rozwijając wiedzę teoretyczną, jak i dostarczając praktycznych wskazówek. Porównując rozbieżne doświadczenia sektorowe, artykuł przyczynia się do stworzenia ram koncepcyjnych dla zrozumienia gotowości wdrożenia gospodarki o obiegu zamkniętym i strategicznych dźwigni zmian.

**Słowa kluczowe:** gospodarka o obiegu zamkniętym, wzorce wdrażania w przemyśle, przedsiębiorstwa wielonarodowe, bariery wdrażania, transformacja w kierunku zrównoważonego rozwoju