DOCTORAL THESIS

Navigating Complexity: Exploring the Dynamics of SMEs' Transition towards Circular Economy

Tarlan Ahmadov

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Hereby I declare that this doctoral thesis, my original investigation and achievement, submitted for the doctoral degree at Tallinn University of Technology has not been submitted for doctoral or equivalent academic degree.

Tarlan Ahmadov

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Author's Contribution to the Publications

I Solo author, problem identification, literature review, data collection and analysis, discussion, and full paper writing.

II Lead author, problem identification, data collection and analysis, discussion, and paper writing.

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Introduction

The global economy faces severe challenges from escalating environmental degradation, resource scarcity, and economic instability (Nguyen et al., 2023). Unsustainable consumption, wasteful production, and the impacts of climate change have led to pollution, biodiversity loss, and the depletion of natural resources, underscoring the urgent need for sustainable solutions (Arora & Mishra, 2023; Bocken & Short, 2021). The traditional linear economic model, with its "take-make-dispose" approach (Kirchherr et al., 2023), has proven unsustainable, driving calls for a transformative shift toward a Circular Economy (CE) (Geissdoerfer et al., 2017; Lüdeke-Freund et al., 2019). CE represents a regenerative economic framework that decouples growth from resource consumption and environmental harm, emphasizing the continuous use and renewal of materials within closed-loop systems (D'Angelo et al., 2023). This alternative approach directly counters the resource-intensive, waste-generating nature of the linear model, offering a path to long-term sustainability (Bocken et al., 2019; Korhonen, Nuur, et al., 2018).

CE addresses critical global challenges by enhancing resource efficiency, reducing waste, and extending product lifecycle (Korhonen, Honkasalo, et al., 2018; Rashid et al., 2025). Unlike linear systems that exacerbate pollution and disrupt ecosystems, CE fosters sustainable practices that conserve natural resources, mitigate biodiversity loss, and align with the Sustainable Development Goals (SDGs), particularly those promoting responsible consumption and climate action (Rodríguez-Espíndola et al., 2022). By adopting closed-loop systems, the CE not only conserves finite resources but also reduces ecological footprints, addressing environmental risks and supporting biodiversity preservation (Panchal et al., 2021). Economically, the CE offers substantial benefits by reducing costs, fostering innovation, and enhancing supply chain resilience (Bassi & Guidolin, 2021; Darmandieu et al., 2022). Practices like recycling, remanufacturing, and reuse lower dependency on raw materials, mitigating risks from resource volatility (Lieder & Rashid, 2016). With projected business advantages of 1.8 trillion Euros in Europe by 2030, the CE strengthens competitiveness and aligns corporate strategies with sustainability goals (Ahmed et al., 2022; Sohal et al., 2022). Environmentally, CE significantly reduces greenhouse gas emissions, combats pollution, and supports climate change mitigation. By conserving resources and reducing waste, it directly addresses the environmental damage caused by linear systems, paving the way for a low-carbon, sustainable future (Lehmann et al., 2022; Wiedenhofer et al., 2021). Socially, the CE fosters inclusive growth by creating green jobs and ensuring equitable access to resources. It strengthens economic resilience while promoting societal well-being, making it a holistic and sustainable development model (Triguero et al., 2022). By encouraging collaboration and innovation, the CE balances economic, environmental, and social priorities effectively.

The transition to CE requires systemic transformations across industries and organizational contexts (Chirumalla et al., 2024; Leder et al., 2023), with small and medium-sized enterprises (SMEs) playing a pivotal role in this process (Gennari, 2023). SMEs account for 99% of firms in the European Union and 95% of businesses in OECD countries, contributing significantly to employment, gross domestic product (GDP), and economic stability globally (Cheffi et al., 2023; Rocca et al., 2023). Their prominence in both developed and emerging economies underscores their potential to drive sustainable development through CE adoption. However, their environmental impact is substantial, with SMEs in Europe alone responsible for approximately 64% of industrial

emissions and a significant share of industrial waste, particularly in resource-intensive sectors like manufacturing and construction (Gajanayake et al., 2024; Piispanen et al., 2022). Manufacturing, for example, accounts for 50–60% of global industrial emissions and 64% of air pollution in Europe, making the adoption of circular practices in SMEs critical for mitigating environmental degradation (Dainelli et al., 2024; Subramanian & Suresh, 2022).

Implementing CE measures such as resource efficiency, waste reduction, and energy optimization allow SMEs to reduce their environmental footprint significantly. Closed-loop systems and recycling decrease raw material dependency, enhance resource efficiency, and contribute to SDGs related to responsible consumption and climate action (Gao et al., 2024; Kara et al., 2022; Knable et al., 2022). In the manufacturing sector, these practices result in cost savings, improved supply chain sustainability, and enhanced competitiveness, while reducing reliance on imported materials (Baldassarre, 2025; Kumar et al., 2023; Sakao et al., 2024).

These characteristics enable SMEs to address local environmental needs efficiently, leveraging digital technologies like automation, Internet of Things (IoT), and data analytics to optimize operations and advance CE goals (Moktadir et al., 2018; Schöggl et al., 2023). As pivotal players in supply chains, SMEs significantly influence sustainability by adopting and promoting circular practices, which often cascade across industries (Lüdeke-Freund et al., 2019; Primadasa et al., 2024). Through collaborative partnerships with larger corporations, SMEs benefit from technology transfer and shared learning, enhancing their capabilities and accelerating the wider adoption of CE principles (Mishra et al., 2019). Integrating CE practices also supports social inclusion and economic equity, positioning SMEs as critical actors in advancing the SDGs. Their unique ability to balance innovation, community engagement, and sustainability underscores their essential role in the transition toward a more resilient and circular economic model.

SMEs demonstrate both strengths and limitations in their transition towards CE, having a complex dynamic that shapes their transition. SMEs possess distinct advantages that position them favourably for CE adoption. Their operational agility and flexibility enable them to respond quickly to market changes and implement innovative practices (Arsawan et al., 2022; Chan et al., 2019). Their close ties to local communities and markets allow them to better understand and respond to customer needs, while their smaller size facilitates faster decision-making and implementation of new practices (Christodoulou et al., 2024). The capacity for innovation stands as a key strength of SMEs in CE transition. Their ability to experiment with and adopt innovative business models faces less bureaucratic resistance compared to larger corporations (Faiz et al., 2024). This adaptability enables them to pioneer various circular approaches (Howard et al., 2022).

Despite the advantages of CE adoption, SMEs face unique barriers stemming from their limited resources, operational scale, and structural constraints, creating a complex web of challenges that impede successful implementation (Takacs et al., 2022). These barriers manifest across various dimensions, from organizational to systemic levels, highlighting the multifaceted nature of the transition to CE for smaller enterprises.

SMEs grapple with significant financial constraints, which severely limit their capacity to invest in CE initiatives. The high upfront costs associated with circular products and processes, combined with restricted access to capital, create substantial constrains (Heras-Saizarbitoria et al., 2023; Rizos et al., 2016). Unlike larger corporations, SMEs typically operate with tighter budgets, forcing them to prioritize immediate operational needs over long-term sustainability investments (Bakos et al., 2020). The situation is

further exacerbated by limited access to external funding, often due to restrictive eligibility criteria and complex application processes for grants or loans (Harrison et al., 2022).

Technical and knowledge deficiencies compound these financial challenges. SMEs frequently lack the necessary expertise to effectively implement CE practices, a stark contrast to large corporations with substantial research and development (R&D) budgets (Moktadir et al., 2018). This knowledge gap extends beyond mere technical skills to a comprehensive understanding of CE principles and their practical application. Rodríguez-Espíndola et al. (2022) argue that insufficient awareness of the long-term economic and environmental benefits of CE can lead to a perception of sustainability practices as costly and complex, further deterring commitment to the transition. The interplay between financial constraints and knowledge gaps creates a self-reinforcing cycle that significantly impedes CE adoption in SMEs.

Cultural and operational barriers add another layer of complexity to the CE transition. Organizational resistance to change, risk-averse management mindsets, and limited willingness to collaborate across value networks significantly hinder CE adoption (Cantú et al., 2021). In sectors with deeply entrenched linear practices, such as manufacturing and construction, these cultural barriers are particularly pronounced.

Operationally, SMEs often lack the organizational capacity to restructure supply chains or implement circular strategies across multiple stages of production and distribution. The fragmentation of supply chains further complicates matters, as SMEs typically have limited influence over upstream and downstream partners (Primadasa et al., 2024). This lack of control over the broader supply network can render even well-intentioned CE initiatives ineffective, highlighting the need for collaborative approaches that span entire value chains.

Regulatory and policy frameworks, while intended to promote CE, often present additional challenges for SMEs. Lüdeke-Freund et al. (2019) critique the inconsistent enforcement and complex compliance requirements that disproportionately affect smaller enterprises. The lack of tailored support frameworks further hinders SMEs' ability to align with regulatory standards. In emerging economies, these challenges are compounded by systemic issues such as inadequate infrastructure and weak institutional support (Rizos et al., 2016).

These barriers do not operate in isolation but form an interconnected system where one challenge often amplifies others. Although SMEs are increasingly recognized as pivotal actors in the transition to a CE, current research often falls short in adopting an integrative approach (Dzhengiz et al., 2023; Sinha, 2022). Existing studies tend to focus on isolated aspects of CE adoption, such as technological innovation or policy influence (e.g., Khan et al., 2022; Suchek et al., 2021), but fail to adequately address the complex interplay between different actors and mechanism that is essential for a successful transition (Gennari, 2023; Ghisellini et al., 2024; Kaewunruen et al., 2024; Mazur-Wierzbicka, 2021). While studies recognize that the transition of SMEs to CE involves multifaceted challenges and requires a holistic approach (Dzhengiz et al., 2023; Malik et al., 2022; Rosa & Paula, 2023; Trevisan et al., 2023), there is a lack of comprehensive understanding that capture the complex interdependencies between internal organizational factors, external stakeholder dynamics, and systemic influences across micro, meso, and macro levels.

This narrow focus limits researchers', policymakers', and practitioners' ability to comprehensively understand and address the systemic challenges and opportunities faced by firms in their transition to CE. SMEs operate within complex stakeholder

networks and face varying degrees of external pressures and internal constraints, necessitating a more holistic approach to analysis and support (Dzhengiz et al., 2023; Malik et al., 2022; Rosa & Paula, 2023; Trevisan et al., 2023).

Against the above-mentioned research background, this doctoral thesis ***aims to advance the understanding of the multi-faceted transition process of SMEs to CE***, focusing on the interplay of co-dependent factors across micro, meso, and macro levels. Addressing the shortcomings of the current body of knowledge is important for several reasons.

Firstly, understanding the complex interplay between various actors and levels in the CE transition process is essential for developing effective strategies that support SMEs in overcoming barriers to adoption (Ghisellini et al., 2024). By considering the systemic nature of CE, researchers can identify leverage points and opportunities for intervention, facilitating the development of more coordinated and holistic approaches to CE adoption in SMEs (Dzhengiz et al., 2023).

Secondly, exploring the intricate web of stakeholder relationships and complex systems that SMEs navigate provide valuable insights into the role of collaboration and partnerships in achieving sustainable outcomes (Harrison et al., 2023). SMEs operate within intricate networks of stakeholders, including suppliers, customers, regulators, and financiers, and their ability to engage and collaborate with these actors is critical for successful CE implementation (Adomako & Tran, 2022; Ayaz & Tatoglu, 2024; Palombi et al., 2024). Examining the dynamics of these relationships reveals strategies for fostering collaboration and co-creation of value, thereby enhancing SMEs' capacity to adopt CE practices (Trevisan et al., 2023).

Thirdly, the proposed framework and the newly created knowledge that comes with it can also inform policy interventions and support mechanisms that facilitate SMEs' transition to CE. Policymakers play a crucial role in shaping the regulatory and institutional environment that influences SMEs' decision-making processes (Alcalde-Calonge et al., 2024). By understanding the systemic challenges and opportunities SMEs face, policymakers can design targeted interventions that address specific barriers, such as financial constraints, lack of technical expertise, and limited access to markets (Dzhengiz et al., 2023).

Moreover, the outcomes of this thesis are considered essential for contributing to environmental and societal goals. The transition to CE is both a business imperative and a societal necessity, as it contributes to climate change mitigation, resource conservation, and sustainable development (Dantas et al., 2021). Supporting SMEs in their CE transition can foster a more sustainable and resilient economic system that aligns with global sustainability goals, such as the United Nations' SDGs (Trevisan et al., 2023).

To systematically address the above-mentioned aim, the research is structured around a central research question that examines ***how SMEs manage the transition process, considering organizational changes, external pressures, and stakeholder relationships.*** This central question is supported by three sub-questions that align with specific research objectives (Figure 1):

- Research question 1: What are the key factors, actors and mechanism influencing the transition of SMEs to a CE at the micro, meso, and macro levels?
- Research question 2: How do organizational dynamics and stakeholder interactions shape the pathways for CE adoption in SMEs?
- Research question 3: What critical elements are necessary to implement and sustain CE practices in SMEs for long-term success?

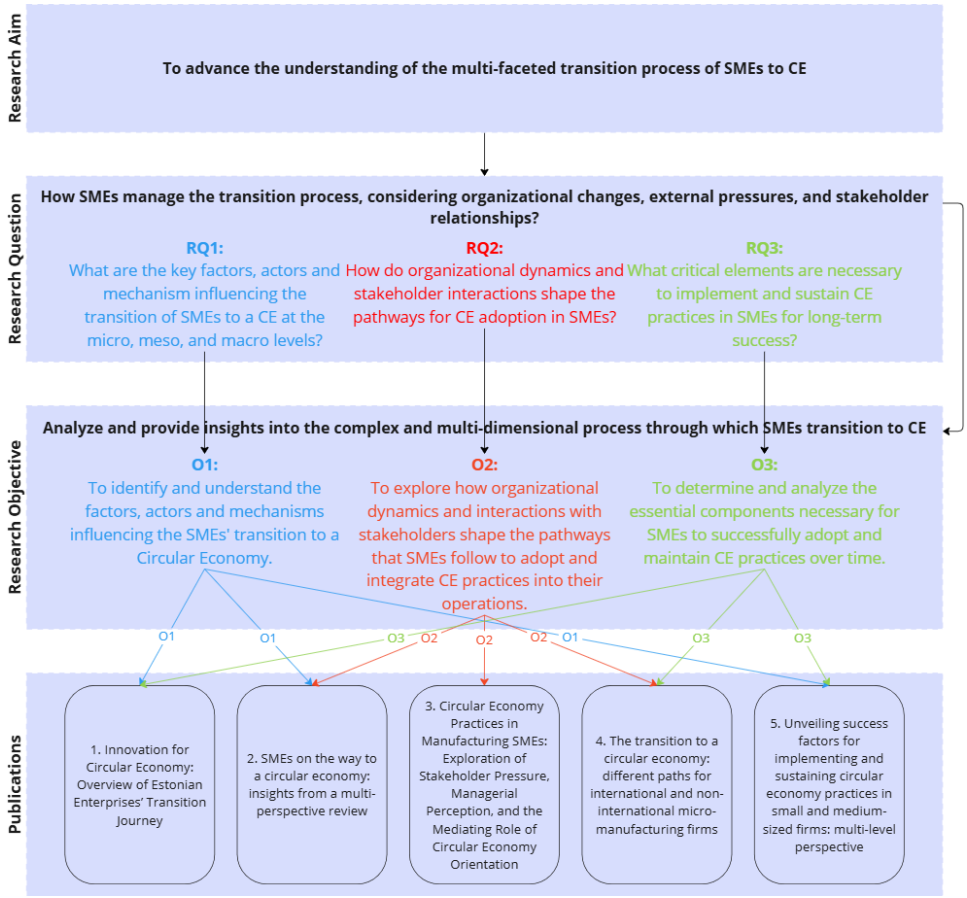

Figure 1. Alignment of Overall Research Aim, Questions and Objectives for Understanding SMEs' Transition to a CE.
Source: Composed by the author.
Note: RQ=Research Question; O=Objective.

The ***primary objective of this thesis is to analyse and provide insights into the complex and multi-dimensional process through which SMEs transition to a CE***. To achieve this, the study focuses on three specific objectives (Figure 1):

Objective 1: identify and understand the key factors, actors, and mechanisms influencing the transition of SMEs to a CE across micro (organizational), meso (industry), and macro (policy and market) levels. By examining the factors, actors, and mechanisms that are interconnected, the research seeks to uncover how they collectively shape the adoption of CE practices. This objective is primarily addressed through Articles 1, 2, and 5 of the published papers. Article 1 highlights micro-level barriers such as resource constraints and technical challenges, while emphasizing macro-level government-led incentives. Article 2 employs the Multi-Level Perspective (MLP) framework by Geels (2002) to systematically map out influences at all three levels. Article 5 proposes a holistic framework integrating success factors across these levels, enabling a nuanced analysis of the enabling and constraining forces shaping CE transitions.

Objective 2: explores how organizational dynamics and stakeholder interactions influence the pathways SMEs follow to adopt and integrate CE principles into their operations. This involves understanding the interplay between internal capabilities and external pressures, as well as the collaborative networks that facilitate or hinder the transition. Articles 2, 3, and 4 primarily address this objective. Article 2 uses the MLP framework to demonstrate how firms navigate stakeholder relationships within their socio-technical environments. Article 3 explores the mediating role of Circular Economy Orientation (CEO), a concept proposed and defined by this thesis, in enabling SMEs to respond to stakeholder pressures. Article 4 reveals how context-specific factors, such as exposure to international regulations and external knowledge networks, create varied stakeholder interaction patterns influencing CE adoption strategies in international and non-international micro-firms.

Objective 3: determine and analyse the essential components necessary for SMEs to successfully implement and sustain CE practices over time. This includes identifying critical enablers, overcoming barriers, and establishing strategies for long-term sustainability. Articles 1, 4, and 5 address this objective. Article 1 identifies foundational enablers such as financial incentives, access to technical expertise, and managerial commitment. Article 4 introduces environmental awareness and stakeholder alignment as essential for creating resilient CE pathways, particularly in micro-firms. Article 5 proposes a framework integrating success factors across the MLP's micro, meso, and macro levels, emphasizing that long-term sustainability requires synergistic alignment between internal capabilities, industry collaboration, and supportive policy environments.

The figure 1 illustrates how the research objectives align with the published articles, showcasing the specific contributions of each paper in addressing key aspects of SMEs' transition to a CE, including multi-level factors, stakeholder dynamics, and critical success elements for sustainable CE practices.

To achieve the objectives, several theoretical lenses were employed to address the systemic, relational, and adaptive nature of SMEs transition. In this thesis, Multi-Level Perspective (MLP), stakeholder theory, and complexity theory were integrated to reach thesis aims/objectives. The combination of these different perspectives or theoretical lenses makes possible a nuanced and holistic understanding of the multi-faceted challenges and dynamics inherent in the CE transition process.

The MLP is particularly suited to this study's main objective because it provides a structured framework for examining the socio-technical transitions required for CE adoption. It analyses interactions across across micro (organizational practices), meso (industry structures), and macro (policy and societal trends) levels, making it ideal for understanding the interdependencies shaping SMEs' CE transitions (El Bilali, 2019; Geels, 2002). The MLP addresses a research gap by connecting stakeholder-level dynamics with larger socio-technical shifts, crucial for understanding how SMEs navigate their CE transition (Ghadimi et al., 2021; Hazen et al., 2020). Stakeholder theory complements this analysis by focusing on relational dynamics between SMEs and their stakeholders. It emphasizes collaboration and co-creation in driving organizational change, particularly important for resource-constrained SMEs (Freeman, 1984; Clarkson, 1995). Integrating stakeholder theory with MLP can help identify key stakeholders at different levels of the MLP, analyse their roles in transition processes, and explore how their interests and actions shape transition pathways (Geels, 2019; Levidow & Upham, 2017). Complexity theory enriches the study by addressing adaptive and non-linear processes in CE transitions (Urry, 2005; Walrave et al., 2018). It provides insights into how SMEs balance

uncertainties, adapt to changing conditions, and build resilience (Burnes, 2005; Natoli et al., 2024). This theory highlights the importance of flexibility and collaboration, especially for SMEs reliant on external networks and support systems (Fernández-Olmos & Ramírez-Alesón, 2017). Together, these theoretical perspectives offer a comprehensive lens to analyse the systemic, relational, and adaptive dimensions of SMEs' transition to CE, addressing critical gaps in existing literature.

The research methodology employs an explanatory sequential design that was selected based on the insights gained during the initial exploration phase, which revealed the need for both broad quantitative analysis and in-depth qualitative investigation to fully understand CE transition in SMEs (Creswell & Clark, 2017). Figure 2 illustrates a comprehensive four-phase research approach investigating CE adoption in SMEs.

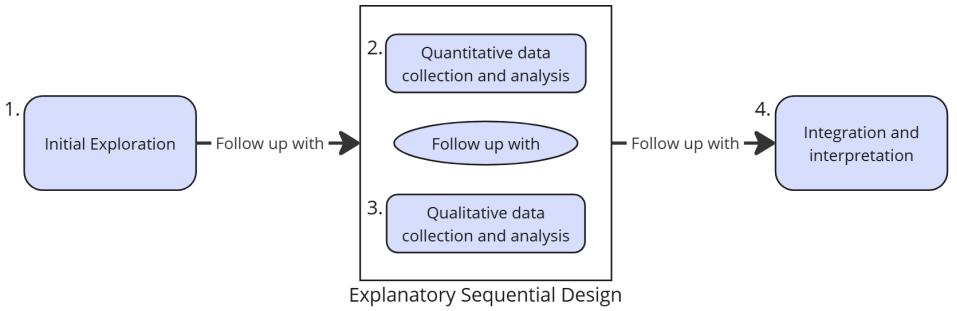

Figure 2. Research Design: A Four-Phase Process for Data Collection, Analysis, and Integration. Source: Composed by the author.

The Initial Exploration phase establishes the research foundation through Article 1, which provides empirical evidence from Estonian SMEs, revealing sector-specific barriers including knowledge gaps and financial constraints. Article 2 contributes theoretical depth by employing the Multi-Level Perspective framework to analyse transitions across organizational, industry, and policy levels, establishing crucial interconnections between micro-level practices and broader systemic influences.

The Quantitative Data Collection and Analysis phase builds upon these insights through Articles 3 and 4. Article 3 examines stakeholder dynamics, demonstrating that internal stakeholders exert stronger direct influence on CE adoption compared to external pressures, with CEO serving as a critical mediating factor. Article 4 employs fuzzy-set Qualitative Comparative Analysis (fsQCA) (Rihoux & Ragin, 2008) to identify five distinct adoption pathways, revealing how international firms leverage stakeholder engagement and regulatory frameworks, while non-international firms prioritize internal sustainability practices.

The Qualitative Data Collection and Analysis phase, anchored by Article 5, deepens understanding through semi-structured interviews and synthesizes previous findings into a holistic framework. This article integrates MLP and complexity theory to examine success factors across multiple levels: organizational culture and leadership commitment at the micro-level, stakeholder collaboration and industry partnerships at the meso-level, and supportive regulatory environments and financial incentives at the macro-level. This comprehensive framework provides practical strategies for SMEs navigating CE transitions.

The Integration and Interpretation phase synthesizes insights from all articles, combining quantitative evidence of stakeholder influences and adoption pathways with qualitative insights into organizational dynamics and systemic conditions. This final phase creates a cohesive narrative that addresses the research objectives comprehensively, demonstrating how SMEs can effectively navigate CE transitions through the interplay of internal capabilities, stakeholder relationships, and enabling systemic conditions. The sequential nature of this design ensures that each phase builds upon and validates previous findings, creating a robust and thorough investigation of CE adoption processes.

The findings of this research provide contributions to both theoretical advancements and practical applications, addressing critical gaps in the understanding and implementation of SMEs' transition to a CE. This research advances the theoretical discourse on sustainability transitions by integrating MLP, stakeholder theory, and complexity theory within the context of SMEs' transition to a CE. By applying MLP, the research bridges the gaps between micro (organizational practices), meso (industry networks), and macro (policy and systemic structures) levels, providing a comprehensive, multi-level understanding of CE adoption. Stakeholder theory is enriched by the study's nuanced exploration of how internal and external pressures influence organizational behaviour, particularly through the mediating role of CEO. Furthermore, the use of fsQCA enhances theoretical rigor, offering novel insights into the heterogeneity of CE adoption pathways. The resulting holistic framework connects multi-level perspectives with organizational and relational dynamics, addressing gaps in single-level analyses and providing a structured approach to understanding sustainability transitions.

The research delivers actionable insights that address the unique challenges SMEs face in adopting and sustaining CE practices. For SMEs, it offers a clear roadmap that emphasizes investing in organizational education and employee training, leveraging digital technologies and CEO, and building collaborative networks to overcome internal and external barriers. For policymakers, the findings provide evidence-based recommendations for designing targeted incentives, such as financial subsidies and tax benefits, and for creating supportive regulatory frameworks that encourage CE transitions. Additionally, the research underscores the importance of advocacy initiatives and capacity-building programs to raise awareness and build technical expertise among SMEs. Industry associations are positioned as pivotal facilitators, encouraged to act as knowledge hubs that disseminate best practices, foster collaboration among stakeholders, and pool resources to accelerate CE adoption. Together, these contributions ensure that the findings not only advance theoretical understanding but also provide practical tools and strategies to support SMEs, policymakers, and industry actors in driving sustainability transitions.

The scope of this research is framed within the context of the Baltic Sea Region, with a specific focus on Estonia and Sweden. These countries offer contrasting yet complementary settings for comparative analysis of sustainability transitions in emerging and advanced economies. Estonia, an Eastern European catch-up economy, exemplifies slower CE adoption due to limited awareness, knowledge gaps, and resource constraints among SMEs (Mazur-Wierzbicka, 2021). This context provides insights into challenges faced by businesses in emerging economies, including cultural norms, resource scarcity, and nascent regulatory environments. Sweden, a global sustainability leader, presents a mature CE ecosystem with strong governmental support, comprehensive regulations, and a well-developed market for sustainable products (Brydges, 2021). Swedish SMEs benefit from advanced technologies, collaborative networks, and institutional support,

offering valuable lessons in best practices for CE adoption. This comparative approach enables a nuanced understanding of how local contexts shape CE implementation, highlighting strategies for overcoming barriers in transitioning economies and applying advanced practices globally.

The research was conducted over a span of four years, from February 2021 to January 2025, allowing for an in-depth investigation of the dynamic and evolving nature of CE adoption. This extended timeframe facilitated the use of a mixed-methods approach across exploratory, quantitative, and qualitative phases, enabling the study to capture both static and dynamic elements of CE transitions. The longitudinal nature of the study also allowed for an examination of the impacts of evolving policies, market trends, and technological advancements on SMEs' sustainability practices. However, given the rapid pace of global developments in CE policies and practices, findings may not fully capture post-2025 shifts or future trajectories in the sustainability landscape. While this thesis makes significant contributions, it has limitations. A detailed discussion of these constraints and their implications for future research is presented in the conclusion section.

The structure of this cover paper is organized into six key chapters. It starts with the introduction section, which outlined the research problem, objectives, and significance of the study. This is followed by the Theoretical Background, where relevant literature and theories are reviewed to provide context. The Methodology section details the research design, including the mixed-methods approach, data collection, and analysis techniques. The Results chapter presents the key findings from both the quantitative and qualitative phases of the study. This is followed by the Discussion, which elaborates on the contributions of the research, addressing empirical, theoretical, and practical implications. Finally, the Conclusion highlights the limitations of the study and offers suggestions for future research directions, providing a comprehensive reflection on the study's overall impact.

Abbreviations

CBMs	Circular Business Models
CE	Circular Economy
CEO	Circular Economy Orientation
fsQCA	Fuzzy-Set Qualitative Comparative Analysis
GDP	Gross Domestic Product
IoT	Internet of Things
MLP	Multi-Level Perspective
R&D	Research and Development
SDGs	Sustainable Development Goals
SMEs	Small and Medium-Sized Enterprises
STS	Socio-Technical Systems

1 Literature Background and Theoretical Framework

1.1 Circular Economy: Concept and Principles

CE has emerged as a promising alternative to the traditional linear economic model, attracting considerable interest for its potential to address economic, environmental, and social challenges (Cagno et al., 2023; Knable et al., 2022). At its core, CE is an economic model that aims to decouple economic growth from resource consumption and environmental degradation by promoting the continuous flow and regeneration of materials and resources within the system (Bowen et al., 2023; D'Angelo et al., 2023).

The concept of CE is built on several key principles. First, it seeks to design out waste and pollution from the outset by rethinking product design and manufacturing processes. Second, it emphasizes keeping products and materials in use through reuse, repair, remanufacturing, and recycling. Third, CE aims to regenerate natural systems, not only minimizing negative impacts but also actively contributing to the restoration of ecosystems (Droege et al., 2023; Neri et al., 2023).

The European Parliament Research Service[1] illustrates this concept through a comprehensive circular economy model (Figure 3), which demonstrates the interconnected stages of a circular economy system. The model encompasses seven key components: raw materials, sustainable design, production, distribution, consumption (including reuse and repair), collection, and waste management (including residual waste).

Figure 3. The Circular Economy Model: Less Raw Material, Less Waste, Fewer Emissions. Source: European Parliament Research Service, 2023

[1] Circular economy: definition, importance and benefits by European Parliament, available at: https://www.europarl.europa.eu/topics/en/article/20151201STO05603/circular-economy-definition-importance-and-benefits

This visual representation emphasizes how the circular economy moves away from the traditional linear model by creating closed loops where resources are maintained within the economic system for as long as possible. The model demonstrates how each stage is connected, from the initial use of raw materials through sustainable design and production, to consumption and ultimately waste management, with an emphasis on minimizing residual waste through effective collection and recycling processes. This framework aligns with the core principles of sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products to extend their lifecycle and reduce environmental impact.

CE practices in businesses typically involve sustainable production strategies aimed at waste reduction, resource optimization, and prolonging product and material lifecycles. This includes transitioning from the linear "take-make-dispose" model to a more regenerative approach that emphasizes resource reuse within closed loops (Arsawan et al., 2024). The adoption of CE principles offers multiple benefits, including minimizing waste, encouraging sustainable development, and enhancing resource efficiency (Bowen et al., 2023; D'Angelo et al., 2023).

As the concept continues to gain traction, governments, industries, and societies worldwide are actively promoting CE to tackle resource scarcity and environmental concerns (Sohal & De Vass, 2022). The transition to a CE is expected to lead to a low-carbon economy, reduced greenhouse gas emissions, and increased workforce opportunities (Findik et al., 2023). The implementation of CE practices is viewed as a pathway to redesigning products and processes, paving the way for more sustainable business practices that balance social, economic, and environmental considerations. This recognition has led to the development of circular business models (CBMs) that focus on creating value by utilizing economic value present in items after their initial use to manufacture new offerings (Frishammar & Parida, 2019; Linder & Williander, 2017).

1.2 The Significance of SMEs in Economic Systems

SMEs play a crucial role in economic systems worldwide, serving as key drivers of innovation, employment, and economic growth. Their significance is underscored by their sheer numbers and economic impact. In the European Union, for instance, SMEs account for 99% of all businesses and provide two-thirds of total employment (European Commission, 2018). This prevalence is not unique to Europe; SMEs form the backbone of many economies globally, contributing substantially to GDP and job creation.

One of the primary contributions of SMEs to economic systems is their role in fostering innovation. Due to their size and flexibility, SMEs are often more agile and adaptable than larger corporations, allowing them to respond quickly to market changes and emerging opportunities. This agility makes them ideal incubators for new ideas and technologies. SMEs are disproportionately responsible for breakthrough innovations, particularly in emerging fields and niche markets where larger firms may be hesitant to invest (Bouncken et al., 2015; Del Giudice et al., 2019)

Furthermore, SMEs are crucial for employment generation and poverty alleviation. They tend to be more labour-intensive than larger firms, creating jobs across various skill levels and geographic areas. This characteristic is particularly important in developing economies and rural regions where job opportunities may be scarce. According to the World Bank (2020), formal SMEs contribute up to 40% of national income GDP in emerging economies and create 7 out of 10 jobs.

SMEs also play a vital role in supply chains and industrial ecosystems. They often serve as suppliers, subcontractors, or service providers to larger corporations, fostering industrial linkages and knowledge spillovers. This interconnectedness enhances overall economic productivity and competitiveness. As highlighted by Gereffi and Lee (2012) the integration of SMEs into global value chains can lead to significant economic upgrading and technological learning (Epede & Wang, 2022).

In the context of sustainable development and circular economy transitions, SMEs are increasingly recognized as key players. Their collective environmental impact is substantial, and their transition to more sustainable practices can significantly contribute to achieving sustainability goals. Massari and Giannoccaro (2023) argue that implementing circular economy practices at the SME level can be a faster route to reaching sustainable development targets, underscoring the potential environmental and economic advantages.

The COVID-19 pandemic has further highlighted both the vulnerability and resilience of SMEs. While many SMEs were severely impacted by lockdowns and economic disruptions, others demonstrated remarkable adaptability, pivoting their business models and embracing digital technologies to survive and even thrive in challenging conditions (OECD, 2021). Recognizing the significance of SMEs, many governments and international organizations have implemented policies and programs to support their development. These include measures to improve access to finance, enhance skills and technology adoption, and reduce regulatory burdens. For instance, the European Union's SME Strategy for a sustainable and digital Europe aims to support SMEs in their transition to more sustainable and digitalized business models (European Commission, 2020).

1.3 SMEs' Transition to Circular Economy

The implementation of CE in SMEs is seen as a faster route to achieving sustainable development targets, offering potential environmental and economic advantages (Massari and Giannoccaro, 2023). By embracing circular practices, SMEs can enhance their brand reputation, reduce operating costs, stimulate business growth, and contribute to environmental recovery and sustainability while reaping economic benefits from resource reuse and waste minimization (Lahti et al., 2018; Lüdeke-Freund et al., 2019; Riesener et al., 2019). However, the transition from linear to circular operations requires a comprehensive restructuring of industries in terms of development, management, operations, supply chain, business strategy, and customer relationships (Frishammar and Parida, 2019). This shift presents unique challenges for SMEs due to their limited resources and expertise (Dey et al., 2019; Mura et al., 2020). To overcome these challenges, regulatory frameworks, public sector involvement, financial support, ecosystem innovation, and technological infrastructure provided by the state play crucial roles in driving SMEs towards CE (Kirchherr et al., 2018; Koc et al., 2023; Konietzko et al., 2020).

The transition to CE can occur through two main approaches: top-down, driven by societal legislation and regulations, or bottom-up, initiated by industries seeking competitive advantages and improved profitability (Lieder and Rashid, 2016). Both approaches challenge the traditional linear model of growth and resource optimization, emphasizing the reduction of raw material consumption and the recovery of waste through recycling or repurposing (Kirchherr et al., 2017; Korhonen et al., 2018). To facilitate SMEs' transition to CE, researchers have proposed several frameworks, including the Multi-Level Perspective (MLP). The MLP framework, which conceptualizes transition processes as the result of interplay between developments at three analytical

levels (micro, meso, and macro), has been applied to understand the factors influencing the adoption of CE practices in SMEs (Malik et al., 2022; Zhu et al., 2022). This approach offers a comprehensive view of the complex relationships and interactions that shape SMEs' transition to CE (Trevisan et al., 2023). As SMEs navigate their transition to CE, they must address diverse stakeholder interpretations of the CE concept, which have led to ambiguous strategies for implementation and operationalization (Ho et al., 2023). Developing well-conceived plans becomes vital to effectively address the complexity of this transformation. By adopting comprehensive, industry-specific strategies and fostering collaborative efforts between governments, enterprises, and consumers, SMEs can successfully navigate this paradigm shift towards a circular and sustainable future, unlocking opportunities for innovation, competitiveness, and long-term growth while minimizing environmental impact (Assmann et al., 2023; Mauss et al., 2022; Piispanen et al., 2022).

1.3.1 Factors Impacting SMEs Transition to CE at the Individual Enterprise Level

The transition of SMEs towards CE practices is deeply influenced by internal business practices such as strategic decision-making and operational processes. Gallardo-Vázquez et al. (2024) assert that adopting a CEO is crucial, as it represents a comprehensive strategic mindset that encompasses resource use, product design, and business model transformation beyond waste minimization. Leadership is another cornerstone, with Chen et al. (2022) emphasizing that management's environmental awareness significantly impacts CE adoption. Leaders who prioritize sustainability allocate resources and cultivate a culture of environmental responsibility within their organizations. Moreover, Neri et al. (2023) highlight the importance of building technical expertise and fostering innovation, noting that SMEs with strong internal capabilities, particularly in eco-design and resource efficiency, are better positioned for CE success. Additionally, the ability to absorb external knowledge, as noted by Agyabeng-Mensah et al. (2022), is vital for effective CE implementation.

Innovation is central to the transition, requiring SMEs to integrate CE principles into R&D and product design. As Centobelli et al. (2021) suggest, circular innovation involves rethinking product design to enhance repairability, reusability, and recyclability, alongside developing new business models like product-service systems. Financial management is equally critical, as Austin and Rahman (2022) explain, with the transition to CE demanding significant investments in technology and training. SMEs must strategically manage resources and explore new revenue streams to overcome financial barriers. Operational practices, particularly in supply chain management, are pivotal, with Kayikci et al. (2022) highlighting the benefits of adopting circular supply chain practices, such as reverse logistics, to boost circular performance. Human resource management also plays a crucial role, with Omarova and Jo (2022) advocating for training programs that enhance employees' understanding of CE principles.

Moreover, effective internal communication is essential, as Kushwaha and Sharma (2016) suggest, for embedding CE principles throughout an organization and overcoming resistance to change. Performance measurement is becoming increasingly important, with Cagno et al. (2023) recommending the development of metrics to track circular performance. The integration of digital technologies, as Neri et al. (2023) note, is a critical enabler, with IoT, blockchain, and AI enhancing resource tracking and facilitating new business models. Organizational structures and decision-making processes also influence CE readiness, with Arranz et al. (2022) highlighting the advantage of flexible structures

that encourage cross-functional collaboration. Risk management, emphasized by Werning and Spinler (2020), involves assessing and mitigating risks tied to new technologies and market preferences. Finally, Lüdeke-Freund et al. (2019) stress that developing CBMs, such as product-as-a-service or resource recovery systems, is fundamental for a successful CE transition. Overall, a concerted effort across strategic orientation, leadership, innovation, financial management, and organizational structures is essential for SMEs to effectively transition to CE practices.

1.3.2 Industry Collaboration and Networks for SMEs' CE adoption

As SMEs navigate their transition to circular economy practices, their interactions within the broader industry ecosystem become increasingly important. Supply chain relationships are a key aspect of industry interactions that impact SMEs' transition to CE. The implementation of circular practices often requires changes throughout the supply chain, from sourcing raw materials to managing end-of-life products. SMEs that engage in environmental-oriented supply chain cooperation practices are better positioned to implement CE principles (Susanty et al., 2020). This cooperation can involve joint efforts to reduce waste, improve resource efficiency, and develop closed-loop systems. For instance, in the wooden furniture industry, cooperation between suppliers and manufacturers has been shown to facilitate the implementation of CE practices (Susanty et al., 2020).

The role of industry associations and networks is crucial in facilitating knowledge sharing and collective action towards CE. These organizations can serve as platforms for disseminating best practices, providing training and resources, and advocating for supportive policies. For example, in the textile and apparel sector, industry associations have played a significant role in promoting CE principles through stakeholder mapping, collaborative spaces, and awareness-raising initiatives (Staicu and Pop, 2018).

Collaboration with other firms, including competitors, can also drive CE adoption among SMEs. Collaborative networks can help SMEs overcome resource constraints and access complementary capabilities necessary for implementing circular practices. These networks can facilitate joint innovation efforts, shared infrastructure for recycling and remanufacturing, and the development of industry-wide standards for circular products and processes (Centobelli et al., 2021).

Cross-sector collaborations are increasingly recognized as important for advancing CE practices. SMEs can benefit from partnerships with organizations in different sectors, including academia, non-profit organizations, and government agencies. These collaborations can provide access to specialized knowledge, funding opportunities, and new markets for circular products and services (Holzer et al., 2021).

The development of local and regional circular ecosystems is an emerging trend that highlights the importance of geographical proximity in facilitating CE transitions. These ecosystems involve interconnected networks of firms, often centred around industrial symbiosis, where waste or by-products from one company become inputs for another. SMEs can benefit from participating in these ecosystems by accessing shared resources, knowledge, and infrastructure (Hull et al., 2021). Also, the role of intermediaries, such as consultants, technology providers, and research institutions, is crucial in supporting SMEs' transition to CE. These organizations can provide specialized expertise, facilitate knowledge transfer, and help SMEs navigate the complexities of CE implementation (Hull et al., 2021).

The role of consumers and market demand is another critical aspect of industry interactions that influence SMEs' transition to CE. Increasing consumer awareness and demand for sustainable products can create market pull for circular offerings. SMEs that are attuned to these market trends and can effectively communicate the value of their circular products or services are better positioned to succeed in their CE transition (Triguero et al., 2022).

Interactions with larger firms in the industry can also play a significant role in SMEs' CE transition. Large companies often have more resources to invest in CE initiatives and can exert pressure on their SME suppliers to adopt circular practices. This can create both challenges and opportunities for SMEs, potentially driving innovation but also requiring significant adaptation (Agyabeng-Mensah et al., 2022).

Digital platforms and technologies are transforming industry interactions and creating new opportunities for CE implementation. These platforms can facilitate the sharing of resources, connect waste generators with potential users, and enable new CBMs. SMEs that effectively leverage these digital ecosystems can enhance their ability to implement circular practices and access new markets (Neri et al., 2023).

