

Leveraging Circular Economy R-Strategies for Business Model Innovation: An Exploratory Case Study

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Abstract. *Circular economy-driven business model innovation is an emerging field of study that emphasizes sustainable practices across industries. This study explores how circular economy strategies can act as guiding tools for business model innovation and investigates the main challenges faced by companies adopting circular economy-driven innovations. Building on existing literature, and proposing a 14R circular strategies framework, the research employed a qualitative methodology based on three case studies using semi-structured interviews to collect data, followed by individual case analysis and cross-case comparisons. Findings highlight how circular economy strategies, such as redesign, reuse, and repurpose, can enhance business model elements. The research also emphasizes the critical role of stakeholder relationships in advancing circular economy practices and reveals key challenges, like logistical barriers, limited infrastructure, and shifting market dynamics. Contributions to the field include validating the flexibility of the proposed 14R framework and demonstrating its applicability across diverse industries. The research offers actionable insights for practitioners and policymakers aiming to align the circular economy principles with business model innovation while addressing systemic barriers and fostering sustainable growth.*

Keywords: circular economy, R strategies, circular strategies, business model innovation, sustainable development, case study.

Introduction

For decades, humankind has operated within a linear economy framework that depletes resources at a faster rate than the planet can regenerate them. This unsustainable approach has come at a significant ecological cost that has stressed the need to find urgent solutions that can reconcile economic development with sustainability concerns (Choudhry et al., 2023). A promising solution to address this major problem lies in transitioning to a circular economy (CE). There is a widespread belief that the transition to a CE offers a transformative framework that replaces the linear model of “take-make-use-dispose” with a system that has a regenerative design focused on the efficient use of resources, waste reduction, and an extended lifecycle of materials and products

(Kirchherr et al., 2023). At its core, CE disrupts the linear production and consumption model by focusing on closed-loop processes that prioritize resource recovery, recycling, and reuse (Ranta et al., 2018). By challenging conventional production and consumption patterns, CE represents a paradigm shift offering a strategic pathway for companies seeking to reconcile profitability with environmental sustainability (Tan & Cha, 2020)

The growing emphasis on CE is not just theoretical but is increasingly viewed as an economic necessity. Forecasts indicate that CE could dominate the global economic model by 2030, or potentially become the only viable model, highlighting the need for businesses to innovate and integrate circular practices to remain competitive (Lacy et al., 2020). However, transitioning from a linear to a circular system requires more than incremental operational adjustments; it calls for a fundamental reconfiguration of business models to embed circularity into value creation, delivery, and capture mechanisms. While companies across manufacturing sectors are driven by various motivators ranging from regulatory compliance to competitive advantage, the successful adoption of CE practices is dependent upon overcoming diverse barriers (Mont et al., 2017). These barriers are multifaceted, including financial constraints, short-term operational priorities, technological limitations, insufficient information systems, and ineffective institutional support. Additionally, organizational factors like leadership commitment, customer acceptance, and employee know-how play a key role in facilitating or obstructing the adoption process (Ormazabal et al., 2018). Moreover, companies, given the wide range of available approaches and the lack of standardized frameworks, often struggle to determine the most effective strategies for implementing circularity into their business models (Bocken & Ritala, 2022).

Lüdeke-Freund et al (2019) argue that business model innovation (BMI) serves as a key mechanism for operationalizing CE principles, as it makes companies fundamentally rethink how they create, deliver and capture value. Similarly, Manninen et al. (2018) explain that CE principles, such as resource optimization, extended product lifecycle, and transforming waste into valuable resources, can act as drivers of BMI. To support the integration of CE principles into business practices, various R-frameworks (Scholtysik et al., 2022) or R-strategies (Rahman et al., 2021) have been proposed. However, while these frameworks contribute to advancing CE adoption, they do not explicitly address their implications for BMI. For instance, Blomsma et al. (2019) introduce R-strategies alongside complementary approaches like avoidance and cascading to develop a framework for manufacturing firms pursuing CE-driven innovation. Also, Morsetto (2020) builds on the 10-R framework designed by Potting et al. (2017), advocating for a quantitative approach to measuring CE integration through specific regulatory targets.

While the academic discourse on CE is increasing (Rahman et al., 2021; Costa et al., 2024; Zorpas, 2024), a persistent gap exists in the understanding of how circular principles translate into BMI (Linder & Williander, 2017). Scholars and practitioners continue to struggle with the absence of comprehensive frameworks that clarify the mechanisms by which companies can transition effectively from linear to circular models (Urbinati et al., 2017). This disconnect between theoretical models and practical implementation often results in uncertainty and reluctance among companies to pursue circular transformation (Islam et al., 2024). Additionally, while existing CE research has introduced various R-frameworks to facilitate circular transitions these studies predominantly focus on resource optimization rather than their direct implications for BMI. Consequently, the role of R-strategies in shaping business models remains underexplored, limiting their strategic applicability. This stresses the need for further research to bridge this gap and develop frameworks that facilitate the adoption of CE-driven BMI. Addressing this research gap is

essential to accelerating the transition toward circular practices that align economic value with sustainability objectives (Balaji & Liu, 2020).

Given these research gaps, this study argues that R-strategies have the potential to serve as key drivers of BMI, enabling firms to develop new mechanisms for sustainable value creation while reducing environmental impact. Specifically, this research aims to examine how CE strategies, particularly R-strategies, influence BMI at the firm level. By adopting a micro-level perspective (Lüdeke-Freund et al., 2019), the study seeks to explore how companies integrate these strategies to enhance circularity, as well as the challenges they encounter in doing so. Accordingly, the study aims to answer the following question: *How can R-strategies drive business model innovation to achieve more circularity and what challenges do companies face in adopting CE-BMI?*

To answer this question, the study proposes a novel 14-R circular strategies framework, contributing to both theory and practice by offering a structured approach to integrate circularity within BMI. Through a combination of an extensive literature review and empirical case study analysis, the study aims to bridge the gap between CE theory and practical implementation. By doing so, it offers a nuanced understanding of how companies can use circular strategies to both achieve resource efficiency and economic value. Consequently, the study's findings offer a roadmap for companies, policymakers, and scholars, facilitating more effective transitions toward a CE.