The development of circular value chains is an important aspect of industry interactions that influences SMEs' CE transition. This involves rethinking entire value chains to minimize waste and maximize resource efficiency. SMEs that can position themselves effectively within these circular value chains, for example by specializing in refurbishment or recycling services, can find new opportunities for growth and innovation (Le et al., 2022).

1.3.3 Policy and Institutional Frameworks for CE adoption by SMEs

The broader policy and institutional landscape play a pivotal role in shaping the environment for CE adoption and implementation among SMEs. These frameworks, encompassing regulations, incentives, and support structures, play a crucial role in shaping the environment for CE adoption and implementation.

Regulatory policies are a key driver of CE adoption among SMEs. Governments at various levels can implement laws and regulations that mandate or encourage circular practices. For instance, extended producer responsibility regulations can incentivize SMEs to design products for easier recycling and take responsibility for end-of-life management (Ostermann et al., 2021). Similarly, waste management regulations can create opportunities for SMEs in recycling and resource recovery sectors. However, the effectiveness of these regulations depends on their design and enforcement. Overly complex or burdensome regulations can pose challenges for SMEs with limited resources to navigate compliance requirements (Kayikci et al., 2021).

The development of standardized approaches for CE disclosure and reporting is an emerging area of policy focus. Massari and Giannoccaro (2023) highlight the importance of such standardization in creating a level playing field and enabling SMEs to communicate their circular performance effectively. Clear and consistent reporting frameworks can help SMEs benchmark their progress and attract investment and customers interested in circular solutions. Also, the development of sector-specific CE roadmaps and action plans can provide a framework for coordinated action within industries. These initiatives, often led by industry associations or government bodies, can help align efforts across the sector and provide clear pathways for SMEs to transition towards CE practices (Droege et al., 2023).

Financial incentives and support mechanisms are critical components of policy frameworks that can facilitate SMEs' transition to CE. These can include tax incentives

for circular practices, grants for eco-innovation, and subsidies for implementing resource-efficient technologies. For example, Austin and Rahman (2022) highlight the importance of diverse finance sources, including crowdfunding and capital market funding, in helping SMEs acquire the necessary knowledge and resources to adopt CBMs. Government-backed loan guarantee schemes can also help SMEs overcome financial barriers to CE implementation.

Public procurement policies can serve as a powerful tool to drive CE adoption among SMEs. By incorporating CE criteria into public tenders, governments can create significant market demand for circular products and services. This can provide SMEs with the incentive and opportunity to develop and scale circular offerings (Rodriguez-Espindola et al., 2022).

Education and training policies play a crucial role in building the skills and knowledge necessary for CE implementation. Policies that support the integration of CE principles into educational curricula, vocational training programs, and professional development initiatives can help create a workforce equipped to drive CE transitions in SMEs (Maher et al., 2023).

Innovation policies and support for R&D are essential for fostering the technological advancements and business model innovations needed for CE. Policies that provide funding for CE-related R&D, support collaboration between SMEs and research institutions, and facilitate knowledge transfer can accelerate the development and adoption of circular solutions (Triguero et al., 2022).

Infrastructure development policies are crucial for creating the physical and digital systems necessary to support CE practices. This includes investments in recycling facilities, reverse logistics networks, and digital platforms for resource tracking and sharing. Policies that support the development of such infrastructure can create enabling conditions for SMEs to implement circular practices (Zhu et al., 2022).

The role of intermediary organizations, often supported by public policies, is important in facilitating SMEs' transition to CE. These can include business support agencies, technology transfer offices, and CE hubs that provide guidance, networking opportunities, and technical assistance to SMEs. Policies that support the establishment and operation of such intermediaries can help bridge the gap between SMEs and larger organizations, as well as between SMEs and policymakers.

Several studies highlight the significance of these intermediary organizations in the CE transition process. Hull et al. (2021) explore the development of circular economy incubators, emphasizing their role in supporting SMEs in developing and scaling CBMs. These incubators serve as platforms for knowledge exchange, networking, and access to resources, which are crucial for SMEs with limited internal capabilities.

Holzer et al. (2021) further emphasize the importance of intermediaries in addressing key areas such as resource efficiency, cooperation with stakeholders, and sustainability. Their research provides insights for policymakers and intermediaries on how to effectively target diverse SMEs with varying needs and capacities.

Moreover, Maher et al. (2023) stress the need for training and support programs to encourage and facilitate the uptake of CE practices among SMEs. These programs, often delivered through intermediary organizations, can help SMEs overcome knowledge gaps and build the necessary skills for implementing CBMs.

The below table summarizes the key factors influencing SMEs' transition to CE at three levels: individual enterprise, industry collaboration, and policy frameworks. These multi-level factors collectively shape the landscape for SMEs as they navigate the transition towards CE.

Table 1. Summary of Factors, Actors, and Mechanisms in SMEs' Transition CE.

Focus	*Key Topics*	*Description*	*References*
Enterprise-Level Dynamics (micro)	Strategic Management	Comprehensive approach to CE implementation, including leadership, innovation, and resource management	Gallardo-Vazquez et al. (2024); Chen et al. (2022); Neri et al. (2023); Centobelli et al. (2021); Austin and Rahman (2022); Agyabeng-Mensah et al. (2022)
	Operational Practices	Adoption of circular processes in supply chain, human resources, and performance measurement	Kayikci et al. (2022); Omarova and Jo (2022); Cagno et al. (2023)
	Technological Integration	Incorporation of digital technologies to enhance circular capabilities	Neri et al. (2023)
	Organizational Adaptation	Structural changes and risk management for CE transition	Arranz et al. (2022); Werning and Spinler (2020); Ludeke-Freund et al. (2019)
Industry Ecosystems (meso)	Supply Chain Relationships	Cooperation for improved resource efficiency and circular practices	Susanty et al. (2020); Agyabeng-Mensah et al. (2022)
	Collaborative Networks	Industry associations, cross-sector partnerships, and circular ecosystems	Staicu and Pop (2018); Centobelli et al. (2021); Hull et al. (2021); Holzer et al. (2021); Agyabeng-Mensah et al. (2022)
	Market Dynamics	Consumer demand and large firm interactions influencing CE adoption	Triguero et al. (2022); Agyabeng-Mensah et al. (2022)
	Digital Ecosystems	Platforms facilitating resource sharing and circular business models	Neri et al. (2023)
	Circular Value Chains	Development of industry-wide circular approaches	Le et al. (2022)
Policy and Institutional Frameworks (macro)	Regulatory Environment	Laws and standards promoting circular practices	Ostermann et al. (2021); Kayikci et al. (2021); Massari and Giannoccaro (2023); Droege et al., 2023
	Economic Instruments	Financial incentives and public procurement for CE	Austin and Rahman (2022); Rodriguez-Espindola et al. (2022)

Capacity Building	Education, training, and support programs for CE skills development	Maher et al. (2023)
Innovation Support	Innovation policies and support for R&D	Triguero et al. (2022)
Infrastructure Development	Investments in physical and digital systems for CE	Zhu et al. (2022)
Intermediary Support	Establishment of organizations facilitating CE transition	Hull et al. (2021); Holzer et al. (2021); Maher et al. (2023)

Source: Composed by the author.

1.4 Theoretical Perspectives used in the Thesis

1.4.1 Multi-Level Perspectives

The MLP has emerged as a prominent theoretical framework for understanding and analysing socio-technical transitions, particularly in the context of sustainability and circular economy. Originally developed by Rip and Kemp and further refined by Geels, MLP conceptualizes transitions as the result of interactions across three analytical levels: niches (micro), regimes (meso), and landscapes (macro) (Geels, 2011). This framework has gained significant traction in recent years, offering valuable insights into the processes of innovation, diffusion, and transformation across various sectors.

At its core, the MLP conceptualizes transitions as the result of interactions across three analytical levels: niches (micro), regimes (meso), and landscapes (macro) (Geels, 2011). This multi-layered approach allows for a nuanced understanding of how innovations emerge, evolve, and potentially transform existing systems. At the micro-level, niches represent the breeding grounds for radical innovations that challenge established systems. These innovations are often shielded by specific contexts or policies, allowing them to develop and mature without direct competition from dominant regimes (Geels & Schot, 2007). In the context of CE, niches might include pilot projects and experimental business models that promote sustainable practices, such as zero-waste manufacturing and product-as-a-service models. Small and medium-sized enterprises (SMEs), with their inherent flexibility and adaptability, can play a pivotal role at this level by pioneering innovative circular solutions that can eventually influence larger market trends (Bocken et al., 2016).

The meso-level, or regime, comprises the existing socio-technical systems (STS) that dictate the rules, practices, and norms governing societal functions. These regimes are typically resistant to change due to their embeddedness within institutional structures and networks (Geels, 2011). For a successful transition to circular economy practices, it is crucial to address the barriers posed by existing regimes and facilitate the integration of circular principles into mainstream business operations. This requires coordinated efforts across industries, policy interventions, and stakeholder engagement to dismantle established norms and foster a more sustainable economic framework (de Jesus & Mendonça, 2018).

At the macro-level, landscapes encompass broader socio-economic, cultural, and environmental contexts that influence regime stability and niche development. These factors include global economic trends, political climates, and societal values (Geels, 2011). In the context of circular economy transitions, the increasing awareness of environmental issues and the urgency of addressing climate change have created a supportive landscape

for sustainable innovations. Policies such as the European Green Deal and the United Nations SDGs are examples of macro-level influences that drive the adoption of circular practices by setting ambitious targets and providing a roadmap for sustainable growth (European Commission, 2020; United Nations, 2023).

The MLP's strength lies in its ability to provide a systemic and dynamic view of transitions, highlighting the interactions and feedback loops between different levels. By recognizing the interplay of micro, meso, and macro-level factors, policymakers and practitioners can develop strategies that support the diffusion of circular innovations and accelerate the transition to a circular economy (El Bilali, 2019). This comprehensive approach allows for a more nuanced understanding of the barriers and enablers of change, moving beyond simplistic linear models of innovation diffusion. The interplay between niches, regimes, and the broader sociotechnical landscape, offers valuable insights into the processes, actors, and mechanisms involved in transformative changes and the emergence of sustainable STS (Chembessi et al., 2023).

In the context of studying SMEs' transition to circular economy practices, the MLP offers several advantages. Firstly, it provides a structured approach to understanding the complex interplay of factors influencing SMEs' adoption of circular practices. By examining transitions at multiple levels, researchers can identify key leverage points for intervention and support. For instance, Malik et al. (2022) used the MLP to analyze barriers to circular economy adoption in SMEs, revealing how landscape pressures, regime stability, and niche innovations interact to shape SMEs' transition pathways.

Furthermore, the MLP's emphasis on the dynamic nature of transitions aligns well with the evolving landscape of circular economy practices. As noted by Zhu et al. (2022), the transition to a circular economy is not a linear process but rather an iterative one that requires continuous adaptation and learning. The MLP's focus on the co-evolution of technologies, practices, and institutional structures provides a framework for understanding how SMEs can navigate this complex transition over time.

However, it is important to acknowledge the limitations of the MLP framework. These critiques underscore the need for complementary theoretical approaches to provide a more comprehensive understanding of transition processes. One of the primary limitations of the MLP is the ambiguity in delineating the boundaries between niches, regimes, and landscapes. In practice, these levels often exhibit significant overlap and interconnectedness, making it challenging to categorize phenomena discretely (Genus & Coles, 2008). This blurring of boundaries can lead to difficulties in accurately representing the complex dynamics of real-world transitions.

Furthermore, the MLP has been criticized for its tendency to portray transitions as predominantly bottom-up processes, with innovations emerging from niches and gradually transforming the regime. However, empirical evidence suggests that transitions are often more complex and non-linear, potentially originating from multiple levels simultaneously or even following top-down patterns (Alkemade & de Coninck, 2021). This oversimplification of transition pathways may limit the framework's ability to capture the full spectrum of change processes.

Another significant limitation of the MLP is its inadequate treatment of agency and power dynamics. Critics argue that the framework does not sufficiently account for the role of individual actors and their capacity to influence transition processes (Geels, 2020). The MLP's focus on broader structural changes may overlook the critical role that specific stakeholders play in shaping the direction and pace of transitions. This shortcoming is

particularly relevant when considering the complex interplay of interests and influences that characterize many sustainability transitions.

To address these limitations, integrating stakeholder theory and complexity theory with the MLP can provide a more nuanced and comprehensive analytical framework, which are discussed in the below sections. This integration offers a multifaceted approach that enhances our understanding of the intricate dynamics and interconnected processes inherent in SMEs' transition to circular economy practices.

1.4.2 Stakeholder Theory

Stakeholder theory provides a valuable framework for understanding and facilitating the transition of SMEs to a CE. Originally proposed by Freeman (1984), this theory suggests that organizations should consider the interests of all parties affected by their operations, including employees, customers, suppliers, communities, and regulators. This perspective moves beyond the traditional shareholder-centric model focused solely on profit maximization, encouraging businesses to account for the broader social and environmental impacts of their activities (Jones et al., 2018). In the context of sustainability, stakeholder theory has been widely applied across disciplines such as business ethics, corporate social responsibility, and environmental management.

The transition of SMEs to a CE exemplifies a context where stakeholder theory is particularly relevant, as it underscores the importance of collaboration across the value chain in achieving CE goals. Unlike large corporations, SMEs often operate with limited resources and closer relationships with their stakeholders (Klein et al., 2021). Applying stakeholder theory helps SMEs engage with diverse actors, fostering collaboration and co-creating solutions that promote circularity. This approach is crucial because the transition to a circular economy is not just an operational change but a systemic transformation requiring multi-stakeholder cooperation (Geissdoerfer et al., 2017).

Stakeholder theory shifts the focus from internal operations to the wider ecosystem in which SMEs operate. For instance, SMEs must work with suppliers to access sustainable materials, collaborate with customers who demand eco-friendly products, and align with regulatory frameworks that support CBMs (Kirchherr et al., 2018). This theory emphasizes the interconnectedness of these relationships and how co-creating circular solutions is critical. Without such collaboration, SMEs would struggle to develop closed-loop systems, which depend on coordination at all stages of the product lifecycle – from design to disposal and recycling (Boiral et al., 2020).

Partnerships play a crucial role in this context. SMEs can partner with suppliers to establish closed-loop supply chains or collaborate with customers to drive demand for sustainably designed products (Lüdeke-Freund et al., 2018). Partnerships with research institutions can facilitate access to cutting-edge technologies, while collaborations with industry associations can help SMEs navigate regulatory landscapes (Jonker et al., 2020). These collaborations align with the principles of stakeholder theory, which encourages businesses to build mutually beneficial relationships with key actors. For example, partnerships with suppliers can enable access to sustainable materials, while customers may become advocates for circular products through sustainable consumption choices (Masi et al., 2018).

Regulators and policymakers play a pivotal role as stakeholders in driving the CE transition. They establish regulatory frameworks, offer financial incentives, and provide technical assistance, which are critical for enabling SMEs to adopt sustainable practices (de Jesus & Mendonça, 2018). However, navigating complex regulations can be challenging

for resource-constrained SMEs. Proactive engagement with policymakers can help SMEs shape supportive regulations while ensuring compliance with environmental standards (Hazen et al., 2020). A study by Kirchherr et al. (2018) showed that regulatory support is crucial for encouraging circular business practices, particularly in sectors with stringent environmental regulations.

Internally, employees and management are vital stakeholders in the CE transition. Employee engagement can drive innovation and improve the implementation of circular practices. Training programs and capacity-building initiatives can enhance employees' skills, enabling them to contribute effectively to sustainability goals (Adams et al., 2016). Moreover, leadership commitment from management significantly influences organizational priorities and the integration of circular strategies (Ghadimi et al., 2021). A shared vision for sustainability among internal stakeholders fosters a culture that supports continuous improvement in environmental performance (Freudenreich et al., 2020).

Stakeholder theory is essential for fostering innovation, trust, and shared value – elements critical in overcoming the resource and capability limitations SMEs face during the transition to CE. SMEs can leverage external knowledge and resources through stakeholder collaboration, compensating for their limited internal capacities (Masi et al., 2018). Trust, a central component of stakeholder theory, is particularly relevant in circular initiatives, where long-term partnerships based on trust between SMEs and their stakeholders can lead to more effective collaboration and innovation in resource efficiency and waste reduction (Boiral et al., 2020).

Furthermore, stakeholder theory provides a framework for understanding the socio-economic and regulatory dimensions of the transition to CE. Many challenges SMEs face are external, such as market conditions, consumer demand, or the regulatory landscape (Kirchherr et al., 2017). By engaging with stakeholders, SMEs can influence these external factors. For instance, they can work with regulators to advocate for favorable policies that support CBMs or collaborate with other firms to create a secondary materials market (Kirchherr et al., 2018).

Engaging with a diverse set of stakeholders can help SMEs identify new opportunities for circular practices. For example, collaboration with local communities can lead to the discovery of novel ways to reduce waste or increase resource efficiency (Mont et al., 2021). The circular economy depends on viewing operations from a systems perspective, where waste in one part of the system can be repurposed as a resource in another (Korhonen et al., 2018). Stakeholder theory helps SMEs recognize this interconnectedness and enables them to build partnerships that close resource loops and reduce waste across the value chain (Masi et al., 2018).

To sum, stakeholder theory provides a holistic understanding of the actors involved in the transition to a circular economy by emphasizing the interconnectedness of these actors and their collective potential to drive systemic change (Lüdeke-Freund et al., 2018). For SMEs, adopting a stakeholder-centric approach allows them to move beyond short-term financial goals and consider broader environmental and societal impacts (Freudenreich et al., 2020). By fostering strong relationships and aligning stakeholder interests with circular goals, SMEs can overcome barriers and leverage opportunities for sustainable growth in their transition to a circular economy (Hazen et al., 2020).

Despite its strengths, stakeholder theory has certain limitations when applied to the complex dynamics of SMEs transitioning to a CE. One key shortcoming is its limited capacity to address the systemic and interdependent nature of CE transitions.

Stakeholder theory traditionally focuses on dyadic relationships between businesses and individual stakeholders, overlooking the broader network of interconnected actors that shape sustainability outcomes (Kirchherr et al., 2018). To address these limitations, integrating complexity theory and the MLP can enhance the applicability of stakeholder theory in studying SMEs' CE transitions.

1.4.3 Complexity Theory

Complexity theory, originally developed in disciplines such as mathematics and physics, examines the behaviour of systems comprising numerous interconnected elements. Interactions within such systems lead to emergent properties that are not easily predictable due to non-linear dynamics and feedback loops (Manson, 2001). Unlike traditional linear models, where outcomes can be directly traced to specific causes, complexity theory suggests that small changes in one system component can produce significant, often unexpected, effects in other parts due to interdependencies (Cilliers, 1998). This conceptualization offers valuable insights into socio-economic and organizational contexts, including the transition of SMEs toward CE practices.

In the context of CE transitions, complexity theory helps elucidate how diverse factors such as technological innovation, policy changes, and stakeholder behaviour interact dynamically to influence the adoption of circular practices. Feedback loops and non-linear causality are central to this framework, wherein minor adjustments in one area of an SME's operations can trigger large-scale transformations across the entire system, a phenomenon often termed the "butterfly effect" (Manson, 2001). Furthermore, complexity theory highlights emergent properties arising from these interactions, meaning that new, unanticipated behaviours and outcomes may occur that cannot be understood by analysing individual elements in isolation (Cilliers, 1998).

Adaptability and resilience are critical aspects of complexity theory, emphasizing that SMEs must adopt flexible strategies to navigate the uncertain and evolving nature of CE transitions. This perspective supports the identification of leverage points within interconnected systems, enabling targeted interventions for accelerating CE adoption (Kumar et al., 2022). By acknowledging the dynamic interplay between various internal and external elements, complexity theory fosters a holistic understanding of the transition process.

Moreover, complexity theory underscores the multi-level nature of CE transitions, involving micro (firm-level), meso (industry-level), and macro (policy-level) dynamics shaped by interdependencies and reciprocal influences (Kumar et al., 2022). This approach aligns with STS theory, which advocates for collaborative efforts across social and technical domains to address transition challenges (Sohal et al., 2022). Recognizing these multi-level interactions enables a deeper understanding of the systemic barriers and opportunities that SMEs encounter in adopting CBMs.

To further enhance analytical precision, complexity theory can be complemented by fuzzy logic, which addresses uncertainty and ambiguity inherent in complex systems. Fuzzy logic allows for degrees of membership within sets, facilitating nuanced representations of real-world phenomena where binary categorizations fall short (Zadeh, 1965). This capability proves particularly relevant for SMEs' CE adoption, which often occurs along a continuum rather than through discrete steps (Ghadimi et al., 2020). Integrating fuzzy logic with complexity theory allows for more precise modelling of gradual and uncertain transitions.

The combined application of complexity theory and fuzzy logic provides a robust framework for understanding and managing SMEs' transition to CE practices. This integrated approach supports the development of adaptive strategies that accommodate variability, enabling firms to better predict, respond to, and shape emergent properties during the transition process (Rittershaus et al., 2023). Researchers and practitioners can leverage this combined theoretical lens to devise more effective interventions, enhancing SMEs' resilience and ensuring successful transitions toward sustainable business models (Grobman, 2005; Kumar et al., 2022).

Despite its strengths, complexity theory alone may fall short in capturing the roles and motivations of individual actors within CE transitions, as it primarily focuses on systemic dynamics. This limitation can be addressed by integrating stakeholder theory, which emphasizes the interests and power dynamics among diverse actors, and the MLP, which highlights interactions across socio-technical levels. Together, these frameworks offer a comprehensive view by linking individual, organizational, and systemic dimensions, enabling a more holistic analysis of SMEs' CE transitions.

1.4.4 A Multi-Theoretical Perspective for Understanding SMEs' Transition to a CE

The transition of SMEs to CE represents a complex, multi-dimensional challenge that cannot be adequately captured by any single theoretical framework. While the MLP, Stakeholder Theory, and Complexity Theory each offer valuable insights, their individual limitations necessitate an integrated approach. This synthesis addresses the systemic, relational, and adaptive dimensions of CE transitions, providing a holistic analytical lens to unravel the interdependencies, power dynamics, and non-linear processes inherent in SMEs' sustainability journeys.

The MLP's strength lies in its systemic conceptualization of transitions across niche, regime, and landscape levels, offering a structured understanding of how macro-level policies, meso-level industry norms, and micro-level innovations interact (Geels, 2011). However, its limitations – such as ambiguous boundaries between analytical levels, neglect of agency, and oversimplified bottom-up transition pathways (Genus & Coles, 2008; Alkemade & de Coninck, 2021) – underscore the need for complementary theories. Stakeholder Theory addresses the MLP's oversight of actor-level dynamics by emphasizing the role of collaborative relationships, power asymmetries, and value co-creation among SMEs, suppliers, customers, and regulators (Freeman, 1984; Boiral et al., 2020). For instance, SMEs' reliance on stakeholder networks to overcome resource constraints (Klein et al., 2021) aligns with MLP's niche-level focus but enriches it by detailing how trust and shared goals enable circular innovations. Yet Stakeholder Theory's traditional focus on dyadic relationships risks overlooking systemic interdependencies, a gap bridged by Complexity Theory's emphasis on emergent properties and feedback loops within interconnected systems (Cilliers, 1998; Kumar et al., 2022).

Complexity Theory, with its focus on non-linear causality and adaptability, elucidates how SMEs navigate uncertainty through iterative learning and flexible strategies (Manson, 2001; Ghadimi et al., 2020). However, its systemic orientation often neglects the motivations of individual actors, a shortcoming mitigated by Stakeholder Theory's attention to divergent interests and collaboration. Meanwhile, the MLP contextualizes these dynamics within broader socio-technical landscapes, such as regulatory shifts under the European Green Deal (European Commission, 2020), revealing how macro-level pressures interact with micro-level SME practices. For example, policy incentives for circular practices (de Jesus & Mendonça, 2018) may create landscape-level momentum,

but SMEs' ability to leverage these opportunities depends on stakeholder collaboration (meso) and adaptive capacity (micro) – dynamics explicable only through theoretical integration.

The integration of these theories offers a multi-faceted framework that addresses critical gaps in transition scholarship. First, the MLP's macro-meso-micro structure provides scaffolding to map systemic influences, while Stakeholder Theory injects agency into this structure by detailing how SMEs negotiate relationships with regulators, suppliers, and communities to align circular strategies with external expectations (Kirchherr et al., 2018; Hazen et al., 2020). Complexity Theory, in turn, explains why such strategies often yield unpredictable outcomes due to feedback loops, such as how a minor supply chain adjustment might cascade into market-level shifts (Rittershaus et al., 2023). This tripartite integration resolves the MLP's linear bias by framing transitions as iterative processes where stakeholder collaboration (Stakeholder Theory) and adaptive experimentation (Complexity Theory) co-evolve with regime-level changes (MLP).

Second, the framework addresses the compartmentalization of prior research. While Stakeholder Theory highlights SMEs' partnerships for material recovery (Masi et al., 2018), Complexity Theory reveals how these partnerships form adaptive networks that enhance resilience to market disruptions (Kumar et al., 2022). Simultaneously, the MLP contextualizes these networks within niche-regime interactions, such as how pilot projects scale into industry norms (Geels & Schot, 2007). This synergy is particularly vital for SMEs, whose resource limitations make them reliant on external ecosystems for innovation and risk mitigation (Jonker et al., 2020). For example, circular design initiatives often require SMEs to collaborate with academia for R&D (Stakeholder Theory), adapt to regulatory changes (MLP), and respond to emergent consumer trends (Complexity Theory) – a convergence explicable only through a multi-theoretical lens.

Figure 4 visually demonstrates the rationale for integrating these three theories. The overlap between MLP and Stakeholder Theory bridges structural and relational dimensions of CE transitions (Systemic and Relational Interdependencies). While MLP maps the systemic landscape (e.g., policy regimes, market structures), Stakeholder Theory elucidates how SMEs navigate these structures through relationships with suppliers, customers, and regulators. For instance, MLP's regime level highlights institutional barriers to CE adoption, such as entrenched linear supply chains (Geels, 2011), but Stakeholder Theory explains how SMEs overcome these barriers by building alliances with eco-conscious suppliers or lobbying policymakers (Boiral et al., 2020). Conversely, stakeholder-driven innovations (e.g., circular product designs) can destabilize existing regimes, accelerating niche-to-regime transitions (Bocken et al., 2016). This synergy addresses MLP's neglect of agency by demonstrating how SMEs' strategic stakeholder engagement reshapes socio-technical systems.

The intersection of Stakeholder Theory and Complexity Theory highlights how SMEs leverage collaborative networks to navigate uncertainty (Collaboration and Adaptive Capacity). Stakeholder Theory emphasizes trust-building and shared value creation (Freeman, 1984), while Complexity Theory underscores the need for adaptive strategies in volatile environments (Manson, 2001). For example, SMEs collaborating with competitors to establish circular industrial symbiosis networks (Stakeholder Theory) must adapt to emergent challenges like fluctuating material flows or regulatory changes (Complexity Theory) (Kumar et al., 2022). This overlap reveals how relational resilience – rooted in stakeholder trust – enables SMEs to absorb shocks and experiment with circular practices despite systemic unpredictability.

The convergence of MLP and Complexity Theory resolves MLP's linear bias by framing transitions as iterative, non-linear processes (Non-Linear Socio-Technical Transitions). MLP's landscape pressures (e.g., climate policies) create macro-level momentum for CE, but Complexity Theory explains how SMEs' micro-level adaptations generate feedback loops that reconfigure regimes (Geels, 2020). For instance, a small-scale shift toward remanufacturing by SMEs (niche innovation) might trigger industry-wide standards (regime change) through cumulative interactions, a process MLP conceptualizes as scaling but Complexity Theory attributes to emergent, self-organizing dynamics (Zhu et al., 2022). This synergy enriches MLP's structural analysis with Complexity Theory's emphasis on path dependency and unintended consequences.

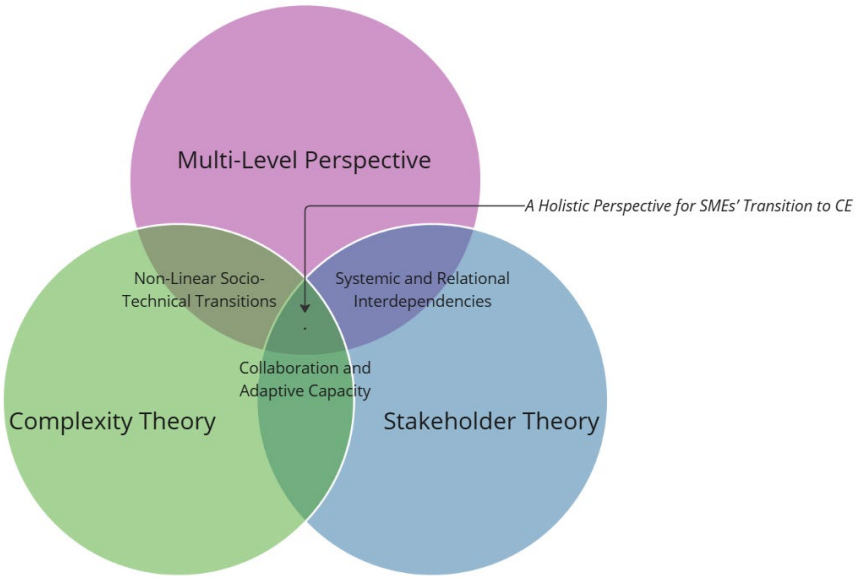

Figure 4. Integrating Theories for SMEs' Transition to CE.
Source: Composed by the author.

At the core, where all three theories converge, emerges a "Holistic Perspective for SMEs' Transition to CE." This integrated view reflects the comprehensive approach needed to thoroughly analyse the dynamics and complexities of SMEs' transition to CE. It acknowledges that the transition is not merely an operational change but a systemic transformation requiring multi-stakeholder cooperation, adaptive strategies, and an understanding of complex socio-technical interactions (Geissdoerfer et al., 2017; Korhonen et al., 2018).

While the integration of these theories is synergistic, inherent tensions arise from their epistemological differences. MLP's hierarchical levels (niche, regime, landscape) imply a structured progression of transitions, whereas Complexity Theory posits that transitions are emergent and non-linear, often bypassing "levels" altogether. For SMEs, this tension manifests in the unpredictability of CE adoption: while MLP might frame digital CE platforms as niche innovations scaling to regime dominance, Complexity Theory warns that their success depends on contingent factors like consumer behaviour or competitor responses, which may defy linear trajectories (Rittershaus et al., 2023). This tension challenges researchers to balance MLP's analytical clarity with Complexity

Theory's acknowledgment of chaos. Stakeholder Theory assumes that collaborative engagement can align divergent interests, but MLP highlights how regime-level inertia may stifle SMEs' circular initiatives regardless of stakeholder goodwill. For example, SMEs advocating for extended producer responsibility (Stakeholder Theory) may face resistance from incumbent firms entrenched in linear regimes (MLP) (de Jesus & Mendonça, 2018). This conflict underscores the need to temper Stakeholder Theory's idealism with MLP's realism about power asymmetries. Complexity Theory's focus on uncertainty and emergent outcomes can conflict with Stakeholder Theory's pragmatic emphasis on actionable strategies. SMEs require clear roadmaps for stakeholder collaboration, yet Complexity Theory suggests that outcomes are inherently unpredictable. Resolving this tension requires frameworks that blend adaptive stakeholder networks (e.g., modular partnerships) with iterative learning cycles (Ghadimi et al., 2020).

2 Methodology

This chapter details the research methodologies and approaches used in this study, highlighting the procedures involved in conducting the research for data collection and analysis purposes. Trochim and Donnelly (2001) stated that every research is governed by assumptions regarding the way the universe is perceived and understood. These assumptions are informed by various factors, including the focus area of the research and the theme under investigation (Remenyi et al., 1998). To conduct research in the hopes of finding answers to the research questions posed, research is carried out using frameworks that are proven and well-established through the guiding paradigm of research philosophies.

2.1 Research Philosophy

When discussing the foundations of research, it's important to break down the core elements that shape the study. Ontology helps define "what is out there to know" while epistemology explores "what and how can we know about it" (Grix, 2002, p. 180). Axiology, in turn, relates to the role of values and ethics in the research, guided by the ontological and epistemological perspectives, and influencing the chosen methodological approach (Geels, 2010).

Methodologies represent the approaches for acquiring knowledge, with methods and sources being the specific techniques and data collection tools (Grix, 2002). All these components are closely intertwined and stem from a philosophy of science. Therefore, in this chapter, I address the facets of the research paradigm I've adopted, linked to my beliefs about the nature of transitions (ontology), how I perceive knowledge about them (epistemology), and the role of values and ethics within my research (axiology) (Geels, 2010; Lincoln & Guba, 1985; Tashakkori & Teddlie, 2010; Zolfagharian et al., 2019). These perspectives have a profound impact on the methodologies employed in my research, the methods I've chosen to conduct the studies, and the data sources I've utilized. As a result, they significantly influence the nature of the results obtained and the subsequent interpretation. Hence, in the following subsection, I introduce the scientific philosophies that underpin my thesis research.

2.1.1 Ontology and Epistemology

My scientific philosophy primarily aligns with pragmatism, which focuses on actions and change in a constantly evolving world: "the essence of a pragmatist ontology is actions and change; humans acting in a world that is in a constant state of becoming" (Goldkuhl, 2012, p. 139). This philosophy is evident in my research goals, which prioritize not only the development of theoretical insights but also the creation of practical frameworks that can be applied directly in real-world contexts. This research, which explicitly aims to enhance analytical knowledge while creating practical, applicable frameworks, aligns well with this ontological stance. By addressing real-world applications in published articles, this thesis embodies the pragmatist commitment to linking theoretical development with actionable outcomes.

Additionally, elements of critical realism are woven into my scientific philosophy and thesis research: "the evidence we observe can come close to reality but is always a fallible, social, and subjective account of reality" (Sturgiss & Clark, 2020, p. 143). This perspective fits well with the complexity of CE implementation and change of SMEs,

where multiple interconnected factors shape outcomes. It helped address questions about how and why transitions to a circular economy progress, such as the X-curve framework (Hebinck et al., 2022), in interdisciplinary real-world contexts.

Although transitions are dynamic, we often use static categories for analytical purposes, such as the X-curve constructs: "we assert that specific patterns and mechanisms are generic and thus intransient because we assume there are 'stable' patterns in dynamic structures" (Loorbach et al., 2017). We believe some patterns and mechanisms are stable despite the fluid nature of transitions and aim to analyse these enduring patterns that lead to lock-ins and dependencies over time. My pragmatic approach involves anticipating elements that might continue while acknowledging the inherent uncertainty in dynamic transitions: "Because we live in a world in process, the future, although continuous with the past is not its bare repetition" (Dewey, 1929, p. 40).

However, this approach also faces key ontological and epistemological challenges. The commitment to a flat ontology and an open, exploratory research design introduces dilemmas regarding empirical openness versus the necessity to define practical boundaries. For instance, while striving for broad empirical inclusivity, there remains a need to establish limits in terms of sectoral focus, actor groups, and geographical scope. These choices inevitably shape how well the study captures the complexity of CE implementation in SMEs.

Additionally, despite a clear conceptual framework, the open exploration inherent in this approach can yield findings that align with diverse epistemological perspectives. Insights may emerge that speak not only to sustainability but also to technological advancements, management practices, or the social dimensions of work. This broad relevance introduces challenges of "demarcation" (Jones & Murphy, 2011), where defining the appropriate boundaries of practices as analytical objects becomes complex. In practice-oriented research, balancing this openness while maintaining conceptual clarity is critical to ensuring a coherent yet rich interdisciplinary inquiry.

2.1.2 Axiology

Axiology, which pertains to values in research, has its roots in ontology and epistemology. It involves fundamental beliefs about ethics that are deeply ingrained in research paradigms and guide researchers in their decision-making processes: "basic beliefs about what is ethical are embedded in research paradigms and guide the researcher's decision making" (Killam, 2013, p. 6). This implies that axiology encompasses the values of research, including the need for clear contextual transparency regarding the researcher's position and its implications for research methodologies (Pontoretto, 2005).

The axiology of my research, directly linked to my ontology and epistemology, blends elements of pragmatism and critical realism. The elements of my work were created, researched, and developed in alignment with my interests and values in the field of the circular economy. John Dewey, a foundational pragmatist, posited that "all human experience involves some amount of interpretation – interpreting knowledge and beliefs leads to action, and reflecting on actions leads to new ways of knowing and acting" (Kelly & Codeiro, 2020, p. 2). Similarly, critical realists acknowledge the existence of true reality but understand that it can only be imperfectly apprehended and measured: "critical realists 'accept a true reality but believe it can only be apprehended and measured imperfectly'" (Ponterotto, 2005, p. 131). While we constantly strive for transparency and objectivity in our roles as scientists and in our analytical endeavors, we acknowledge that

our backgrounds, experiences, and values can unintentionally and implicitly influence our work to some extent. Therefore, it is valuable for the reader to appreciate the contextual and background factors that underlie my research.

2.2 Research Strategy and Study Design

Building on the insights gained during the exploratory stage, which informed the identification and design of the study, this research employs an explanatory sequential mixed methods design, which involves first collecting and analysing quantitative data, followed by qualitative data to further explain or build upon the initial findings, as shown in Figure 5 (Creswell & Plano Clark, 2018). The rationale for selecting this design lies in its ability to address the complex and multi-dimensional nature of SMEs' transition to a CE by capturing both systemic patterns and contextual nuances. Mixed methods research balances the strengths of quantitative and qualitative approaches while addressing their respective limitations, enabling a more holistic analysis (Johnson & Onwuegbuzie, 2004; Teddlie & Tashakkori, 2008).

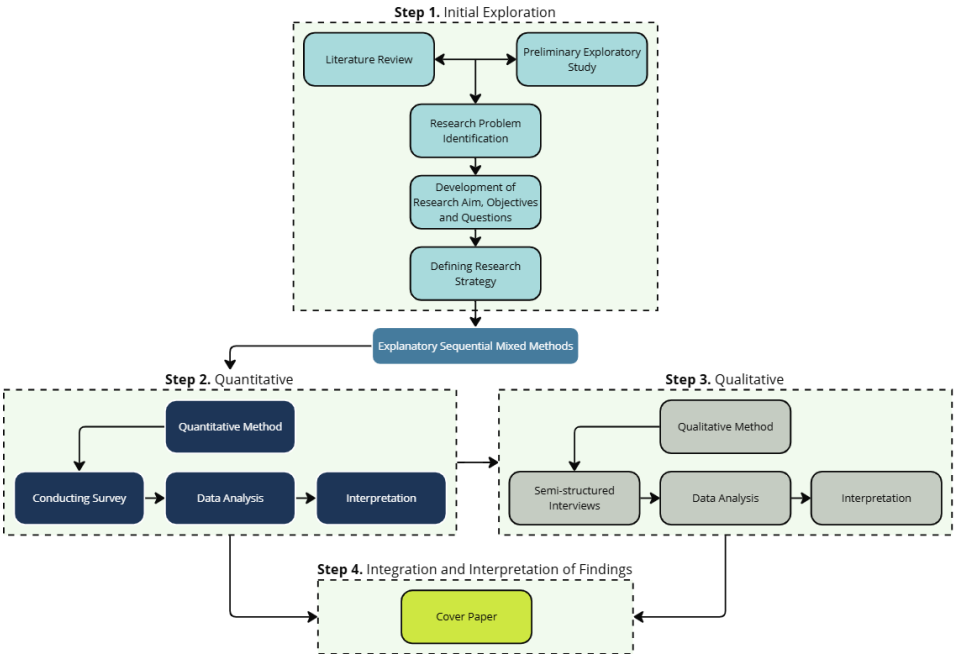

Figure 5. Explanatory Sequential Mixed Method Research Design for Investigating SMEs' Transition to a CE.
Source: Composed by the author.

Step 1. Initial Exploration Phase: The initial exploration phase focuses on identifying knowledge gaps, defining research objectives, and establishing a robust research framework. This phase includes a comprehensive literature review and a preliminary exploratory study to map the key challenges and opportunities in CE adoption.

Article 1 provides an empirical investigation into CE adoption among SMEs in Estonia, focusing on industry-specific barriers and enablers. By examining the adoption of CE practices across five stages of the product life cycle, the study highlights critical obstacles,

including limited knowledge, financial constraints, and low prioritization of CE practices. For example, the metal industry demonstrated higher levels of innovation compared to sectors like chemicals and electronics, offering sector-specific insights.

Article 2 employs the Multi-Level Perspective (MLP) framework to systematically analyze the dynamics influencing CE transitions. This study maps the micro-level (organizational practices), meso-level (industry networks), and macro-level (policy frameworks), identifying the interdependencies between these levels. The theoretical contribution addresses a key gap by linking organizational-level changes with broader systemic and policy-level influences. Together, these studies provide a critical understanding of the barriers, enablers, and systemic dynamics shaping CE transitions in SMEs. This foundational knowledge guides the design of subsequent quantitative and qualitative inquiries, ensuring a focused and coherent research trajectory.

Step 2. Quantitative Phase: The quantitative phase validates and expands upon the exploratory findings. This phase focuses on identifying patterns, relationships, and causal pathways that influence CE adoption.

Article 3 explores the impact of stakeholder pressures and managerial perceptions on CE practices. The study reveals that internal stakeholder pressures (e.g., employees and managers) have a more direct influence on CE adoption compared to external pressures (e.g., customers and regulators). However, external pressures exert an indirect effect through the mediating role of CEO, highlighting the importance of strategic alignment within organizations.

Article 4 applies fsQCA to uncover distinct causal pathways for CE adoption among international (firms that operate in international markets) and non-international (operate solely within domestic markets) micro-manufacturing firms. The study identifies five pathways, with international firms relying more on stakeholder engagement and regulatory frameworks, while non-international firms focus on internal sustainability practices. This highlights the heterogeneity of CE transitions and the need for context-specific strategies. The insights from these studies deepen the understanding of stakeholder dynamics, organizational behavior, and contextual influences, forming the basis for targeted qualitative investigations in the next phase.

Step 3. Qualitative Phase: The qualitative phase builds on the quantitative findings to provide an in-depth exploration of the complexities of CE adoption. Semi-structured interviews are used to capture the nuanced perspectives of key stakeholders.

Article 5 synthesizes insights from earlier studies to propose a holistic framework for CE adoption. By integrating MLP and complexity theory, the study examines success factors across micro-, meso-, and macro-levels. At the micro-level, factors such as organizational culture, employee training, and leadership commitment are identified as critical drivers. At the meso-level, stakeholder collaboration and industry partnerships are emphasized as key enablers, while at the macro-level, supportive regulatory environments and financial incentives are highlighted as essential for fostering systemic alignment. This study bridges theoretical insights with practical strategies, providing a comprehensive roadmap for SMEs to navigate their CE transitions. The qualitative findings add depth to the quantitative results, revealing the dynamic and adaptive processes that underpin successful CE transitions. They also highlight the interconnectedness of internal capabilities, stakeholder relationships, and systemic conditions.

Step 4. Integration and Interpretation Phase: The final phase synthesizes the insights from all previous stages into a cohesive narrative, culminating in the preparation of a cover paper. This phase integrates quantitative data and qualitative findings to address

the research objectives comprehensively. The integration of findings ensures a robust understanding of the factors influencing CE transitions at the micro (organizational), meso (industry), and macro (policy) levels.

The explanatory sequential design is particularly well-suited to this study because it allows for a phased exploration of the research problem. In the quantitative phase, broad patterns, relationships, and systemic trends are identified, providing measurable and generalizable insights. For example, surveys and statistical analysis highlight barriers, drivers, and stakeholder dynamics shaping CE transitions in SMEs. The qualitative phase then builds on these results, delving deeper into contextual and relational dynamics through semi-structured interviews. This two-phase approach ensures a comprehensive understanding, as the qualitative insights enrich and contextualize the quantitative findings (Creswell, 2002). By integrating data across phases, the study provides a robust understanding of the factors influencing CE transitions at the micro (organizational), meso (industry), and macro (policy) levels.

The rationale for this design is rooted in the complexity of CE transitions, which require an understanding of both systemic interactions and individual organizational behaviours. SMEs operate within interconnected ecosystems, where factors such as regulatory frameworks, market dynamics, and stakeholder pressures interact to shape sustainability outcomes. A single-method approach would fail to capture this complexity. The sequential mixed methods design ensures that the study addresses both the breadth and depth of the research problem, providing a nuanced perspective that is both generalizable and contextually rich (Poth & Munce, 2020).

The chosen design also aligns with the study's philosophical foundations, which integrate pragmatism and critical realism. Pragmatism focuses on practical solutions and real-world applicability, making it an ideal fit for this study's aim to generate actionable insights for SMEs, policymakers, and industry stakeholders. It allows for flexibility in research methods, ensuring that the design adapts to the demands of the research context (Biesta, 2010). Critical realism, on the other hand, emphasizes the interplay between observable phenomena and the underlying structures or mechanisms that influence them. This perspective is particularly valuable for understanding the systemic and relational dimensions of CE transitions, acknowledging that patterns identified through quantitative methods are shaped by deeper social, cultural, and economic contexts (Sturgiss & Clark, 2020).

2.3 Research Instruments and Methodological Approach

This thesis utilized a combination of quantitative and qualitative research methods as the primary data collection instruments, selected for their ability to capture both measurable trends and nuanced insights into SMEs' transition to a CE. This approach enabled the integration of large-scale, standardized insights with in-depth, contextual exploration, addressing the multifaceted nature of SMEs' transition to a CE.

The mixed methods approach ensured a comprehensive understanding of the research problem by integrating the breadth of quantitative data with the depth of qualitative insights. The sequential design allowed findings from the quantitative phase to inform the qualitative phase, creating a cohesive and iterative research process. For example, while the surveys identified broad systemic patterns, such as the role of stakeholder pressures, the interviews provided deeper insights into how SMEs experience and respond to these pressures in practice.

By combining structured survey data with nuanced qualitative narratives, the study achieved a holistic perspective on the factors influencing CE adoption among SMEs. This integration reflects the strengths of mixed methods research in addressing both generalizable trends and context-specific dynamics (Poth & Munce, 2020; Tashakkori & Teddlie, 2003). Together, these instruments and methods provided a robust foundation for achieving the study's objectives and advancing both theoretical and practical knowledge on SMEs' transition to CE.

2.3.1 Quantitative Research Method

The primary instrument for the quantitative phase was a structured survey questionnaire, designed to capture standardized data across a broad sample of SMEs. As Marczyk et al. (2005) suggest, questionnaires are highly effective for statistical analysis, allowing the identification of patterns and relationships between variables. In this study, the survey was tailored to measure constructs such as environmental awareness, stakeholder pressure, internal barriers, and CE adoption practices. Questions were derived from validated scales in existing literature to ensure methodological rigor. A five-point Likert scale was employed to quantify respondents' attitudes and practices, facilitating detailed statistical analysis.

To enhance clarity and minimize common pitfalls such as bias and ambiguity, the questionnaire adhered to established design principles (Saunders et al., 2009). A pilot test was conducted with a small sample of SMEs, following Marczyk et al.'s (2005) recommendations, to identify and address any issues with question clarity or structure before full deployment. This step ensured both the reliability and validity of the survey instrument.

The survey was distributed online to SMEs in Estonia, leveraging digital platforms to maximize accessibility and participation. Participants were recruited through industry associations, professional networks, and direct outreach, ensuring diversity in industry representation and firm sizes. Data from the survey were analysed using descriptive and inferential statistical methods to identify patterns and relationships. Additionally, fsQCA was applied to uncover complex interactions between factors affecting CE adoption, such as organizational capabilities and stakeholder influences. This advanced analytical method allowed for the identification of multiple pathways through which firms adopt CE practices, offering nuanced insights into the diversity of SME experiences (Marczyk et al., 2005).

2.3.2 Qualitative Research Method

The qualitative phase involved semi-structured interviews, recognized for their ability to explore complex issues in depth (Saunders et al., 2009). A thematic interview guide was developed based on insights from the quantitative analysis, ensuring alignment with key areas such as stakeholder pressures and internal challenges that emerged as significant factors. This iterative approach allowed the qualitative phase to complement and expand upon the findings of the quantitative phase.

The semi-structured format provided flexibility, enabling the researcher to probe deeper into participants' responses and explore emerging themes. This aligns with Marczyk et al.'s (2005) assertion that qualitative research methods allow for open-ended responses, uncovering new dimensions of the research topic. The interviews focused on Swedish SMEs, offering insights into organizational, relational, and systemic dynamics in a mature CE ecosystem.

The data were analysed using thematic analysis, a systematic approach involving the coding of transcripts to identify recurring themes and patterns (Saunders et al., 2009). The use of NVivo software facilitated the organization and systematic analysis of the qualitative data, ensuring transparency and consistency in identifying themes. These insights contextualized the quantitative findings, providing richer, more detailed understanding of how SMEs navigate CE transitions.

2.4 Sample and Data Collection

This study employed a purposive sampling strategy. The sampling criteria were designed to capture a variety of perspectives and experiences, focusing on firms engaged in manufacturing, a sector critical to CE transitions. Additional criteria included organizational size (micro, small, and medium enterprises) and varying levels of CE adoption, ensuring the inclusion of both early adopters and firms in the initial stages of CE implementation. The sample size varied across the research stages, reflecting the specific objectives and methodological requirements of each phase. Figure 6 shows a multi-stage research methodology diagram spanning from January 2021 to January 2025, spanning the four year of PhD study.

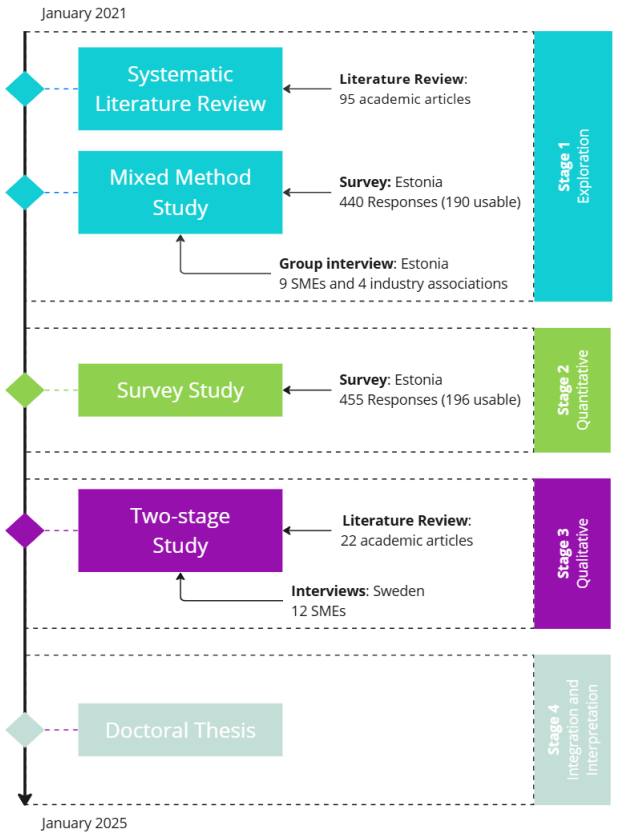

Figure 6. Four-Stage Mixed Methods Research Design: From Exploration to Integration and Interpretation.
Source: Composed by the author.

2.4.1 Stage 1: Exploration Phase

The exploration phase utilized a dual approach to data collection, combining a systematic literature review with a mixed-method study in Estonia. For the literature review, a sample of 95 academic articles was systematically selected from Web of Science and Scopus databases. The selection criteria focused on articles relevant to SMEs' transition to CE practices. This comprehensive sample provided a solid foundation for understanding the current state of research in the field (Article 2). The mixed-method study in Estonia involved both quantitative and qualitative data collection. A survey was distributed to 2,211 SMEs across four industries in Estonia between October and December 2021. The survey yielded 440 responses, of which 190 were deemed usable after screening. This represents a response rate of approximately 8.6%, which is consistent with similar studies in the field. Four group interviews were conducted, involving 9 SMEs and 4 industry associations from four sectors. These semi-structured interviews lasted approximately one hour each and were audio-recorded and transcribed for analysis (Article 1).

2.4.2 Stage 2: Quantitative Phase

The quantitative phase expanded on the exploratory findings through a comprehensive survey study in Estonia. The sampling and data collection process was rigorous and multi-faceted.

A randomized sample of 1,500 SMEs was drawn from the Orbis Europe database, ensuring representativeness across the Estonian SME landscape. The survey was administered through the Qualtrics platform on January 10th, 2023. To accommodate the diverse linguistic background of Estonian firms, the survey was made available in three languages: Estonian, Russian, and English. The data collection occurred in three phases, comprising the baseline survey and two follow-up surveys, spanning a period of three weeks. The survey yielded 455 initial responses, representing a 30.33% response rate. After rigorous data cleaning and application of inclusion criteria, 196 complete and valid responses were retained for analysis, resulting in a final response rate of 13.07%. A subset of the data focused specifically on micro-firms, yielding 128 usable responses after applying strict inclusion criteria

2.4.3 Stage 3: Qualitative Phase

The qualitative phase employed a two-stage methodology, combining a focused literature review with in-depth interviews of Swedish SMEs. A focused review of 22 academic articles was conducted, providing a theoretical foundation for the qualitative investigation. The initial sample pool consisted of 55 SMEs identified through an extensive online search of Swedish CE-focused organizations. This was narrowed down to 32 SMEs based on the extent and impact of their CBMs. Ultimately, 12 SMEs agreed to participate in the study. Semi-structured interviews were conducted with executive managers from the 12 participating SMEs. These interviews were carried out online using Microsoft Teams between January and February 2023, with an average duration of 40 minutes each. The decision to conduct 12 interviews was guided by the principle of theoretical saturation, with redundancy of information observed after the 10th interview.

2.4.4 Stage 4: Integration and Interpretation Phase

The final stage synthesizes findings across all previous phases, integrating quantitative and qualitative insights to develop a comprehensive understanding of CE implementation in manufacturing SMEs. This integration phase enables triangulation of findings and development of robust theoretical and practical implications.

2.5 Data Analysis

The analysis across the five articles reveals a diverse array of methodologies combining both quantitative and qualitative approaches. These methodologies were applied to explore various dimensions of CE implementation among SMEs.

The analysis in Article 1 employed a mixed-methods approach, combining qualitative and quantitative analysis techniques. For the qualitative component, thematic analysis was applied to the transcripts of four group interviews, identifying key themes related to CE awareness, initiatives, motivations, and barriers. The quantitative analysis of survey data from 190 complete responses was conducted using SPSS version 27, employing descriptive statistics and analysis of variance to examine constraints hindering CE innovation implementation. This integration of qualitative and quantitative findings allowed for a holistic understanding of CE innovation among Estonian SMEs.

Article 2 employed content analysis using NVIVO 14 and MS Excel to analyse 95 academic articles. The analysis followed Mayring's (2014) main steps, including review idea, operationalization, and results interpretation. The coding process adhered to the Webber protocol, involving multiple stages such as defining recording units, determining coding categories, and testing coding on sample texts. This rigorous approach allowed for both quantitative and qualitative exploration of the articles, providing insights into complex managerial phenomena related to SMEs' transition to CE.

Article 3 employed a comprehensive methodological approach to analyse survey data from 196 valid responses. Descriptive analyses were conducted to explore the main characteristics of survey items, including mean and standard deviation. To ensure robustness, reliability and validity assessments were performed on all survey items and constructs. Harman's single-factor test was used to assess common method bias (Harman, 1976). Reliability was assessed through measures such as Cronbach's alpha coefficient (Churchill, 1979; Cronbach, 1951), average variance extracted (Bagozzi & Yi, 1988), and composite reliability (Nunnally, 1978). Convergent validity was established through exploratory factor analysis (Hair et al., 2010). Correlation analysis was conducted to identify patterns of association between constructed variables. Finally, ordinary least square (OLS) regression and structural equation modelling (SEM) were employed to test hypotheses and examine complex relationships between variables, including mediation effects (Hayes & Preacher, 2013).

Article 4 utilized fsQCA to analyse data from 128 usable questionnaires. The analysis followed a three-step fsQCA process: data calibration, truth table building, and truth table minimization. In the calibration phase, indicator values were aggregated for each variable, and thresholds were computed using maximum, average, and minimum values. The truth table was constructed with a frequency threshold of 1 and a consistency level of 0.75 (Pappas and Woodside, 2021). Data minimization was performed using the standard analysis command, resulting in complex, parsimonious, and intermediate solutions. The focus was on intermediate solutions to determine causal configurations, comparing them with parsimonious solutions to identify core and peripheral conditions.

This approach allowed for a nuanced analysis of the complex interplay between factors influencing CE adoption in micro-firms.

Lastly, Article 5 employed thematic analysis following Braun and Clarke's (2006) guidelines to analyse the rich data collected through semi-structured interviews. The analysis process involved an iterative collaboration among the authors, using both inductive and deductive approaches. The Gioia method was utilized to ensure rigorous and reliable analysis, involving multiple rounds of coding and refinement (Gioia et al., 2013). NVivo software supported the analysis of manually transcribed interviews. The process involved identifying first-order concepts, categorizing them into second-order categories, and consolidating them into core categories based on the Multi-Level Perspective framework. This approach allowed for a systematic and in-depth exploration of success factors contributing to the adoption of CE practices in manufacturing SMEs.

Data Quality Assurance played a crucial role in ensuring the reliability and validity of the research findings across the studies. The researchers employed a variety of rigorous techniques to maintain high standards of data integrity and minimize potential biases.

One of the primary methods used for data quality assurance was the implementation of reliability and validity assessments. In Article 3, comprehensive reliability tests, including Cronbach's alpha coefficient, average variance extracted, and composite reliability measures conducted. Cronbach's alpha, in particular, is widely recognized as a robust measure of internal consistency, with values above 0.7 generally indicating acceptable reliability. These measures helped ensure that the constructs used in the study were consistently measuring what they were intended to measure.

To address the potential issue of common method bias, which can arise when data for both dependent and independent variables are collected from the same respondents, Harman's single-factor test was employed. This test involves conducting an exploratory factor analysis to determine whether a single factor accounts for the majority of the variance in the responses. In Article 4, the results of this test revealed that the first factor accounted for only 20.5% of the total variance, well below the 50% threshold, indicating that common method bias was not a significant concern.

Validity was another critical aspect of data quality assurance. In Article 3, convergent validity was established through exploratory factor analysis. This technique helps to confirm that items that are theoretically related to each other demonstrate high correlations. Additionally, to assess multiple relationships within an integrated framework SEM employed, allowing for a more comprehensive examination of the hypothesized relationships.

For qualitative data, rigorous thematic analysis techniques were employed. In Article 5, Braun and Clarke's (2006) guidelines for thematic analysis followed, which involves a systematic approach to identifying, analysing, and reporting patterns within the data. The use of the Gioia method further enhanced the rigor of the qualitative analysis, providing a structured approach to developing data-driven theoretical insights.

To ensure the robustness of quantitative data, the "complete case analysis" method was used to address missing data, as seen in Articles 3 and 4 (Hughes et al., 2019). This approach involves excluding cases with incomplete or missing responses from the analysis, thereby maintaining the integrity of the dataset. While this method can potentially reduce sample size, it helps to avoid the introduction of bias that can occur with some imputation methods.

In Article 4, the process of using fsQCA involved setting thresholds for full membership, non-membership, and the cross-over point for each variable, ensuring that the data was appropriately prepared for this specific analytical technique.

The use of multiple coders in Article 2's content analysis helped to ensure inter-coder reliability and validity of the data source, particularly for articles indexed in Scopus or Web of Science. This approach helps to mitigate individual biases and enhance the consistency of the coding process.

2.6 Research Ethics

Building on the empirical exploration of the significance of the CE for SMEs presented in Chapter 2, I have come to recognize that the CE fundamentally aligns with principles of environmental stewardship, societal well-being, and intergenerational fairness – key elements of an ethical society. However, through the application of critical realism and a pragmatic approach, it becomes evident that the actual implementation and reality of the CE diverge significantly from these idealistic expectations. This divergence does not, in any way, imply that ethical considerations should be diminished in CE research. On the contrary, it underscores the heightened importance of maintaining stringent ethical standards throughout the research process. Any compromise, no matter how minor, would fundamentally contradict the ethical foundations of the CE itself, resulting in an inherent paradox where unethical methods are used to study an ethical concept.

As Lincoln and Guba (1985) and Creswell (2013) suggest, a researcher's morals, values, and belief system profoundly influence the ethical considerations of their study, reflecting an axiological approach to research. This perspective becomes evident in the researcher's interactions with interviewees, the framing of the research questions, the design of the study, and the interpretation and communication of findings. Similarly, Cooper and Schindler (2008) emphasize that every stage of the research process must be conducted in a morally responsible manner. In alignment with these principles, I have rigorously adhered to the highest ethical standards at every step of this research.

Regarding the interview phase, I ensured confidentiality by limiting the disclosure of specific details about the participating organizations. Consent was obtained from all interviewees before proceeding, and they were informed that their participation was entirely voluntary, with the option to withdraw at any time. Participants were explicitly informed of the confidentiality guidelines outlined in TalTech's ethical policy[2], which governed the handling of data, including the recording of conversations and the access granted to my two supervisors.

In addition to interviews, ethical considerations were also crucial during the survey phase of this study. Participants in the survey were fully briefed on the study's purpose, and their anonymity was guaranteed. Like the interviews, informed consent was sought, and participants were made aware that they could opt out of the survey at any stage without any consequences. Data gathered from the survey was handled with the same strict confidentiality protocols, ensuring that no sensitive information could be traced back to individual respondents.

[2] TalTech's Principles of Academic Ethics (Code of Academic Ethics) provide comprehensive guidelines on confidentiality and ethical conduct in academic research. Available at: https://oigusaktid.taltech.ee/en/principles-of-academic-ethics-code-of-academic-ethics/

This research has adhered to TalTech's code of conduct, upholding ethical standards on two primary levels: (a) safeguarding the rights and interests of both interviewees and survey participants, and (b) ensuring the rigor, validity, and reliability of the research findings by avoiding biases, selective reporting, and maintaining transparency throughout. The ethical integrity maintained across both qualitative (interview) and quantitative (survey) methods ensures that the study remains consistent with the underlying ethical principles of the CE, reinforcing the importance of ethics in both the content and conduct of research.

3 Results

The central aim of this study was to explore and analyse the transition process of SMEs from traditional, linear business models to adopting CE principles. This exploration focused on how SMEs manage this journey by balancing internal organizational changes, responding to external pressures, and evolving their stakeholder relationships. The results section is structured around three key objectives:

Each of the five articles in this study contributes to one or more of these objectives, providing a comprehensive and multi-faceted analysis of the research questions. Objective 1 focuses on identifying and understanding key factors, actors, and mechanisms influencing this transition, and is primarily addressed by Articles 1, 2, and 5. Objective 2, which explores how organizational dynamics and stakeholder interactions shape CE pathways, is primarily addressed in Articles 2, 3, and 4. Lastly, objective 3, which determine the critical elements for implementing and sustaining CE practices in SMEs, is addressed by Articles 1, 4, and 5.

By organizing the results around these three objectives, rather than by individual papers, this study provides a cohesive and integrated analysis of SMEs' transition to CE. This approach allows for a more comprehensive understanding of the interconnected factors influencing this transition, while still acknowledging the unique contributions of each article to the overall research goals.

3.1 Key Drivers and Mechanisms in SMEs' Circular Economy Transition

The transition of SMEs to CE is a complex process influenced by a multitude of factors, actors, and mechanisms operating at various systemic levels. A comprehensive understanding of these factors is crucial for facilitating this transition, which has garnered increasing academic attention. Articles 1, 2, and 5 showcase a comprehensive picture of these influences, providing valuable insights into the challenges and opportunities faced by SMEs in their CE transition journey.

At the micro-organizational level, Article 1 identifies significant barriers such as the lack of knowledge regarding CE principles and technological expertise among SMEs. This knowledge gap hinders innovation and effective implementation of circular practices. The study also highlights financial constraints as a critical obstacle, limiting their ability to invest in necessary innovations for CE transition (Article 1). Complementing these findings, Article 5 emphasizes the importance of internal capabilities and resources, specifically innovation capacity, leadership commitment, and employee engagement, as crucial success factors for CE implementation at the micro level. The research suggests that firms with strong innovative capabilities and dedicated leadership support for sustainability initiatives are better positioned to successfully implement and maintain CE strategies (Article 5).

At the meso-industry level, Article 2 underscores the significance of industry associations and networks as key actors facilitating collaboration and knowledge sharing among SMEs. These entities serve as crucial intermediaries in the CE transition process. The study also highlights the importance of stakeholder engagement, including suppliers, customers, and local actors, as a key factor in successful CE implementation (Article 2). Article 5 further elaborates on the meso level, focusing on the socio-technical regime encompassing industry norms, standards, and networks. It emphasizes the importance of collaboration with supply chain partners, engagement with industry

associations, and the adoption of new technologies that facilitate circular processes. The research highlights how these inter-organizational relationships and industry-wide initiatives create an enabling environment for CE implementation (Article 5).

At the macro level, all three articles (Article 1,2 and 5) highlight the crucial role of institutional and governmental support in facilitating the transition to CE. Article 1 identifies insufficient support from governmental and public institutions as a significant impediment to the progress of SMEs in adopting CE practices, suggesting that policy interventions and supportive institutional frameworks are crucial for widespread implementation of CE principles. Article 2 reinforces this by emphasizing the role of institutional support as a significant mechanism influencing the CE transition process, highlighting the importance of institutions and policymakers in creating advocacy and awareness for CE principles. Article 5 further expands on this, emphasizing the role of broader societal and environmental factors in shaping the CE landscape. It underscores the significance of supportive regulatory frameworks, economic incentives, and public awareness campaigns in fostering a societal shift towards circular principles (Article 5).

The research also reveals the interconnected nature of these levels and the complex interplay between various factors. Article 2 employs the MLP framework to systematically map out influences at all three levels, providing a comprehensive understanding of the CE transition process. Article 5 takes this further by developing a holistic framework that integrates insights from all three levels – micro, meso, and macro. This integrated approach offers a more nuanced perspective on the challenges and opportunities associated with CE adoption, emphasizing the non-linear and interconnected nature of factors influencing CE practices (Article 5).

3.2 Organizational Dynamics and Stakeholder Roles in Circular Economy Adoption

Organizational dynamics and stakeholder interactions play a crucial role in shaping the pathways towards CE adoption in SMEs. The interplay between internal organizational processes and external pressures creates a complex landscape that firms must navigate to successfully implement CE practices. This section synthesizes insights from three articles (Article 2,3 and 4) to elucidate how these dynamics unfold and influence CE adoption strategies.

Article 2 illuminates the complex relationship between organizational dynamics and stakeholder interactions in shaping CE adoption within SMEs. The study emphasizes the critical role of organizational culture and leadership commitment as internal factors that foster an environment conducive to CE implementation. SMEs with a strong sustainability-oriented culture and ethical leadership are better positioned to overcome barriers and integrate CE principles into their strategies and operations. This finding underscores the importance of internal organizational dynamics in facilitating CE adoption (Article 2).

Furthermore, Article 2 highlights the significant role of stakeholder engagement in the CE adoption process. Active interactions with a diverse range of stakeholders, including suppliers, customers, and industry associations, serve as conduits for knowledge sharing and collaboration. The study identifies collaboration and co-creation as critical mechanisms in the CE adoption process, enabling SMEs to leverage external expertise and resources.

This collaborative ecosystem helps SMEs navigate the complexities inherent in the CE transition, demonstrating how stakeholder interactions can facilitate the integration of CE principles (Article 2).

Article 3 builds upon these findings by revealing a multifaceted framework of influences that collectively drive or hinder CE implementation within SMEs. The study identifies both internal and external stakeholder pressures as significant factors influencing SMEs' decisions to adopt CE practices. External stakeholders, such as customers and regulatory bodies, exert considerable influence through their demands, while internal stakeholders play a crucial role in fostering an organizational culture supportive of CE initiatives. This dual pressure mechanism underscores the importance of a holistic approach to stakeholder management in the context of CE adoption (Article 3).

A novel contribution of Article 3 is the identification of CEO as a mediating factor that enhances SMEs' responsiveness to stakeholder pressures. Organizations with a strong CEO demonstrate an increased ability to align their strategies with stakeholder expectations, thereby facilitating the adoption and integration of CE practices. This finding emphasizes the importance of cultivating a CE-focused organizational mindset as a strategic approach to sustainability, illustrating how internal capabilities can interact with external pressures to shape CE adoption pathways (Article 3).

Article 4 provides additional insights by examining the role of international activities and context-specific factors in promoting CE practices among micro-firms. The study reveals that SMEs operating internationally are exposed to diverse regulatory frameworks and market requirements, which encourages the adoption of CE practices. This finding highlights how exposure to international regulations and external knowledge networks can create varied stakeholder interaction patterns, influencing CE adoption strategies (Article 4).

The research in Article 4 employs fsQCA to identify distinct pathways for CE adoption, differentiating between internationally operating micro-firms and non-international ones. For international micro-firms, three paths emerge: CEO as a core driver, the combined influence of stakeholder pressure and environmental awareness, and stakeholder pressure as a primary force offsetting internal barriers. Non-international micro-firms follow two paths: a focus on CEO and environmental awareness, and a holistic approach integrating CEO, environmental awareness, and stakeholder pressures. These findings illustrate the diverse strategies available to micro-manufacturing firms for implementing CE practices, emphasizing how organizational dynamics and external pressures interact to shape CE adoption pathways (Article 4).

Collectively, these articles provide a comprehensive answer to the research objective by demonstrating how organizational dynamics and stakeholder interactions influence CE adoption in SMEs. They reveal that successful CE implementation requires a delicate balance between internal capabilities (such as organizational culture, leadership commitment, and CEO) and external pressures (including stakeholder demands and regulatory requirements). The studies highlight the importance of collaborative networks and stakeholder engagement in facilitating knowledge sharing and resource leveraging, which are crucial for overcoming barriers to CE adoption.

Moreover, the research underscores the context-specific nature of CE adoption pathways, particularly evident in the differentiation between international and non-international micro-firms. This context-specificity emphasizes the need for tailored approaches to CE implementation that consider the unique organizational dynamics and stakeholder interactions of each SME.

3.3 Critical Components for Sustaining Circular Economy Practices in SMEs

The implementation and sustainment of CE practices in SMEs is a complex process that requires the alignment of various critical elements across multiple levels. The findings from Articles 1, 4, and 5 provides a multifaceted understanding of the essential components necessary for SMEs to successfully implement and sustain CE practices. These articles collectively address the research objective by identifying critical enablers, strategies for overcoming barriers, and approaches for ensuring long-term sustainability of CE practices in SMEs.

Article 1 identifies four fundamental components critical for SMEs to effectively implement and sustain CE practices: knowledge and awareness, financial support and resources, collaboration and partnerships, and a supportive policy framework. The study emphasizes that a comprehensive understanding of CE principles is crucial for SMEs to recognize potential benefits and integrate circular practices into their business models. This finding underscores the importance of knowledge dissemination and capacity building as essential enablers for CE adoption (Article 1).

Financial support and access to resources emerge as another critical component in Article 1. The study highlights that financial constraints often impede SMEs from investing in the necessary innovations required for CE implementation. This finding emphasizes the need for targeted financial incentives and support mechanisms to enable SMEs to overcome resource-related barriers to CE adoption (Article 1).

Article 1 also emphasizes the importance of collaboration and partnerships, highlighting that successful implementation of CE practices necessitates joint action among various stakeholders, including suppliers, customers, and other businesses. This finding underscores the role of ecosystem engagement in facilitating CE adoption and suggests that establishing strategies for effective collaboration is crucial for long-term sustainability of CE practices (Article 1).

Article 4 builds upon these findings by introducing environmental awareness and stakeholder alignment as essential components for creating resilient CE pathways, particularly in micro-firms. The study emphasizes that cultivating a strong sense of environmental consciousness within the organizational culture serves as a driving force for the adoption of CE practices. This environmental awareness creates a foundation for long-term commitment to circular principles, ensuring that sustainability becomes an integral part of the business ethos (Article 4).

Stakeholder pressure is identified in Article 4 as another crucial element in the CE adoption process. The research highlights the importance of engaging with stakeholders and responding to their expectations regarding sustainability and environmental standards. This finding suggests that actively engaging with stakeholders and incorporating their concerns into business strategies can enhance SMEs' reputation and create a supportive ecosystem for CE implementation (Article 4).

Article 4 also emphasizes the importance of a clear CEO as an essential component for SMEs. This involves integrating CE principles into the core business strategy and operations, ensuring a long-term commitment to sustainable practices. The study suggests that firms with a strong CEO are better positioned to overcome challenges and sustain their circular practices over time (Article 4).

Article 5 proposes a holistic framework that integrates success factors across the micro, meso, and macro levels. At the micro level, the research highlights the critical importance of internal organizational capabilities such as innovation capacity, leadership commitment, and employee engagement. These micro-level factors collectively form the foundation upon which SMEs can build and sustain their CE practices (Article 5).

At the meso level, Article 5 focuses on the importance of inter-organizational relationships and industry-wide initiatives. The study underscores the significance of collaboration with supply chain partners and engagement with industry networks and associations. This finding aligns with the collaboration and partnerships component identified in Article 1, emphasizing the crucial role of ecosystem engagement in sustaining CE practices over time (Article 5).

At the macro level, Article 5 emphasizes the role of supportive government policies and economic incentives in creating an enabling environment for CE adoption among SMEs. This aligns with the supportive policy framework component identified in Article 1, highlighting the critical role of robust policy mechanisms in guiding and incentivizing SMEs towards CE practices (Article 5).

The integrated framework proposed in Article 5 provides a comprehensive understanding of the complex interplay of factors necessary for successful CE adoption and maintenance. This holistic approach allows for a more nuanced appreciation of the challenges and opportunities associated with transitioning to circular practices, enabling SMEs to develop more effective strategies for implementation and long-term sustainability (Article 5). Table 2 below provides a summary of the research findings, structured around the study's three main objectives.

Table 2. Summary of Research Findings Aligned with Objectives

Objective	**Key Findings**
Objective 1: Identify key factors, actors, and mechanisms influencing SMEs' CE transition	- Micro level: Barriers include knowledge gaps, financial constraints, and limited innovation capacity. Internal enablers include leadership commitment and employee engagement. - Meso level: Industry associations and networks facilitate collaboration and knowledge sharing. Supply chain partnerships play a critical role in aligning practices with circular principles. - Macro level: Regulatory frameworks, economic incentives, and institutional support are essential for creating an enabling environment.
Objective 2: Explore how organizational dynamics and stakeholder interactions shape CE pathways	- Organizational culture and leadership commitment foster sustainability-oriented practices. - CEOs mediate between stakeholder pressures and internal strategies, enhancing responsiveness to external demands. - Stakeholder collaboration (e.g., with suppliers, customers, regulators) enables resource sharing, co-creation, and knowledge transfer. - International SMEs adopt distinct pathways influenced by exposure to diverse regulations and markets.
Objective 3: Determine critical elements for implementing and sustaining CE practices in SMEs	- Knowledge dissemination and capacity building are foundational for CE adoption. - Financial support through incentives or grants helps overcome resource constraints. - Collaboration across supply chains and with external stakeholders fosters innovation and resilience. - Supportive policies (e.g., subsidies, public procurement) create market demand for circular products. - Environmental awareness within organizational culture ensures long-term commitment to CE principles.

Source: Composed by the author.

4 Discussion

The discussion section is structured around the three primary objectives that guided this study, which were explored in the results section through an integrated analysis of the five articles. Rather than focusing on individual papers, this approach synthesizes their collective contributions, offering a cohesive and systemic examination of the findings. Each objective is discussed here, highlighting how the results from the articles collectively address key aspects of SMEs' transition to CE practices.

4.1 Key Drivers and Mechanisms in SMEs' CE Transition

The transition of SMEs to CE is a multifaceted process shaped by diverse drivers and mechanisms operating across micro, meso, and macro levels. The findings align with and extend the existing literature by emphasizing the interconnectedness of these levels, as well as the systemic nature of the transition process.

At the micro level, findings from Article 1 highlight key organizational barriers such as knowledge gaps, financial constraints, and limited internal capabilities. These challenges are well-documented in the literature (Ormazabal et al., 2018; Ritzén & Sandström, 2017). For instance, SMEs' lack of technical expertise and understanding of CE principles has been identified as a significant impediment to innovation and implementation (Gallardo-Vázquez et al., 2024; Kirchherr et al., 2018). Similarly, financial constraints remain a critical issue due to SMEs' limited access to capital and tighter budgets compared to larger firms (Austin & Rahman, 2022). However, the prominence of the "not applicable to us" response as a barrier adds a new dimension to the understanding of CE adoption challenges. This finding suggests that many SMEs may not perceive CE as relevant to their operations in Estonia, indicating a need for greater awareness and education about CE principles and their applicability across various sectors.

Findings from Article 5 emphasize the importance of internal capacities such as leadership commitment, innovation capabilities, and employee engagement. This aligns with studies that underscore leadership's role in fostering a sustainability-oriented culture and driving CE adoption (D'Angelo et al., 2023; Frishammar and Parida, 2019; Chen et al., 2022; Ghadimi et al., 2021). However, while the result suggests that strong internal capacities can mitigate barriers, the literature also notes that these capacities are often underdeveloped in SMEs, necessitating external support (Masi et al., 2018).

At the meso level, findings from Article 2 and 5 points to the critical role of industry associations, networks, and stakeholder engagement in enabling collaboration and knowledge sharing. The identification of stakeholder engagement and collaboration as critical meso-level factors aligns with the work of Benz (2022) and Govindan (2023), who highlight the significance of partnerships in driving circular practices. This resonates with findings emphasizing that SMEs benefit significantly from participating in collaborative networks that provide access to resources, expertise, and shared infrastructure (Staicu & Pop, 2018; Centobelli et al., 2021). The role of supply chain relationships is particularly noteworthy; SMEs often face challenges in restructuring fragmented supply chains to align with circular principles (Kayikci et al., 2022). The findings echo this complexity but also highlight opportunities for partnerships with suppliers and customers to drive circular practices. In addition, findings emphasize collaboration at the meso level, existing literature also points out that SMEs may struggle to influence broader industry norms due to their limited bargaining power within supply chains (Agyabeng-Mensah et al., 2022).

At the macro level, Article 1,2 and 5 underscores the importance of institutional and governmental support in shaping an enabling environment for CE adoption. This is consistent with studies highlighting regulatory frameworks, economic incentives, and public awareness campaigns as critical drivers for CE transitions (Kirchherr et al., 2018; Maher et al., 2023). However, findings also note insufficient institutional support as a barrier – a challenge frequently cited in emerging economies where weak infrastructure and inconsistent policy enforcement exacerbate difficulties for SMEs (Kayikci et al., 2021). The literature further emphasizes that policy interventions must be tailored to SMEs' specific needs, such as simplifying compliance requirements or providing targeted financial incentives like grants or tax benefits (Austin & Rahman, 2022; Rodriguez-Espindola et al., 2022). The findings align with this perspective but also add nuance by highlighting how macro-level factors interact with micro- and meso-level dynamics through feedback loops.

Finally, the integrated framework developed at Article 2 and 5 aligns closely with recent calls for holistic approaches to understanding CE transitions. The use of frameworks like MLP provides valuable insights into how micro-level innovations interact with meso-level regimes and macro-level landscapes to drive systemic change (Malik et al., 2022; Zhu et al., 2022). Complexity theory complements this by emphasizing non-linear dynamics and emergent properties in transitions (Kumar et al., 2022). The findings from Articles 2 and 5 contribute to this discourse by demonstrating how interconnected factors across levels create both challenges and opportunities for SMEs. For example, while financial constraints at the micro level may hinder investment in circular practices, supportive policies at the macro level can offset these barriers by providing subsidies or fostering market demand through public procurement initiatives.

Overall, the findings from Articles 1, 2 and 5 enrich the existing literature by offering a comprehensive view of the drivers and mechanisms influencing SMEs' transition to CE. They underscore not only the importance of addressing barriers at each systemic level but also underline the need for coordinated efforts across levels to create an enabling ecosystem for circular practices. This integrated perspective is essential for designing effective interventions that support SMEs in overcoming challenges while leveraging their unique strengths – such as agility and innovation capacity – to adopt circular practices.

4.2 Organizational Dynamics and Stakeholder Roles in CE Adoption

The findings from Articles 2,3 and 4 provide and insightful understanding on organizational dynamics and stakeholder roles in SMEs' transition to. The nuanced exploration of internal organizational capabilities, external stakeholder interactions, and contextual influences extends the conversation on SME transitions by offering a layered understanding of how internal and external forces shape CE adoption.

The intersections between organizational dynamics and stakeholder engagement in CE adoption underscore a duality that is well-documented but insufficiently integrated in existing studies. The findings emphasize the mediating role of organizational culture, leadership commitment, and CEO, particularly in aligning internal capabilities with external pressures. These insights resonate with the literature's acknowledgment of leadership's centrality to fostering a sustainability mindset (Chen et al., 2022) and organizational culture's role in embedding CE principles (Gallardo-Vázquez et al., 2024). However, the findings from Articles 3 and 4 advances this discourse in its demonstration of how these internal dynamics mediate the relationship between external stakeholder

pressures and the strategic reorientation of SMEs, thus reframing internal capabilities as not merely enablers but also dynamic responders to external forces. Findings from Article 4 on the role of environmental awareness contribute to the ongoing debate about its importance in driving CE practices. While some previous research has emphasized environmental awareness as a crucial factor (Khan 2021; Cao 2022), this study suggests its significance may vary depending on the firm's international status. This nuanced perspective adds to our understanding of how environmental consciousness translates into CE practices in different organizational contexts.

The concept of "CE orientation" articulated in findings of Article 3 and 4 is particularly compelling. By identifying this orientation as a mediating factor between stakeholder pressures and CE adoption (Article 3), the results builds on yet diverges from traditional CE research. While Kirchherr et al. (2018) and Malik et al. (2022) emphasize external drivers such as regulatory and customer demands, the emphasis in the findings on CEO as a proactive internal framework challenges the observer bias of existing studies, which often frame SMEs as passive actors responding to external pressures. Instead, the findings stress that cultivating a CEO allows SMEs to anticipate, interpret, and align with such pressures, transforming challenges into opportunities. This insight underscores the agency of SMEs in shaping their own transition pathways, shifting the narrative from one of constraint to one of strategic adaptability.