Following the introduction, the next section presents the theoretical background of this study, critically engaging with existing literature on CE, circular R-strategies and BMI. This discussion helps establish the conceptual framework that underpins the research. The following section details the research methodology, justifying the chosen approach. The study's findings are then presented and analyzed considering the theoretical insights, offering a discussion of their implications. Finally, the paper concludes by reflecting on theoretical and practical implications, discusses the research limitations and proposes future research directions.

Theoretical background

The circular economy and its R-strategies

CE is “a system where materials never become waste and nature is regenerated” (EMF, 2017), where the value of products, materials, and resources is preserved within the economy for as long as possible, reducing waste to a minimum (Mansilla-Obando et al., 2022). Scholars argue that CE offers a path forward to safeguard the environment, promote social equity, and foster sustainable and balanced economic development across regions (Geissdoerfer et al., 2017). By integrating CE principles, companies can contribute to sustainable development through resource optimization, waste reduction, and innovative business strategies (Kirchherr et al., 2017). Furthermore, emerging research highlights that CE encourages innovation in product design and business models, and stimulates collaboration between various stakeholders across the value chain (Muller et al., 2024).

From a business perspective, transitioning to a CE involves adopting practices and business models that prioritize resource efficiency, waste reduction and sustainability. Mostaghel et al. (2023) assert that by reducing waste and improving resource efficiency production is decreased and operational costs are reduced. Several companies have already embraced innovative business models aligned with CE principles, like product-as-a-service, where products instead of being sold are leased or rented, and take-back schemes, where products at the end of their life cycle are reclaimed for remanufacturing or recycling (Kirchherr et al., 2023). Despite these advantages, there is no universally accepted framework for integrating CE principles into business operations, posing

challenges for firms seeking to implement CE strategies effectively (Barreiro-Gen & Lozano, 2020).

The Ellen MacArthur Foundation (EMF, 2017) identifies three core design principles underpinning the CE paradigm: “eliminate waste and pollution, circulate products and materials, and regenerate nature.” These principles were encapsulated in different R-frameworks and sought to maximize resource efficiency and sustain product utility while mitigating environmental impact (Kirchherr et al., 2023). However, as the concept of CE has evolved numerous interpretations and applications of these frameworks have emerged, displaying different sustainability goals and industry-specific efforts (Reike et al., 2018). While this diversity demonstrates CE’s adaptability across diverse sectors, it also highlights the challenge of maintaining conceptual coherence and ensuring successful implementation. Hence, establishing a shared understanding and standardized approach to CE is essential for achieving its full potential.

A growing body of research has identified a variety of R strategies, ranging from simplified 3R models to more extensive frameworks encompassing up to 100Rs (Zorpas, 2024). Despite this diversity, the 3R and 4R models remain the most widely adopted due to their simplicity and practical applicability (Kirchherr et al., 2023). For instance, Barreiro-Gen & Lozano (2020) used a 4R framework (reduction, repair, remanufacture and recycling) to examine how companies implement CE practices. Their findings revealed that reduction and recycling efforts are prioritized over repair and remanufacturing, with a primary focus on internal operations rather than fostering external collaborations. Similarly, Stumpf et al. (2021) identified six core circularity strategies: reduce, reuse, recycle, recover, remanufacture, and redesign (6R). This research highlighted that companies engaged in implementing CE practices predominantly emphasized design innovation, resource recovery, and recycling, with recycling emerging as the most frequently implemented strategy.

More extensive frameworks, such as the 10Rs, aim to provide greater granularity and emphasize higher value retention within circular systems (Zorpas, 2024). For example, Potting et al. (2017) proposed a 10R hierarchy, that organizes circularity strategies into a structured priority order: refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, and recover. This hierarchical approach prioritizes strategies that minimize resource input and waste generation at the design and production stages (refuse, rethink, reduce) before addressing product longevity (reuse, repair, refurbish, remanufacture, repurpose) and material recovery (recycle, recover). While this framework offers a structured approach to circularity, its practical implementation varies across industries and economic contexts.

Alternative perspectives on the 10R framework have surfaced to enhance flexibility and adaptability. Reike et al. (2018), for instance, categorize their 10R framework into short, medium, and long loops, offering a more dynamic interpretation of circularity and flexibility. Refuse, reduce, reuse/resell and repair are part of the shorter loop and focus on reducing consumption and extending the lifecycle of products. The next 3Rs, refurbish, remanufacture and repurpose, are part of the medium loops and aim at increasing the durability and functionality of products. While recycling, recover and re-mine, part of long loops, address the material recovery when product-level reuse is no longer feasible. This categorization recognizes the varying levels of resource retention and sustainability impact associated with each strategy.

Building on Potting et al. (2017) work, Costa et al. (2024), extended the 10R framework by proposing three additional strategies: redesign, remine, and return. Redesign is part of the “smarter product use and manufacture category”, advocating for sustainability-driven product innovation (Potting et al., 2017). Remine and return are part of the effective utilization of materials category.

Applying this expanded 13R framework, Costa et al. (2024), through a survey-based study, examined circularity practices in the Portuguese hotel industry. Their findings indicated that four strategies (reduce, reuse, recycle, and repair) were the most frequently adopted, suggesting a gradual shift in the Portuguese hotel industry towards more sustainable operations. Similarly, Rahman et al. (2021) utilized the 10R framework to assess circular solutions for LED lamp end-of-life management, identifying recycling as the most dominant strategy.

In a further expansion of CE principles Uvarova et al. (2023), proposed an extensive 60R framework, grouping strategies into four main categories: reduce, reuse, recycle and reverse logistics. Among these principles, three stand out due to their strategic importance: redesign, reevaluation, and rebalance. Redesign, because it aims to innovate products, redesigning them for sustainability. Reevalue, because it is focused on ongoing assessment and improvement of circularity practices. And rebalance as it adjusts the allocation of resources for better efficiency. These principles underline the increasing complexity of CE frameworks and the growing need for adaptable, industry-specific approaches to implementation.

Recent research has significantly expanded the scope of CE strategies with Zorpas (2024) identifying over 100 different R strategies beyond the widely recognized principles of "reduce, reuse, recycle". These strategies contribute in various ways to waste management and the advancement of circularity. Additionally, these expanded R-strategies are closely aligned with several sustainable development goals, emphasizing their central role in implementing circularity and fostering sustainable development.