Stakeholder relationships emerge as a critical pathway for overcoming barriers to CE adoption, particularly through collaboration and knowledge co-creation (Article 2). Article 4 emphasize on stakeholder pressure as a key factor, particularly for international micro-firms, aligns with prior research underlining the influence of external stakeholders on CE adoption (Adomako 2022; Baah 2024). Existing literature validates the importance of these relationships, with studies by Staicu and Pop (2018) and Agyabeng-Mensah et al. (2022) outlining the role of partnerships in addressing resource and knowledge gaps. The positive relationship between stakeholder pressure and CE practices corroborates findings from earlier studies (Baah et al., 2023; Chiappetta Jabbour et al., 2020; Winans et al., 2021). Furthermore, the study's emphasis on the role of managerial perceptions in shaping CE practices is consistent with existing literature that underscores the significance of leadership attitudes in CE adoption (Al-Kwifi et al., 2023; Ruokonen, 2021; van Langen et al., 2021). However, the findings from Article 3 provides new insights that internal stakeholder pressure has a more substantial impact on CE practices compared to external pressure. This contrasts with previous research that has often emphasized the coercive role of external stakeholders, particularly government regulations, in driving CE adoption (Genovese et al., 2017; Govindan & Hasanagic, 2018). The study's results suggest that SMEs in Estonia are less responsive to external stakeholders, including regulatory bodies, which challenges the conventional wisdom about the primacy of external pressures in shaping organizational behaviour. Another noteworthy divergence is the mediating role of CEO in the relationship between stakeholder pressure and CE practices. While previous studies have recognized the importance of sustainability orientation (Jagani & Hong, 2022) and closed-loop orientation (Schmidt et al., 2021) in driving CE practices, this study introduces CEO as a critical mediating factor. This nuanced perspective adds depth to our understanding of how organizations translate stakeholder pressures into concrete CE practices.

Moreover, Article 4's exploration of context-specific pathways for CE transitions, especially the differentiation between international and non-international micro-firms (Article 4), adds a crucial layer of specificity that is often missing in the literature. While

studies such as Austin and Rahman (2022) acknowledge the role of international market exposure in fostering innovation and sustainability, they generally fall short in identifying how these contextual factors translate into distinct CE adoption strategies. The pathways identify – such as stakeholder pressure offsetting internal barriers for international firms or the integration of CEO and environmental awareness in non-international firms – complicate the overly generalized frameworks of studies like Frishammar and Parida (2019). By articulating these nuanced strategies, the results from Article 4 not only addresses the heterogeneity of SMEs but also offers a blueprint for tailored interventions based on organizational context.

However, while the findings provide a robust understanding of CE adoption, they also invite critique in light of certain gaps and oversights. First, the emphasis on stakeholder engagement predominantly centres around formal, externally defined relationships, such as those with suppliers, customers, and regulators. This perspective, while aligned with Kirchherr et al. (2017), risks marginalizing the informal and community-based networks that often play a pivotal role in SME ecosystems. For instance, local collaborations rooted in community knowledge and shared resources, as noted by Harrison et al. (2023), could offer additional pathways for fostering CE transitions, particularly for non-international firms with limited access to global markets.

4.3 Critical Components for Sustaining CE Practices in SMEs

The implementation and sustainment of CE practices in SMEs require the alignment of critical components across organizational, relational, and systemic dimensions. The findings from Articles 1, 4, and 5 provide a nuanced understanding of these components, which align with and expand upon existing literature on the multifaceted challenges and enablers of CE adoption.

Knowledge dissemination and capacity building emerge as foundational elements for CE adoption, as highlighted in Article 1. The emphasis on knowledge and awareness aligns with Kirchherr et al. (2018), who argue that insufficient understanding of CE principles often deters SMEs from engaging in circular practices. Dey et al. (2019) similarly note that technical expertise is a significant barrier, particularly for smaller firms lacking robust R&D capabilities. This underscores the need for targeted training programs and educational initiatives to bridge knowledge gaps, as advocated by Maher et al. (2023). Furthermore, the integration of CE principles into organizational culture, as emphasized in Article 4, resonates with Gallardo-Vázquez et al. (2024), who highlight the importance of a CEO in fostering strategic and operational alignment with sustainability goals.

Financial constraints remain a persistent challenge for SMEs transitioning to CE, as noted in Article 1. The high upfront costs associated with circular innovations are well-documented in the literature (Austin & Rahman, 2022; Lahti et al., 2018). Restricted access to external funding exacerbates this issue, with complex grant application processes and stringent eligibility criteria often sidelining SMEs (Mura et al., 2020). Article 5's emphasis on supportive macro-level policies aligns with calls for government-backed financial mechanisms, such as tax incentives and green bonds, to alleviate these barriers (Rodriguez-Espindola et al., 2022; Zhu et al., 2022). Additionally, public procurement policies that prioritize circular products can create market demand and incentivize SMEs to invest in sustainable practices (Massari & Giannoccaro, 2023).

Collaboration and partnerships are pivotal for overcoming resource limitations and fostering innovation in SMEs' CE transitions. Article 1 underscores the importance of ecosystem engagement through stakeholder collaboration, a finding echoed by Susanty et al. (2020), who highlight the role of supply chain relationships in implementing circular practices. The meso-level focus in Article 5 further reinforces this perspective by emphasizing inter-organizational networks and industry-wide initiatives. Hull et al. (2021) argue that participation in local and regional circular ecosystems enables SMEs to access shared resources and infrastructure, thereby enhancing their capacity for CE adoption. Similarly, cross-sector collaborations with academia, non-profits, and government agencies provide SMEs with access to specialized knowledge and funding opportunities (Holzer et al., 2021).

Environmental awareness within organizational culture is another critical enabler identified in Article 4. This aligns with Chen et al. (2022), who emphasize that leadership commitment to sustainability drives resource allocation and cultural shifts towards environmental responsibility. Stakeholder pressure, also highlighted in Article 4, plays a dual role by creating both opportunities and challenges for SMEs. While regulatory compliance can drive innovation, market-driven demands for sustainability often require significant adaptation efforts (Hazen et al., 2020; Kirchherr et al., 2018). Engaging stakeholders effectively can enhance reputation and foster trust, enabling SMEs to navigate these pressures more successfully (Boiral et al., 2020).

The holistic framework proposed in Article 5 integrates success factors across micro, meso, and macro levels, offering a comprehensive approach to understanding the interplay of internal capabilities, external networks, and systemic influences. At the micro level, innovation capacity and leadership commitment are critical for embedding circular principles into business models (Centobelli et al., 2021; Neri et al., 2023). At the meso level, collaborative networks facilitate resource sharing and joint innovation efforts (Jonker et al., 2020). At the macro level, policy interventions such as extended producer responsibility regulations create an enabling environment for CE adoption (Ostermann et al., 2021).

Overall, sustaining CE practices in SMEs requires a multi-dimensional approach that addresses organizational readiness, stakeholder dynamics, and systemic barriers. By aligning internal capabilities with external opportunities through collaboration and supportive policies, SMEs can navigate the complexities of transitioning to circularity while contributing to broader sustainability goals. The findings from Articles 1, 4, and 5 not only corroborate but also enrich existing literature by providing an integrated understanding of the critical components necessary for successful CE adoption.

The below Venn diagram (Figure 7) illustrates the empirical findings from five research articles, to summarize and demonstrating how each article contributes to understanding SMEs' CE transition through three theoretical lenses: Multi-Level Perspective (evidenced by Articles 1, 2, and 5's findings on systemic influences), Stakeholder Theory (supported by Articles 2, 3, and 4's insights on stakeholder dynamics), and Complexity Theory (demonstrated through Articles 4 and 5's analysis of adoption pathways), while their intersections reveal critical insights about systemic interdependencies, non-linear transitions, and collaborative adaptive capacity in CE implementation.

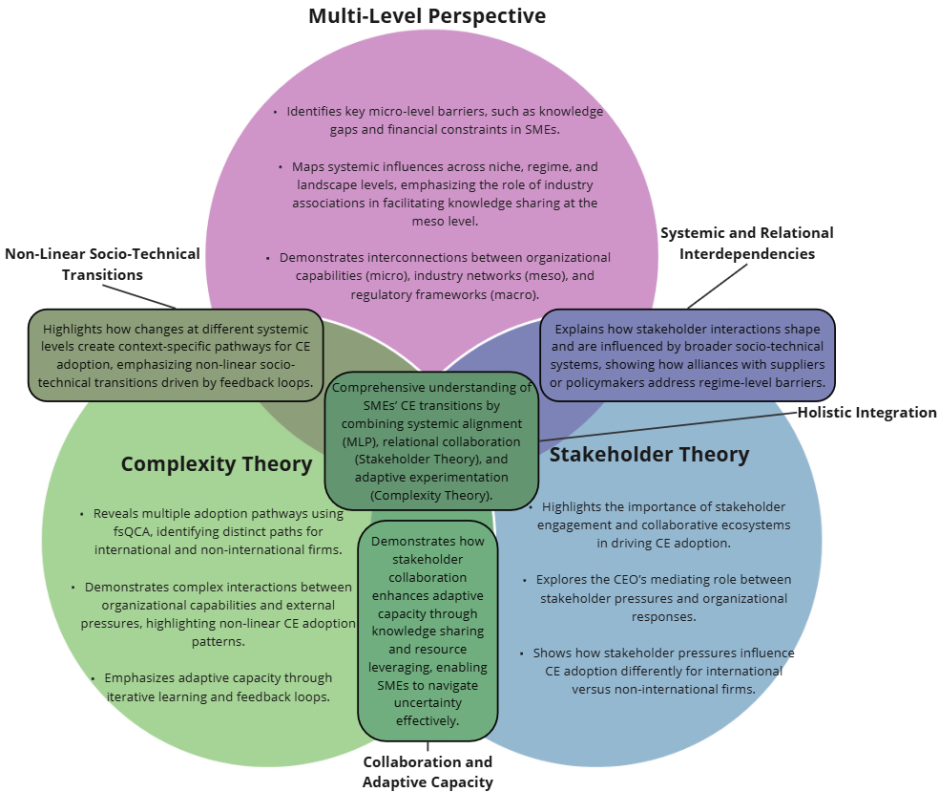

Figure 7. Integration of Research Articles' Findings Through Multi-Theoretical Framework for Understanding SMEs' Transition to CE.
Source: Composed by the author.

The MLP provides a structured hierarchy for analysing transitions across niche (micro), regime (meso), and landscape (macro) levels, elucidating how macro-level policies, meso-level industry norms, and micro-level innovations interact (Geels, 2011). Empirical studies demonstrate that SMEs face micro-level barriers such as knowledge gaps in CE technologies and financial constraints for circular business models (Articles 1, 2, 5), while meso-level enablers like industry associations foster knowledge sharing and collaboration (Article 1). Macro-level drivers, including regulatory frameworks such as the EU Green Deal (Article 2), create landscape pressures that accelerate compliance with circular certifications.

Stakeholder Theory addresses MLP's oversight of actor-level dynamics by emphasizing collaborative relationships, power asymmetries, and value co-creation among SMEs, suppliers, customers, and regulators (Freeman, 1984). Empirical findings reveal that SMEs' reliance on stakeholder networks to overcome resource constraints (Klein et al., 2021) aligns with MLP's niche-level focus but enriches it by detailing how trust and shared goals enable circular innovations. For instance, CEO-led stakeholder engagement in SMEs correlates with higher CE adoption (Article 3), illustrating the pivotal role of relational strategies. Yet Stakeholder Theory's traditional focus on dyadic relationships

risks overlooking systemic interdependencies, a gap bridged by Complexity Theory's emphasis on emergent properties and feedback loops within interconnected systems (Cilliers, 1998).

Complexity Theory elucidates how SMEs navigate uncertainty through iterative learning and flexible strategies (Manson, 2001). Empirical analyses, such as fsQCA results identifying multiple equifinal pathways to CE adoption (Article 4), challenge linear models by demonstrating how configurations of policy incentives, stakeholder collaboration, and adaptive capacity yield divergent outcomes. However, Complexity Theory's systemic orientation often neglects individual actor motivations, a shortcoming mitigated by Stakeholder Theory's attention to divergent interests and collaboration. Simultaneously, MLP contextualizes these dynamics within broader socio-technical landscapes, revealing how macro-level pressures interact with micro-level SME practices. For example, policy incentives for circular practices (de Jesus & Mendonça, 2018) may create landscape-level momentum, but SMEs' ability to leverage these opportunities depends on stakeholder collaboration (meso) and adaptive capacity (micro) – dynamics explicable only through theoretical integration.

The theoretical intersections provide particularly rich insights. The overlap between MLP and Stakeholder Theory, demonstrated in Articles 2 and 3, reveals how stakeholder interactions both shape and are influenced by broader socio-technical systems. This synergy addresses MLP's neglect of agency by demonstrating how SMEs' strategic engagement reshapes socio-technical systems. The intersection between Complexity Theory and MLP, evidenced in Articles 4 and 5, shows how changes at different systemic levels create multiple context-specific pathways for CE adoption. This synergy resolves linear transition biases by framing socio-technical shifts as iterative, non-linear processes. The convergence of Stakeholder Theory and Complexity Theory, supported by Articles 2 and 4, illuminates how stakeholder collaboration enhances adaptive capacity through knowledge sharing and resource leveraging. This overlap reveals how relational resilience enables SMEs to absorb shocks and experiment with circular practices despite systemic unpredictability.

This integrated theoretical approach provides a more nuanced understanding of CE transition than any single theoretical perspective could offer. The empirical findings validate the necessity of considering systemic interdependencies, stakeholder relationships, and complexity dynamics simultaneously, offering a comprehensive understanding and facilitating SMEs' transition to CE practices. The integration of these theories is not without inherent tensions. MLP's hierarchical levels imply structured progression, whereas Complexity Theory posits emergent, non-linear transitions that may bypass hierarchical trajectories. For SMEs, this tension manifests in the unpredictability of CE adoption: digital CE platforms, framed by MLP as niche innovations scaling to regime dominance, may succeed or fail based on contingent factors like consumer behaviour or competitor responses (Rittershaus et al., 2023). Similarly, Stakeholder Theory's assumption of collaborative engagement aligning divergent interests conflicts with MLP's realism about regime-level inertia. SMEs advocating for extended producer responsibility (Stakeholder Theory) often face resistance from incumbent firms entrenched in linear regimes (MLP) (de Jesus & Mendonça, 2018), underscoring power asymmetries that temper idealism.

5 Conclusion

This thesis addressed the complex challenge of understanding how SMEs' transition from traditional linear business models to CE practices. The research aimed to provide a comprehensive analysis of this multi-faceted transition process by examining the interplay of factors across micro, meso, and macro levels, exploring organizational dynamics and stakeholder interactions, and identifying critical elements for implementing and sustaining CE practices in SMEs.

The study's multi-theoretical approach, integrating the MLP, stakeholder theory, and complexity theory, provided a robust framework for analysing the systemic, relational, and adaptive dimensions of SMEs' transition to CE. This integrative perspective highlighted the non-linear nature of sustainability transitions and the critical importance of aligning internal capabilities, stakeholder relationships, and supportive external environments to facilitate successful CE adoption in SMEs.

The published five articles collectively deliver a comprehensive insight that captures the complexity of SMEs' transition to CE. The first objective, build on the Article 1,2 and 5 lays the groundwork by identifying key factors, actors, and mechanisms influencing the CE transition. It emphasizes the multi-level nature of the process, drawing attention to micro-level barriers, such as knowledge gaps and financial constraints, as well as meso-level dynamics, including industrial collaborations and supply chain integration.

Building on this foundation, the second objective, build on the Article 2, 3 and 4 delves deeper into the organizational and relational dimensions that shape the pathways SMEs take to integrate CE practices. It reveals the non-linear and context-dependent nature of CE adoption, showing that while some firms are driven by internal commitment to sustainability, others are motivated or constrained by external pressures. This objective demonstrates that successful adoption is not solely a matter of overcoming barriers; it is also about strategically leveraging organizational capabilities and external relationships.

The third objective, build on Article 1, 4 and 5, ensures that these findings are actionable, offering a roadmap for the long-term sustaining and success of CE initiatives in SMEs. It focuses on the essential components that enable firms not only to adopt but also to sustain circular practices over time, including ongoing education and training, leadership commitment, and stakeholder collaboration. This objective highlights the need for continuous learning and adaptation, reinforcing the idea that CE is not a one-time shift but an ongoing process that requires consistent commitment and support.

The research demonstrates that successful CE adoption requires alignment between internal organizational capabilities, supportive industry ecosystems, and enabling policy environments. It emphasizes the context-specific nature of CE transitions, with different firms requiring tailored support based on their size, industry, market exposure, and internal capabilities. This nuanced understanding is crucial for designing interventions that are both effective and sustainable, ensuring that support mechanisms are responsive to the varying needs of SMEs.

To sum, this comprehensive approach not only meets the main objective but also provides a deeply contextualized understanding that is essential for driving meaningful change in the transition towards a more circular economy. By addressing vital aspects of the CE transition process, from diagnosis to implementation and long-term sustainability, the thesis offers a holistic view that is invaluable for navigating the complexities of adopting and maintaining CE practices in SMEs.

5.1 Theoretical Contribution

The theoretical contributions of this doctoral thesis are significant in advancing the understanding of SMEs' transition to CE by synthesizing and extending existing frameworks while addressing critical gaps in the literature. Through the integration of the MLP, stakeholder theory, and complexity theory, this thesis provides a comprehensive lens for analysing the systemic, relational, and adaptive dimensions of CE transitions. These contributions not only refine existing theoretical constructs but also offer new insights into the unique challenges and opportunities faced by SMEs in navigating this complex process.

One of the key contributions lies in the application and refinement of the MLP framework to the context of SMEs' CE transitions. While previous studies have employed MLP to examine sustainability transitions broadly (Geels, 2011; El Bilali, 2019), its application to SMEs has been limited, particularly in understanding how smaller firms manage interactions across micro (organizational), meso (industry), and macro (policy and societal) levels. This thesis demonstrates that SMEs CE transition is interconnected and complex, and necessitate multi-perspective view, rather than isolated view. Findings showed that CE practices are constrained by misalignments with meso-level industry regimes and macro-level policy environments. For example, fragmented supply chains or inconsistent regulatory frameworks can hinder SMEs' ability to scale their circular innovations, highlighting the importance of multi-level coordination. This nuanced understanding extends the MLP by emphasizing that successful CE transitions require alignment across all three levels, addressing critiques that MLP often underrepresents the dynamic interplay between levels (Trevisan et al., 2023; Malik et al., 2022).

The integration of stakeholder theory further deepens the theoretical discourse by emphasizing the interactive and relational dimensions of CE transitions. Unlike larger corporations, SMEs operate within closer proximity to their stakeholders, including suppliers, customers, regulators, and local communities (Klein et al., 2021). This research highlights that stakeholder relationships are not isolated but are embedded within broader socio-technical systems. For instance, meso-level dynamics such as industry norms and collaborative networks significantly shape SMEs' ability to align their stakeholder interactions with broader CE objectives. By demonstrating how internal organizational attributes – such as leadership commitment and CEO – mediate stakeholder pressures, this study enriches stakeholder theory by linking external pressures with internal processes. This perspective addresses a key limitation in stakeholder theory, which often overlooks systemic factors influencing stakeholder dynamics (Kirchherr et al., 2018; Boiral et al., 2020).

A particularly novel contribution is the introduction of CEO as a mediating factor that bridges external stakeholder pressures with internal organizational strategies. This concept provides a more granular understanding of how SMEs internalize external demands for sustainability and translate them into actionable practices. For example, SMEs with strong CEO are better positioned to respond to customer demands for eco-friendly products or regulatory requirements for resource efficiency. These finding challenges traditional assumptions in stakeholder theory that external pressures alone drive organizational change (Govindan & Hasanagic, 2018) and instead underscores the importance of internal cultural and strategic alignment.

Complexity theory adds another critical dimension by addressing the emergent, non-linear dynamics inherent in CE transitions. By applying complexity theory to SMEs' CE transitions, this research highlights the importance of adaptability and iterative learning processes. For instance, SMEs must continuously experiment with circular practices and refine them based on feedback from market conditions, regulatory shifts, and stakeholder interactions. This dynamic perspective challenges linear models of organizational change and offers a more realistic portrayal of how SMEs navigate uncertainties during their transition to CE.

The integration of these three theoretical perspectives – MLP, stakeholder theory, and complexity theory – results in a multi-theoretical lens that addresses several gaps in existing literature. First, it provides a systemic understanding of how micro-level innovations interact with meso- and macro-level structures to either enable or constrain CE adoption. Second, it emphasizes the relational aspects of CE transitions by analysing how SMEs engage with diverse stakeholders across value chains and ecosystems. Third, it captures the adaptive processes through which SMEs respond to evolving market demands, regulatory landscapes, and technological advancements.

This integrated perspective also offers new insights into context-specific dynamics that shape SMEs' CE transitions. For example, findings from Article 4 demonstrate how international exposure influences stakeholder relationships differently for international versus non-international micro-firms. While international firms leverage global networks to access knowledge and markets for circular products (Gallardo-Vázquez et al., 2024), non-international firms rely more heavily on local collaborations to overcome resource constraints. These differentiated pathways challenge one-size-fits-all approaches to CE adoption and underscore the need for context-sensitive theories that account for geographical and operational diversity.

Furthermore, this research contributes to advancing temporal dimensions in CE transition studies by exploring how success factors evolve over time. Article 5's findings reveal that while R&D capabilities are critical during initial implementation phases, their importance diminishes in sustaining phases as firms shift focus toward operational efficiency and stakeholder alignment. This temporal perspective aligns with complexity theory's emphasis on iterative processes but has been underexplored in prior research on CE transitions (Frishammar & Parida, 2019). By highlighting these evolving priorities, this study provides a more dynamic understanding of how SMEs sustain their circular practices over time.

In summary, this research makes several theoretical contributions by refining existing frameworks and offering new conceptual insights into SMEs' transition to CE. The application of MLP extends its relevance to smaller firms by illustrating how they navigate multi-level interactions despite resource constraints. Stakeholder theory is enriched through its integration with systemic perspectives and its emphasis on mediating factors like CEO. Complexity theory adds depth by capturing the emergent dynamics and adaptive strategies critical for navigating uncertainties in CE transitions. Together, these contributions provide a robust theoretical foundation for understanding the multi-dimensional nature of SMEs' transition to CE while addressing critical gaps in existing literature related to systemic interdependencies, relational dynamics, and temporal evolution.

5.2 Empirical Contribution

A key empirical contribution lies in addressing the geographical and contextual diversity of CE adoption. Article 1's focus on the Central and Eastern European context, particularly Estonia, enriches the empirical understanding of CE transitions in underrepresented regions. Existing literature has often concentrated on Western Europe or highly industrialized economies (Mazur-Wierzbicka, 2021), leaving a gap in understanding how SMEs in emerging or transition economies navigate CE adoption. This study reveals region-specific barriers such as limited knowledge and financial constraints, as well as cultural perceptions that CE is not relevant to certain industries. These findings highlight the importance of tailoring policy interventions to regional contexts, offering actionable insights for policymakers aiming to foster CE transitions in diverse economic environments.

The application of the MLP framework in Article 2 provides another significant empirical contribution by systematically mapping the interconnected dynamics across micro-, meso-, and macro-levels. While prior studies often focus on isolated dimensions of CE adoption (e.g., Khan et al., 2022; Suchek et al., 2021), this research empirically demonstrates how organizational strategies at the micro level are influenced by meso-level industry dynamics and macro-level policy structures. For instance, regulatory incentives at the macro level can either enable or constrain SMEs' ability to innovate within supply chains at the meso level. This empirical validation of MLP underscores its utility in capturing the systemic nature of CE transitions and provides concrete evidence for designing multi-level interventions that align policies with industry practices.

Article 3 makes a notable empirical contribution by quantifying the mediating role of CEO in SMEs' responses to stakeholder pressures. The findings challenge conventional assumptions that external pressures such as regulations or customer demands are the primary drivers of CE adoption (Govindan & Hasanagic, 2018). Instead, this study demonstrates that internal stakeholder pressures – such as leadership commitment and employee engagement – have a more direct influence on CE practices, with CEO acting as a critical mediating factor. This nuanced understanding offers empirical support for developing internal organizational capabilities as a prerequisite for effectively engaging with external stakeholders. By bridging external pressures with internal processes, this study provides a more comprehensive model of how SMEs operationalize CE principles.

The comparative analysis conducted in Article 4 further enhances the empirical contributions by uncovering distinct causal pathways for CE adoption among international and non-international micro-manufacturing firms using fsQCA. This methodological approach allows for a nuanced understanding of how different combinations of factors – such as environmental awareness, stakeholder collaboration, and market exposure – lead to successful CE adoption. The findings reveal that international firms leverage global networks to access resources and knowledge, while non-international firms rely more heavily on local collaborations. This differentiation challenges the one-size-fits-all approach often assumed in SME-focused research (Jabbour et al., 2020) and highlights the importance of context-specific strategies for fostering CE transitions.

Finally, Article 5 synthesizes these insights into an empirically grounded holistic framework that integrates success factors across micro-, meso-, and macro-levels. By emphasizing dynamic interactions between internal capabilities, industry collaboration, and policy environments, this framework provides a comprehensive model for

understanding successful CE transitions. The temporal dimension highlighted in this study – where factors such as R&D are critical during implementation but less so during sustaining phases – adds depth to existing literature by illustrating how priorities evolve over time. This finding addresses gaps noted by Kannan et al. (2022) regarding the need for longitudinal analyses of success factors in sustainability transitions.

Collectively, these empirical contributions advance our understanding of SMEs' transition to CE beyond theoretical propositions by providing concrete evidence of the complex interplay between various factors influencing CE adoption. The multi-method approach employed across these studies – ranging from qualitative case studies to quantitative analyses using fsQCA – enhances the robustness of these findings. For example, while qualitative insights from Article 1 illuminate region-specific barriers and enablers, quantitative data from Articles 3 and 4 offer generalizable patterns that inform broader strategies for supporting SMEs.

Moreover, this research addresses critical gaps in existing literature by emphasizing systemic interdependencies and contextual variability. For instance, while much prior research has focused on technological innovation or policy influence in isolation (Kirchherr et al., 2018; Malik et al., 2022), this study demonstrates how these factors interact dynamically across levels to shape SMEs' transition pathways. By situating SMEs within broader socio-technical systems while accounting for their unique constraints – such as limited resources and localized operations – this research provides actionable insights for both theory and practice.

5.3 Practical Contribution

From a practical standpoint, the findings have significant implications for policymakers, industry stakeholders, and practitioners aiming to support SMEs' transition to CE.

For SMEs, the thesis provides holistic insights and understanding for navigating the complexities of CE adoption. A key finding is the importance of fostering a strong CEO as a foundational element for successful transitions. This internal alignment enables SMEs to interpret stakeholder pressures – such as regulatory demands or customer expectations – not as threats but as opportunities for innovation and competitive differentiation. The emphasis on managerial commitment and environmental awareness underscores the critical role of leadership in embedding CE principles into organizational culture. Leaders who prioritize sustainability can drive resource allocation toward circular initiatives, cultivate employee engagement, and foster innovation in business models (Chen et al., 2022; Gallardo-Vázquez et al., 2024). Practical recommendations include investing in employee training programs to build technical expertise and integrating CE principles into operational processes, such as eco-design and reverse logistics (Kayikci et al., 2022). These strategies equip SMEs to overcome resource constraints while positioning themselves as leaders in sustainable innovation.

The comparative analysis of international and non-international micro-firms offers additional practical insights for SMEs considering global expansion. The findings reveal that internationalization exposes firms to diverse regulatory environments and global sustainability trends, which can accelerate the development of advanced CE practices. However, it also introduces complexities such as heightened stakeholder pressures and internal barriers. For example, international firms often benefit from access to global knowledge networks and markets for circular products but must navigate more stringent regulatory requirements (Gallardo-Vázquez et al., 2024). Non-international firms, on the other hand, rely more heavily on local collaborations to overcome resource limitations.

These insights enable SMEs to make informed decisions about their growth strategies by preparing for both the challenges and opportunities associated with international operations.

A key contribution of this research is its focus on why certain industries are more amenable to CE practices. For example, sectors such as metals demonstrate higher levels of innovation due to factors like supply chain integration and regulatory incentives, whereas industries like chemicals or electronics face greater challenges due to fragmented supply chains or complex product designs. These insights suggest that targeted policy interventions should consider industry-specific dynamics. Policymakers could develop sector-specific CE roadmaps that align efforts across industries while providing tailored support mechanisms, such as subsidies for recycling infrastructure in manufacturing or incentives for industrial symbiosis in textiles. By addressing sectoral nuances, these interventions can enhance the scalability and effectiveness of CE adoption.

For large companies, this research offers significant implications by demonstrating how lessons from SMEs' agility and innovative approaches can inform their own CE strategies. Large firms often face bureaucratic inertia that slows down sustainability transitions; however, they can draw inspiration from SMEs' ability to rapidly adapt to stakeholder pressures and implement circular innovations at smaller scales. Additionally, large companies can benefit from collaborating with SMEs within circular ecosystems by leveraging their flexibility and localized knowledge. Partnerships with SMEs can enable large firms to test pilot projects, co-develop circular products, or establish industrial symbiosis networks that reduce waste and optimize resource use across supply chains.

For industry networks, this research underscores the pivotal role of collaboration in facilitating CE transitions. Industry associations and networks are identified as critical enablers that can act as knowledge hubs by disseminating best practices, fostering cross-sector partnerships, and pooling resources for shared infrastructure like recycling facilities or remanufacturing systems (Susanty et al., 2020; Centobelli et al., 2021). The findings emphasize the importance of developing sector-specific CE roadmaps that align efforts across industries while providing clear guidelines for SMEs. For instance, action plans tailored to specific sectors – such as manufacturing or textiles – can help firms identify opportunities for industrial symbiosis, where waste from one company becomes a resource for another (Hull et al., 2021). Industry networks can also facilitate local and regional circular ecosystems by connecting firms with complementary resource needs or waste outputs. These ecosystems create opportunities for SMEs to participate in closed-loop systems without requiring substantial individual investment in infrastructure.

The research also highlights the value of cross-sector collaborations involving academia, non-profits, and government agencies. Such partnerships provide SMEs with access to specialized knowledge, funding opportunities, and new markets for circular products (Holzer et al., 2021). Additionally, digital platforms are identified as transformative tools that enable resource sharing and foster new business models within circular value chains (Neri et al., 2023). Industry networks can play a crucial role in scaling these innovations by creating digital ecosystems that connect waste generators with potential users or facilitate secondary material markets.

For policymakers, this thesis offers evidence-based recommendations to design effective support mechanisms that address the unique challenges faced by SMEs. Financial incentives such as tax benefits, grants, subsidies, or green bonds are highlighted

as critical tools for overcoming initial cost barriers associated with transitioning to CBMs (Austin & Rahman, 2022). However, financial support must be complemented by investments in infrastructure development – including recycling facilities, reverse logistics networks, and digital platforms – to create enabling conditions for CE adoption (Zhu et al., 2022). Policymakers are encouraged to adopt a MLP to understand the systemic nature of CE transitions. This approach highlights the need for coordinated policies that align micro-level firm initiatives with meso-level industry dynamics and macro-level regulatory frameworks (Trevisan et al., 2023).

The findings emphasize policy coherence and long-term stability as critical factors in creating an enabling environment for CE adoption. Fragmented or inconsistent regulations can deter investment in circular practices by increasing uncertainty for businesses. Policymakers are therefore urged to align environmental policies with industrial and innovation strategies to send consistent signals to firms (Kirchherr et al., 2018). Public procurement policies that incorporate CE criteria into tenders can also create market demand for circular products while providing SMEs with incentives to innovate (Rodriguez-Espindola et al., 2022).

Education and training policies are another area where policymakers can make a significant impact. Integrating CE principles into educational curricula at all levels – from vocational training programs to professional development initiatives – can build a workforce equipped to implement circular practices in SMEs (Maher et al., 2023). Additionally, intermediary organizations such as business support agencies or CE hubs can act as bridges between policymakers and SMEs by providing technical assistance, facilitating knowledge transfer, and supporting capacity-building initiatives (Hull et al., 2021).

Finally, this research underscores the importance of fostering local circular ecosystems through policy interventions that encourage industrial symbiosis and regional collaboration. By supporting initiatives that connect firms within geographic clusters – such as shared recycling facilities or collaborative logistics systems – policymakers can reduce transaction costs while enhancing resource efficiency across value chains (Hull et al., 2021).

5.4 Limitations

Despite its contributions, this thesis has several limitations that should be acknowledged, providing opportunities for future research to address these gaps. First, the geographical focus on the Baltic Sea region, specifically Estonia and Sweden, while offering valuable comparative insights, limits the generalizability of the findings to regions with significantly different socio-economic, cultural, and policy contexts. For instance, the dynamics of CE adoption in developing countries or regions with weaker institutional frameworks, less developed infrastructure, or different cultural attitudes toward sustainability may differ significantly (Mazur-Wierzbicka, 2021). Future research could expand the geographical scope to include diverse regions such as emerging economies or global South contexts to capture a broader range of CE transition dynamics. This would provide a more comprehensive understanding of how factors like institutional voids or informal economies influence CE adoption.

Second, while the exclusive focus on SMEs is intentional due to their critical economic role and unique resource constraints, it inherently excludes large enterprises and other organizational forms that face distinct challenges and opportunities in CE adoption. Furthermore, except for one study (Article 4), this thesis aggregates micro, small, and

medium-sized enterprises into a single category. This aggregation potentially obscures important variations in CE adoption strategies, barriers, and opportunities across these sub-categories. For example, micro-enterprises may lack even basic resources to initiate CE practices, whereas medium-sized firms might have greater capacity for innovation but face more complex stakeholder pressures (Jabbour et al., 2020). Future studies should disaggregate SMEs into their respective categories to provide a more nuanced understanding of how firm size influences CE transitions. Additionally, comparative studies between SMEs and large enterprises could further illuminate how organizational scale impacts the ability to adopt circular practices.

Third, the reliance on mixed methods introduces methodological limitations that warrant consideration. While the combination of qualitative and quantitative approaches provides a rich dataset for exploring CE adoption, the use of self-reported data from surveys and interviews may be subject to respondent bias. For example, participants may overstate their commitment to sustainability or underreport challenges due to social desirability bias (Podsakoff et al., 2003). Moreover, perceptions of CE practices may not always align with actual implementation. To address this limitation, future research could incorporate observational methods or longitudinal case studies to validate self-reported data and capture real-world practices more accurately. Additionally, the cross-sectional nature of some data collection methods limits the ability to fully understand the dynamic and evolving nature of CE transitions over time. Longitudinal studies would be particularly valuable in examining how SMEs adapt their strategies in response to changing market conditions, regulatory environments, or technological advancements.

Forth, Paper 3 lies in the treatment of Circular Economy Orientation (CEO) as a mediator rather than a moderator. This discrepancy highlights an opportunity for future research to further refine and develop the CEO construct, exploring its dual potential as both a mediating and moderating factor in the relationship between stakeholder pressures and CE adoption. Additionally, the argument that stakeholder pressures lead to CEO implicitly assumes a temporal effect, as organizational-level change typically unfolds over time. However, the cross-sectional nature of the current study limits its ability to capture these dynamic processes.

Fifth, while this thesis integrates multiple theoretical perspectives – namely the MLP, stakeholder theory, and complexity theory – to provide a comprehensive analytical framework for understanding SMEs' CE transitions, this approach introduces challenges related to theoretical coherence and parsimony. The complexity of integrating these frameworks may make it difficult to isolate specific effects of individual factors or delineate clear boundaries between theoretical constructs. For instance, distinguishing between meso-level industry dynamics in MLP and relational dimensions in stakeholder theory can be conceptually challenging (Geels & Schot, 2007; Kirchherr et al., 2018). Future research could refine these theoretical integrations by developing hybrid models that explicitly map interactions between systemic structures and stakeholder relationships while maintaining conceptual clarity.

Sixth, although the study emphasizes success factors across micro-, meso-, and macro-levels using a holistic lens, it may not fully capture real-time interdependencies or emergent complexities inherent in CE transitions. The non-linear nature of CE processes means that feedback loops or cascading effects between levels may have been overlooked or oversimplified in this analysis (Cilliers, 1998). For example, small-scale innovations at the micro-level could trigger significant changes at meso- or macro-levels over time – a phenomenon that requires deeper exploration through adaptive systems

modelling or simulation techniques (Manson, 2001). Future research could employ such methods to better understand these emergent dynamics and identify leverage points for accelerating systemic change.

Seventh, the temporal scope of this research presents another limitation. Given the rapidly evolving nature of CE practices, policies, and technologies – such as advances in digital platforms for resource sharing or emerging regulatory frameworks – some findings may become less relevant over time (Zhu et al., 2022). The study's insights are inherently tied to the specific period during which data was collected and may not fully account for future developments in sustainability transitions. Longitudinal research designs or scenario-based analyses could help address this limitation by exploring how SMEs' CE strategies evolve under different future conditions.

Lastly, while this thesis provides practical recommendations for SMEs and policymakers based on its findings, translating these insights into actionable strategies remains challenging due to the complexity of CE transitions and the diversity of SME contexts. One-size-fits-all solutions are unlikely to be effective given variations in firm size, industry sector, geographic location, and regulatory environments (Trevisan et al., 2023). For instance, while financial incentives like subsidies or tax breaks are universally recommended as enablers for overcoming cost barriers (Austin & Rahman, 2022), their design must account for regional differences in policy implementation capacity and SME access to funding mechanisms. Future research could focus on co-developing tailored interventions with SMEs through participatory action research approaches that consider their specific needs and constraints.

5.5 Future Research Directions

Building on the limitations identified in this research, several promising directions for future inquiry emerge, offering opportunities to deepen and broaden the understanding of SMEs' transition to CE practices. These directions address gaps in geographical scope, organizational focus, methodological approaches, theoretical integration, sector-specific insights, and technological applications.

First, expanding the geographical scope of future research is crucial to enhance the applicability of findings across diverse socio-economic and cultural contexts. While this study focused on the Baltic Sea Region, particularly Estonia and Sweden, future research should investigate how CE success factors identified in developed economies might need to be adapted for SMEs in countries with less developed sustainability policies or different cultural attitudes towards environmental issues. For instance, systemic challenges such as inadequate institutional frameworks, limited access to technology, and informal economies prevalent in developing regions could significantly influence CE adoption strategies. Comparative studies across regions would provide valuable insights into how local contexts shape barriers, enablers, and outcomes of CE transitions.

Second, future research could explore the role of Circular Economy Orientation as a mediating factor in greater depth. This study highlighted CEO's ability to enhance organizational responsiveness to stakeholder pressures; however, longitudinal research is needed to understand how CEO develops over time and interacts with internal and external drivers. For example, how does CEO evolve as SMEs overcome initial barriers like financial constraints or knowledge gaps? Additionally, future studies could examine whether CEO moderates the relationship between stakeholder pressures and CE adoption differently across industries or organizational sizes.

Third, future research could broaden the organizational focus to include larger enterprises, non-profit organizations, social enterprises, and public sector entities. Comparative analyses between SMEs and larger corporations could illuminate how organizational scale and resource availability impact CE adoption strategies. For example, large firms may have greater capacity for innovation but face bureaucratic inertia, whereas SMEs may excel in agility but struggle with resource constraints. Additionally, examining CE transitions in non-profit or public sector organizations could provide a holistic understanding of sustainability transitions across various organizational forms. Such studies would help identify cross-sectoral synergies and collaborative opportunities for advancing CE practices.

Fourth, there is an opportunity to extend the focus beyond CE to investigate alternative sustainability frameworks such as regenerative business models. Unlike CE's emphasis on closing material loops, regenerative models aim to create net-positive environmental and social impacts by restoring natural systems and enhancing biodiversity. Future research could examine how SMEs can integrate regenerative practices into their operations, such as adopting agroecological methods in agriculture or designing products that actively regenerate ecosystems. This shift would provide a broader perspective on sustainability transitions by addressing critiques of CE's limitations in achieving full circularity.

Fifth, sector-specific studies are essential to uncover why certain industries are more amenable to CE practices than others. For instance, this research found that sectors like metals demonstrated higher levels of innovation compared to chemicals or electronics. Future work could analyse how industry-specific factors such as supply chain complexity, regulatory requirements, or market demand influence CE adoption pathways. In-depth case studies of successful implementations could identify best practices for overcoming barriers like entrenched linear business models or fragmented supply chains.

Sixth, longitudinal studies tracking SMEs' CE adoption over extended periods would address the limitations of cross-sectional data by capturing the dynamic nature of sustainability transitions. Such research could explore how policy interventions or industry collaborations influence SMEs' ability to sustain circular practices over time. For example, tracking firms' progress could reveal how the importance of R&D capabilities shifts during different phases of CE implementation or how firms adapt their strategies in response to evolving regulatory landscapes.

Seventh, further refinement of theoretical frameworks is needed to capture the nuanced interactions between systemic structures (as analysed through MLP), stakeholder dynamics (Stakeholder Theory), and adaptive processes (Complexity Theory). Scholars could develop more precise constructs to measure these interactions while integrating complementary perspectives such as Institutional Theory or Resource-Based View. These additions would address gaps related to power dynamics and resource management in CE transitions while providing a more comprehensive understanding of multi-level influences.

Eights, future research should explore the transformative role of emerging technologies – such as artificial intelligence, blockchain, and IoT – in facilitating SMEs' transition to CE. These technologies have shown potential to enhance resource tracking, enable closed-loop supply chains, and support new circular business models like product-as-a-service. However, empirical studies are needed to investigate how SMEs can overcome barriers such as high implementation costs or limited technical expertise to adopt these technologies effectively. Research could also examine how digital

platforms facilitate collaboration among stakeholders by creating ecosystems for resource sharing or secondary material markets.

Lastly, exploring policy innovations that support SMEs' transition to CE represents a critical avenue for future research. While this study highlights financial incentives and regulatory frameworks as key enablers, further work is needed to design policies that address SMEs' unique challenges comprehensively. For instance, policies that integrate education and training programs with financial support mechanisms could simultaneously build capacity and reduce cost barriers for SMEs adopting circular practices. Additionally, comparative analyses of policy effectiveness across regions or sectors could identify best practices for fostering systemic change.