One emerging area of interest is the role relationships play in implementing CE principles. Specifically, how collaborative support and stakeholder engagement facilitate the effective implementation of CE principles (Moreno-Miranda & Dries, 2024). While stakeholder collaboration is widely acknowledged as a key enabler of circular transitions Zorpas (2024) argue that there is a need for a more nuanced understanding of what defines positive and productive relationships between stakeholders in this context. Similarly, Salvador et al. (2021), through a systematic literature review and expert survey, identified that forming strategic partnerships to advance circularity, engaging stakeholders across the value chain, and utilizing digital technologies are among the most influential strategies for circular business modelling. Collectively, these studies underscore the adaptability of R-strategy frameworks across diverse industrial settings while also revealing variations in how circular strategies are adopted and implemented. This variation suggests that while general CE principles provide a foundation, industry-specific challenges and opportunities must be accounted for when circular innovations are implemented in business models.

Studies have acknowledged the importance of BMI for companies transitioning towards a CE (Hellström & Olsson, 2024; Diaz Lopez et al., 2019) but they also highlighted a lack of knowledge surrounding CE strategies that drive BMI (Islam et al., 2024) and a scarcity comprehensive frameworks that successfully integrate circular economy strategies into BMI (Linder & Williander, 2017). Guldmann & Huulgaard (2020) also argue that company-level implementation of CE is under-researched, hindering operational frameworks. Assmann et al. (2023) note that even though various factors influence the adoption of circular business models have been studied a comprehensive understanding of how different circular strategies can drive BMI within the CE context is missing. This suggests that there is a recognized need for further investigation into how CE strategies can be better integrated into BMI, indicating the existing knowledge gap.

To address these gaps, this study introduces a proposed 14R circular strategies framework, presented in Figure 1, as a structured approach to integrating CE strategies into BMI. Developed from an extensive literature review, this framework includes 14 different circular strategies as a proposed solution for companies to transition from a linear economic model to a more circular model. The definition of each strategy, along with key scholarly sources, are presented in Table 1. While some researchers argue that circular strategies should follow a hierarchical structure (Kirchherr et al., 2017; Potting et al., 2017), the 14 R-framework does not have a hierarchy adopting the perspective of Reike et al. (2018), emphasizing flexibility. Rather than imposing a rigid prioritization, this approach allows for the critical assessment of each R-strategy within the specific context of a company, ensuring that the most relevant strategies are selected to maximize CE objectives.

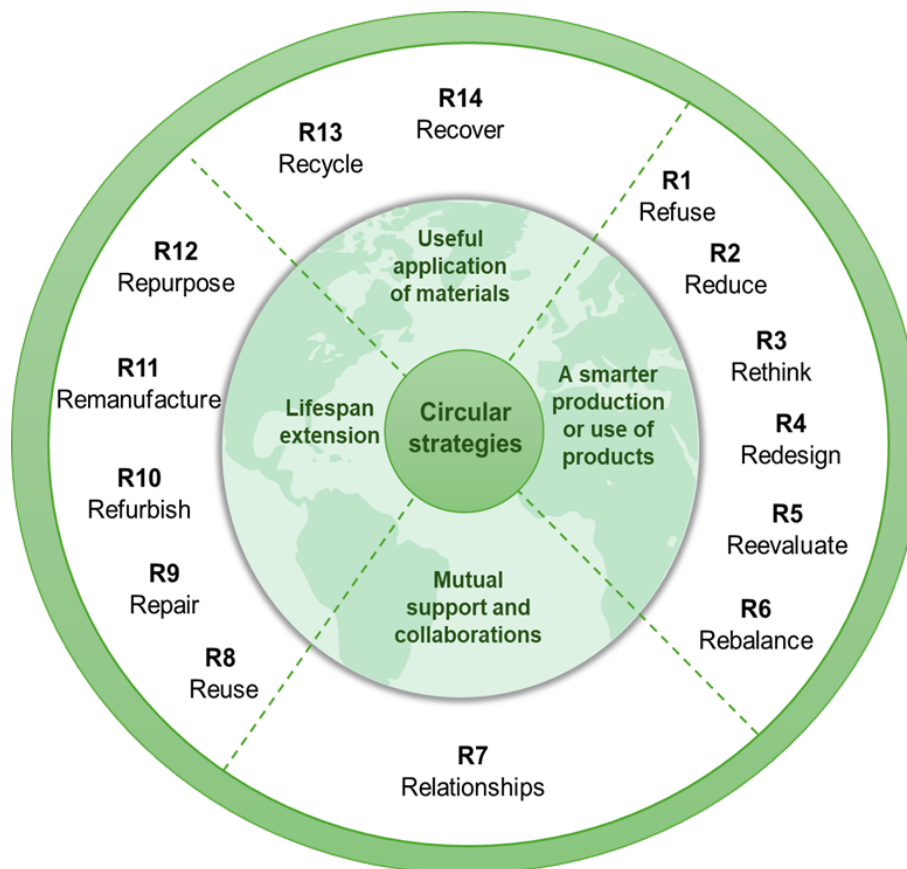


Figure 1. The 14R circular strategies framework

Source: Adapted from Zorpas (2024), Potting et al.(2017) and Reike et al. (2018).

The first set of strategies (R1–R6) falls under the "reduce" category, focusing on optimizing manufacturing processes and promoting more efficient product use (Kirchherr et al., 2017). Strategies R8–R12 emphasize "reuse," aiming to extend the lifespan of products through various restorative and repurposing methods. Meanwhile, R13 and R14 target material optimization, and make certain that resources are utilized in the most effective way possible (Potting et al., 2017). Notably, R7 (relationships) is positioned as a cross-cutting strategy that functions symbiotically with all three core categories acting as a link, through mutual support and stakeholder collaborations, between various strategies that help facilitate the implementation of CE principles in business.

Table 1. The definitions of the 14R-strategies proposed framework

R	Circular strategy	Definition	Key academic sources
R1	Refuse	Preventing the use of raw materials by eliminating the need for a product, either through avoiding its use, offering innovative alternatives, or encouraging consumers to not use it altogether.	Zorpas (2024); Potting et al. (2017); Reike et al. (2018)
R2	Reduce	Enhance efficiency in product manufacturing and use by minimizing the use of natural resources and materials, thereby lowering the environmental footprint and prioritizing waste prevention.	Mansilla-Obando et al. (2022); Zorpas (2024); Potting et al. (2017)
R3	Rethink	Intensifying product use by enabling shared access among multiple users without ownership, thus creating broader opportunities to integrate CE principles across different project stages.	Potting et al. (2017); Kirchherr et al. (2017)
R4	Redesign	Focusing on innovating and reimagining products or processes to increase sustainability and advance the transition toward a CE.	Zorpas (2024); Uvarova et al. (2023)
R5	Reevaluate	Continuously assessing and refining business practices, strategies, and processes to ensure their alignment with CE objectives.	Uvarova et al. (2023)
R6	Rebalance	Adjusting and optimizing the allocation of resources, processes, and strategies to achieve a more sustainable and efficient operation.	Uvarova et al. (2023)
R7	Relationships	Forming strategic alliances and engaging stakeholders across the value chain to enable mutual support and collaboration in advancing CE practices.	Moreno-Miranda & Dries (2024); Zorpas (2024) ; Salvador et al. (2021).
R8	Reuse	Extending the lifecycle of products or components by allowing them to be used again by another consumer for their original purpose without reprocessing, in that way reducing the need for virgin materials.	Mansilla-Obando et al. (2022); Salvador et al (2021); Potting et al.(2017)
R9	Repair	Focus on restoring defective products to their original functional state through maintenance or repair, either by self-repair or professional services, allowing continued use and fulfilling their intended purpose.	Zorpas (2024); Potting et al. (2017)
R10	Refurbish	Improving and modernizing an old product by restoring it to its original state or enhancing it beyond its original condition to align with current standards and functionalities.	Potting et al. (2017); Zorpas (2024)
R11	Remanufacture	Rebuilding a product to its original specifications by integrating intact components from discarded products, along with repaired or new parts, to create a new product with the same function.	Potting et al. (2017); Zorpas (2024); Reike et al. (2018); Salvador et al. (2021)
R12	Repurpose	Adapting discarded products or their components for use in entirely new applications, offering a different function and benefit from the original design.	Kirchherr et al. (2017); Potting et al. (2017)
R13	Recycle	Recovering and reprocessing materials from waste to create products, materials, or substances for the same or different purposes, enabling multiple-use cycles and minimizing resource depletion.	Mansilla-Obando et al. (2022); Potting et al. (2017); Salvador et al. (2021)
R14	Recover	Extracting value from waste materials through processes such as energy recovery via incineration, rather than recycling them into new materials.	Potting et al. (2017); Zorpas (2024)

Source: Authors' own research.

Business model innovation in the circular economy context

Business models, according to Teece (2018, p. 40), “describe an architecture for how a firm creates and delivers value to customers and the mechanisms employed to capture a share of that value”. Its main elements are value proposition, value creation and delivery, and value capture (Bocken et al., 2014). More recently academics have argued that BMI plays a pivotal role in enabling the implementation of circular economy practices within organizations (Geissdoerfer et al., 2020). Key aspects include redefining the value proposition, improving value creation and delivery processes, and innovating revenue generation strategies. BMI can manifest in two main ways: the creation of a completely new business model or the reconfiguration of components within an existing one.

BMI can range from incremental changes to radical transformations, allowing companies to adapt to market dynamics and improve their competitive advantage (Foss & Saebi, 2018). Furthermore, the evolution of business models is essential for companies to remain relevant in a rapidly changing environment, as it involves continuous refinement and adaptation to meet emerging challenges and opportunities, like the ones presented by the CE movement. Thus, BMI is not only a response to competition but also a proactive strategy for sustainable growth and innovation that ultimately aims to enhance competitiveness and drive business success (Shakeel et al., 2020).

BMI serves as a strategic tool for advancing sustainability and circularity by reconfiguring traditional business models to enable broader and more impactful value creation (Itkin, 2020). That means companies need to create value propositions that focus on circularity, like using recycled materials, designing products that last longer, and implementing schemes that collect the used products to be reused. Hence, companies need to find solutions to keep their resources in use as long as possible, in other words, they need to innovate to close, slow or narrow resource loops (Lit et al., 2024). Circular business model innovation, according to Diaz Lopez et al. (2019), seeks to incorporate the core principles of circularity directly into the BMI process. Additionally, when developing an innovation strategy, companies must determine the extent to which they will incorporate circularity within their business models, either through internally driven initiatives, collaborative efforts with external stakeholders, or a combination of both approaches (Bocken & Ritala, 2022).

Lüdeke-Freund et al. (2019) highlight the importance of business models when bridging the gap between CE theory and practical implementation, noting that they act as frameworks to implement CE principles, using strategies like reuse, repair, remanufacture, recycle, repurpose, and refurbish. For example, companies that implement the CE transition from a product provider to a service provider, adopt a product-as-a-service business model where the producer is the owner of the products and the customer pays for their use, thus reducing waste and increasing resource efficiency (Centobelli et al., 2020).

CE principles challenge companies to innovate in ways that align profitability with sustainability. However, the shift from a linear to a circular approach in business requires companies to rethink their business models. This is not an easy task, even though the integration of CE and BMI seems to create synergies that benefit both businesses and the environment (Geissdoerfer et al., 2017). Additionally, the existing approaches for BMI towards circularity fall short of providing actionable and practical guidance to practitioners (Pieroni et al., 2021). This gap between theoretical conceptualization and practical application is further emphasized by Barreiro-Gen & Lozano (2020) who highlight the disconnect between the CE principles and their practical application in actual business settings, stressing the need to find effective strategies that can address these challenges and accelerate the adoption of CE practices. Furthermore, the broader body of

research on CE and BMI has an unstructured and fragmented nature, restricting the development of a universal understanding of how CE strategies drive business model change (Islam et al., 2024). This lack of consistency brings significant challenges, as it impedes the capability to identify the best practices, assess the efficacy of circular strategies, and develop innovative frameworks.

Key challenges in adopting circular economy-driven business model innovation

Adopting CE-driven business models presents a range of interconnected challenges, both internal and external, that vary across organizational contexts and industries. Although the link between CE and changing business models towards circularity is amply discussed in the literature, its practical implementation is another story, companies facing numerous challenges.