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Abstract

Navigating Complexity: Exploring the Dynamics of SMEs' Transition towards Circular Economy

The global economy faces critical challenges from environmental degradation, resource scarcity, and economic instability, necessitating a transition from the unsustainable linear "take-make-dispose" model to a Circular Economy (CE). CE represents a regenerative framework that decouples economic growth from resource consumption and environmental harm by emphasizing closed-loop systems, resource efficiency, and waste reduction. This doctoral research focuses on the multi-faceted transition of small and medium-sized enterprises (SMEs) to CE, addressing systemic challenges and opportunities across micro (organizational), meso (industry), and macro (policy) levels. SMEs are pivotal in this transition due to their economic significance and potential to drive sustainable practices. They exhibit both strengths and challenges in their transition to CE: their agility, innovation capacity, and close community ties enable rapid adoption of circular practices, yet they are constrained by financial limitations, knowledge gaps, cultural resistance, and fragmented supply chains.

The study adopts a holistic perspective by combining the Multi-Level Perspective (MLP), stakeholder theory, and complexity theory to analyse the systemic, relational, and adaptive dimensions of SMEs' CE adoption. Through an explanatory sequential design, the research integrates qualitative and quantitative methods across four phases: initial exploration, quantitative analysis, qualitative analysis, and integration. Empirical evidence from Estonia and Sweden highlights sector-specific barriers, adoption pathways, and success factors for CE transitions.

The research focuses on three interconnected areas critical to understanding the interconnected and complex transition of SMEs to CE. First, it examines the factors and actors influencing CE adoption, spanning organizational practices, industry networks, and broader policy and market frameworks. This analysis highlights how internal resource constraints, external regulatory pressures, and systemic enablers collectively shape SMEs' ability to implement CE principles. Second, the study explores organizational dynamics and stakeholder interactions that influence CE pathways. It emphasizes the interplay between internal capabilities and employee engagement, and external pressures from customers, suppliers, and regulators. Collaborative networks emerge as pivotal in facilitating knowledge sharing and resource pooling, as well as CE orientation, enabling SMEs to overcome barriers to CE adoption. Finally, the research identifies essential components for sustaining CE practices over time, including financial incentives, technical expertise, managerial commitment, and supportive policy environments.

By integrating theoretical perspectives, the thesis provides a holistic understanding of the systemic challenges and opportunities in SMEs' CE adoption. It offers actionable insights for SMEs to enhance their CE orientation while guiding policymakers in designing targeted interventions that address barriers like funding shortages and technical deficiencies. The findings underscore the importance of collaborative approaches across micro-, meso-, and macro-levels to ensure long-term success in transitioning SMEs toward a more CE models.

Lühikokkuvõte

Komplekssuse juhtimine: VKEde ülemineku dünaamika ringmajandusele

Globaalne majandus seisab silmitsi kriitiliste väljakutsetega, nagu keskkonna halvenemine, ressursside nappus ja majanduslik ebastabiilsus, mis nõuavad üleminekut jätkusuutmatult lineaarselt "võta-tooda-viska ära" mudelilt ringmajandusele (CE). CE kujutab endast taastuvat raamistikku, mis lahutab majanduskasvu ressursitarbimisest ja keskkonnakahjudest, rõhutades suletud ahelaga süsteeme, ressursside tõhusust ja jäätmete vähendamist. Käesolev doktoritöö keskendub väikeste ja keskmise suurusega ettevõtete (VKEde) mitmetahulisele üleminekule CE-le, käsitledes süsteemseid väljakutseid ja võimalusi mikro- (organisatsiooniline), meso- (tööstuslik) ja makro- (poliitiline) tasandil. VKEd on selles üleminekus võtmetähtsusega oma majandusliku olulisuse ja jätkusuutlike tavade edendamise potentsiaali tõttu. Nad näitavad nii tugevusi kui ka väljakutseid: nende paindlikkus, uuendusvõime ja tihedad sidemed kogukonnaga võimaldavad neil kiiresti rakendada ringmajanduse praktikaid, kuid neid piiravad rahalised kitsaskohad, teadmiste puudujäägid, kultuuriline vastupanu ja killustatud tarneahelad.

Uuring võtab tervikliku lähenemisviisi, kombineerides mitmetasandilise perspektiivi (MLP), sidusrühmade teooria ja keerukuse teooria, et analüüsida VKEde CE-le ülemineku süsteemseid, suhtelisi ja kohanemisvõimelisi mõõtmeid. Selgitava järjestikuse disaini kaudu integreeritakse uurimuses kvalitatiivsed ja kvantitatiivsed meetodid neljas etapis: esialgne uurimine, kvantitatiivne analüüs, kvalitatiivne analüüs ja süntees. Eesti ja Rootsi empiirilised andmed toovad esile sektorispetsiifilised takistused, rakendusteed ja edutegurid CE-le üleminekul.

Uuring keskendub kolmele omavahel seotud valdkonnale, mis on olulised VKEde keeruka ülemineku mõistmiseks CE-le. Esiteks uuritakse tegureid ja osalejaid, kes mõjutavad CE vastuvõtmist organisatsiooniliste praktikate, tööstusvõrgustike ning poliitika- ja tururaamistike tasandil. Teiseks analüüsitakse organisatsioonilist dünaamikat ja sidusrühmadevahelisi suhteid, mis kujundavad CE-le ülemineku teid. Koostöövõrgustikud osutuvad oluliseks teadmiste jagamise ja ressursside ühendamise hõlbustamisel ning CE suunitluse edendamisel. Lõpuks tuvastatakse olulised komponendid CE praktikate pikaajaliseks säilitamiseks, sealhulgas rahalised stiimulid, tehniline asjatundlikkus, juhtkonna pühendumus ja toetav poliitikakeskkond.

Integreerides teoreetilisi perspektiive, pakub väitekiri terviklikku arusaama VKEde CE-le ülemineku süsteemsetest väljakutsetest ja võimalustest. See pakub praktilisi soovitusi VKEdele nende CE suunitluse tugevdamiseks ning juhiseid poliitikakujundajatele sihipäraste sekkumiste kavandamiseks. Tulemused rõhutavad koostöö tähtsust mikro-, meso- ja makrotasandil VKEde edukaks üleminekuks jätkusuutlikumale majandusmudelile.

Appendix 1

Publication I

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Tarlan Ahmadov

Innovation for Circular Economy: Overview of Estonian Enterprises' Transition Journey

1. Introduction

The concept of circular economy (CE) is viewed as an economic system that can contribute to the sustainability of organizations and challenges the prevailing idea of sustaining linear model growth (Kirchherr et al., 2017; Korhonen et al., 2018; Lieder & Rashid, 2016). It is argued that the transition to CE results in a win-win situation for organizations, the economy, and the environment (Barreiro-Gen & Lozano, 2020; Korhonen et al., 2018).

Although there seems to be an appreciable awareness of the benefits of the CE and substantial public support, implementation remains in its early stages with progress being slow and neither widespread nor uniform (Kirchherr et al., 2018). The adoption of CE practices means having to overcome a variety of barriers and challenges in line, that is, with each firm's strategy, resources, and capabilities. This is especially true of small and medium-sized firms (SMEs), given that they typically face greater constraints regarding the availability of resources (Ormazabal et al., 2018). The role of innovation for CE in the development of SMEs has begun to attract research attention (Iqbal et al., 2021; Jahanshahi et al., 2020). The OECD (2011) proposes that sustainable growth is an inevitable trend in future development and that sustainable development is driven by innovation (Fernández Fernández et al., 2018).

However, to date, data constraints have substantially limited empirical analyses of the barriers to the CE to theoretical and conceptual frameworks and case studies (Govindan & Hasanagic, 2018) and, as De Jesus and Mendonça (2018) have highlighted, more empirical evidence concerning these barriers is still required. In addition, current studies ignore the perspectives from Central and Eastern Europe (Mazur-Wierzbicka, 2021) where enterprise transition to CE comes with a certain delay.

According to the literature, Estonia has acknowledged the importance of implementing CE practices within SMEs. In this context, the government has introduced several initiatives and reforms such as fiscal incentives to accelerate the implementation of digitalization and improvement of resource and energy efficiency (Ahmadov et al., 2022). Also, a recent study by the Tallinn University

of Technology (TalTech, 2022) shows that there is some level of awareness about CE applications in organizations. These findings from Estonia show that although there are policies and initiatives to build a sustainable and low-carbon economy, their uptake by the business organizations is questionable, which warrants further empirical investigation, making the country a suitable candidate for the study.

To fill this gap, in the present study, the author seeks to provide an empirical answer to the following research question: What is the proportion of Estonian firms undertaking technical innovation for circular practices and the difference between industries? and, How Estonian SMEs have encountered with regard to undertaking technical innovations for circular practices? To do so, the author carried out mixed method research, which provides the opportunity to study a set of barriers related to the innovation implementation for circular practices at five phases of the product life cycle.

2. Literature Review

The circular economy reduces the extraction of raw materials from nature and the heap of waste in landfills by extending the useful life of materials and goods already in circulation. Since the CE strategy is founded on claims of saving the environment and increasing GDP, it has garnered a lot of interest from industry and policymakers alike (Ghisellini et al., 2016). Firms must embrace CE principles and make linear models circular and resource-efficient.

Special attention should be given to SMEs, as they represent about 90 % of businesses and more than 50 % of employment worldwide (World Bank Finance, 2021). Manufacturing SMEs are reported to account for 64 % of air pollution, whereas only a small proportion of 0.4 % of these SMEs comply with an environmental management program (Bonner, 2019). This can be attributed to the fact that a manufacturer spends more than 60 % of its income on materials and services (Krajewski et al., 2010). In order for a product, process or service to be more efficient and circular, there is a context of innovation (Neder et al., 2019).

Innovation, in turn, introduces new routines, new procedures and new practices into the production chains that choose to make the transition to the CE (Scarpellini et al., 2020). They range from eco-innovation to the introduction of new business models, environmental accounting, application of the principles of the 3Rs and management of the flow of materials so that they can be reintroduced into new production chains, reused, recycled or remanufactured, thus closing the loop of the material processes.

There are several barriers to adopt advanced environmental measures within SMEs' such as a lack of financial support, inadequate information management system, lack of proper technology, technical and financial resources, lack of consumer interest in the environment, lack of support from public institutions, lack of access to qualified professionals in environmental management, and lack of senior management commitment, which collectively lead to slower and/or unsuccessful uptake of circular economy within these organizations (Ormazabal et al., 2016; Prieto-Sandoval et al., 2018; Ritzén & Sandström, 2017; Rizos et al., 2016).

3. Methodology

The author implemented a mixed methodology, starting with qualitative (group interviews) and quantitative (survey) methods and descriptive in nature.

For the qualitative part of the study, four group interviews were conducted with a heterogeneous sample of SMEs (9 SMEs and 4 industry associations) (Table 1) to explore key themes and develop deeper understandings. These interviews, which comprised a semi-structured interview schedule with follow-up, probing questions around emerging themes, were approximately one hour in length. With the permission of all respondents, these were audio recorded for subsequent transcription for data analysis.

Table 1. Group interview sample structure

Industry	Participants
Manufacture of computers, electronic and optical equipment	2 SMEs
Production of electrical equipment	3 SMEs and 1 industry association
Manufacture of chemicals and chemical products, except plastics industry	2 SMEs and 1 industry association
Production of metal products	2 SMEs and 2 industry associations

For the quantitative part, an online survey questionnaire was set up digitally by the author and distributed in Estonia (October 2021–December 2021). The total number of SMEs targeted was 2,211 from four industries and a total of 440 (≈20 %) responses were received, and based on the screening (removing the partly filled responses) 190 were deemed as useful (complete). All the responses

were considered complete to undertake the analysis without missing values. The demographics of the sample obtained are shown in Table 2.

Table 2. Survey sample structure

Industry	**Number**	**Percentage (%)**
Manufacture of computers, electronic and optical equipment	24	13
Production of electrical equipment	27	14
Manufacture of chemicals and chemical products, except plastics industry	34	18
Production of metal products	105	55
Total	*190*	*100*
Number of employees		
0–9	143	75
10–49	26	14
50–249	21	11
Total	*190*	*100*
Year of establishment		
≤3	33	17
4–9	49	26
≥10	108	57
Total	*190*	*100*

4. Results Analysis and Discussion

4.1. Group Interview

Before exploring the main motivation behind the involvement in CE and the potential challenges that they face, circular initiatives have been a topic of discussion to find out if the participant of the group interview is aware of the CE and if they implement it to some degree. There have been several initiatives already taking place in those firms that participated in the qualitative part of the study. An example from the computer industry, firm A: "running a campaign to buy back lighting from our customers. Because we can recycle all expensive mechanical parts and even electronics." Meanwhile, firm B: "recycling of cable waste so that it can be measured back" and firm C from the electric industry: "waste, e.g. the packaging materials, the raw material of the cable is taken away—it is then sold

back to the manufacturer." There are also some initiatives in the participant from the chemical and metal industry: "we started to pick up the packaging back through the co-network and gave the customer a choice in the e-shop, with or without an outer package"—firm B from the chemical industry; "We do the same packaging, but we put less metal in … makes the material thinner"—firm A from the metal industry. Those mentioned initiatives are examples of circular practices that cover recycling, recovering and redesigning. But the question is what drives those companies to engage in circular activities? To answer the question, group interview participants were asked about their main motivation for the implementation of innovation for circular practices.

Participants also underlined the importance of customer engagement as their driver: "more and more customers are making a much more informed choice and a cleaner / more sustainable choice"—firm A from the chemical industry; "The main motive is efficiency … If you don't think about it (innovation for CE), there's nothing to do with Scandinavia"—firm A from the metal industry. Moreover, improvement in product design toward circularity leads to motivating consumers to opt for such products (Cui et al., 2017). In the case of group interview participants, the Ecodesign directive by European Commissions motivate them to develop more efficient products: "The Ecodesign Directive (Ecodesign and Energy Labelling—2009/125/EC) also points in the direction of developing more efficient products"—firm A from the electric industry.

A company's policies and strategies are considered a significant cornerstone for the successful implementation of circular practices (Ferasso et al., 2020). However, when these policies are not devised appropriately in coherence with other sectors, such as service providers, governing bodies and stakeholders, they become a salient restraint (Kumar et al., 2019). In the case of firm B from the computer industry, they see company strategy as a barrier to innovation: "As part of big company …. we are developing the printed circuit board here (Estonia). There is no other innovation." In this case, they are not fully involved in the product life cycle and are limited to a single phase where they cannot innovate toward CE.

The extant literature has recognized financial and cost barriers as significant hindrances to circularity implementation (Kirchherr et al., 2018). A firm's transition to CE requires massive investments in technological ventures, employee training for new operations and the production and sale of circular products. Similar to the literature, the participant in the group interview sees finance as one of the main barriers. Participant C from the electric industry put financial barriers as: "Upgrading the equipment is certainly necessary, but it is lagging behind the finances" and "Cooperation with science is a painful issue."

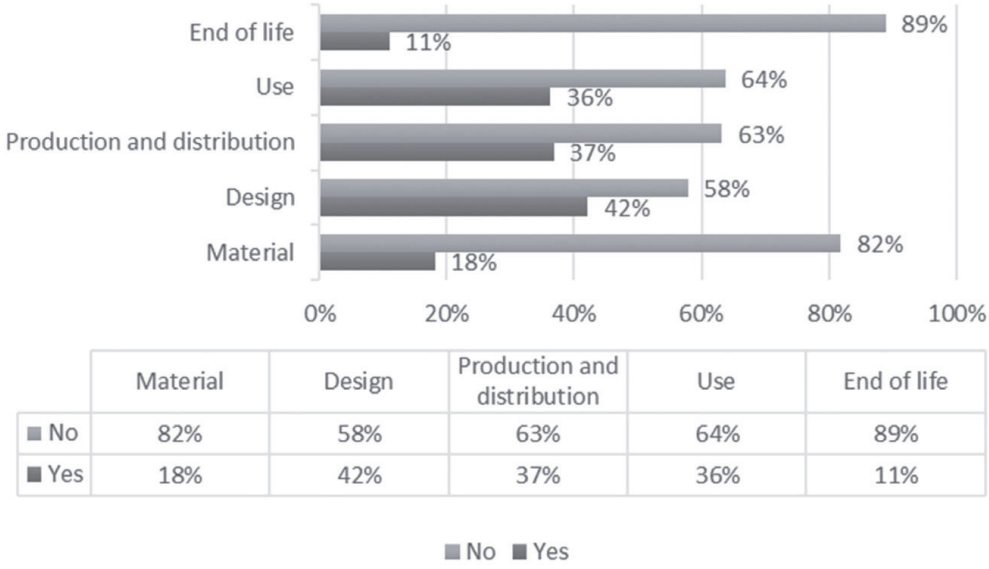
Meanwhile, an industry association from the chemical industry confirm firm C by adding: "A company does not digitize if the process is expensive." The financial barrier exists in the electric industry as firm B states: "Everything is still behind the finances."

The lack of knowledge regarding the circular practices among participants was considered a barrier. An example of firm B from the metal industry: "we still have no knowledge" and this statement was confirmed by the industry association in the same industry: "It (innovation abilities and skills) is not particularly available in Estonia and there is no competence" and "human resources are the biggest problem." However, in addition to knowledge as a barrier, collaboration between partners is also seen as the main barrier in the case of group interview participants. Bocken et al. (2016) indicated social relationships and collaboration as crucial components of the closed-loop supply chain and in the case of the chemical industry in Estonia: "most partners did not find it worthwhile to start cooperating"—association from the chemical industry. Also, the lack of knowledge regarding collaborations continues to impede firms' efforts to adopt circular practices (Jabbour et al., 2019) and this is relevant for firm A from the electric industry: "it's hard to find a partner to practice."

4.2. Questionnaire

This section presents the results of the survey study which will provide a broader understanding of the results. To investigate survey responses, the Statistical Product and Service Solutions (SPSS) software version 27 was used to sort, code and analyze using descriptive statistics such as percentage and frequency distribution. Analysis of variance was used to measure constraints hindering technical innovation implementation for circular practices by Estonian SMEs.

According to the participants' answers, 42 % of the participants had been engaged in an innovation implementation for circular practices in some way, which was done in the phase of product design (Figure 1). The results presented in Figure 1 demonstrated the application of innovation for circularity along the life cycle of the product. Most of the participants have not implemented any innovation at the end-of-life phase and material phase which accounts for 89 % and 82 %, respectively.



	Material	Design	Production and distribution	Use	End of life
No	82%	58%	63%	64%	89%
Yes	18%	42%	37%	36%	11%

Figure 1. The proportion of implementation of innovation for circular practices
Source: Author's own, N = 190 firms

The SME's involvement in innovation for circular practices in Estonia varies based on the industry. Figure 2 demonstrates the share of innovation implementation for circular practices within industries. In the computer industry, technical innovation is implemented mostly in the use phase and followed by the design phase. The production and distribution phase also innovated in the computer industry compared to the material and end-of-life phases where the innovation is only 17 % and 15 %, respectively. Meanwhile, data from the electric industry demonstrate that most innovation for circular practices takes place in the design phase at 42 % and follows by the production and distribution as well as use phase (31 % and 30 %). End-of-life phase is the least innovative phase in the electric industry in Estonia, where only 6 % of participants are involved in innovation for circular practices. The chemical industry, on the other side, is mostly involved in production and distribution as well as the use phase with 29 % and 24 %, respectively. The other three phases, share a similar result for innovation implementation, between 13–16 %. Results from the metal industry demonstrate the current involvement in innovation for circularity takes place in the design, production and distribution and use phases with 47 %, 36 % and 33 %, respectively. Also, some technical innovation is implemented in the material phase, as 20 % of respondents from the Estonian metal industry confirm their

engagement with technical innovation for circular practices. End-of-life phase of metal products comes as the least innovative phase, only 10 %.

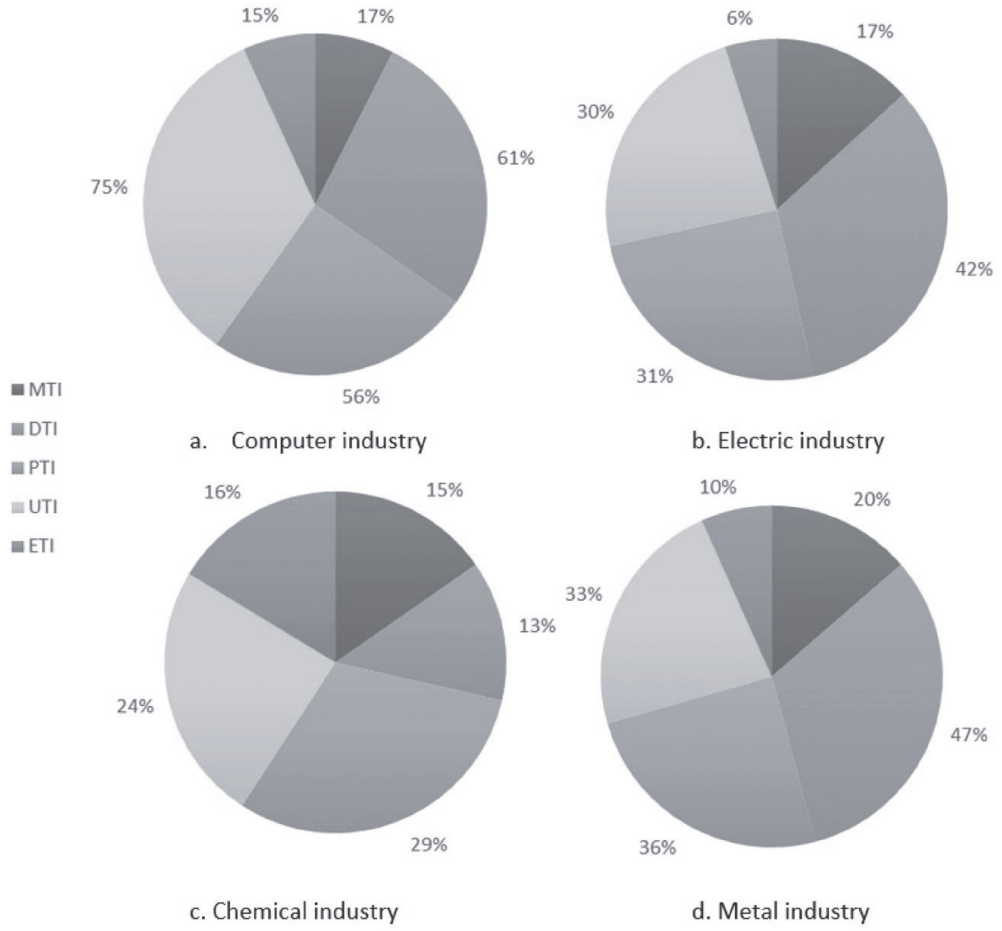


Figure 2. Share of innovation implementation for circular practices in each phase of a product life cycle in four industries. Shares as a percentage of each industry's innovative activities in the relevant phase

Source: Author's own, N = 190 firms

The questionnaire also covers the aspect of why technical innovation is not implemented in each phase of the product life cycle of Estonian SMEs. To uncover the reasons, a set of options is developed based on the literature and provided: (1) We lack necessary knowledge; (2) There is a lack of trust; (3) Our current financial situation does not allow it; (4) It is hard to get a loan; (5) It is

not a priority; (6) Lack of potential cooperation partners; (7) It is not applicable to us; (8) Other. Questionnaire participants also could specify other reasons in each section of the above-listed options did not cover the barrier that they face.

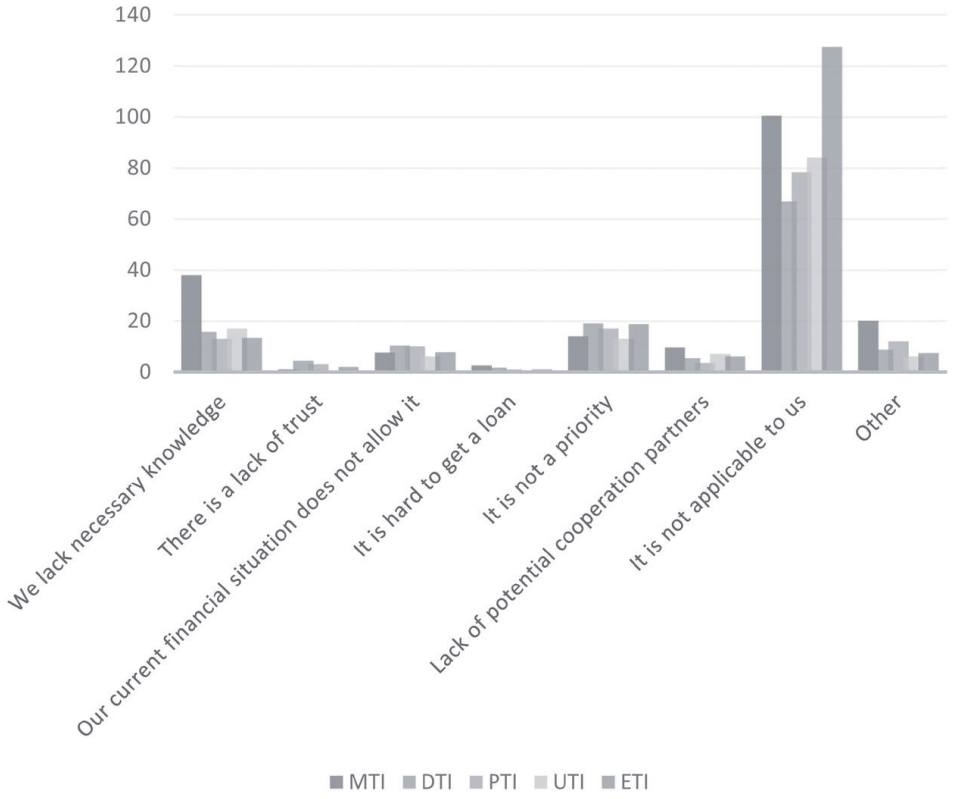


Figure 3. Share of SMEs that encountered any of the following issues when undertaking innovation for circular practices

Source: Author's own, N = 190 firms

Figure 3 shows the reasons Estonian SMEs for not implement technical innovation for circular practices. The majority of the respondents selected the "it is not applicable to us." The reason for SMEs to select "it is not applicable to us" or "it is not a priority" can be as a barrier to the implementation of innovation for CE, either due to the unfamiliarity of the concept of CE (Ormazabal et al., 2018) or due to the non-existent exchange of information among companies (Piñeiro-Chousa et al., 2019). The majority of firms selected this reason for not implementing innovation for circular practices the reason for this is probably that the sample includes all SMEs, regardless of their knowledge of CE. To dive

more into the reasons, the author excluded the option of "it is not applicable to us" in Figure 4 to show the details of what Estonian SMEs perceive as a barrier to innovation implementation.

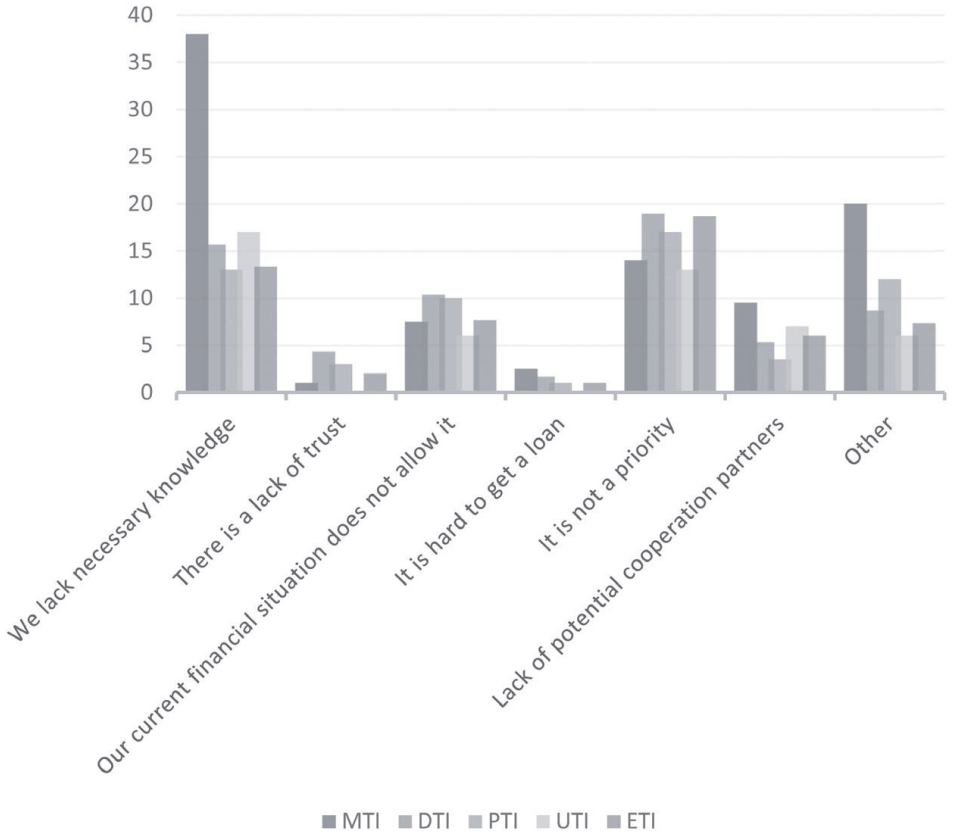


Figure 4. Share of SMEs that encountered any of the following issues, excluding the "it is not applicable to us" option when undertaking innovation for circular practices

Source: Author's own, N = 190 firms

Figure 4 shows the survey respondents lack the necessary knowledge to implement technical innovation for circular practices. One of the barriers that empirical investigation brought is collaboration. CE implementation involves complexity and interdependence between the actors that no company can achieve alone, so joint action by an entire ecosystem is necessary (Parida et al., 2019). Gregory et al. (2020) also concluded that the transition to CE depends on the recognition by stakeholders that no single actor can address the core issue alone. Respondents also could specify their reason why they are not engaged with innovation. Among

the answers, some SMEs respond as: "We do not engage in production ourselves" "the final product is 95 % completed by a subcontractor" where they outsource the production part or "we are not product owners and what is left from our facility, does not come back" or "our production is handicraft, there is no such technology" which is not applicable to them or "there are no technologies used in our field" which might be based on the lack of awareness and knowledge in the field or "small business, not so financially reasonable" which the financial aspect seen as the barrier or "we deal with very old designs. … as a result, the design does not allow for change" or "we are subcontractors" where they do not involve in the product design phase of the product life cycle. Similar to the findings from the literature, SMEs in Estonia see finance as the barrier to the innovation implementation for CE and it is followed by a lack of potential cooperation partners. Lack of trust and access to a loan for innovation implementation is not considered an important barrier in the case of Estonia.

5. Conclusion

The results have shown that Estonian SMEs' involvement in innovation for circular practices is uneven across the product life cycle. The most interest is given to the product design phase, while the material and end-of-life phases are neglected. This result can be explained by the firms' perceived barriers on their journey for innovation which are lack of knowledge, missing technological know-how, and lack of awareness that leads them to not prioritize sustainability. The innovation is necessary to leave behind the traditional business practices and commit to new circular practices and new ways of operating in the supply chains that allow the circle to be closed and all the waste to be taken advantage of.

Based on the results of the empirical investigation of Estonian SMEs' involvement in innovation for circular practices, some recommendations are drawn to policymakers to accelerate the transition of SMEs in Estonia toward CE. To foster the transition toward a CE, a policy framework needs to be developed and strengthened; there must be diverse support mechanisms in addition to institutional support; implementation support programs need to be developed for companies to help them engage with partners to straighten collaboration. Finally, end consumers and citizens should be educated on the environmental, economic and social advantages of purchasing close-the-loop products. This would lead to support for CE-oriented companies that have undertaken a strategic path to sustainability, generating a positive return on their investment.

To conclude, some future research directions are suggested that emerge from the findings. Future research could investigate organizational factors to map

more in detail the human aspect of the challenges that Estonian SMEs face. In addition, explore the impact of public incentives on the uptake of CE among businesses of different sizes and sectors. Finally, researchers could also examine the extent to which a company's inclination toward the CE effectively affects its creditworthiness.

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Appendix 2

Publication II

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SMEs on the way to a circular economy: insights from a multi-perspective review

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Abstract

The transition to a circular economy (CE) has garnered widespread attention as a solution to address economic, environmental, and social challenges. While large enterprises and policymakers have made steps in adopting CE practices, small and medium-sized enterprises (SMEs) face unique challenges due to limited resources and expertise. Understanding the multi-level perspective (MLP) is essential for SMEs to successfully transition to a CE, as it considers factors at the micro, meso, and macro levels. However, current research often focuses on single levels, necessitating a comprehensive understanding of the phenomenon through systematic research. To address this need, this study conducts a systematic literature review (SLR) using the MLP framework to analyse existing research on SMEs' transition to a CE. The study aims to identify macro-, meso-, and micro-level factors, actors, and mechanisms influencing the transition process. The SLR contributes to academic understanding by developing a conceptual model that elucidates the dynamics of the circular transition process within SMEs. Additionally, it provides practical recommendations to support SMEs in navigating the transition successfully. The adoption of the MLP framework empowers SMEs, policymakers, industry associations, and consumers to play their roles effectively in driving the CE transition. While the study acknowledges certain limitations, it opens avenues for future research and enhancement of CE practices in SMEs.

Keywords Small and medium-sized enterprises · Circular economy · Multi-level perspective · Transition · Systematic literature review

JEL Classification M10 · Q56

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1 Introduction

The emergence of the circular economy (CE) as an alternative to the linear economic model has garnered significant attention as a means to address economic, environmental, and social challenges (Cagno et al. 2023; Knable et al. 2022). The CE concept revolves around the idea of decoupling economic growth from resource extraction and environmental destruction (Franzo et al. 2021). Governments, companies, and influential figures from various sectors are increasingly recognizing the importance of transitioning to a CE to combat resource scarcity (Maher et al. 2023) and mitigate environmental impacts (Schroeder et al. 2019; Yang et al. 2023). This urgency stems, among other things, from the pressure exerted on the global economy by the continuous consumption of finite resources (Ibn-Mohammed et al. 2021). However, despite growing attention and efforts, the global economy's circularity remains low, with only 8.6% being circular, and resource recycling rates are generally insufficient (Circle Economy 2020; Tan et al. 2022).

While large enterprises and policymakers have started adopting CE practices (Garces-Ayerbe et al. 2019; Ghisellini et al. 2016), small and medium-sized enterprises (SMEs), defined by the European Union as businesses that employ up to 250 people with an annual turnover of up to EUR 50 million (EC 2020), face distinct challenges due to their limited resources and expertise (Dey et al. 2019; Mura et al. 2020). Although SMEs play a vital role in the global economy, contributing to economic growth, employment, and innovation, their capacity to adopt CE practices is often constrained compared to larger enterprises (Rotar et al. 2019). Against the background of their importance, the active involvement and support of SMEs in the transition to a CE is not only critical but also essential for achieving widespread sustainable change (Smith et al. 2022). While existing literature has shed light on various aspects of SMEs' transition to a CE, such as management (Khan et al. 2023), strategies (Yazdani et al. 2021), supply chains (MahmoumGonbadi et al. 2021), innovation (Suchek et al. 2021), government policies (Mhatre et al. 2021) and others, in this vein, there is a lack of studies on SMEs transition to CE that consider a broader, multi-level perspective. It is crucial to recognize the significance of implementing CE at various levels, as acknowledged by multiple scholars. The micro-level involves factors at the firm level (Ghisellini et al. 2016). The meso-level pertains to the geographical proximity of supply chain partners and market-related aspects, such as customer acceptance (Delgadillo et al. 2021; Ghisellini et al. 2016) while the macro-level encompasses policy structures (Kirchherr et al. 2017).

However, current research often focuses on just one level, disregarding the fact that SMEs transitioning to CE require considering multiple perspectives. To transition towards CE, one must take into account various levels and overcome obstacles collectively. Despite the wealth of attention paid to the topic, a comprehensive understanding of the phenomenon is essential, requiring systematic research that looks in more detail at the interdependence and interactions of businesses with other stakeholders, specifically for SMEs (Dzhengiz et al. 2023; Trevisan et al. 2023),

facilitating the successful transition towards CE. It is necessary to unpack the multi-level perspective of SMEs transition towards CE, increase the knowledge of the different levels that are missing in the previous literature.

To address this gap, this study adopts the Multi-Level Perspective (MLP) framework as a theoretical lens. This framework explains social transformations that elaborate both the bottom-up and top-down dynamics and the multi-level nature of change (El Bilali 2019; Geels 2002, 2020; Walrave et al. 2018), offering a holistic view of the complex relationships and interactions among factors, actors, and mechanisms that influence SMEs' transition to a CE (Trevisan et al. 2023). By shifting the research focus from single-level aspects to the MLP, this study aims to identify and examine macro-, meso-, and micro-level factors, actors, and mechanisms that shape the transition to a CE within SMEs. The application of MLP can provide a systematic approach to examining intricate and extensive transitions such as sustainability (Kuhl et al. 2023; Smith et al. 2010), and can be applied for transition to CE. Therefore, MLP serves as a valuable theoretical lens for analysing the dynamics of the transition process.

The primary objective of this paper is to conduct a systematic literature review (SLR) using the MLP approach as the theoretical lens to determine and analyse existing research on SMEs' transition to CE. The guiding research question for this study is: How does the existing literature analyse and address the factors, actors, and mechanisms that influence the transition process toward CE in SMEs, as viewed through the lens of the Multi-Level Perspective?

By examining the factors, actors and mechanisms in-depth, this review aims to contribute to both academic understanding and practical implementation. The academic contribution lies in the development of a conceptual model that elucidates the dynamics of the circular transition process within SMEs, incorporating the interplay of factors, actors, and mechanisms at multiple levels. Additionally, this study seeks to provide practical recommendations to the unique challenges faced by SMEs, enabling them to navigate the transition successfully.

The paper is structured as follows: Sect. 2 provides the theoretical background on SMEs' transition to a CE and the MLP framework. Section 3 details the methodology employed for the systematic literature review. This is followed by sections presenting and discussing the findings in Sect. 4. Section 5 discuss the findings and Sect. 6 concludes the paper, presenting future research avenues and study limitations.

2 Theoretical background

2.1 CE and SMEs transition towards CE

CE has garnered significant attention and recognition for its potential to address pressing global challenges related to sustainability, resource efficiency, and economic growth. Several articles highlight its multifaceted benefits, emphasizing its capacity to reduce waste, promote sustainable development, and enhance resource efficiency (Bowen et al. 2023; D'Angelo et al. 2023; Neri et al. 2023; Shao et al.

2023). The adoption of CE strategies has been identified as a crucial factor in achieving sustainability goals, offering economic, environmental, and social advantages (D'Angelo et al. 2023). Moreover, the implementation of CE practices at the SME level is seen as a faster route to reaching sustainable development targets, underscoring its potential environmental and economic advantages (Massari and Giannoccaro 2023). The concept's appeal lies in its ability to decouple economic and social growth from natural resource usage and environmental degradation (Mura et al. 2020). Furthermore, the transition to a CE can lead to a low-carbon economy, reduced greenhouse gas emissions, and increased workforce opportunities (Findik et al. 2023). Governments, industries, and societies worldwide are actively promoting the CE concept to tackle resource scarcity and environmental concerns (Sohal and De Vass 2022). With its emphasis on redesigning products and processes, circular principles are expected to pave the way for more sustainable business practices (Hull et al. 2021). According to Zhu et al. (2022), CE is becoming increasingly important as a guiding framework for a more sustainable future that balances social, economic and environmental considerations. Arranz et al. (2022) note a consensus on the power of CE that underscores the need for a restorative industrial system that ensures economic growth while preserving natural capital and promoting societal well-being. The importance of incorporating sustainability into business strategies and product design is also increasingly acknowledged in organizations (Dorado et al. 2022).

Considering the discussion around CE by various researchers (e.g., Arranz et al. 2022; Ahmadov 2023; Bowen et al. 2023; D'Angelo et al. 2023; Dorado et al. 2022; Findik et al. 2023; Hull et al. 2021; Massari and Giannoccaro 2023; Mura et al. 2020; Neri et al. 2023; Shao et al. 2023; Sohal and De Vass 2022; Zhu et al. 2022), we view CE as an economic model that seeks to decouple economic growth from resource consumption and environmental degradation by promoting the continuous flow and regeneration of materials and resources within the system. It aims to design out waste and pollution, maintain the value of products, and regenerate natural systems. CE is crucial because it presents a sustainable alternative to the traditional linear economy, where resources are extracted, used, and then discarded as waste. Through a circular approach, CE can significantly contribute to reducing waste, increasing resource efficiency, and promoting sustainable development.

Morseletto (2020) suggests that adopting a methodical approach is crucial for transitioning towards CE, and this involves developing a tool to analyse a company's current position and establish a route for the transition. Merli et al. (2018) also emphasize the importance of such a methodical approach. In line with this, a sustainable business model, often referred to as a circular business model (CBM), is defined as one that focuses on creating value by utilizing economic value present in items after their initial use, to manufacture new offerings (Frishammar and Parida 2019; Linder and Williander 2017; Rittershaus et al. 2023; Shao et al. 2023). This view aligns with the idea of closed-loop supply chains and encompasses practices like recycling, remanufacturing, reusing, refurbishing, restoration, or repair (Linder and Williander 2017). By embracing a circular business model, companies can capitalize on the economic benefits of reusing resources and minimizing waste,

contributing to both their profitability and environmental sustainability (Lahti et al. 2018; Lüdeke-Freund et al. 2019; Riesener et al. 2019).