The CE-driven BMI is influenced by a range of different drivers, broadly categorized into market, financial, organizational and external factors. Geissdoerfer et al. (2022) argue that market and financial motivations serve as critical driving forces for start-ups and company diversification efforts, indicating that economic viability and market demand are essential to the adoption of circular business practices. In contrast, for established businesses undertaking transformative changes, organizational dynamics, such as leadership and strategic alignment, linked with market conditions, play a more significant role. These findings emphasize the contextual nature of the drivers that influence BMI towards circularity.

Expanding on these insights, Hina et al. (2022), provide a more granular perspective by classifying the drivers of BMI into internal and external factors. Internal drivers involve organizational leadership, resource availability, financial incentives, and innovations in product and process development, which together provide the foundation for circular innovations within firms. On the other hand, external drivers such as policy frameworks, regulatory support, supply chain collaboration, societal and environmental concerns, stakeholder pressures, and infrastructure availability act as catalysts that encourage businesses to adopt circular practices.

Empirical research further illustrates the difference of these drivers across various industries and company sizes. Engzell & Kambanou (2024) argue that drivers and barriers for BMI differ significantly depending on firm size, industry and business model. They further elaborate that what motivates companies to adopt circular practices aimed at BMI are mainly market opportunities, delivering enhanced value to customers, and growing awareness and concern for environmental problems. Likewise, Ademi (2024), surveying small and medium-sized Macedonian companies, advances the idea that technological innovations and digital solutions also play an important role in facilitating BMI aimed at developing a CE.

The literature review highlights the theoretical potential of the CE to create a regenerative system that aligns economic wealth with environmental and social goals. The transition towards a CE needs innovation across multiple dimensions, including new products and services, as well as changes in production and distribution processes (Bauwens et al., 2024). Although progress has been made in advancing CE practices, particularly in areas such as recycling and energy efficiency, concepts like remanufacturing and reducing consumption remain less widely adopted (Lüdeke-Freund et al., 2019). In addition, from a practical perspective, several challenges were identified in the literature. But at the same time, opportunities also exist, underscoring the potential to use innovation to overcome these challenges. The interplay between these internal and external drivers underlines the multifaceted nature of implementing circular practices that drive BMI, where success often depends on the alignment of organizational capabilities with external enablers, creating an ecosystem favorable to sustainable innovation (Geissdoerfer et al., 2022). Addressing these barriers while leveraging drivers is necessary for fostering a successful transition to a CE.

Methodology

As the CE-driven business model innovation research is a relatively new field of study, and due to the exploratory nature of this research, a qualitative research strategy was adopted. This methodology, according to Yin (2018), enables a deeper exploration and theoretical development of the phenomenon within its real-world context. By combining insights from existing literature with empirical evidence gathered from the analyzed cases, the study wants to develop a better understanding of how the CE strategies can serve as guiding tools to enable BMI and what are the main challenges and opportunities for companies adopting CE-driven business model innovation. The literature analysis established a theoretical foundation for the case studies (Geissdoerfer et al., 2018), highlighting key concepts and challenges in adopting CE strategies, while also informing the focus and the design of the case studies.

Following the literature review, the next step in the research was the selection of the case studies. Purposive sampling was used to ensure a closer alignment between the selected cases and the study's objectives, thus increasing methodological rigor and improving data credibility and findings (Campbell et al., 2020). To increase the chances of identifying companies that offer the most valuable insights into the research question and in alignment with prior studies (Santa-Maria et al., 2021), the selection process focused on cases that represent a mix of industries, different company sizes and have implemented a variety of R-strategies. Due to practical and financial constraints, particularly to allow in-person interviews, the study focused only on Romanian companies. Potential case studies were identified through a combination of desk research and recommendations from the authors' professional network.

Following the approach of Abbate et al. (2023) three sample selection criteria were set: active participation (ensuring that the chosen companies were fully involved in the research process), the companies engaged in some form of circularity practices (to ensure relevance to the study's investigation of CE-driven business model innovation), and companies have sufficient knowledge and expertise in CE principles to ensure that participants could provide informed insights into their CE strategies. These criteria ensured that the selected companies could meaningfully contribute to the study's aim by offering detailed perspectives on the integration of CE principles into BMI. A total of ten companies were contacted to participate in the study, with requests for interviews directed toward managers or company owners actively involved in implementing CE practices within their companies. Over nine weeks, due to time constraints, only three of these companies accepted our request. To maintain confidentiality, the company names are not revealed. The selected cases include a producer of upholstered furniture (company A), a bakery (company B) and a furniture retailer (company C).

Building on Roshan & Chandra Balodi's (2024) approach, the data collection process was conducted in three distinct stages, using multiple sources to ensure a thorough and robust analysis. This approach enabled a deeper understanding of how companies implement CE strategies and how this impacts BMI for circularity.

In the first stage, secondary data sources were extensively reviewed to build a contextual foundation for the study. Academic articles, newspapers, industry reports, and other publicly available documents were analyzed to gain insights into CE strategies used by companies across different industries. This initial research helped identify themes and examples related to the implementation of circular practices, which informed the design of the primary data collection phase.

The second stage involved primary data collection through in-depth, semi-structured interviews with company owners or managers directly engaged in CE implementation. The

interviews were conducted in person, with interviewees fully informed about the study's objectives. They were also assured that both their personal information and company details would remain confidential. Before the interviews started the 14R framework was presented and discussed with the interviewees to ensure there was no confusion during the data collection process. The interviews were done following an interview protocol where questions were mostly open-ended and were designed based on key themes, including CE R-strategies, BMI, and challenges in adopting CE-driven BMI. For instance, interviewees were asked to think about questions like *How has adopting R-strategies influenced the value you deliver to your customers? Have you created new business models (e.g., product-as-a-service, leasing) due to CE practices? Are there any key partnerships or collaborations that have aided the adoption of R-strategies? What internal challenges has your company faced when adopting CE strategies?* Where necessary follow-up questions were used to clarify responses and get further details, allowing for a better understanding of the subjects discussed. The duration of the interviews was approximately between 35 to 60 minutes. The interviews were recorded and afterwards transcribed, with the transcripts serving as the main data source for analysis.