As far as strategies are concerned, Barros et al. (2021), for example, highlight the significance of prioritizing sustainable strategies, such as implementing a circular supply chain. According to their research, to effectively achieve CE, companies need to collaborate, communicate, and configure their operations across different business units and organizational functions. This approach aims to close energy and waste loops, thereby reducing resource consumption and minimizing leakages. Geissdoerfer et al. (2018) further emphasize that working together and fostering collaboration are essential for attaining long-term competitive advantages in the context of a circular supply chain. By adopting such collaborative measures and implementing circular practices, companies can facilitate a successful and enduring transition towards sustainability, promoting both environmental preservation and economic prosperity.

According to Lieder and Rashid (2016), the implementation of a CE can occur through two main approaches. Firstly, it can be driven from the top down by society through legislation and regulations, encouraging businesses to adopt circular practices and policies. Secondly, it can also be initiated from the bottom up by industries, who may find a competitive edge and improved profitability by focusing on environmental impact, economic benefits, and resource scarcity while transitioning towards circular models. Kirchherr et al. (2017) and Korhonen et al. (2018) propose a view of the potential transition as an economic system that supports companies in remaining viable while challenging the traditional linear model of growth and resource optimization. Emphasizing the importance of reducing raw material consumption and recovering waste through recycling or repurposing, these researchers highlight that the government's role is vital in guiding and supporting this transition as well. By adopting either top-down or bottom-up approaches and redefining economic systems, societies can pave the way for a sustainable future, where CE fosters both business viability and responsible resource management.

In recent years, there has been significant attention towards the transition to a CE and given that over 99% of businesses in the European Union are SMEs, accounting for two-thirds of total employment (Eurostat 2020), their crucial role in driving this shift is evident. Nevertheless, the shift from linear to circular operations requires a complete restructuring of industries in terms of development, management, operations, supply chain, business strategy, and customer relationships (Frishammar and Parida 2019). Previous research suggests that organizations implementing CE principles gain a competitive edge over traditional linear models (Rizos et al. 2016). However, diverse stakeholder interpretations of the CE concept seem to have led to ambiguous strategies for implementation and operationalization (Ho et al. 2023). Hence, the development of a well-conceived plan becomes vital to effectively address the complexity of this transformation. By adopting comprehensive, industry-specific strategies and fostering collaborative efforts between governments, enterprises, and consumers, businesses can successfully navigate this paradigm shift towards a circular and sustainable future, unlocking opportunities for innovation, competitiveness, and long-term growth while minimizing environmental impact (Assmann et al. 2023; Mauss et al. 2022; Piispanen et al. 2022).

To facilitate the understanding and support of SMEs in their CE transition, researchers have proposed several frameworks. One notable approach is the MLP framework, which has found application in various contexts including small firm contexts. Researchers (e.g., Malik et al. 2022; Zhu et al. 2022) have developed conceptual frameworks that outline the micro-, meso-, and macro-level factors influencing the adoption of CE practices in SMEs operating in emerging markets. These frameworks can aid SMEs and the broader economic to increase a successful transition towards CE.

2.2 The multi-level perspective as the theoretical underpinning

The MLP is viewed as a promising analytical tool for comprehending socio-technical transitions and their complexities. The tool was first postulated by Rip and Kemp (1998), and further refined by Geels (2002) as an analytical framework that conceptualises transition processes as the result of the interplay of developments at three analytical levels. This framework provides a comprehensive approach to investigating technological transitions, recognizing the interplay of micro-, meso-, and macro-level factors (Klein et al. 1999).

At the micro-level, niches are identified as breeding grounds for radical innovations. These innovations, shielded by specific contexts or supported by targeted policies, hold the potential to instigate transformative changes within established systems (Geels et al. 2017). The micro level refers to wider firm-level factors affecting how a firm proposes, creates, captures and delivers value for its stakeholders in the context of a CE (Joore and Brezet 2015). At this level, the literature (e.g., Bocken and Geradts 2020; Kirchherr et al. 2018; Tura et al. 2019) referred organisational factors linked to strategy, culture, structure and processes as micro level perspective.

The meso-level is represented by socio-technical regimes, comprising institutionalized sets of rules that govern agent groups and their actions within socio-technical systems (Geels 2004, 2011). The literature addressing this level points to various actors, from the geographical proximity of supply chain partners (Delgadillo et al. 2021), to market-related factors, such as customer acceptance (Hina et al. 2022; Kirchherr et al. 2018; Vermunt et al. 2019) as meso level factors. Additionally, the macro-level encompasses broader external factors, such as cultural changes, political shifts, and macro-economic trends, which exert influence over both the regimes and niche innovations (Geels 2002, 2012). An example of a macro-level perspective could be a change triggered by an increasing societal awareness of the urgency and need to transition to a more CE society (Vermunt et al. 2019).

Several advantages are associated with MLP that make it highly applicable to studying SMEs in their transition to CE. Firstly, the framework offers an integrated and systemic perspective for examining socio-technical change (Whitmarsh 2012). Secondly, the focus on niche innovations aligns well with SMEs' potential role as niche innovators (Maher et al. 2023). The emphasis on radical changes sheds light on how SMEs can spearhead transformative shifts in the transition to CE. Moreover, MLP's analysis of socio-technical regimes can enable the identification of barriers that SMEs

encounter while navigating the complexities of transitioning to CE-related practices. Additionally, it provides insights into the governance mechanisms enacted by various actors at different levels, elucidating the roles of government, industry, and society in facilitating or hindering the transition process (Chembessi et al. 2023).

To sum, the MLP literature argues that transitions come about through interacting processes within and between these levels and highlights how novelty, as captured in new knowledge, ideas, and practices is derived from a niche group of innovators, spreads to the socio-technical regimes and before finally shaping into a sound practice at a societal level (Geels 2002; Zhu et al. 2022).

3 Methodology

To develop a comprehensive understanding of the research progress related to SMEs transitioning to CE, we conducted a SLR utilizing a combined approach of descriptive statistical analysis, by diving into the evolution of the research, use of methodologies and theories, and qualitative content analysis (Lahane et al. 2021; Sudusinghe and Seuring 2022; Tranfield et al. 2003). A SLR approach was chosen due to its effectiveness in rigorously investigating the current state of research in a specific area (Kraus et al. 2020).

To answer our research question, the SLR followed a five-step process which are outlines in the following.

The initial step involved conducting a search and selecting relevant strings to survey the existing literature in the Web of Science (WoS) and Scopus databases. These platforms were chosen for their comprehensive coverage of articles from various databases, ensuring the availability of reliable metadata for descriptive statistics and content analysis. After multiple simulations, search strings were refined to align more closely with the study's objectives. The selected search string was:

"circul*" AND ("SME" OR "SMEs" OR "small and medium enterpris*" OR "Small and medium-sized enterpris*" OR "small and medium-sized business*" OR "entrepreneur*") AND ("trans*" OR "chang*" OR "proces*").

All academic articles recorded in English in these databases until 9th June 2023 were considered as part of the initial group (please refer to "Appendix" for more details).

In the second step, we conducted a screening process for the initial sample of 357 documents. Duplicate documents were removed, resulting in a reduced set of 272 documents. The third step involved a careful examination of the title, abstract, and keywords of these documents, applying selection criteria to identify those that studied SMEs' transition to a CE. This process led to the exclusion of 139 documents, leaving a final set of 133 documents. The fourth step, involved a comprehensive review of the full text of all 133 documents, applying the selection criteria to determine if the document specifically studied the transition of SMEs to a CE. As a result, 38 documents were excluded, leaving a final set of 95 documents for further analysis. In the fifth step, we utilized these 95 documents to perform descriptive statistical analysis and content analysis, enabling us to address the research question.

Table 1 Usage of theories and their frequency

Theory	Frequency	Publication Years
Resource-based view (RBV and NRBV)	13	2021, 2022, 2023
Institutional theory	6	2021, 2022
Dynamic capability theory (DCT)	4	2020, 2022
Absorptive capacity (ACAP) theory	3	2022, 2023
Grounded theory approach	3	2022, 2021
Multi-level perspective (MLP)	2	2022, 2023
Self-determination theory (SDT)	2	2022, 2023
System dynamics (SD) theory	1	2021
Extended theory of planned behaviour (ETPB)	1	2021
Fuzzy set theory	1	2021
Institutional entrepreneurship (IE)	1	2021
Contingent theory (CT)	1	2023
Leader-member exchange theory (LMXT)	1	2023
Organizational learning	1	2021
Paradox theory	1	2019
Pecking-order theory	1	2020
Practice-based view (PBV)	1	2022
Stakeholder theory	1	2022
Signaling theory	1	2021
Socio-technical systems (STS) theory	1	2022
Subjectivist entrepreneurial theory	1	2020
System theory	1	2022
Theory elaboration	1	2022
Theory of reasoned action (TRA)	1	2022

We used NVIVO 14 and MS Excel to analyse the articles and produce the descriptive results (please refer to Figs. 2, 3, 4 and Table 1). The content analysis led to the emergence of codes, introducing a feedback loop to enhance the content analysis for the entire iterative process. Content analysis embrace both quantitative and qualitative research (Kannan et al. 2022). This approach holds promise for exploring challenging yet vital issues of interest to management researchers through rigorous investigation of articles, providing valuable insights and understanding of complex managerial phenomena and organizational dynamics (Duriau et al. 2007). The content analysis used in this paper followed the main steps proposed by Mayring (2014), including the review idea (research questions, search strategy, and coding), operationalization (frequency counts and cross-tabulations), and the results and main conclusions (interpretation).

The coding process adhered to the Webber protocol (Duriau et al. 2007), involving various stages: (a) defining the recording units as word and text segments on various levels of MLP and factors, (b) determining the coding categories related to SMEs' transition to CE, (c) identifying codes for the transition themes and

categories from MLP, (d) testing the coding on a sample of text to create a codebook by assigning values to text, such as frequency and presence/absence of information, (e) assessing the accuracy and reliability of the sample coding by comparing the code database and the research database, (f) revising the coding rules to ensure they capture the core of texts related to SMEs' transition to CE, (g) coding all the text and finalizing the codebook, and (h) evaluating the achieved reliability and accuracy by comparing the complete research database with the completed codebook using multiple coders to ensure data source validity, specifically from journals indexed in Scopus or WOS. The research question was ultimately addressed through content analysis of the final sample size of n = 95. The complete process comprising all five steps is illustrated in Fig. 1.

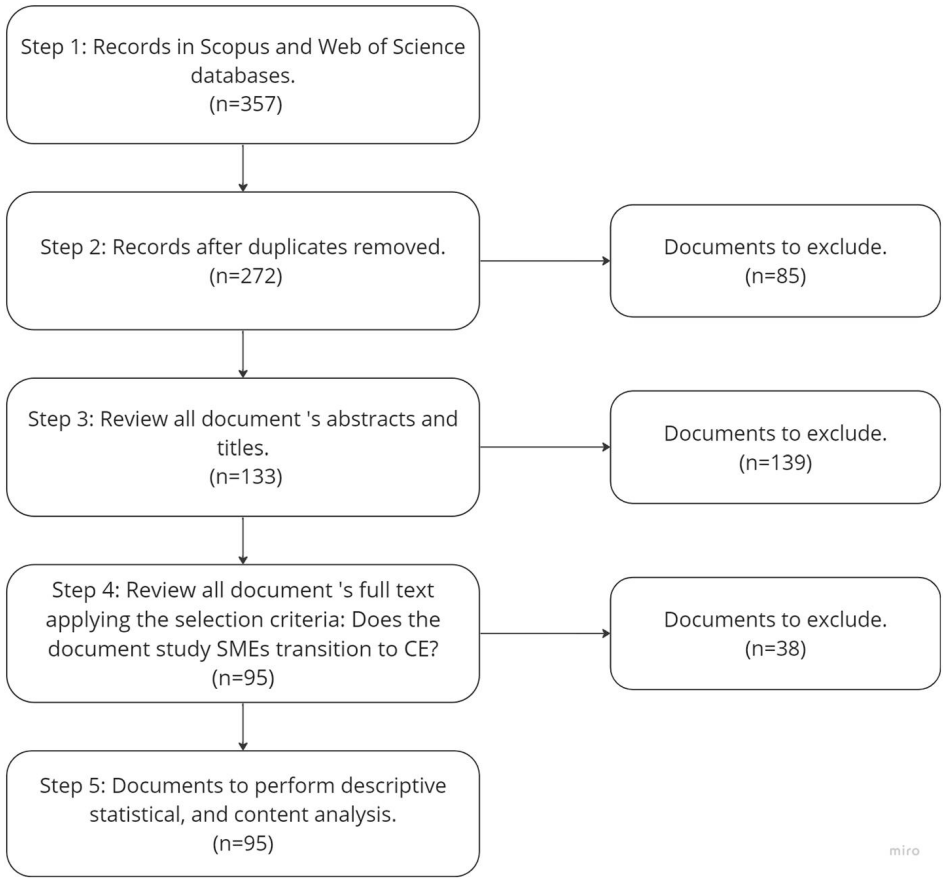

Fig. 1 The data selection process

4 Results

This section is structured as follows. Section 4.1 provides the descriptive statistical analysis and Sect. 4.2 presents the results of the content analysis of the reviewed articles.

4.1 Descriptive analysis of reviewed articles

Figure 2 summarizes the evolution of the number of articles in business and management fields since 2018. Notably, starting from 2021, the topic has gained considerable momentum, with around 80.0% of all articles published (27.0% in 2021, 40.0% in 2022 and 13.0% in 2023).

Regarding the research methods employed in the analysed papers, over the six-year period from 2018 to 2023, we can see the shift in methods employed (Fig. 3). While case studies maintained a prominent position as the most widely used method, the prevalence of surveys significantly increased, becoming a dominant research tool by 2022. The use of interviews showed consistent relevance throughout the period covered, while conceptual development and focus groups displayed moderate and steady usage, respectively.

Throughout the years, a diverse range of theories has been employed. Notably, the resource-based view (RBV) and the institutional theory emerged as the most frequently used theoretical frameworks. RBV and natural resource-based view (NRBV), provided a foundation for several studies, emphasizing the significance of an organization's resources in achieving a CE (e.g., Agyabeng-Mensah et al. 2022; Schmidt et al. 2021). Additionally, institutional theory, often combined with other

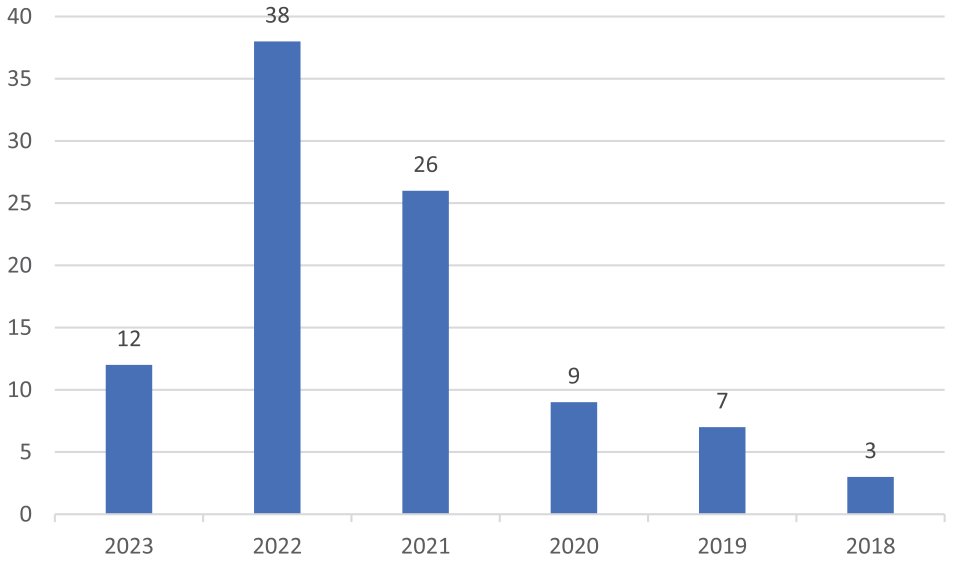

Fig. 2 Evolution of publications by year across the period of analysis (up to June-2023)

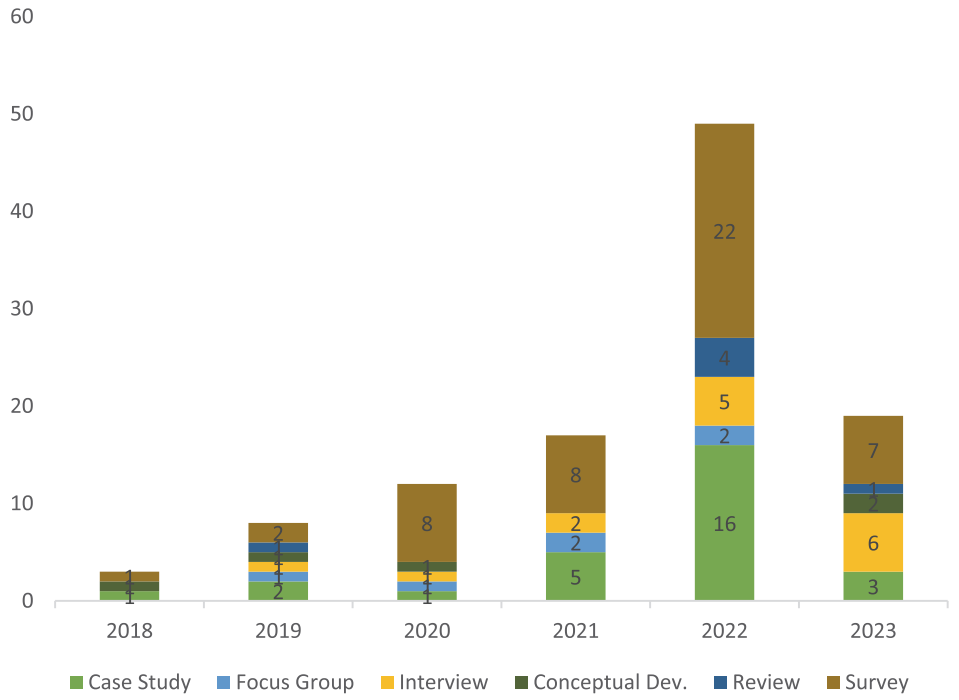

Fig. 3 Publications by research method

perspectives such as institutional entrepreneurship and resource-based view, showcased its relevance in understanding how organizations influence and are influenced by the broader institutional context in the context of CE adoption (e.g., Arranz et al. 2022; Mathivathanan et al. 2022). Furthermore, dynamic capability theory (DCT), Absorptive capacity (ACAP) theory and Grounded theory approach were also notable theories used in a considerable number (29/50) of publications during the studied period.

However, it's worth noting that the application of theories in this field has been somewhat limited. This can be attributed to the emerging nature of the research field, variations in study types and disciplines, and instances where studies do not explicitly mention or employ specific theories or theoretical frameworks. Additionally, some authors may choose to adopt an exploratory approach to understand specific CE practices or phenomena without grounding their work in a particular theory.

Out of the 95 documents analysed, they were published in a total of 31 different journals. A significant concentration of 54 documents, which accounts for 57% of the total, was found in only three specific journals. These journals include "Journal of Business Research" with 19 publications, "Business Strategy and the Environment" with 18 publications, and "Journal of Cleaner Production" with 17 publications. The findings regarding the journals is presented in Fig. 4.

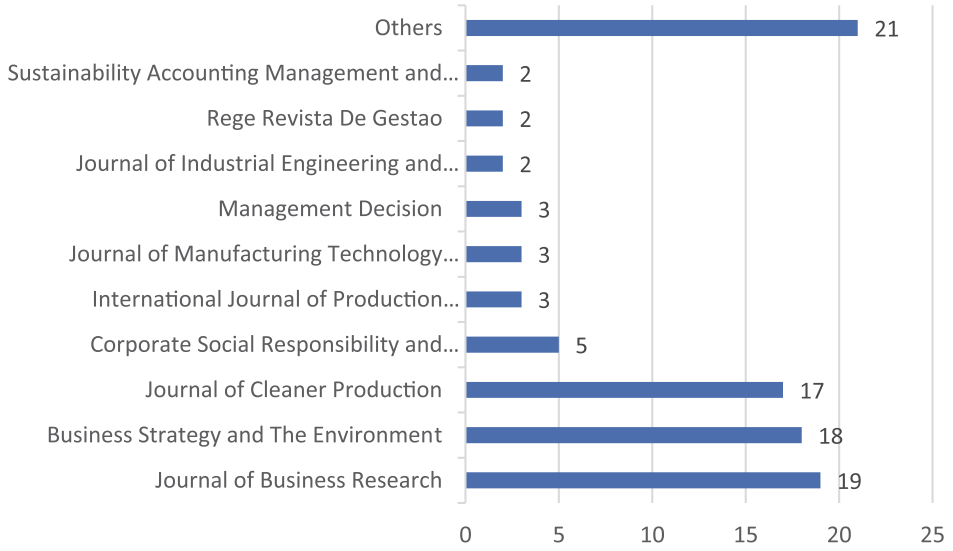

Fig. 4 Publications by journal

4.2 Content analysis and discussion

The following section present the findings of analysed articles that focused on SMEs' transition to a CE at different levels: macro, meso, and micro. Based on the analysis, various themes emerged to reflect the distinct dimensions of influence, encompassing external factors, stakeholder interactions, and internal aspects of SMEs that collectively shape the successful circular transition. At the macro level, the analysis highlights four key themes: taxation and incentives, regulatory policy, collaboration and partnerships, and advocacy and awareness. At the meso level, the text identifies four themes: supply chain practices, the role of consumers, the role of associations and networks, and engagement and collaboration. Lastly, at the micro level, the text covers four themes: strategies, resources and capabilities, management and leadership, and innovation and digitalization.

Macro level:

Four key themes were found to be relevant at the macro level: (I) taxation and incentives, (II) regulatory policy, (III) collaboration and partnerships, and (IV) advocacy and awareness. The 17 examined articles that fit the macro level shed light on various actors and mechanisms that contribute to the adoption and implementation of CE practices. These themes explore the role of stakeholders, such as policymakers, institutions, non-profits, and other government agencies, in creating a supportive environment for CE initiatives through various mechanisms.

(I) Taxation and incentives Policymakers, financial institutions, and regulatory bodies play a crucial role in creating a supportive environment for CE initiatives. Austin and Rahman (2022) covers diverse finance sources, like crowdfunding and capital market funding, to aid SMEs in the necessary knowledge and resources to adopt circular business models and overcome financial barriers. Nudurupati et al.

(2022) explores government initiatives, environmental regulations, and competitive advantage as drivers of CE adoption, fostering a supportive environment for the transition to a CE. Maher et al. (2023) emphasizes the significance of supportive government programs and policies for SMEs to implement circular business models, along with the need for training and support programs to encourage and facilitate the uptake of CE practices among SMEs.

(II) Regulatory Policy Six articles share a common focus on studying the regulatory policies for the CE. Droege et al. (2023) emphasises the importance of policy entrepreneurs, who drive the adoption of CE policies by creating a vision, deriving solutions, and garnering support. Ostermann et al. (2021) highlights the role of laws and regulations as external drivers for CE adoption in the fashion sector. Several articles address the policy aspect under enablers and barriers, collectively revealing the importance of regulatory policies (Droege et al. 2023; Kayikci et al. 2021; Rodriguez-Espindola et al. 2022; Sohal et al. 2022), development of conceptual models and transformative frameworks (Zhu et al. 2022), exploration of standardized approaches for CE disclosure (Massari and Giannoccaro 2023), shaping regulatory policies and addressing the challenges associated with transitioning to a CE.

(III) Collaboration and Partnerships Three articles were assigned to this theme which highlights the significance of collaboration and partnerships involving actors such as non-profits, government agencies, and policymakers in promoting CE practices. Agyabeng-Mensah et al. (2022) examines the role of external pressure and various capabilities (engagement, alliance, circular supply chain) in achieving CE performance, and highlights the importance of collaboration and partnerships in enhancing environmental sustainability commitment and circular supply chain capability. Similarly, Bag et al. (2022) explores the relationships between various factors including institutional pressures, eco-innovation, and firm performance. Hull et al. (2021) explores the challenges and opportunities in developing circular-economy incubators in Trinidad and Tobago. The study emphasizes the need for collaboration among stakeholders, including entrepreneurs, non-profits, academics, and government agencies, with a limited role for the government. Finally, Holzer et al. (2021) investigates the practices and topical areas that are central to the transition towards a CE in SMEs in Austria. The study identifies resource efficiency, cooperation with stakeholders, and sustainability as crucial areas. It emphasizes the importance of addressing these areas to improve overall performance and identifies different strategic groups of SMEs, providing insights for policymakers and intermediaries to effectively target diverse SMEs.

(IV) Advocacy and awareness Three articles formed this theme which collectively highlight the importance of institutions and policymakers as actors in creating advocacy and awareness for CE principles and practices. Cullen (2023) investigates how circular entrepreneurs navigate institutional value systems to create financially viable business models with social and environmental value. It emphasizes adhering to norms, acquiring competencies, and managing tensions in value creation as mechanism. Alonso-Almeida et al. (2021) examines the role of institutional entrepreneurship in driving the CE in the EU. It emphasizes the need for transformative changes by institutions and policymakers. Triguero et al. (2022) focuses on factors influencing environmental innovation adoption in EU firms for the CE. It highlights

financial capabilities, technology, public funding, and collaboration networks to drive transformative change.

Meso level:

This section focuses on four key themes at the meso level: (I) Supply Chain Practices, (II) the Role of consumer, (III) the Role of Associations and Networks, and (IV) Engagement and Collaboration. 22 articles were group under this level. These articles explore different factors and mechanisms that contribute to the adoption and implementation of CE practices at meso level. They provide insights into the relationships between SMEs and their suppliers, the influence of consumers on circular practices, the role of associations and networks in facilitating the transition, and the importance of engagement and collaboration among various stakeholders.

(I) Supply Chain Practices The six articles that belong to this theme share a common focus on supply chain practices and discuss various aspects. The actors involved are SMEs and their suppliers while talking about mechanisms such as stakeholder relations, the role of cooperation and different types of supply chain. Centobelli et al. (2021) focuses on exploring the relationships between various factors related to supply chain management specifically examining the impact of these factors on SMEs. In contrast, Susanty et al. (2020) investigates the implementation of CE practices in the wooden furniture industry in Indonesia, with a specific focus on the role of environmental-oriented supply chain cooperation (ESCC) practices. While both articles examine the factors influencing supply chain practices, Staicu and Pop (2018) explores CE and social entrepreneurship in the textile and apparel sector, emphasizing stakeholder mapping, collaborative spaces, and increasing awareness. Kusumowardani et al. (2022) investigates CE principles to address food loss and waste in the agri-food supply chain, analysing growers, distributors, and retailers. Kayikci et al. (2022) delves into the concept of a smart circular supply chain and closed-loop supply chain, assessing the readiness and maturity levels of SMEs. Finally, Le et al. (2022) explores how CE practices and circular entrepreneurship promote sustainable supply chain management and performance in SMEs within the food value chain. Overall, the selected articles show how different practices, collaborations, and frameworks influence the adoption and implementation of circular supply chain practices across various industries.

(II) Role of Consumer Three articles provide insights into the role of the consumer in the dynamic of the CE transition. Sharma et al. (2021) focuses on the prospects, impediments, and prerequisites for transitioning to a CE from a linear economy. It acknowledges the role of consumer acceptability in this transition, emphasizing the importance of gaining consumer support for circular practices. In contrast, Nudurupati et al. (2022) primarily centres around the adoption of CE practices in Indian SMEs and it touches upon the influence of customer pressure. The article recognizes that customer demands and competitive advantage act as market forces that encourage SMEs to embrace circular practices to meet consumer expectations and gain a competitive edge. On the other hand, Re and Magnani (2022) takes a broader perspective by exploring the co-creation processes and value creation in circular entrepreneurship involving SMEs and their key actors. It identifies the importance of customers, suppliers, and partners in these processes, highlighting their active role in collaborative activities such as product design, waste reduction

initiatives, knowledge sharing, resource pooling, and joint innovation projects. The article emphasizes the significance of these co-creation mechanisms in achieving circular outcomes.

(III) Role of Associations and Networks Four articles discuss the role of associations and networks to facilitate the transition of SMEs towards the CE. Ormazabal et al. (2018) emphasises the role of industrial associations in promoting collaboration among SMEs. Silva et al. (2019) focuses on the specific network of small companies and entrepreneurs, investigating the interactions and dynamics within the network, and highlighting challenges and the need for restructuring commercial relations. Zucchella et al. (2022) emphasizes the role of entrepreneurs, organizations, and external stakeholders in driving the CE transition and examines the firm's network and interactions with external stakeholders, emphasizing the role of customers' culture and willingness to pay. Zhu et al. (2022) adopts a multilevel perspective, addressing macro, meso, and micro factors and actors and highlighting the importance of government policies, industry collaborations, and internal capabilities within SMEs. Also, underline industry associations and networks that play a crucial role in disseminating knowledge, sharing best practices, and facilitating the adoption of CE practices.

(IV) Engagement and Collaboration Nine articles provide insights into engagement and collaboration in the transition towards a CE from a meso-level perspective. These findings underscore the significance of active engagement, collaboration, and coordination among actors to foster a sustainable and CE. Scipioni and Niccolini (2021) explores the transition of SMEs towards a CE through organizational learning processes, emphasizing the importance of engagement and collaboration among the actors. In line with this, Hull et al. (2021) focuses on understanding stakeholders' perceptions and barriers to participation in CE strategies. Similarly, Mishra et al. (2021) examines the role of collaboration in technology transfer and organizational learning to enable resource efficiency and the adoption of clean technology. Building on this, Holzer et al. (2021) delves into corporate practices in SMEs, emphasizing factors such as cooperation with stakeholders. Furthermore, Wade et al. (2022) highlights the significance of capabilities, experimentation, collaboration, and stakeholder connections for successful circular innovation in the mining industry. Expanding the discussion, Sohal et al. (2022) provides a comprehensive understanding of the transition towards a CE in the Indian SME sector, emphasizing engagement and collaboration among actors at different levels, with a focus on industry associations and initiatives. Moreover, Virmani et al. (2022) examines the adoption of CE practices in Indian micro, small, and medium enterprises (MSMEs), identifying roadblocks and effective solutions, while considering stakeholder engagement, supply chain management, and collaboration. Additionally, Kuhl et al. (2022) explores how the implementation of product-service systems (PSSs) and the adoption of circular supply chain (CSC) practices are influenced by interactions and collaborations among various actors. Finally, Howard et al. (2022) emphasizes the importance of engagement, collaboration, and coordination among SMEs and local actors, considering factors such as place-based coordination, cross-institutional organizing, and value sharing.

Micro level:

This section focuses on the micro-level perspective of the CE, exploring strategies, resources and capabilities, management and leadership, innovation and digitalization, and models and frameworks. 62 articles were assigned to this level.

(I) Strategies Nineteen articles addressed the strategies. Firstly, integrating lean management principles and practices with circular production systems emerges as a common strategy across several articles (Afum et al. 2022a, 2022b; Chaudhuri et al. 2022; D'Angelo et al. 2023). This approach focuses on minimizing waste, maximizing resource efficiency, and improving zero-waste performance. Secondly, organizational commitment and leadership play a crucial role in driving the transition to a circular model. Several articles (Dorado et al. 2022; Prieto-Sandoval et al. 2021; Sohal and De Vass 2022; Stelmaszczyk et al. 2023) highlight the significance of top management's commitment and vision in embracing CE practices. Managers are encouraged to demonstrate leadership initiative by exploring sustainable ways of operating and engaging new stakeholders. Collaboration and value co-creation among actors are key strategies identified in the articles. Several articles stress the importance of aligning strategies, fostering a culture of sustainability, and collaborating with industry, government, and university partners (Cullen 2023; Dey et al. 2020; Prieto-Sandoval et al. 2021; Re and Magnani 2022, 2023; Rittershaus et al. 2023; Schmidt et al. 2021). Collaborative efforts range from co-creating processes and product design to waste reduction initiatives, shared knowledge and resources, and joint innovation projects. Lastly, several articles collectively explore various strategic approaches for the transition towards a CE. They highlight the importance of aligning strategies (Scipioni and Niccolini 2021), managing paradoxical tensions (Daddi et al. 2019), considering institutional norms (Cullen 2023), adopting circular practices at different levels (Blasi et al. 2021; Schmidt et al. 2021; Sohal et al. 2022), and integrating sustainability into organizational processes to successfully implement CE practices at SMEs (Afum et al. 2022a).

(II) Resources and Capabilities Eleven articles show the findings related to resources and capabilities for the transition to a CE. Eikelenboom and de Jong (2022) emphasized the significance of organizational attributes, including managers' interpretation and network interactions, in integrating CE into business strategies. Centobelli et al. (2021) explored the impact of factors, actors, and mechanisms at the organizational level on supply chain management and CE capabilities. Scarpellini et al. (2020) focused on environmental capabilities, such as environmental management systems and corporate social responsibility, applied by firms during the introduction of the CE. Ghisetti and Montresor (2020) investigated the relationship between the adoption of CE practices by SMEs and their financing choices, considering different funding sources. O. Khan et al. (2020) delved into the role of dynamic capabilities within organizations and their influence on CE implementation. Prieto-Sandoval et al. (2019) identified key strategies and resources necessary for SMEs to implement the CE, emphasizing eco-innovation, competitive advantage, value creation, differentiation, and dynamic capabilities while Garcia-Quevedo et al. (2020) examines barriers related to resources and capabilities that hinder the implementation of CE activities. Elf et al. (2022) highlighted the importance of dynamic capabilities and entrepreneurship in CE business model innovation. Wade

et al. (2022) analysed the capabilities enabling the creation of products from waste resources, including experimentation, research and development, stakeholder connections, and ecosystem development. Marrucci et al. (2022) focused on absorptive capacity as a critical factor influencing the implementation of CE practices. Finally, Bowen et al. (2023) examined the experiences of SMEs in implementing CE activities post-COVID-19, considering factors such as financial efficiency, resource constraints, and proactive strategies.

(III) Management and Leadership Twelve articles shed light on the importance of ethical leadership, awareness, and management commitment to overcoming barriers in driving the adoption and implementation of CE practices in SMEs. Firstly, based on several studies (e.g., Agyabeng-Mensah et al. 2023; Cheffi et al. 2023; Chowdhury et al. 2022; De Vass et al. 2023; Soni et al. 2023), management commitment is consistently identified as a driving force behind adopting and implementing CE practices. Ethical supply chain leadership (Agyabeng-Mensah et al. 2023), management control systems (Cheffi et al. 2023), adaptive distributed leadership (Soni et al. 2023), leaders' values and vision (De Vass et al. 2023) and overall organizational leadership (Chowdhury et al. 2022) play significant roles in fostering CE concept within organizations. The studies highlight that management commitment is crucial for setting the direction, establishing a culture of CE, allocating resources, and ensuring the successful implementation of CE practices. Secondly, the studies recognize the importance of awareness and knowledge sharing in promoting CE practices (Choudhary et al. 2022; Liakos et al. 2019). They emphasize the role of awareness levels (Liakos et al. 2019), personal norms and behavioural intentions (Choudhary et al. 2022), and motivation (Henry et al. 2023; Rovanto and Finne 2023) that drive organizations' intentions to adopt circular practices. Furthermore, the articles highlight the importance of managerial commitment in achieving the goals of CE business models (Unal et al. 2019) and emphasizes the need for organizations to improve their efforts in engagement with circular practices (Barreiro-Gen and Lozano 2020).

(IV) Innovation and Digitalization Twelve studies emphasize the importance of adopting innovative practices and digital technologies to enable the transition to CE principles, achieve sustainable performance, and address environmental and economic challenges. The mechanisms explored in these articles revolve around how innovation, specifically digitalization and Industry 4.0, facilitates the adoption of CE practices, drives growth, enhances competitiveness, and improves sustainability. They emphasize the significance of innovative practices, technologies, and strategies within small and medium enterprises (SMEs) for achieving growth, competitiveness, and sustainability (Dey et al. 2022; Mondal et al. 2023; Pizzi et al. 2021; Rodriguez-Espindola et al. 2022). The studies also explore the enabling role of Industry 4.0 (Zheng et al. 2023) and digital innovations (Oyinlola et al. 2022) in the CE, identifying mechanisms through which it facilitates SMEs (Zheng et al. 2023). Additionally, the articles discuss the relationship between eco-innovation features and the CE, emphasizing the importance of systemic eco-innovations (Kiefer et al. 2021). Furthermore, the impact of digital technologies, such as reservation systems, and their connection to the CE is examined (Saura et al. 2022). The findings highlight long-term economic and environmental improvements through digital solutions (Darmandieu et al. 2022; Findik et al. 2023; S. A. R. Khan et al. 2022).

(V) Models and Frameworks Five articles provide frameworks, and tools to guide SMEs in their transition to the CE. They address specific challenges, propose management strategies, and offer practical approaches to foster CE within SMEs. The study by Malik et al. (2022) focuses on the challenges faced by SMEs in India in adopting CE practices. It proposes a multilevel conceptual framework grounded in CE and change management literature to facilitate the transition. While Piller (2023) examines how Australian fashion SMEs are implementing circular design practices to overcome the linear fashion model's challenges and provides insights and tools to promote circular design practices. Gennari (2022) identifies key pillars of CE for SMEs and provides a conceptual framework that explains the development of these pillars and offers practical advice for SMEs to assess their transition path and maximize policy interventions' effectiveness. Meanwhile, Guevara-Rivera et al. (2021) provides insights into the challenges and opportunities faced by SMEs in adopting CE practices through the simulation model's evaluation and visualization capabilities. Lastly, Garza-Reyes et al. (2019) proposes the Circularity Measurement Toolkit (CMT) as a means to assess the degree of circularity in manufacturing SMEs. It contributes to the field of CE measurement by enabling companies to evaluate their circular practices, identify corrective actions, and guide future efforts for adopting CE practices.

5 An integrated view of the SMEs transition to CE research

The development of the model was guided by the MLP framework, but the framework has not been without criticisms. Some scholars have argued that it lacks a comprehensive consideration of actor agency (Smith et al. 2005), potentially overlooking the active role of individual actors and social groups in shaping transitions. Furthermore, concerns have been raised about conceptual ambiguities within MLP, particularly regarding the understanding of actors and the distribution of power across different levels (Avelino et al. 2016). Acknowledging these shortcomings, our model further developed upon on MLP, mapping the factors and the identification of key actors and mechanisms on the SMEs transitioning to CE, but lacking on the power dynamics of them.

Figure 5 provides a holistic view of the CE transition in SMEs, showcasing the interconnectedness and interdependence of various factors and actors at different levels: macro, meso, and micro. The MLP framework provides a comprehensive understanding of the complex relationships and interactions among these factors and actors that influence SMEs' successful transition to a CE. Each level plays a crucial role in driving the adoption and implementation of CE practices, and the interactions between these levels create a supportive ecosystem for SMEs' transition towards CE. The macro level sets the policy framework, providing financial incentives and regulatory guidance to foster circular practices. At the meso level, associations and networks disseminate knowledge, and consumers drive market demand, influencing SMEs' circular practices. At the micro level, strategies and innovative practices are implemented, supported by management and leadership commitment, and enabled by the utilization of resources and digital technologies.

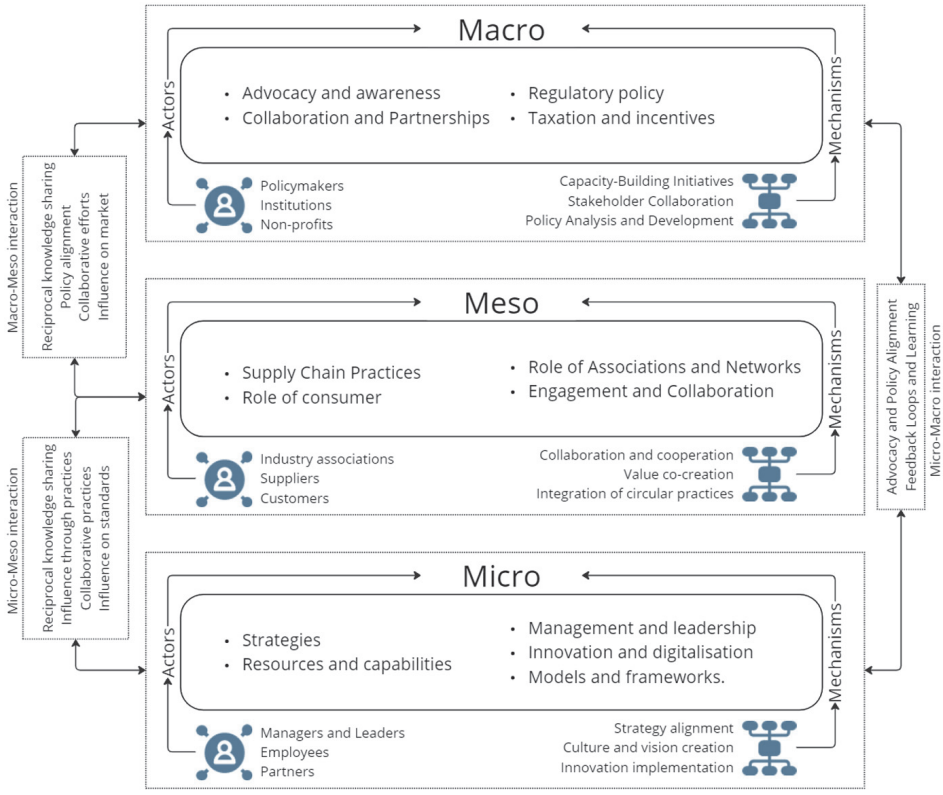

Fig. 5 Multi-level perspective of circular economy transition in SMEs

Macro Level: at the macro level, four key themes have been identified: taxation and incentives, regulatory policy, collaboration and partnerships, and advocacy and awareness. These themes illustrate the influence of policymakers, institutions, non-profits, and government agencies in creating an enabling environment for CE initiatives. Taxation and incentives (I) serve as financial motivators for SMEs to embrace circular business models and overcome financial barriers. Regulatory policies (II) act as external drivers, providing guidelines and standards for adopting circular practices in different industries. Collaboration and partnerships (III) involving various stakeholders foster knowledge exchange, resource sharing, and joint initiatives towards CE. Advocacy and awareness (IV) play a pivotal role in promoting CE principles and practices, influencing public opinion and driving transformative changes.

Meso Level: moving to the meso level, the figure highlights four themes: supply chain practices, the role of consumers, the role of associations and networks, and engagement and collaboration. These themes explore the dynamics between SMEs and their suppliers, the influence of consumers on circular practices, the role of industry associations, and the significance of active engagement among stakeholders. Supply chain practices (I) underscore the importance of circularity in the flow of materials and products among SMEs and their suppliers. The role

of consumers (II) is essential in driving market demand for circular products and services, pushing SMEs to adopt circular practices to meet customer expectations. Associations and networks (III) play a pivotal role in disseminating knowledge, sharing best practices, and fostering collaborations among SMEs. Engagement and collaboration (IV) among various actors lead to the co-creation of circular solutions, resource pooling, and cross-sectoral partnerships, enhancing the overall CE practices in SMEs.

Micro Level: at the micro level, the figure delves into four key themes: strategies, resources and capabilities, management and leadership, and innovation and digitalization. These themes illuminate the internal aspects of SMEs' CE transition, including the strategies employed, the resources and capabilities harnessed, the role of management and leadership, and the significance of innovation and digital technologies. Strategies (I) involve the adoption of lean management practices, fostering collaboration, and aligning with market-oriented approaches. Resources and capabilities (II) are critical for SMEs to implement circular practices, encompassing organizational attributes, environmental capabilities, dynamic capabilities, and financial choices. Management and leadership (III) are central to driving the CE transition, as committed leaders set the vision, establish a culture of CE, and engage employees in circular initiatives. Innovation and digitalization (IV) enable SMEs to adopt innovative circular practices, harnessing digital technologies and Industry 4.0 to achieve sustainability and improve competitiveness. In addition to the main themes, several articles provide practical insights and advice in the form of frameworks and models. These findings support the SMEs and other related stakeholders with hand on tools to further practice the transition towards CE.

Figure 5 emphasizes the interdependence of the macro, meso, and micro levels, with each level contributing to a supportive ecosystem for the CE transition in SMEs. Policymakers, institutions, non-profits, government agencies, industry associations, suppliers, consumers, managers, and employees all play crucial roles in driving the successful adoption and implementation of CE practices in SMEs. At the macro-meso interface, knowledge sharing is a reciprocal process, with macro-level actors offering valuable insights, trends, and research findings to meso-level industry associations and networks. In return, meso-level entities act as knowledge hubs, aggregating practical experiences and case studies from SMEs, ultimately contributing to evidence-based policymaking. Policy alignment is pivotal, with macro-level actors shaping the direction of meso-level initiatives, ensuring compliance with regulatory standards objectives. Simultaneously, meso-level actors advocate for policy changes that better support SMEs, offering insights into their challenges and opportunities and acting as midpoint between micro and macro level actors and mechanism. Collaborative efforts foster co-creation of policies and strategies aligning with the industry's collective goals, while macro-level influence on consumer behaviour influences meso-level market promotion strategies. At the micro-meso level, knowledge sharing is facilitated by SMEs sharing practical experiences with meso-level associations and networks, inspiring others to follow suit. Practices initiated at the micro level can drive meso-level promotion. Showcasing the best practices by SMEs that made the transition towards CE, and the aggregation of knowledge by meso-level actors on those practices aids micro-level actors in implementing CE practices with the help of mechanisms.

Collaborative practices extend to resource pooling, cross-sectoral partnerships, and standard influence, further bridging the micro-meso gap. In the micro–macro interaction, advocacy and policy alignment are key, with SMEs collectively influencing macro-level policymaking, and macro-level regulations impacting micro-level compliance. Feedback loops and learning cycles exist in both directions, with macro-level actors sharing insights, and micro-level actors providing feedback, ensuring continuous improvement of CE practices and strategies at all levels. These interactions, which encompass knowledge exchange, policy shaping, collaboration, and market influence, are essential for the effective transition toward a CE in SMEs. Based on the review conducted it can be concluded that an understanding and leveraging of these relations and factors are essential for supporting the transition of SMEs towards CE.

6 Conclusion

In conclusion, this SLR has provided valuable insights on how the transition of SMEs to CE could succeed with the help of the MLP framework. By adopting the MLP as the theoretical lens, an alternative perspective has been added to the existing literature. The MLP seems to offer the opportunity to develop a more comprehensive view of the CE transition in SMEs by considering the interconnectedness and interdependencies between the micro, meso, and macro levels, thereby going beyond linear and top-down approaches. The interactions between different levels which are dynamic and complex, with bottom-up initiatives from SMEs influencing meso and macro-level policies, and vice versa. This in turn allows ore an improved understanding of these relationships. Understanding the interconnectedness between SMEs, the broader institutional contexts, social dynamics, and technological advancements is crucial for supporting SMEs' transition to CE and thus theory advancement.

The use of the MLP as a theoretical lens for studying SMEs allows researchers to better grasp the intricacies and challenges faced by SMEs in their transition to the CE. By recognizing the interplay of factors and actors at different levels, this approach can facilitate the development of tailored and effective strategies, interventions, and policies that support SMEs' in their efforts; thereby contributing to the overall sustainability of economies.

Furthermore, this work ideally serves as a foundational steppingstone for future research and discussions in this field. It has opened avenues for continued exploration and enhancement of CE practices in SMEs. Researchers can build upon the insights gained from this SLR to delve deeper into specific aspects of SMEs CE transition.

6.1 Practical contribution

Promising practical contributions could be derived based on the interconnected factors and actors at the macro, meso, and micro levels, highlighting in turn the roles and responsibilities of various stakeholders in driving successful CE transition.

- SMEs: The MLP framework empowers SMEs with a comprehensive understanding of the CE transition. It emphasizes the importance of adopting circular business models, lean management practices, and innovative approaches to achieve sustainability and improve competitiveness. SMEs can use the insights provided at the micro level (strategies, resources, management, and innovation) to develop actionable plans for embracing CE concept within their organizations. The knowledge of supply chain practices (meso level) can help SMEs foster collaboration with suppliers, ensuring circularity throughout the value chain. Additionally, engagement and collaboration (meso level) can facilitate SMEs in forming partnerships with industry associations and networks, driving joint initiatives, and accessing valuable resources for circular adoption.
- Policymakers and Government Agencies: Policymakers and government agencies can leverage the MLP framework to design and implement effective CE policies and incentives (macro level). Understanding the interconnectedness of factors at different levels can help in creating a supportive regulatory environment that encourages SMEs to transition towards circular practices. Advocacy and awareness initiatives (macro level) can be strategically designed to promote CE principles among SMEs and the general public.
- Industry Associations and Networks: The meso-level insights on supply chain practices, consumer role, and engagement and collaboration offer a roadmap for industry associations and networks to support SMEs' CE transition. They can facilitate knowledge exchange, best practice sharing, and collaborative projects that drive CE within SMEs. By promoting circular supply chain practices and engaging stakeholders, industry associations can play a pivotal role in creating a circular ecosystem.
- Consumers: The MLP framework emphasizes the critical role of consumers in driving market demand for circular products and services. Consumers can contribute to the CE transition by making conscious and sustainable choices, supporting SMEs that adopt circular practices, and advocating for CE in their communities. Their demand for circular products and services can incentivize SMEs to invest in CE and expand their offerings.

6.2 Limitations and future research opportunities

A few limitations to this article should also be mentioned, such as the exclusive focus on academic journals, limiting the selection to only English language, omitting potential contributions from grey literature on SMEs' transition to CE. Therefore, grey literature might add to the existing knowledge on the SMEs transition to CE, however, the analysis of these is left as suggestions for future research endeavours. Moreover, the research field is still in its early stages for the meso and macro level perspectives, as can be seen from the findings that majority of the articles focuses on various factors at micro level. Failing to consider the meso and macro levels, and interaction between these two with micro level could limit researchers' ability to fully grasp the

systemic challenges and opportunities related to the CE. The gap observed in the list is not only limited to the levels (meso and macro), but also to methodologies (Fig. 3). There are gaps related to the research design, which academic community need to embrace a mixed-methods approach in their future studies related to the CE. As surveys have become a dominant research tool by 2022, they offer valuable quantitative data to understand trends, patterns, and generalizability of findings. However, to gain deeper insights and context-specific understanding, researchers should complement survey data with qualitative methods like interviews and focus groups. Additionally, conducting focus groups can provide a platform for diverse stakeholders to engage in meaningful discussions, uncovering perspectives that may not be apparent through individual interviews or surveys alone. Furthermore, researchers can consider incorporating case studies and conceptual development to provide in-depth exploration and theory-building in specific contexts. Case studies offer an opportunity to examine real-life CE implementations and understand the complexities of individual cases, while conceptual development allows researchers to conceptualize and model the interplay of various factors within the CE. As the field matures and becomes more established, we might expect to see an increased integration of theoretical frameworks to better conceptualize and explain the complexities of CE transitions and implementations.

To address these gaps and further advance the understanding of SMEs' transition to a CE, future research should focus on a comprehensive exploration and examination of the intricate interactions between meso, micro, and macro levels. Below are some key future research recommendations for exploring these levels and addressing the identified gaps:

Macro-Meso: Exploration of the complex dynamics within multi-stakeholder ecosystems operating at the macro-meso interface, investigating the roles, motivations, and power structures of key actors, and their impact on SMEs' transition to CE.

Meso-Micro: An analysis of the strategies SMEs employs to adapt to meso-level influences (e.g., consumer demand, market change, association initiatives), examining the resource (tangible and intangible) and knowledge constraints faced by SMEs, and how they innovate, co-create and reconfigure their business models to align with meso-level circular initiatives.

Micro–Macro: Exploration of the regulatory compliance challenges encountered by SMEs when implementing CE practices, with a focus on understanding the specific barriers and potential policy interventions; An investigation into the mechanisms of knowledge exchange and inter-organizational learning between macro and micro-level actors, considering how feedback loops, and knowledge transfer can be optimized for more effective CE implementation; A longitudinal analysis of the long-term impacts of macro-level CE policies on SMEs, evaluating the sustainability outcomes, economic performance, and resilience of SMEs influenced by these policies over extended periods.

Appendix

See Table 2.

Table 2 Searching details

Database	String	Search in	Doc. Type	Category	Period	Date	Doc	Duplicate removed
WoS Scous	"Circular economy" AND "SMEs" AND “transition”	Title, abstract, and keywords	Article and early access	Business or Management	Up to June 9th 2023	06/06/23	22 24	10
WoS Scous	"Circular economy" AND ("SME" OR "SMEs" OR "small and medium enterpris*" OR "Small and medium-sized enterpris*" OR "small and medium-sized business*" OR "entrepreneur*") AND “transition”	Title, abstract, and keywords	Article and early access	Business or Management	Up to June 9th 2023	06/06/23	44 51	23
WoS Scous	"Circular economy" AND ("SME" OR "SMEs" OR "small and medium enterpris*" OR "Small and medium-sized enterpris*" OR "small and medium-sized business*" OR "entrepreneur*") AND (“trans*” OR "chang*" OR "proces*")	Title, abstract, and keywords	Article and early access	Business or Management	Up to June 9th 2023	06/06/23	96 128	48

Table 2 (continued)

Database	String	Search in	Doc. Type	Category	Period	Date	Doc	Duplicate removed
WoS Scous	"circul*" AND ("SME" OR "SMEs" OR "small and medium enterpris*" OR "Small and medium-sized enterpris*" OR "small and medium-sized business*" OR "entrepreneur*") AND (“trans*” OR "chang*" OR "proces*")	Title, abstract, and keywords	Article and early access	Business or Management	Up to June 9th 2023	06/06/23	139 218	85

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Declarations

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Appendix 3

Publication III

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Research paper

Circular Economy Practices in Manufacturing SMEs: Exploration of Stakeholder Pressure, Managerial Perception, and the Mediating Role of Circular Economy Orientation

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Abstract
This study delves into the dynamics of Circular Economy (CE) practices in Small and Medium-sized Enterprises (SMEs), acknowledging their essential contribution to promoting sustainability. As we explore the various influences on SMEs' adoption of CE, we closely examine the distinct impacts of internal and external stakeholder pressure. Additionally, we highlight the role of positive managerial perceptions and introduce a fresh perspective by framing CE orientation as a mediating force. Employing a survey methodology, our data collection spanned three phases, resulting in 196 responses from the Estonian SMEs. The results challenge the assumptions of uniform stakeholder pressures, unveiling nuanced effects on CE practices. Significantly, a heightened CE orientation emerges as a driving factor in enhancing organisational responsiveness to external stakeholder pressure. This study advances our understanding of the intricate relationships between stakeholder dynamics, managerial perceptions, and CE practices, providing valuable insights essential for SMEs to navigate the path towards sustainable practices. This study presents both theoretical and practical contributions and suggests avenues for future research to further explore the multifaceted nature of the relationships uncovered in this study.

Keywords: Circular Economy Practices · Small and Medium-sized Enterprises (SMEs) · Stakeholder Pressure · Managerial Perception · CE Orientation

1. INTRODUCTION

Circular economy (CE) has been proposed as a promising alternative to the traditional linear economic model, attracting considerable interest for its potential to address economic, environmental, and social challenges (Cagno et al., 2023; Knable et al., 2022). Research indicates that small and medium-sized enterprises (SMEs) classified by the European Union as businesses with up to 250 employees and an annual turnover of up to EUR 50 million (EC, 2018), tend to lag behind larger companies in the adoption of CE practices due to limited resources and expertise (Dey et al., 2019; Mura et al., 2020), while larger private and public organisations have started integrating CE practices (Garces-Ayerbe et al., 2019; Ghisellini et al., 2016). Given the importance of SMEs to economies, representing approximately 99% of companies in the EU (EC, 2018) and accounting for 50% of the region's GDP (Rodríguez-Rebés et al., 2024) their role in sustainability is undeniable. A gradual adoption of CE practices by SMEs could significantly advance the transition to a CE and emphasise the important contribution of these companies to sustainable development(de Jesus Pacheco et al., 2024; Smith et al., 2022).

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Research has indicated that engaging in CE practices, which entail sustainable production strategies geared towards waste reduction, resource optimisation, prolonged product and material lifecycles, and emphasising resource reuse within closed loops (Ahmadov et al., 2023; Arsawan et al., 2024), offers SMEs opportunities for value creation (Broccardo & Zicari, 2020; Ferasso et al., 2023). According to Ly (2021), it can also improve the firm competitiveness in the short and long term by enhancing operational efficiency, fostering innovation, and aligning business models with evolving consumer and regulatory demands. This enables SMEs to flourish economically, socially, and environmentally.

The transition from a linear economy to a circular economy is accompanied by a number of constraints. Barriers such as lack of demand or social awareness (Geissdoerfer et al., 2023; Kirchherr et al., 2018), regulatory complexities (Govindan & Hasanagic, 2018), and resource limitations (García-Quevedo et al., 2020), combined hinder SMEs ability to adopt circular economy practices. However, alongside these barriers, certain factors also act as enablers, such as supportive regulatory frameworks (Droege et al., 2023), market demand for sustainable products (Godinho Filho et al., 2024), and increasing stakeholder awareness (Baah et al., 2023). Among the factors influencing the adoption of these practices by SMEs, stakeholder pressures have been highlighted as a critical factor of implementation and engagement with CE practices. Both external and internal stakeholder pressure play a pivotal role in driving SMEs to adopt CE practices (Baah et al., 2022; Chiappetta Jabbour et al., 2020; Genovese et al., 2017). The same applies to managers' perceptions of the importance of these practices (Al-Kwifi et al., 2023; Ruokonen, 2021; van Langen et al., 2021). Moreover, CE orientation has garnered recognition in various studies for its beneficial impact on business (Arranz et al., 2023; Jagani & Hong, 2022; Schmidt et al., 2021). There are thus a large number of internal and external influencing factors and actors that together influence the transition to CE in SMEs (Ahmadov et al., 2023; Trevisan et al., 2023). This complexity, characterised by the dual role of factors as facilitators or obstacles, underscores the need for further research that not only recognises but also actively integrates this situation (e.g. Govindan, 2023; Kannan et al., 2022; Salmenperä et al., 2021). Against this background, the present study utilises a theoretical framework (Figure 1) based on stakeholder theory, legitimacy theory and strategic management theory. This framework provides the theoretical lens to better analyse and understand the influencing factors that shape the adoption of CE practices in SMEs.

Stakeholder theory, as articulated by Freeman (1984), examines the relationships and pressures exerted by various stakeholders on organizational processes, shedding light on the broader network of interactions within which organizations operate. Freeman (1984) further posits that stakeholders not only influence but are also influenced by the decisions and outcomes of an organization. Clarkson (1995) expand on this by explaining that stakeholders possess rightful interests and significant stakes in a firm's operations due to their invested financial or human capital. This not only underscores the reciprocal relationship between firms and their stakeholders but also highlights the latter role in supporting or hampering the adoption of CE practices. In the existing CE literature, there are studies that have employed stakeholder theory to establish connections between the adoption of CE practices and the influence of stakeholders (Baah et al., 2022; Salvioni & Almici, 2020). The findings of these studies (e.g., Chiappetta Jabbour et al., 2020; Hernández-Arzaba et al., 2022; Jiao et al., 2020) indicate that stakeholder, such as governments, suppliers, customers, NGOs, and the media, can exert significant pressure on organizations to embrace sustainable practices. Bag et al. (2020) argue that while governments play a role in initiating policies and frameworks to promote the circular economy, it is the immediate stakeholders of firms who are often the most critical drivers of change at the organizational level. While stakeholder theory provides a good perspective to explain the role of stakeholders in driving companies towards environmentally friendly practices, the processes by which companies accumulate the resources required to implement CE practices cannot be explained with this perspective. Legitimacy theory, elucidated by Suchman (1995), explains how organisations maintain societal approval by aligning their actions with prevailing norms and values, shaping managerial perceptions of strategic decisions. This alignment enhances legitimacy and influences managerial perceptions of strategic decisions. For example, Zheng et al. (2023) examine how SMEs in emerging markets leverage Industry 4.0 to enhance their organizational legitimacy with both government and market stakeholders, thereby enabling them to effectively capture value from adopting CE practices in their operations. Eventually, strategic management theory, as outlined by (Goodstein, 1994), underscores the significance of managerial practices that are aligned with organizational missions and values, positing that such practices are more likely to be embraced. For instance, the study by Astuty et al. (2024) has shown

that using strategic management theory is an appropriate perspective to explain how micro-businesses can formulate resilient strategies by aligning internal resources with responsive approaches to bring business performance in line with the 2030 Sustainable Development Goals agenda.

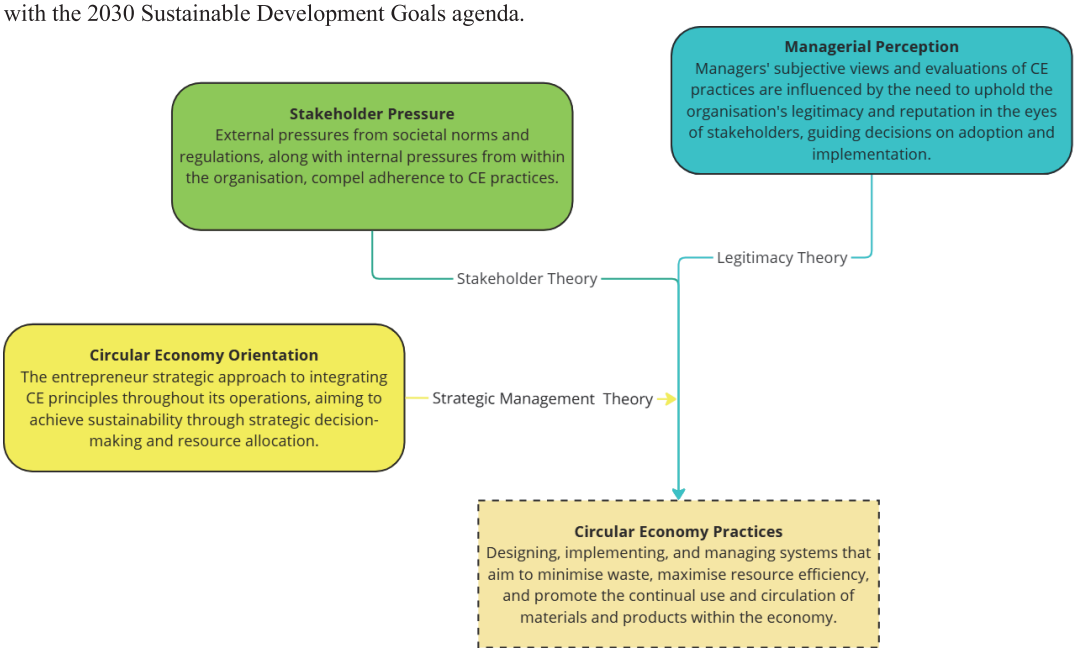

Figure 1. Theoretical Framework: Exploring the Synergy of Stakeholder Influence, Managerial Perception, and Strategic Orientation in Advancing Circular Economy Practices in SMEs

Using these three theoretical perspectives provides a useful theoretical framework to better understand and explain the assumptions of CE practices of SMEs. More specifically, the use of these three theories allows for a more holistic explanatory perspective required to understand the multiple forces affecting the adoption of CE practices in SMEs. Consequently, this integrated framework can also be seen as a contribution of this paper to enable more differentiated SME studies and also insights into environmental engagement.

To date, research is lacking on why some companies in Central and Eastern Europe (CEE) practice CE, whereas others are lagging (Ahmadov, 2023; Mazur-Wierzbicka, 2021). Understanding the interplay of the various factors in this process of SMEs practicing CE is crucial in understanding the complexity and drawing implications to support SMEs, as well as inform the literature on CE practices in SMEs to foster the transition towards CE. Therefore, this study aims to deepen our understanding of the dynamics that shape CE practices in these organisations. More precisely, we analyse the influence of different stakeholders on CE practices in SMEs. Research shows that SMEs must work with different stakeholders to overcome any shortcomings associated with smallness (Durst et al., 2020). Therefore, these stakeholders can have a significant impact on SME activities, such as CE practices (Ahmadov, Ulp, et al., 2024; Baah et al., 2022). Acknowledging the critical role of SME owners and managers in CE and its implementation (Prieto-Sandoval et al., 2019), we also want to provide further evidence of managerial perception as a key driver of CE practices in SMEs. Finally, in recognising the pivotal role of stakeholder involvement in shaping CE orientation (Moggi & Dameri, 2021), we decided to integrate CE orientation as a mediating force to explore the intricate relations between stakeholder pressure, SME management perceptions, and CE practices.

This study contributes to the literature by challenging the assumptions of uniform stakeholder pressure (Baah et al., 2023; Chiappetta Jabbour et al., 2020), revealing distinct impacts of internal and external stakeholder pressure on CE practices. Additionally, it emphasises the crucial role of positive managerial perception as a motivator for

embracing CE principles and introduces a novel perspective framing CE orientation as a mediating force between stakeholder pressure, managerial perception, and CE practices. Our findings suggest that a heightened CE orientation enhances organizational responsiveness to stakeholder pressures, advancing our understanding of nuanced mediating mechanisms and emphasising the importance of CE initiatives, particularly for SMEs.

The remainder of this paper is organised as follows. The next section discusses the theoretical background and develops the hypotheses. Section 3 describes the research methodology used in this study. Section 4 presents the results of this study. Section 5 discusses the theoretical and practical implications of this study's findings. Finally, Section 6 discusses the study's limitations and suggests future recommendations.

2. LITERATURE REVIEW AND HYPOTHESES

This section outlines the theoretical foundation and hypotheses for the study, focusing on the critical roles of stakeholder pressures, managerial perceptions, and organizational orientation in driving the adoption of CE practices. Drawing from established literature, the discussion delves into the distinct and interconnected influences of these factors, setting the stage for a deeper exploration of their impacts on CE transitions. The section also highlights key gaps in current research, emphasizing the need for a comprehensive understanding of these dynamics to advance sustainable business practices.

2.1 Role of Stakeholder Pressure on CE Practices

This discussion underscores the critical role of stakeholder pressure in shaping the adoption of CE practices (Baah et al., 2023; Hernández-Arzaba et al., 2022; Jakhar et al., 2019). Baah et al. (2022) and Rodríguez-Espíndola et al. (2022) emphasised the challenges faced by SMEs in voluntarily engaging with CE, highlighting the pivotal influence of external pressures. This study further notes that without stakeholder pressures, the adoption of CE practices in industrial settings is hampered (Baah et al., 2023). This aligns with growing awareness among stakeholders regarding ecological and social issues, resulting in increased calls for firms to align their operations with environmental and social concerns (Jakhar et al., 2019; Winans et al., 2021).

Examining stakeholder pressure in the context of CE practices, Govindan and Hasanagic (2018) found that the government plays a prominent role in coercing firms to embrace CE practices. Genovese et al. (2017) argue that external stakeholder pressures facilitate CE practices adoption, reinforcing the notion that stakeholder pressures significantly contribute to the integration of CE practices. External stakeholders such as customers, NGOs, competitors, and government agencies play significant roles in shaping the adoption of CE practices. Customers, by driving the demand for sustainable products, exert pressure on firms to embrace CE principles in their operations (Santos et al., 2023). NGOs contribute to raising awareness and advocating for environmental responsibility, potentially influencing organisational behaviour towards CE adoption (Ahmadov et al., 2024; Mazzucchelli et al., 2022). Competitors can exert mimetic pressures, leading firms to emulate the successful CE strategies observed in their industry to maintain competitiveness (Calzolari et al., 2023). Moreover, government policies and regulations represent a form of coercive pressure that can mandate or incentivize the adoption of CE practices, further influencing firms' decisions in this regard (Amjad & Diaz-Elsayed, 2024; Fleischmann, 2019). However, based on the seminal work by Cantele and Zardini (2020), Dubey et al. (2019) and Jansson et al. (2017), it becomes apparent that SMEs are less responsive to top-down regulatory mandates compared to larger enterprises. This nuanced observation suggests that, while external pressure (regulatory pressure) plays a significant role in driving CE practices among SMEs, its impact may vary depending on the size and organizational structure of the enterprise. Internal stakeholders, notably company owners, employees, and shareholders, also have significant influence, potentially surpassing that of external stakeholders in fostering the adoption of CE business models (Chiappetta Jabbour et al., 2020). At the operational level, employee involvement is crucial for the successful implementation of CE practices, ensuring that sustainable initiatives are effectively implemented (Dräger & Letmathe, 2023). Meanwhile, top management's strategic orientations and commitment are pivotal in setting the agenda and providing the necessary resources for CE implementation (Behlau, 2020). Additionally, stakeholder pressures, including those from investors, can influence corporate social responsibility (CSR) participation and the adoption of CE practices, highlighting the importance of internal alignment and buy-in (Baah et al., 2023). SMEs disregarding stakeholder pressures risk adverse consequences such as bad publicity, loss of goodwill, and potential lawsuits, hindering

collaboration and innovation capabilities (Agyabeng-Mensah et al., 2022). Responding to stakeholder pressure is imperative to mitigate these consequences (Chiappetta Jabbour et al., 2020).

To further develop a nuanced understanding, it is crucial to distinguish between internal and external stakeholder pressure. The interplay between internal and external stakeholders profoundly impacts a company's sustainability and competitiveness (González-Rodríguez et al., 2019). Recognising these distinctions is essential for comprehending the complex dynamics that influence the adoption of CE practices. Building on these insights, we propose the following hypotheses:

- *H 1: Pressure from stakeholders positively influences the adoption of CE practices.*
- *H 1a: Pressure from internal stakeholder positively influences the adoption of CE practices.*
- *H 1b: Pressure from external stakeholder positively influences the adoption of CE practices.*

2.2 Managerial Perception's Role in CE Practices

Examining managers' perspectives on CE transitions is crucial for understanding the awareness and implementation of CE concepts within organisations. Santos Álvarez and García Merino (2008) characterized managerial perceptions as "the substratum", which is closely connected to the personal attributes of managers and serves as the foundation for determining the most suitable alternative. O'dwyer (2002) defines it as a subjective understanding and interpretation by senior managers within organisations. Firms are more likely to perform behaviours that they perceive can result in better performance than others (Ajzen, 1991). Consequently, we posit that positive managerial perceptions of CE will serve as a motivating factor for companies to embrace CE practices. These positive managerial perceptions stem from the recognised advantages and benefits associated with the adoption of CE principles.

Previous studies (e.g., García-Quevedo et al., 2020; Jiao et al., 2020; Liakos et al., 2019; Masi et al., 2018) have delved into the analysis of how companies perceive and incorporate CE practices. Ormazabal et al. (2018) identified key factors influencing a company's perception of CE, emphasizing material provisions, resource recovery, and cost-savings as primary considerations. Such perceptions often act as a lens through which managers evaluate the feasibility and strategic value of CE practices, shaping their willingness to engage in CE-related initiatives. For example, if managers associate CE practices with cost efficiencies or reputational gains, these perceptions can create a positive feedback loop that reinforces the prioritization of CE within the organization.

CE practices introduce intricate tension among managers. Decisions in this realm necessitate navigating through ambiguous contexts and demanding managerial judgments and perceptions. In line with Wallo et al. (2024), organizational resilience, knowledge management, and a socially sustainable working environment are critical factors for achieving CE. Managerial perceptions play a key role in interpreting these factors, determining whether CE adoption is seen as an opportunity for innovation or as a challenge requiring extensive resources. As CE practices become a part of sustainability issues, increasingly intertwined economic, environmental, and social concerns, key decision-makers, such as owners, must grapple with the complexities of these interconnected dimensions (Hahn et al., 2014).

In the evolving landscape of CE, scholars have recognised the significance of managerial perceptions in the planning and implementation of sustainability initiatives (Al-Kwifi et al., 2023; Peng & Liu, 2016; Ruokonen, 2021; van Langen et al., 2021). Nascent research in this field underscores the pivotal role that managerial perceptions play in shaping the trajectory of CE practices within organisations. These perceptions not only influence strategic decisions but also set the tone for how sustainability goals are integrated into daily operational processes, highlighting their critical impact on organizational commitment to CE practices.

The intricate web of economic, environmental, and social considerations in sustainability further emphasises the role of managerial perceptions as a compass in navigating the complexities inherent in CE adoption. By serving as a bridge between organizational objectives and actionable strategies, managerial perceptions enable firms to align CE adoption with broader sustainability goals, ensuring both strategic coherence and operational feasibility. Building on these insights, we propose the following hypothesis:

- *H 2: Managerial perception positively influences the adoption of CE practices.*

2.3 CE Orientation and Its Influence on CE Practices

The examination of CE orientation at the organizational level remains in its nascent stages, with a limited number of research articles identified (Gallardo-Vázquez et al., 2024; Ozkan-Ozen et al., 2020; Schmidt et al., 2021; Shaharudin et al., 2023). Despite its preliminary status, the construct has garnered increasing attention from researchers, hinting at its potential to act as a catalyst for gaining competitive advantage (Afum et al., 2022). Recent study by Gallardo-Vázquez et al. (2024) have emphasized the significance of philosophy of orientation towards the CE as a new paradigm of sustainable management, integrating insights from Institutional and Stakeholders Theories. This growing body of research suggests a rising recognition of CE orientation as a pivotal factor in driving organizational sustainability efforts and gaining competitive advantage. However, the variability in conceptualizations of CE orientation in the literature remains a limitation, potentially affecting the consistency and generalizability of findings.

Addressing this need (absence of an accepted definition for CE orientation) for clarity, Liu and Chang (2017, p.7) introduce the term "closed-loop orientation," defining it as the "strategic orientation towards the recyclability of materials/components/products throughout the entire supply chain loop." This term provides a valuable mechanism for understanding the translation of general strategic orientations into tangible CE practices. Alternatively, Goyal et al. (2018) contribute to the discourse by defining CE orientation as "involving the focus on setting up end-to-end processes for e-waste collection, sorting, and segregation into reusable metal extracts." Meanwhile, Arranz et al. (2023) consider the CE orientation as “adoption of relevant regulations and standards, which requires the development of learning processes and organizational routines that facilitate their implementation”. This necessitates the establishment of learning processes and organizational routines to facilitate implementation, leading to increased efficiency. These processes enable effective waste management, identification of areas for improvement, and prompt responses to monitoring and auditing results.

Synthesising insights from the existing literature (Afum et al., 2022; Arranz et al., 2023; Gallardo-Vázquez et al., 2024; Goyal et al., 2018; Liu & Chang, 2017), the present study defines CE orientation as both minimisation mindset and an operational framework that extends beyond basic waste minimization and recycling efforts. It encompasses a spectrum of initiatives, fostering internal comprehension of CE practices and facilitating seamless coordination among all stakeholders. This definition underlines the critical importance of the alignment of stakeholders and their power and expectations (the underlying notion of stakeholder theory) and of a company management that is aware of which resources are available and how they can be used in the best possible way to create a competitive advantage (in the sense of strategic management theory).

Jagani and Hong (2022) have highlighted the pivotal role of sustainability orientation, integrating economic, environmental, and social factors within firms. This supports companies in the sustainable development of new products and creates a positive cascade effect. The study further suggests that sustainable product development positively influences environmental performance, ultimately correlating with enhanced overall business performance. Schmidt et al. (2021) conducted a study, shedding light on the pivotal role of closed-loop orientation, grounded in CE principles, particularly recyclability, in driving the effective implementation of CE practices. Based on these observations, it can be hypothesized that a CE orientation has a positive influence on CE practices:

- *H 3: CE orientation positively influences the adoption of CE practices.*

2.4 Stakeholder Pressures and CE Orientation

Existing research highlights the significant impact of stakeholder pressure on compelling firms to address environmental concerns, engage in active environmental management, and innovate sustainable measures (Jennings & Zandbergen, 1995; Lee et al., 2018; Moggi & Dameri, 2021). However, the transition from responding to stakeholder pressure to embracing CE practices necessitates a strategic mindset that permeates the organization. This strategic mindset, in other word, CE orientation, fosters internal comprehension of CE practices and facilitates seamless coordination among stakeholders (see Section 2.3).

While the literature provides insights into the influence of stakeholder pressure on environmental initiatives (Baah et al., 2022; Jiao et al., 2020), according to the authors’ knowledge, the specific nexus between stakeholder pressure and the development of a CE orientation remains an underexplored domain. This critical gap motivates our investigation, driven by the hypothesis that stakeholder pressure, whether internal or external, serves as a catalyst for cultivating a robust CE orientation.

- *H4: Pressure from stakeholder pressure positively influences the CE orientation.*
- *H4a: Pressure from internal stakeholder positively influences the CE orientation.*
- *H4b: Pressure from external stakeholder positively influences the CE orientation.*

The hypothesises posit that stakeholder pressure acts as a driving force in the development of CE Orientation. This aligns with the arguments presented by Nason et al. (2018), who observed a consensus among various stakeholders on the salience of environmental issues and incorporated these expectations as reference points for environmental performance. Increased pressure is anticipated to stimulate greater efforts to integrate environmental concerns into strategic, tactical, and operational activities, leading to the development of internal knowledge and capabilities to navigate heightened output constraints (Delgado-Ceballos et al., 2012).

Our focus extends to the mediating role of CE orientation in the intricacies of stakeholder dynamics. This study aims to dissect the complex relationships between stakeholder pressure (both internal and external) and the adoption of CE practices within firms. Our rationale for this enquiry stems from the recognition that firms characterised by varying levels of CE orientation may exhibit distinct responses to internal and external pressures.

Our argument asserts that the observed reactions to internal and external pressures are contingent on the inherent level of CE orientation within the company. A higher degree of CE orientation is proposed to intensify a firm's responsiveness to stakeholder pressure, exerting a more pronounced influence on the adoption of CE practices. In essence, CE Orientation is conceptualised as a mediating force between stakeholder pressure and the subsequent implementation of CE practices.

- H 5: CE orientation mediates the relationship between stakeholder pressure and CE practices.
- H 5a: CE orientation mediates the relationship between internal stakeholder pressure and CE practices.
- H 5b: CE orientation mediates the relationship between external stakeholder pressure and CE practices.

2.5 Managerial Perceptions and CE Orientation

Examination of managers' perspectives on CE transitions is imperative for understanding the awareness and implementation of CE concepts. Drawing from Ajzen (1991) notion that firms are inclined to adopt behaviours perceived as advantageous, we argue that positive managerial perceptions of CE act as a driving force for companies to adopt CE practices. These positive perceptions originate from the recognised advantages associated with the adoption of CE principles.

However, the implementation of CE practices introduces complex tensions for managers. Decisions in this domain require navigating through ambiguous contexts, demanding nuanced managerial judgments and perceptions. As CE practices, intertwined with sustainability issues, corporate decision-makers grapple with the intricacies of these interconnected dimensions (Hahn et al., 2014). This nascent research highlights the pivotal role managerial perceptions play in shaping the trajectory of CE practices within organizations.

The fusion of managerial perceptions and CE practices is particularly noteworthy, as companies viewing CE as an opportunity for material provisions, resource recovery, and cost-savings are more likely to integrate circular practices into their business models. The intricate interplay of economic, environmental, and social considerations in sustainability further underscores the role of managerial perceptions as a compass for navigating the complexities inherent in CE adoption. Despite the increasing focus on sustainability research, several scholars (e.g., Al-Kwifi et al., 2023; Ruokonen, 2021; van Langen et al., 2021) have emphasized the potential importance of managerial perceptions in planning and implementing sustainability initiatives, as well as recognise the intricate relationship between managerial perception and the practical implementation of CE. Building on these arguments, we propose following hypothesises:

- H 6: Managerial perception positively influences CE Orientation.
- H 7: CE Orientation mediates the relationship between managerial perception and CE practices.

In the following section, we present a comprehensive overview of the literature review, as summarized in Tab 1. This table consolidates key findings and research gaps related to the role of stakeholder pressure, managerial perception, and CE orientation in driving the adoption of CE practices. By synthesizing insights from existing studies, Tab 1 offers a clear and structured presentation of the findings, along with identified opportunities for future research.

Table 1. Summary of Key Findings and Research Gaps in CE Literature

Research Gap	Key Findings	Implications for Future Research
Role of Stakeholder Pressure on CE Practices	• Stakeholder pressure significantly influences the adoption of CE practices (Baah et al., 2023; Genovese et al., 2017) • Government regulations play a prominent role in coercing firms towards CE practices (Govindan & Hasanagic, 2018) • SMEs are less responsive to top-down regulatory mandates compared to larger enterprises (Jansson et al., 2017) • Internal stakeholders, including company owners and shareholders, also influence CE adoption (Chiappetta Jabbour et al., 2020)	• Further investigation into the differential impact of stakeholder pressure on SMEs and larger enterprises (Baah et al., 2022) • Exploration of effective strategies for SMEs to navigate stakeholder pressures (Dubey et al., 2019) • Examination of the nuances in the influence of internal stakeholders on CE adoption (Chiappetta Jabbour et al., 2020)
Managerial Perception's Role in CE Practices	• Positive managerial perception towards CE serves as a motivating factor for companies (García-Quevedo et al., 2020; Masi et al., 2018) • Managerial perceptions are crucial in navigating the complexities of CE adoption (Al-Kwifi et al., 2023; Peng & Liu, 2016)	• Investigation into the factors influencing managerial perceptions towards CE (García-Quevedo et al., 2020) • Examination of how managerial perceptions translate into actionable strategies for CE adoption (Ruokonen, 2021) • Assessment of the role of leadership styles in shaping managerial perceptions towards CE (van Langen et al., 2021)
CE Orientation and Its Influence on CE Practices	• CE orientation encompasses strategic mindset and operational framework beyond waste minimization (Arranz et al., 2023; Liu & Chang, 2017) • Sustainability orientation correlates with enhanced overall business performance (Jagani & Hong, 2022) • Closed-loop orientation, grounded in CE principles, drives effective CE practices implementation (Schmidt et al., 2021)	• Development of a standardized definition for CE orientation (Arranz et al., 2023) • Examination of the mechanisms through which CE orientation facilitates CE practices implementation (Ozkan-Ozen et al., 2020) • Exploration of the role of CE orientation in fostering innovation and sustainable product development (Jagani & Hong, 2022)

Our conceptual model, illustrated in Figure 2, describes the relationships among stakeholder pressure (both internal and external), CE orientation, managerial perception, and their collective impact on CE practices. Developed based on the literature, this model goes beyond a linear representation, incorporating the mediating role of CE orientation in shaping the dynamics between stakeholder pressure and the subsequent adoption of CE practices.