The third and final stage involved the collection of additional secondary data to complement and validate the findings from the interviews. Company websites, social media platforms, sustainability reports, and news articles were analyzed to double-check statements made during the interviews and offer a more holistic view of each company's CE initiatives. This triangulation process, a recognized best practice in case study research, helped to enhance the credibility, reliability and validity of the study's findings (Farquhar et al., 2020).

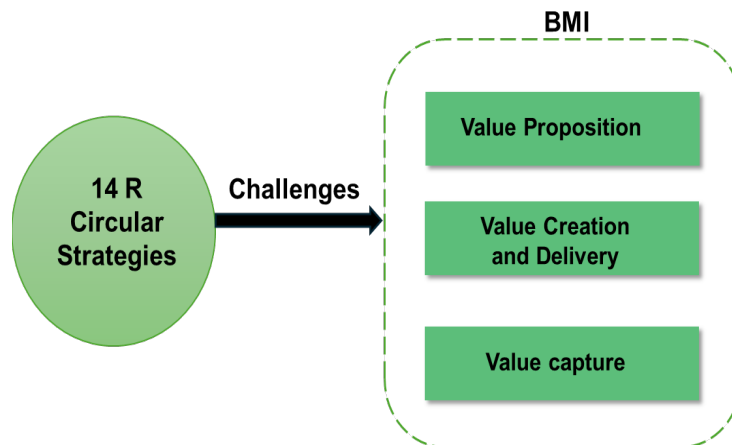


Figure 2. Research framework

Source: Authors' own research.

Each case was examined individually using a qualitative approach, guided by the business model elements (value proposition, value creation and delivery, and value capture) offered by Bocken et al. (2014), and the proposed 14R framework (see Figure 2.). This methodological approach allowed for a structured analysis of how CE strategies are rooted within business models at the firm level. Given the limited understanding of the phenomenon, more rigid theory-based pattern-matching techniques, such as categorization or analysis across various dimensions, were deemed less feasible (Ranta et al., 2018). Instead, as the final part of the analysis, a cross-case comparison was made to identify commonalities or differences across the three cases. This comparative approach enhanced the study's external validity by offering a broader understanding

of how different companies operationalize circular strategies and navigate BMI challenges (Abbate et al., 2023).

Results and discussions

The results of the study are presented in two parts. Consistent with the approach adopted by Ranta et al. (2021), the first part offers a detailed analysis of the results for each case. This is followed by a cross-case comparison, where the similarities and differences among the cases are systematically summarized and examined.

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Case company A

Company A is a manufacturer that produces a wide range of upholstered furniture, sofas and mattresses, from the design stage and raw material processing to quality control, storage and dispatch. It is a large company that has been on the market for over 20 years serving businesses and consumers alike. It has an environmental department promoting a forward-thinking environment that aligns with eco-friendly practices ensuring the implementation of procedures that safeguard transparency and efficiency. Additionally, the company uses advanced equipment that allows for the optimization of raw material consumption and minimization of waste generation.

By incorporating R-strategies like redesigned products that use recycled materials and sustainable practices Company A has managed to enhance its value proposition by addressing the rising consumer demand for eco-friendly solutions (Ashley et al., 2023). Additionally, the transformation of production waste into innovative products, such as wood-plastic composites, exemplifies, as highlighted in Perey et al., (2018) study, how reframing waste as a resource can drive both resource efficiency and BMI. This approach not only resolves the burden-resource tension but also enhances value propositions, aligning with the demands of environmentally conscious markets and fostering deeper integration of circular principles across value networks.

Regarding value creation and delivery Company A has reengineered its processes to prioritize waste prevention and integrate internal recycling systems, supported by advanced equipment that minimizes raw material consumption and waste generation, aligning with CE principles. Building relationships as an R-strategy is integral to driving BMI, as demonstrated by the steel industry's reliance on collaborative networks to address challenges in recycling processes and resource efficiency (Berlin et al., 2022). Through collaborative supply chain partnerships, Company A has replaced plastic packaging with sustainable alternatives like paper and cardboard and implemented packaging return programs, strengthening relationships with eco-conscious suppliers and enhancing operational efficiency. Additionally, the adoption of key R- strategies, like redesign, repurpose, and recycle, has led to the diversification of the company's revenue streams, while cost savings have been achieved through internal recycling, reduced raw material usage, and minimized packaging waste. Furthermore, replacing plastic with paper or cardboard not only reduces costs associated with plastic disposal and recycling but according to Shogren et al. (2019) also aligns with sustainable production practices by minimizing waste and promoting internal recycling.

As emphasized by Geissdoerfer et al. (2022) the drivers and barriers to developing new business models that adhere to CE principles vary contextually, with market opportunities, leadership, and regulatory support acting as critical enablers. The transition to a CE demands significant changes to business models, as demonstrated by Company A's adoption of R-strategies, which required specialized expertise, process optimization, and overcoming operational complexities. R-strategies play a pivotal role in the long-term evolution of Company A's business

model by driving innovation through advanced technologies that optimize resource use, fostering supplier collaboration for sustainable practices, and implementing internal recycling systems to transform waste into value-added products.

Case company B

Company B is an intriguing and possibly less commonly considered example for investigating R-strategies and their impact on BMI. While bakeries might not be the best CE pioneers, this one has implemented several creative ways to embed circular principles into its business model. Company B is a medium-sized regional bakery chain, with over 25 years of experience, delivering fresh products daily, ranging from bread and pretzels to cakes, sandwiches, and other delicacies. Committed to quality and innovation, the company stays modern by adopting fresh recipes, collaborating with local farmers, and embracing environmentally friendly practices.

The sustainability efforts of Company B are mainly focused on reducing waste, collaborating with local producers to source locally the necessary ingredients, introducing reusable packaging, energy efficiency and waste disposal. These efforts have helped the company to position itself as an innovative and eco-conscious bakery. Old-day bread is repurposed and transformed into breadcrumbs or croutons and then sold to customers. This together with the introduction, as a trial, of reusable packages, has led to an enhanced value proposition. To avoid overproduction and waste the company uses technology for demand forecasting. It also rebalanced its priorities by gradually shifting from traditional operations to more CE practices. Even though Company B was interested in composting its food waste there are no composting facilities available in its proximity. So, it had to find some other solutions. It has strengthened and built relationships with local farmers, creating agreements not only to get a local supply of ingredients but to donate some of the waste to be used as food for animals or, for those who wanted, to use it as compost for their fields.

The adoption of circular practices has unlocked new revenue streams, such as upcycled products like breadcrumbs and croutons made from surplus bread, while also reducing some of the waste disposal costs. Although the offering of reusable packaging has slightly increased costs, these costs are hoped to be offset by operational efficiency. The adoption of R-strategies has required staff training but leadership and collaborations with suppliers, and farmers, have played a major role in implementing CE practices that have led to incremental BMI. A major challenge was the inconsistent local recycling and lack of composting facilities which complicated waste management for the company.

Case company C

Company C is a young company, formed just four years ago. With a team of fewer than 10 employees, the company combines creativity, craftsmanship, and environmental consciousness to offer unique products and services to its customers. At its core, the company operates as a reseller of second-hand furniture and wall accessories, primarily sourced through donations or purchases from Western European markets. The company partners with skilled restoration experts and furniture builders to offer clients value-added services such as refurbishing, minor alterations, and customizations. In addition to its resale operations, the company has established a niche in event rentals, offering a diverse selection of outdoor furniture for small gatherings and parties.

Adopting R-strategies has significantly enhanced Company C's CE-driven business model by integrating sustainability with customer value. The reuse of second-hand furniture reduces waste and materials costs while offering affordable, unique products. Refurbishment adds a customized touch, extending product life cycles and meeting customer demands. The renting of the outdoor

furniture appeals to individuals or event organizers offering an additional revenue stream. While the repair and customization services further extend product durability.

Several challenges have posed difficulties for Company C in adopting R-strategies for CE. Internally, the limited experience in restoration has necessitated relying on external partners. Additionally, sourcing consistent, high-quality second-hand furniture and managing logistics from Western Europe pose logistical barriers, while ensuring the durability and repairability of refurbished products can be resource intensive. Market dynamics, like demand fluctuation and competition from low-cost new furniture, influence the feasibility of circular models, yet growing consumer demand for sustainable alternatives offers opportunities. Building trusting relationships with restoration experts is vital for offering quality refurbishing services. Looking ahead, Company C believes that CE practices will continue to drive growth, with long-term goals focusing on expanding resale, leasing, and additional circular initiatives.

Cross case analysis

This cross-case analysis explores the adoption and impact of R-strategies on circular-driven BMI in three different companies. All three companies incorporate sustainability into their business models, but the application of circular practices differs based on industry needs. The results of the three cases are summarized in Table 2.

Company A enhances its value proposition by integrating recycled materials and transforming production waste into wood-plastic composites, while Company B repurposes surplus bread into upcycled products and uses reusable packaging. Company C, operating in the second-hand market, focuses on refurbishing furniture and offering rental services. Each company taps into the growing demand for eco-friendly solutions, but challenges arise from sector-specific factors, such as sourcing, logistics, and infrastructure limitations.

Table 2. Business model elements, R-strategies and key challenges of the three cases

Aspects	Case A	Case B	Case C
Value proposition	Redesign products made with recycled materials, use sustainable packaging and transform waste into value.	Positioned as an eco-conscious bakery, new products from upcycled goods.	Second-hand furniture and wall accessories, refurbished items, leasing outdoor event furniture.
Value creation and delivery	Waste prevention, internal recycling of production scraps, and optimized raw material consumption, collaboration with suppliers to minimize packaging waste and replace it with sustainable alternatives.	Demand forecasting, collaborations with local farmers, and development of reusable packaging systems.	Efficient logistics for sourcing, sorting, and refurbishing second-hand furniture, with Western European sourcing and expert partnerships, drive innovation through customization.
Value capture	New revenue streams from selling wood-plastic composites, cost savings via recycling, reduced raw material usage, and minimized packaging waste.	New revenue streams from new products, savings from reduced waste and energy efficiency.	Resale of refurbished furniture and outdoor furniture leasing.
Key R-strategies	R4 Redesign R8 Reuse R7 Relationships R12 Repurpose R13 Recycle	R2 Reduce R8 Reuse R14 Recover R12 Repurpose	R8 Reuse R9 Repair R10 Refurbish Resell Rent

Aspects	Case A	Case B	Case C
Challenges	Need for expertise in product redesign and circular process optimization, operational complexities.	Costs with staff training, local issues for waste management, pressures from low-cost rivals, and improving packaging recyclability.	Limited experience in restoration, issues in sourcing consistent, high-quality second-hand furniture, logistical barriers, fluctuating market demand and competition from low-cost furniture.

Source: Authors' own research.

Despite the challenges, the adoption of circular practices has led to diverse revenue streams and cost savings. Company A generates new revenue from innovative products like wood-plastic composites and reduces costs through internal recycling and sustainable sourcing. Company B achieves waste reduction through upcycling bread and reusing packaging, although it faces higher initial costs for sustainable packaging. Company C, through its resale, refurbishment, and rental services, maximizes product lifespan, which supports both its environmental and revenue goals. While these companies have seen operational efficiencies, they also face hurdles such as the high initial costs of equipment, inconsistent recycling infrastructure, and reliance on external partnerships for refurbishment and logistics.

Discussion

This cross-case analysis emphasizes how R-strategies drive BMI in diverse industries, reflecting the flexibility and complexity of CE principles. The proposed 14 R framework, which classifies circular strategies into three dimensions, useful application of materials, lifespan extension, and mutual support and collaborations, offers a robust lens for assessing the integration of R-strategies into BMI. Companies A and B use strategies like repurposing (R12) and recycling (R13) to optimize material flows. For example, Company A's transformation of production waste into wood-plastic composites exemplifies the application of recycling and repurposing strategies is consistent with Potting et al. (2017), who stress the importance of recycling in achieving resource efficiency. However, while Company B incorporates various R-strategies, its challenges in achieving scalable recyclability due to infrastructure limitations echo the findings of Barreiro-Gen and Lozano (2020), who highlight the existence of systemic barriers to material recovery in CE adoption.

The focus of Company C is on reuse (R8), repair (R9) and refurbish (R10), circular strategies that aim to extend the life cycle of products. Through second-hand furniture sales and its rental model, the company extends resource efficiency while reducing the need for virgin materials. This aligns with Reike et al.'s (2018) recommendation for selecting medium-loop strategies that maintain product functionality and value. However, the reliance on external partners and challenges in ensuring durability highlight barriers to scaling these strategies. These findings resonate with Stumpf et al. (2021), who stated that repair and refurbishment face practical limitations in terms of cost and complexity, particularly for small and medium-sized companies.

An interesting, but not surprising finding was the fact that relationships (R7) are central to all three companies' CE initiatives. Company A collaborates with suppliers to develop packaging return programs, Company B works closely with local farmers, while Company C engages with restoration experts and furniture builders to enhance its refurbishment capabilities. This finding supports Salvador et al. (2021) study, which emphasizes the role of stakeholder partnerships in advancing CE practices. Yet, the companies' challenges in fostering systemic collaborations

highlight a gap in operationalizing the “mutual support and collaborations” dimension of the proposed framework. While these relationships enable strategy implementation, their limited scalability and dependency on external actors point to the need for stronger institutional support, as highlighted by Zorpas (2024). Additionally, some other R-strategies were mentioned in the case of company C (resell and rent) that were not addressed by the framework, illustrating the possibility of introducing as many R-strategies as needed to achieve CE objectives.

The proposed 14R framework with its four main categories of R strategies points up the importance of choosing strategies that best align with organizational context and resource capacity. Companies A and B, for instance, are focused on long-loop strategies (Reike et al., 2018), reflecting their production orientations. In contrast, Company C’s emphasis on medium-loop strategies (reuse and refurbishment) aligns with its role as a reseller of second-hand goods. These strategy choices underline the flexibility of the 14R framework, as advocated by Reike et al. (2018), who acknowledges that not all strategies are equally applicable across industries. Nonetheless, the cases also reveal a tendency to select short-term, lower-complexity strategies over long-term, high-value retention strategies such as remanufacturing (R11) and redesign (R4). The cases also illustrate how BMI can act as a bridge between CE theory and practice, enabling companies to integrate circular strategies into their business model elements. For example, Company B’s use of demand forecasting and local partnerships shows how CE principles can enhance operational efficiency and customer engagement. Company C’s rental model aligns with the product-as-a-service trend (Kirchherr et al., 2023), indicating how BMI can transition companies' value proposition from ownership to access. However, these innovations are not without challenges. The fluctuating demand for Company C’s rental services and the rising costs faced by Company B emphasize the practical difficulties of sustaining CE-driven business models. As noted by Hina et al. (2022), such challenges highlight the need for incremental innovation, digital tools, and supportive regulatory environments to enable BMI.

Conclusion

This study explores how CE strategies can drive BMI by analyzing three distinct companies across different industries. The findings highlight the transformative potential of CE strategies, such as redesign, reuse, refurbish, and repurpose, in enhancing value propositions, optimizing resource flows, and fostering new revenue streams. The case analyses reveal that while each company successfully adopts R-strategies aligned with its operational and market context, significant challenges remain, emphasizing the need for tailored approaches to CE adoption.

The research makes several contributions to the academic discourse on CE and BMI. First, it extends the applicability of the 14R framework by demonstrating its versatility across industries with varying degrees of circular maturity. Second, this study stresses the importance of relationships (R7) in operationalizing CE practices, with all three companies leveraging collaborations to drive resource efficiency and innovation. This finding aligns with prior research emphasizing the critical role of stakeholder partnerships in advancing CE initiatives (Salvador et al., 2021). Additionally, the results indicate that BMI can act as a bridge between CE theory and practice, supporting companies to transform core business model elements through the implementation of circular strategies.

The study’s findings also suggest some practical applications that companies and policymakers can leverage to facilitate the transition toward CE-driven BMI. Companies can leverage the insights from this study to align their CE strategies with organizational capabilities, industry-specific demands, and different stakeholder needs. They could select the R-strategies that

best suit their industry context and business model. For instance, manufacturing companies might benefit from recycling (R13) and repurpose (R12) strategies to increase resource efficiency, while retailers could focus on reuse (R8) and refurbishment (R10) to extend the life of their products. Policymakers could use these findings to develop supportive frameworks that address infrastructure issues, encourage collaboration, and incentivize CE adoption.

The importance of relationships (R7) in transitioning towards a CE stresses the role of supplier collaboration, customer engagement, and different stakeholder partnerships in accelerating circular BMI. Consequently, companies should actively seek partnerships with relevant suppliers, technology providers, and industry organizations to improve circular innovations and address challenges like logistical difficulties, the high costs of circular processes, or lack of expertise. Companies planning to capture value from implementing CE strategies could also accelerate their BMI innovation process by introducing feasible, service-oriented models, such as rental, resale, and product-as-a-service. From a policy perspective, these insights offer a foundation to develop supportive frameworks that address infrastructure issues, encourage collaboration, and incentivize CE adoption.

Even though our study was carefully designed, it has certain limitations, particularly regarding external validity. Given that we relied on a purposive sampling approach (Tsang, 2014), we acknowledge that the extent to which the study's findings can be generalized beyond the specific cases examined is limited. As the selected cases are context-dependent, replication becomes difficult and limits the transferability of insights to different settings (Köhler, 2024). The small sample size and its geographical location also limit the generalizability of the research findings. Furthermore, the chosen qualitative methodology may be prone to researcher bias. However, we aimed to mitigate this through measures like researcher triangulation (Flick, 2004).

However, future research could build on our study and analyze a larger and more diverse set of companies across different industries and geographic regions to enhance the generalizability of findings and test the applicability of the 14R framework in various contexts. Researchers could also use longitudinal case studies to investigate how companies implement and refine circular R-strategies to drive BMI which could reveal deeper insights into long-term challenges, and the evolution of R-strategies. Further studies could explore how emerging digital technologies like AI or blockchain could enhance the implementation of CE strategies and drive BMI, particularly in overcoming challenges related to resource tracking, process optimization, and scalability (Sjödin et al., 2023). Finally, given the importance of relationships (R7) highlighted in this study, future research could explore multi-stakeholder collaborations in CE-driven BMI, analyzing best practices and barriers to systemic change, and expanding the practical and theoretical understanding of BMI.

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