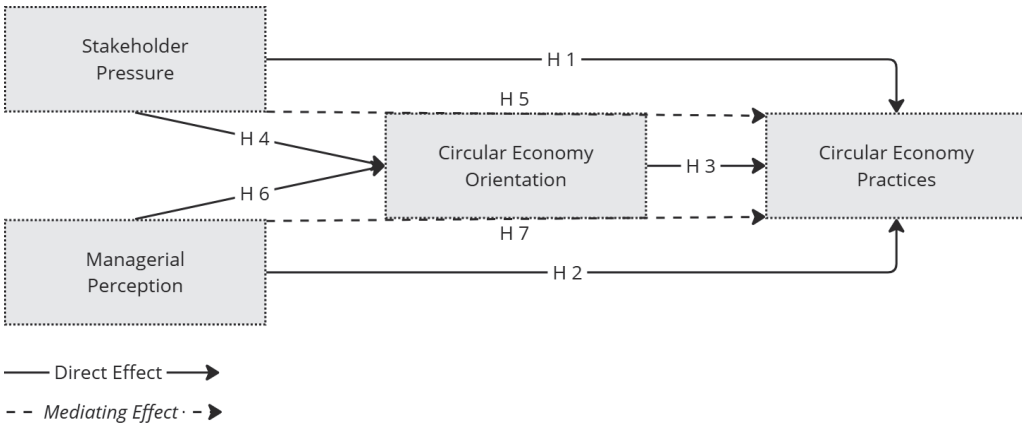

Figure 2. Conceptual Model (Authors' Own Figure)

3. RESEARCH DESIGN AND METHODOLOGY

The use of quantitative approaches such as surveys, statistics and structural modelling is intended to test the framework of the hypothesis or assess the relationship (correlation) between constructs (Götz et al., 2009; J. F. Hair et al., 2012). In the social science context, this methodology has been used extensively (Tarka, 2018), and it enables researchers to construct and test theoretical models that reflect the complexity of the relationships, thereby providing a deeper understanding of the factors that influence the adoption of CE practices (Chowdhury et al., 2022; Dey et al., 2020; Rodríguez-Espíndola et al., 2022). While causal models, such as Figure 2, are instrumental in exploring complex relationships in management research, they may oversimplify dynamic interactions among variables. Critics argue that such models assume linear causality, which may not fully capture feedback loops or emergent phenomena inherent in stakeholder interactions and CE practices (Bollen & Pearl, 2013). Despite critiques of causal models, this approach enables a systematic examination of the hypothesized relationships, supported by Structural Equation Modelling (SEM), which accounts for measurement errors and captures complex interactions between variables.

3.1 Measures of Constructs

The hypotheses in this study were tested using a survey instrument grounded in the existing literature. The constructs employed were adapted from previously established frameworks identified during the literature review to ensure reliability and validity (Churchill, 1979). A five-point Likert scale was used for measurement, ranging from 1 (completely disagree) to 5 (completely agree).

The questionnaire comprised four sections, aligning with the constructs depicted in the framework (Figure 2.). The first section focused on stakeholder pressure, which investigates both internal and external pressures influencing the adoption of CE practices, using items adapted from Adomako and Tran (2022). Internal stakeholder questions focused on the influence of management, employees, and investors. External stakeholder items assessed the impact of factors such as customer environmental concerns, pressure from NGOs, competitors, and government regulations. The second section addressed managerial perception, adapted from Ormazabal et al. (2018). Questions explored perspectives on how circular practices contribute to organizational sustainability, cost-effectiveness, customer retention, competitive advantage, and environmental pollution reduction. The third section explored CE orientation, items were derived and build upon Papadas et al. (2017) to assess the organization's strategic inclination towards CE principles. Questions addressed the provision of CE-related training, recruitment of employees with CE expertise, use of external environmental sustainability support, and the significance placed on waste minimization and resource efficiency. This construct acts as a mediating variable between external pressures, managerial perceptions, and CE practices. Finally, the fourth section focused on CE practices. This section included items adapted from Rodríguez-Espíndola et al. (2022) to measure the implementation of CE practices within organizations. Questions explored areas such as the replacement of non-recyclable raw materials with sustainable

alternatives, collaboration with suppliers for ecological design, use of recycled materials, and policies for resource optimization and waste management. A detailed list of the questions included in the survey is presented in Table 2.

Table 2. Questionnaire Constructs and Sources

Construct	Item	Source
Circular Economy Practices	• In our company, we have replaced non-recyclable raw materials with renewable, recyclable, or biodegradable inputs. • We work with clients/suppliers for the ecological design of products. • During the design stage, we consider the possibility to reuse products after they have served their initial purpose. • We are using recycled materials as inputs in our processes. • We have policies and practices in place to dispose of machinery and equipment on time. • In our company we intentionally make changes to processes to use the least amount of energy and resources	Rodríguez-Espíndola et al. (2022)
Circular Economy Orientation	• My organization provides Circular Economy related training (e.g., waste minimization, improve recycling) to our employees. • My organization recruits new employees who understand Circular Economy practices. • In our organization, we have a strong understanding of circular economy practices. • In our organization, we use external help for environmental sustainability support (such as sustainability consultants or support). • In our organization, we are able to coordinate effectively with all internal departments, suppliers, and customers in the context of implementing and adopting circular economy practices. • In our organization, we understand the significance of waste minimization and its use.	Papadas et al. (2017)
Stakeholder Pressure	Internal Stakeholder: • 'Management will' is necessary for taking valuable steps supporting effective CE in the firm. • Employees put pressure on our company to pursue sustainable environmental practices. • Investors put pressure on our company to pursue sustainable environmental practices. External Stakeholders: • Environmental issues, such as carbon emissions, critically affect the buying decisions of our customers. • NGOs put pressure on our company to pursue sustainable environmental practices.	Adomako and Tran (2022)

	• Competitors put pressure on our company to pursue sustainable environmental practices. • The government put pressure on our company to pursue sustainable environmental practices.	
Managerial Perception	• Adoption of circular practices e.g., reduce, reuse, and recycle will help the firm to develop sustainability as an organization. • Adoption of circular practices e.g., reduce, reuse, and recycle will help the firm to be more cost-effective. • Adoption of circular practices e.g., reduce, reuse, and recycle will help the firm to retain customers. • Adoption of circular practices e.g., reduce, reuse, and recycle will help the firm to attract new customers. • Adoption of circular practices e.g., reduce, reuse, and recycle will help the firm to gain a competitive advantage. • Adoption of circular practices e.g., reduce, reuse, and recycle will help the firm to reduces environmental pollution.	Ormazabal et al. (2018)

To account for potential factors that could influence the adoption of CE practices, four control variables were included in the study: firm age, firm size, internationalization, and industry/sector. Firm age was incorporated to capture the effect of organizational maturity, as older firms may have greater experience and knowledge, potentially enhancing their propensity to adopt CE practices (Li et al., 2019). This variable was measured using a 5-point scale ranging from 1 for firms 5 years or younger to 5 for firms over 30 years old (Jiao et al., 2020). Firm size was included as larger organizations often have greater resources and face higher environmental pressures (González-Benito & González-Benito, 2006; Rivera-Camino, 2012). Size was categorized according to the EU SME classification: 1 for micro firms (fewer than 10 employees), 2 for small firms (10 to 49 employees), and 3 for medium firms (50 to 250 employees) (EC, 2018). Internationalization was considered, as firms operating internationally often encounter more stringent environmental pressures and institutional demands, influencing their eco-innovation and sustainability practices (Ahmadov et al.,2024; Amer, 2023; Marco-Lajara et al., 2023). This variable differentiated firms with international operations from those operating domestically (Barbosa et al., 2022). Finally, industry/sector differences were addressed, recognizing that firms in carbon-intensive industries, such as cement, steel, and electricity, may adopt CE practices more readily to reduce carbon emissions and mitigate financial impacts from carbon taxes (Bendikiene et al., 2019). These control variables ensure a more comprehensive analysis of the factors influencing CE adoption across diverse organizational contexts.

3.2 Sample and Data Collection

This study employed an online survey methodology, deployed through the Qualtrics platform, accompanied by an introductory email outlining the study's objectives. A randomized sample of 1,500 SMEs was drawn from the Orbis Europe database to ensure representativeness. Data collection occurred in three phases—comprising the baseline survey and two subsequent follow-up surveys—spanning a period of three weeks. The structured survey was administered on January 10th, 2023, targeted participants from manufacturing SMEs located in Estonia. To accommodate the diverse backgrounds of Estonian firms, the survey was translated into three languages: Estonian, Russian, and English. This approach resulted in a total of 455 responses (30.33% response rate). To enhance the robustness of the data, the "complete case analysis" method was employed to address missing data, in line with the recommendations of Hughes et al. (2019). As a result, questionnaires with incomplete or missing responses were excluded from the analysis. Furthermore, firms exceeding the SME threshold or industry focus (i.e., those with more than 250 employees, or a service companies) were removed from the dataset. Following this data refinement process, 196 complete and valid responses were obtained for analysis, representing a response rate of 13.07% (196 out of 1500).

Adhering to Podsakoff et al. (2003) guidelines to mitigate potential common method bias, various procedures were implemented, ensuring the confidentiality and anonymity of respondent information. The study emphasises the exclusive use of results for research purposes, with randomised question ordering. The study gathered responses from mostly micro firms (68.37%) followed by small (26.53%) and medium-sized firms (5.10%) and from a predominantly male respondent base (79.92% male). Educational backgrounds varied, with 41.33% holding a Diploma/Certificate, and the rest with university degrees. Most participants held positions as owners (75%), while 25% were managers within their respective firms. The respondents in the study represent various sectors of manufacturing, with the highest participation from the manufacture of fabricated metal products (17.35%). Tab 4 illustrates the profiles of the final sample in terms of firm size, years in business, type, industry/sector and respondent's gender, education and positions.

Table 3. Distribution of Responses by Industry/Sector

Attributes	**Description**	**Frequency**	
		(n)	%
Firm size	≤9	134	68.37
	10-49	52	26.53
	50-249	10	5.10
Gender	Male	139	70.92
	Female	57	29.08
	Prefer not to say	0	0
Education	Doctorate	0	0
	Master's	64	32.65
	Undergraduate	51	26.02
	Diploma/Certificate	81	41.33
Position in the firm	Owner	147	75
	Manager	49	25
Years in business	Above 30 years	16	8.16
	21 – 30 years	40	20.41
	11 – 20 years	58	29.59
	5 – 10 years	58	29.59
	Less than 5 years	24	12.25
Business Type	B2B (business-to-business)	66	33.67
	B2C (business-to-consumer)	45	22.96
	Both	85	43.37
Industry/sector	Manufacture of food products	10	5.10
	Manufacture of beverages	7	3.57
	Manufacture of tobacco products	0	0.00
	Manufacture of textiles	6	3.06
	Manufacture of wearing apparel	13	6.63
	Manufacture of leather and related products	2	1.02
	Manufacture of wood and of products of wood and cork	32	16.33
	Manufacture of paper and paper products	2	1.02
	Printing and reproduction of recorded media	7	3.57
	Manufacture of coke and refined petroleum products	0	0.00
	Manufacture of chemicals and chemical products	6	3.06
	Manufacture of basic pharmaceutical products	4	2.04
	Manufacture of rubber and plastic products	7	3.57
	Manufacture of other non-metallic mineral products	3	1.53
	Manufacture of basic metals	7	3.57

	Manufacture of fabricated metal products	34	17.35
	Manufacture of computer, electronic and optical products	3	1.53
	Manufacture of electrical equipment	1	0.51
	Manufacture of machinery and equipment	20	10.20
	Manufacture of motor vehicles, trailers and semi-trailers	5	2.55
	Manufacture of other transport equipment	3	1.53
	Manufacture of furniture	24	12.24

3.3 Statistical Method

In this study, we employed a comprehensive methodological approach to rigorously analyse our data and test our hypotheses. Firstly, we conduct descriptive analyses to explore the main characteristics of our survey items. Specifically, we investigate the data using different summary measures, including mean and standard deviation to provide insights into the central tendency and dispersion of our variables.

Secondly, to ensure the robustness of our results, we subject all our survey items and constructs to rigorous reliability and validity assessments. To verify that common method bias does not exist in our study, we use Harman's single-factor test to assess whether a single dominant factor could account for the variance in our survey responses (Harman, 1976; Podsakoff et al., 2003). However, as with any survey-based research, there remains a potential tendency for bias to occur due to self-reported data, which may be influenced by social desirability or respondent interpretation. Reliability is assessed through measures such as Cronbach's alpha coefficient (Churchill, 1979; Cronbach, 1951), average variance extracted (Bagozzi & Yi, 1988), and composite reliability (Nunnally, 1978). In the meantime, convergent validity is established through exploratory factor analysis, as we have a relatively large set of variables (Hair et al., 2010). We also conduct correlation analysis to identify patterns of association between our constructed variables. These statistical procedures provide valuable insights into the underlying structure of our measured variables while also ensuring the reliability and robustness of our conclusions.

Finally, to empirically test our hypotheses and shed light on the complex interplay between factors in our models, we employ ordinary least square (OLS) regression and structural equation modelling (SEM). SEM offers several advantages, including the ability to simultaneously assess multiple relationships within an integrated framework (Hayes & Preacher, 2013). Applying SEM enabled us to establish both direct and indirect relationships between variables, including the mediation effect of CE orientation (CO) on the relationship between Circular Practices (CP) and various independent variables.

4. RESULTS

4.1 Descriptive Statistics

Table 4 presents summary statistics, including means and standard deviations among our variables. Among the five-point Likert scale items, CP6 displayed the highest average value ($\mu = 4.327$), whereas CO4 registered the lowest mean value ($\mu = 2.036$). Additionally, CP5 demonstrated the greatest variability (SD = 1.490), while CO6 showed the least variability (SD= 0.722).

Table 4. Summary Statistics, Measurement Items, Factor Analysis

	Mean	SD	Factor loadings
Stakeholder Pressure			
IP1	4.087	0.904	0.567
IP2	2.153	0.991	0.680
IP3	2.051	0.954	0.808
EP1	2.520	1.139	0.590
EP2	2.245	1.003	0.759
EP3	2.281	1.017	0.771
EP4	2.474	1.107	0.593
Managerial Perception			
MP1	3.893	0.885	0.722
MP2	3.704	1.010	0.773
MP3	3.730	0.941	0.883
MP4	3.745	0.943	0.875
MP5	3.505	0.984	0.821
MP6	4.276	0.807	0.825
CE Orientation			
CO1	2.832	1.103	0.726
CO2	2.781	1.140	0.733
CO3	3.378	0.923	vv0.594
CO4	2.036	1.049	0.649
CO5	2.980	1.062	0.593
CO6	4.219	0.722	0.678
CE Practices			
CP1	3.934	1.216	0.530
CP2	3.765	1.311	0.737
CP3	3.984	1.303	0.676
CP4	3.852	1.242	0.724
CP5	3.495	1.490	0.695
CP6	4.326	0.748	0.510
Note: Exploratory factor analysis with varimax rotation. Kaiser–Mayer–Olkin criterion = 0.8174 *IP- Internal Pressure; EP- External Pressure; MP- Managerial Perception; CO- CE Orientation; CP- CE Practices.*			

4.2 Common Method Bias

To verify that common method bias (CMB) is not a major threat to our results, we use the Harman single-factor test (Harman, 1976; Podsakoff et al., 2003). The results show that a single factor is extracting 21.763% of total variance. Since it is far less than the recommended threshold of 50%, CMB is not an issue in our study.

4.3 Reliability and Validity of the Measures

To examine the convergent validity of our constructs, we conduct exploratory factor analysis (EFA) with a varimax rotation (Hair et al., 2010). The results are shown in Tab 4. According to Hair et al. (2010), an acceptable factor loading value should be more than 0.5, therefore all items used in the questionnaire can be considered satisfactory. We also perform Bartlett's test of sphericity and use the value of Kaiser–Meyer–Olkin (KMO) to determine the sample adequacy and the suitability of the data for our models (Cerny & Kaiser, 1977). The results confirm the suitability of our data and models (Chi-square = 2095.8; df = 300, $p<0.01$; KMO = 0.817).

To assess internal consistency reliability, we use Cronbach's alpha (Churchill, 1979; Cronbach, 1951) with a threshold of 0.6 (Hinton et al., 2014) , composite reliability (CR) scores with a threshold of 0.7 (Nunnally, 1978),

and Average Variance Extracted (AVE) with a threshold of 0.5 (Bagozzi & Yi, 1988). All used constructs meet the respective thresholds, except for Internal Pressure, External Pressure, and Shareholder Pressure with an AVE of less than 0.5. However, as their CR values are higher than the acceptable level of 0.7, the convergent validity of these constructs can be considered as adequate (Fornell & Larcker, 1981). Tab 5 shows Cronbach's alpha, CR, and AVE values for our measurement constructs.

Table 5. Validity and Reliability Indicators

	Number of items	Cronbach's alpha	AVE	CR
IP	3	0.520	0.479	0.730
EP	4	0.692	0.467	0.775
SP	7	0.7794	0.472	0.860
MP	6	0.873	0.669	0.924
CO	6	0.800	0.441	0.825
CP	6	0.728	0.425	0.813
Note: AVE = Average Variance Extracted; CR = Composite Reliability; IP - Internal Pressure; EP - External Pressure; SP - Stakeholder Pressure; MP - Managerial Perception; CO - Circular economy Orientation; CP - Circular economy Practices.				

Finally, to assess discriminant validity, we show the square root of AVE along with the pair-wise correlation for each of the construct (Fornell & Larcker, 1981). Tab 6 shows that the square root of AVE of each construct is much more than the correlation between any two constructs, discriminant validity is thus supported.

Table 6. Correlations and Discriminant Validity

Variables	(1)	(2)	(3)	(4)
(1) CE Practices	*0.652*			
(2) CE Orientation	0.280	*0.664*		
(3) Stakeholder Pressure	0.088	0.472	*0.687*	
(4) Managerial Perception	0.152	0.410	0.260	*0.818*
Note: The square root of the AVE is displayed in italics.				

4.4 Hypotheses Tests

We initially tested our proposed direct hypotheses (see Tab 7). Hypothesis 1 posited that stakeholder pressure positively influences CE practices; this is confirmed by our results. As shown in Tab 5, the direct association between CE practices and stakeholder pressure is significant and positive (β=0.164, $p<0.05$). Recognising the multidimensional nature of stakeholder pressure, we proceed to dissect it into internal and external pressure dimensions for a more in-depth analysis. Our analysis revealed that internal pressure exhibits a significant effect (β=0.513, $p<0.01$), whereas external pressure does not show a significant effect on CE practices. Furthermore, the results confirm that a positive and significant relationship exists between CE orientation and practices (β=0.358, $p<0.01$). Thus, Hypothesis 2 is supported. Similarly, Hypothesis 3 is confirmed, showing that management perception significantly impacts CE practices (β=0.253, $p<0.01$).

Additionally, as shown in Tab 7, our results support Hypothesis 4, indicating that stakeholder pressure, both internal and external, collectively has a significant positive impact on CE orientation (β=0.421, $p<0.01$). Moreover, internal pressure has a stronger effect (β =1.055, $p<0.01$) than external pressure (β =0.520, $p<0.01$). Hypothesis 5 is likewise confirmed, showing a significant impact of managerial perception on CE orientation (β =0.388, $p<0.01$).

Table 7. Regression Results. Dependent Variable: CE Practices

	Dependent variables	
	CE Practices	CE orientation
Stakeholder Pressure	0.164**	0.421***
	(0.0763)	(0.0619)
Internal Pressure	0.513***	1.055***
	(0.177)	(0.142)
External Pressure	0.161	0.520***
	(0.116)	(0.0975)
CE Orientation	0.358***	
	(0.0801)	
Manager Perception		0.388***
		(0.0711)
Controls	Yes	Yes
N	196	196
Note: Standard errors in parentheses. Control variables include internalization, firm industry, firm size, and firm age. * p<0.1 ** p<0.05 *** p<0.01.		

For the mediation analysis, we follow the procedures outlined by Preacher and Hayes (2004). The results, as shown in Tab 8, confirm a mediating effect of CE orientation on all the examined relationships, albeit with varying degrees of influence. CE orientation is found to partially mediate the relationship between management perceptions and CE practices. Concerning stakeholder pressure and CE practices, CE orientation is identified as a partial mediator in this relationship. However, upon further analysis where stakeholder pressure is deconstructed into internal and external pressure, it is noted that CE orientation fully mediates the relationship solely between external pressure and circular economy practices, not internal pressure.

Table 8. Significance Levels of the Direct and Indirect Effect

Path	Indirect effect	Direct effect	Type of mediation
SP-CO-CP	0.202(0.190)	0.345	Partial mediation
IP-CO-CP	0.792(0.229)	0.380	Partial mediation
EP-CO-CP	0.217(0.170)	0.357	Full mediation
MP-CO-CP	0.195(0.175)	0.333	Partial mediation
Notes: Values in parenthesis are standardised estimates. IP - Internal Pressure; EP - External Pressure; SP - Stakeholder Pressure; MP - Managerial Perception; CO - Circular Economy Orientation; CP - Circular Economy Practices.			

5. DISCUSSION

5.1 Theoretical Contributions

The theoretical framework proposed in this study aimed to provide a comprehensive lens for analysing the complex dynamics shaping SMEs adoption of CE practices. By integrating stakeholder theory, legitimacy theory, and strategic management theory, the framework offered a robust foundation for understanding how stakeholder pressures, managerial perceptions and CE orientation interact to influence CE practices within SMEs. However, through empirical investigation and analysis, our study has evolved to offer deeper insights and perspectives on the interplay between stakeholder dynamics, managerial perceptions, CE orientation, and CE practices within SMEs.

One of the key strengths of the theoretical framework lies in its ability to capture the multifaceted nature of the forces at play in SMEs' CE engagements (Baah et al., 2022; Salvioni & Almici, 2020). By considering both the external and internal pressures exerted by stakeholders and the internal dynamics of organizational legitimacy and strategic orientation, the framework acknowledges the diverse array of factors that shape SMEs' decisions regarding

CE practices. This holistic perspective is crucial for developing a nuanced understanding of the challenges and opportunities faced by SMEs in transitioning towards a CE practices.

The investigation into stakeholder pressure contributes by refining the existing understanding of its role in shaping CE practices. The positive relationship between stakeholder pressure and CE practices, as confirmed by this study, aligns with prior research findings (Ahmadov et al., 2024; Chiappetta Jabbour et al., 2020; Winans et al., 2021). However, the distinct influence of internal stakeholders revealed in this study adds nuance to the literature. Previous studies (e.g., Genovese et al., 2017; Govindan & Hasanagic, 2018; Kirchherr et al., 2018) have emphasized the coercive role of external stakeholders, particularly the government, in compelling firms to adopt CE practices. The study results regarding the external pressure that does not have a significant impact on CE practices are quite intriguing. In line with the arguments put forward by Cantele and Zardini, (2020), Dubey et al. (2019) and Jansson et al. (2017) SMEs tend to be less receptive to top-down regulatory requirements than larger enterprises. This finding is supported by the study, which shows that SMEs in Estonia are less responsive to external stakeholders, including regulatory bodies. The current research introduces a crucial distinction by demonstrating that internal stakeholder pressure, notably from company owners and shareholders, also plays a significant role. This finding challenges the prevailing assumption that external pressures uniformly shape organizational behaviour and highlights the need for a nuanced understanding of the diverse influences of different stakeholder categories.

The exploration of managerial perceptions as a driving force for CE practices aligns with Ajzen's (1991) framework, emphasizing the role of perceived benefits in motivating organizations. This perspective expands on previous studies that have delved into how companies perceive and incorporate CE practices (García-Quevedo et al., 2020; Jiao et al., 2020; Liakos et al., 2019). The study adds depth to this understanding by emphasizing the critical influence of managerial attitudes in navigating the complexities of sustainability initiatives.

Moreover, the conceptualization of CE orientation as a mediating force between stakeholder pressure and CE practices introduces a novel viewpoint. The study posits that a heightened degree of CE orientation amplifies an organization's responsiveness to stakeholder pressures. This builds on the insights provided by Jagani and Hong (2022) and Schmidt et al. (2021), who highlighted the pivotal role of sustainability and closed-loop orientation, respectively, in driving CE practices. The current research extends these ideas, suggesting that CE orientation serves as a key mediator in the interplay between external stakeholder pressure and CE practices.

The nuanced mediation analysis conducted in this study reveals additional layers of understanding. External pressure, initially showing no significant impact on CE practices, but a significant impact on CE orientation, becomes influential on CE practices when mediated by CE orientation. This means that external pressure can lead companies to reflect on their environmental impact and adjust their organizational priorities accordingly. As a result, the mediation by CE orientation highlights the transformative effect of external pressures on shaping companies' fundamental approach to environmental practices, ultimately driving changes in their behaviour and decision-making processes. This finding challenges the conventional belief that external pressures alone are sufficient to drive CE practices. Instead, it underscores the importance of having a strategic orientation towards CE within the organization to effectively respond to external pressures.

Similarly, the partial mediation of internal pressure and managerial perception by CE orientation concerning CE practices adds depth to the understanding of the role of CE orientation. These findings emphasize that while CE orientation plays a crucial role in responding to internal pressure and managerial perceptions, it is not the sole determinant. This nuanced perspective encourages future research to explore the multifaceted nature of the relationship between CE orientation and different facets of stakeholder influence on organizational behaviour in the context of sustainability initiatives.

5.2 Practical Contributions

The practical implications of our study resonate with organizations navigating the complexities of integrating CE practices into their operational fabric. The delineation of internal and external stakeholder pressures carries substantial managerial implications. The findings highlight the significant managerial implications of distinguishing between internal and external stakeholder pressures. While external pressures have traditionally been perceived as potent drivers of change, the findings underscore the critical importance of internal stakeholders in shaping strategies. By recognizing the influential role of employees, investors, and company owners, organizations are urged to prioritize internal stakeholder engagement to foster a collaborative approach towards CE adoption. This strategic

emphasis aligns with the theoretical insight that internal stakeholder pressure, notably from company owners and shareholders, plays a significant role in shaping organizational behaviour alongside external pressures.

The emphasis on managerial perceptions as catalysts for CE practices underscores the importance of leadership in driving change. The identification of managerial perceptions as key drivers of CE practices underscores the pivotal role of leadership in steering change within organizations. As managerial attitudes significantly influence decision-making processes, organizations are encouraged to invest in fostering positive perceptions towards CE principles among their leadership cadre. This practical recommendation aligns with the theoretical insight that managerial perceptions, shaped by perceived benefits and advantages associated with CE practices, serve as motivational factors in driving organizational adoption of sustainable initiatives.

Moreover, the mediating role of CE orientation in the relationship between stakeholder pressure and CE practices offers actionable insights. The mediating role of CE orientation offers actionable insights for organizations to optimize their responses to stakeholder pressures. By understanding their CE orientation level, organizations can strategically align their responses to internal and external pressures more effectively. For instance, a higher level of CE orientation becomes crucial for translating external stakeholder pressures into tangible CE practices. This strategic alignment empowers organizations to optimize their efforts in pursuing circular and sustainable practices, leveraging their CE orientation as a strategic mediator between stakeholder pressures and organizational behaviour.

6. CONCLUSION

Our empirical investigation into the adoption of CE practices within CEE, specifically in Estonia has revealed significant insights into the influencing dynamics. Through the developed theoretical framework, that integrates stakeholder, legitimacy, and strategic management theories the study provided deeper insights into the interplay between stakeholder dynamics, managerial perceptions, CE orientation, and CE practices within SMEs. Crucially, the study's findings challenge prevailing assumptions by highlighting the significant role of internal stakeholder pressure alongside external pressures in shaping CE practices. Moreover, the exploration of CE orientation as a mediating force between stakeholder pressure, managerial perception and CE practices offers a novel perspective, emphasizing its transformative impact on organizational responsiveness to stakeholder pressures and managerial perception. The nuanced mediation analysis reveals that CE orientation is pivotal in driving changes in organizational behaviour, underscoring the importance of strategic orientation towards CE for effective response to external pressures.

However, it is crucial to acknowledge the limitations of our study. Firstly, the research focused primarily on SMEs in Estonia, which may limit the generalizability of the findings to other geographical contexts, cultural settings, or larger organizational structures. Secondly, the study's use of self-reported data from SME managers, which could introduce common method bias, potentially affecting the accuracy of responses and the validity of the results. Despite efforts to mitigate this through anonymity and confidentiality, the possibility of social desirability bias or subjective interpretations remains. Thirdly, while efforts were made to control for various factors such as internalization, firm industry, size, and age, the potential influence of unmeasured variables—such as external market conditions, technological capabilities, or regional regulatory differences—cannot be entirely ruled out. Additionally, the study employed a cross-sectional design, which limits the ability to draw causal inferences or capture dynamic changes over time in stakeholder pressures or CE practices. Lastly, the exclusive use of a quantitative approach, while valuable for hypothesis testing, may have overlooked nuanced qualitative insights that could provide a deeper understanding of the mechanisms underlying stakeholder pressures, managerial perceptions, and CE practices within SMEs.

Building on our findings, several avenues for future research emerge. Firstly, further exploration into the contextual factors that influence the effectiveness of stakeholder pressures on CE practices could provide valuable insights. Comparative studies across different industries, regions, and organizational sizes may shed light on the nuanced dynamics at play and help identify strategies for effectively managing stakeholder relationships to drive sustainability initiatives. Secondly, investigating the mechanisms through which internal stakeholder pressures influence CE practices within SMEs could deepen our understanding of organizational decision-making processes. Qualitative research methods such as interviews and case studies may uncover the underlying motivations and constraints faced by SME owners and shareholders in adopting CE practices, offering practical implications for fostering internal support for sustainability initiatives. Moreover, future research could delve into the role of

managerial perceptions in shaping organizational responses to sustainability challenges. Longitudinal studies tracking managerial attitudes and behaviours over time may provide insights into the evolution of sustainability strategies within SMEs and the factors driving managerial commitment to CE practices. Integrating insights from fields such as organizational psychology and behavioural economics may offer new perspectives on how to cultivate a culture of sustainability within SMEs and incentivize proactive engagement with CE initiatives. Lastly, examining the moderating effects of regulatory frameworks, market pressures, and industry characteristics on the relationship between stakeholder pressures, managerial perceptions, CE orientation, and CE practices could provide valuable context-specific insights. Comparative studies across different regulatory environments and industry sectors may elucidate the contingent factors that shape SMEs' responses to sustainability challenges and inform tailored policy interventions and support mechanisms.

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AUTHOR CONTRIBUTIONS

Tarlan Ahmadov: Responsible for the conceptualisation, data collection, conceptualisation and final editing of this article.
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DECLARATIONS

Competing interests The authors declare no competing interests.

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Appendix 4

Publication IV

Ahmadov, T., Foli, S., Durst, S., & Gerstlberger, W. (2024). The transition to a circular economy: different paths for international and non-international micro-manufacturing firms. *Discover Sustainability*, Vol. 5, Issue 1, pp. 178. https://doi.org/10.1007/s43621-024-00367-3

Discover Sustainability

Research

The transition to a circular economy: different paths for international and non-international micro-manufacturing firms

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Abstract
This article examines how environmental awareness, stakeholder pressure, circular economy orientation and internal barriers influence circular economy practices in international and non-international micro-firms. For this, we utilised fuzzy set qualitative comparative analysis (fsQCA) using data from 128 micro firms operating in different manufacturing industries in Estonia. Three paths were identified for explaining circular economy practices in internationally operating micro-firms and two paths for explaining it in micro-firms that do not operate internationally. Our results show that understanding the impact of the four before-mentioned aspects can be beneficial for engaging in circular economy efforts in both international and non-international micro-firms. The intricate five pathways (three for international and two for non-international) through which environmental awareness, stakeholder pressure, circular economy orientation, and internal barriers shape circular economy practices in micro-firms, challenging conventional understandings and offering nuanced insights for effective engagement in sustainable business practices. Based on the findings, theoretical and practical implications of this study and directions for future research are discussed.

Keywords Circular economy · Transition · Micro-firms · Environmental awareness · Stakeholder pressure · Circular economy orientation · Internal barriers · Circular economy practices

1 Introduction

The transition to a circular economy (CE) is urgently needed [1]. CE has been described as an economic model that seeks to decouple economic growth from resource consumption and environmental degradation by promoting the continuous flow and regeneration of materials and resources within the system [2]. This study focuses on CE practices that involve the transition from the traditional linear model of manufacture, use and disposal to a more sustainable production approach based on the reuse, remanufacturing and recycling of resources [3, 4]. These practices aim to enhance the overall sustainability of companies and societies [5]. The transition is associated with major investments as well as organisational changes [6]. At the same time, companies are exposed to a number of simultaneous crises that make this transition considerably more difficult [7]. Smaller companies in particular find it difficult to tackle and implement significant changes [2]. This is especially true for micro-enterprises, which make up the majority of businesses in all economies [8]. Despite

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the abundance of existing studies on the adoption of CE practices in smaller enterprises [9–13], there appears to be a lack of studies examining the role of various internal and external factors on the readiness and implementation of CE practices in micro-enterprises (with fewer than 10 full-time employees and an annual turnover or balance sheet total of less than EUR 2 million). This applies to both nationally and internationally operating micro-enterprises. Investigating the differences between international and non-international micro-enterprises in the adoption of CE practices appears relevant for a variety of reasons. (I) International activities (such as exporting different types of products) expose companies to different regulatory frameworks and market requirements, which can encourage the adoption of CE practices such as waste treatment, reduction and recycling, thereby improving the brand reputation and financial performance of the companies concerned [14, 15]. (II) The need to comply with international regulations increases the pressure on companies to adopt environmentally innovative practices, such as life cycle assessment (LCA) or eco-design [16, 17]. (III) Internationally operating companies can also benefit from access to external knowledge networks, which can be crucial in the implementation of CE practices, including process redesign and technological innovation [18]. Investigating the differences between international and non-international micro-enterprises regarding the introduction of CE practices is therefore seen as relevant to accelerate the transition to CE. Additionally, the execution of country-specific studies is crucial because the adoption of CE practices is influenced by contextual factors, such as government policies, economic conditions, cultural norms, the impact of stakeholders, or the levels of environmental awareness and organizational readiness which can differ considerably from one country to another [19, 22–24]. Hence, identifying and understanding contextual (local) nuances is vital for developing and executing tailored measures and programmes dedicated to the adoption of CE practices in micro-enterprises.

Against the background presented, this paper asks the following questions: (i) How do aspects such as environmental awareness, stakeholder pressure, CE orientation, and internal barriers influence CE practices in micro-firms? And (ii) How do they differ between international and non-international micro-firms? Existing research suggests that these four aspects are critical regarding CE adoption. The study is based on a sample of 128 Estonian micro-enterprises operating in different manufacturing sectors. Estonia, as part of Eastern Europe with a catch-up economy [20], faces unique challenges in transitioning to a CE. This transition has been slower compared to Western European countries [21], which makes the country an interesting subject of study and contributes to the diversity of CE studies.

To answer the research questions, we apply a configurational approach (i.e., fsQCA). This technique allows us to specify interactions between a set of interrelated aspects, thus allowing us to better understand how certain organizational aspects affect CE practices in micro-enterprises. fsQCA offers the opportunity to gather a deeper understanding of the relationship between variables to better predict and explain real-world business phenomena [25]. Moreover, we adopt complexity theory as the theoretical lens of the paper as it is well-suited for analysing patterns of interaction among system elements at different levels and times [26]. Thus, this theory seems suitable for this study. A focus on micro-enterprises operating in manufacturing industries is justified by existing research that highlights the distinctions between manufacturing and service industries, including differences in business models and value chain organization [27, 28]. Finally, a distinction between international and non-international micro-enterprises seems to be useful in this context, as research has highlighted the role of internationalisation as a push factor for changes in smaller companies [29, 30].

By unearthing the role of the above-mentioned aspects in conjunction with CE practices in internationally and non-internationally operating micro-firms located in Estonia, this study advances existing research dedicated to sustainable development and strategic management of smaller firms, micro-firms in particular.

The paper is organised as follows. The next section provides the theoretical foundation of the study. The study's methodology is outlined in the third section. The data analysis and results are presented in section four. This is followed by the discussion and the study's implications. The paper terminates with a conclusion that also highlights the study's limitations and directions for further research.

2 Theoretical background

This study delves into the landscape of micro-firms within the manufacturing sector, focusing on five pivotal constructs: CE practices as the primary outcome, and environmental awareness, stakeholder pressure, CE orientation, and internal barriers as key antecedent conditions [31, 32]. This selection is guided by the distinct dynamics of the manufacturing industry, acknowledging variances in business models and value chain organisation compared to service industries [27, 28]. The four selected antecedent conditions influencing CE practices in micro manufacturing firms are chosen for their critical roles in shaping CE practices. Environmental awareness stands out as a fundamental motivator for firms to

embrace CE principles, as evidenced by the imperative to reduce waste and emissions, contributing to sustainable production and resource efficiency [33, 34]. Stakeholder pressure, both internal and external, significantly influences firms' decisions to adopt CE practices, with stakeholders such as customers, employees, investors, non-governmental organisations (NGOs), and competitors exerting considerable influence on economic and environmental performance [19, 35]. CE orientation, driven by organizational agility and external pressures, underscores the strategic adoption of circular business models and practices, further emphasizing the importance of aligning business strategies with sustainability goals [36]. Additionally, internal barriers, including technical expertise and communication challenges, pose significant hurdles to CE adoption, highlighting the need to address internal organizational dynamics to facilitate successful transitions towards circularity [37]. By focusing on these factors, we aim to provide a comprehensive understanding of the multifaceted challenges and opportunities micro-manufacturing firms encounter in embracing CE practices, ultimately aiding in the development of targeted interventions and strategies to promote sustainable manufacturing practices and achieve long-term environmental goals. Based on the literature background (2.1–2.5) and taking the theoretical lens of complexity theory, we developed Fig. 1 to illustrate the complex interactions and configurations of the antecedent conditions influencing CE practices in micro-manufacturing firms. This figure highlights how environmental awareness, stakeholder pressure, CE orientation, and internal barriers interact dynamically to shape CE practices, emphasizing the importance of a holistic and configuration-based perspective.

2.1 Circular economy practices in micro-manufacturing firms

The rise of the CE as an alternative to the linear economic model has attracted considerable notice as a strategy for tackling economic, environmental, and social issues [38, 39]. In Europe alone, CE practices are estimated to generate business benefits of 1.8 trillion Euros annually by 2030 [40]. The manufacturing sector, which is heavily dominated by smaller companies, assumes a pivotal role in global economies, necessitating focused attention on CE practices within these organisations [41]. Nevertheless, despite increasing awareness and initiatives, the circularity of the global economy remains limited, with only 8.6% adopting circular practices, and resource recycling rates are generally inadequate [42].

CE implementation requires conducive factors such as favourable regulations, infrastructure, and cost-effective circular practices [2, 43]. The significance of finance, technology investment, and managerial skills becomes apparent in the transformation from linear to circular [44]. In the manufacturing context, micro-manufacturing firms emerge as a critical focus for research on CE practices. Despite their size, these micro-firms collectively contribute significantly to global environmental impacts. In Europe, for instance, micro-firms represent a staggering 93% of all businesses and play a vital role in terms of value added (18.7%) and employment (29.2%) [45]. Moreover, micro-firms contribute substantially to carbon emissions, accounting for 63% of the total carbon emissions from European firms [46]. Recognizing the pervasive influence of micro-firms on environmental sustainability, it becomes imperative to focus on this segment in the study of CE practices.

These entities face unique challenges, including limited financial resources and technical skills, making the transition to CE more intricate [47]. While recent studies addressing CE practices have not exclusively focused on micro-enterprises,

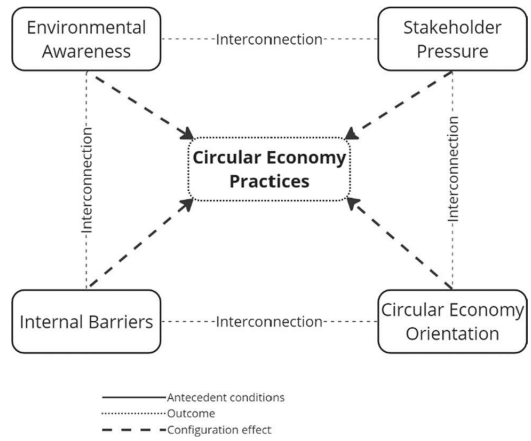

Fig. 1 Research model (compiled by the authors)

it is noteworthy that these investigations have included micro-enterprises as part of their broader samples of micro, small and medium enterprises (MSMEs) e.g., [48–50].

2.2 Environmental awareness

Environmental awareness within enterprises stands as a pivotal construct in the literature on circular economy [51, 52] and is referred to as a firm's concern and comprehension of environmental problems [53]. Increasing environmental awareness is imperative for fostering a consistent understanding among managers and employees on various facets of environmental management, including strategies and policies at different organizational levels (e.g., firm, region, state) [54]. Effectively supporting environmental awareness in a business, particularly in micro-enterprises, necessitates explicit communication of core environmental concerns both internally and externally [55]. These critical environmental concerns encompass issues such as escalating environmental pollution, the accountability of firms for environmental degradation, and the tangible capacities of businesses to embrace circular initiatives aimed at mitigating environmental pollution—such as the principles of reduce, reuse, and recycle [53].

While previous research has extensively explored customers' environmental awareness [56], relatively few empirical investigations have delved into environmental awareness at the firm level. Notably, recent studies have primarily focused on practices that cultivate environmental consciousness among managers [57]. Consequently, empirical research addressing the transformation of environmental awareness through sustainability strategy formulation at the firm level remains scarce [32]. However, the study by Margaret et al. [58] suggests that multinational firms are often subject to international scrutiny and may have higher environmental awareness due to the need to comply with diverse environmental standards and to maintain their global reputation. International small and medium-sized enterprises (SMEs) tend to have higher environmental awareness levels compared to non-international SMEs, as they are more exposed to global sustainability trends and regulations [59]. This heightened awareness in international firms is driven by the necessity to navigate varying environmental regulations across different countries and the pressure to uphold their reputation on a global scale. Exposure to international markets brings international SMEs into contact with progressive environmental policies and practices, which they are often motivated to adopt not only for compliance but also to enhance their competitiveness and brand image. The integration of sustainable practices allows these firms to differentiate themselves in the marketplace, attract eco-conscious consumers, and enter new markets that have stringent environmental requirements. The study by Pronti, Zecca, and Antonioli [8] that micro-firms' strategies are more influenced by the environmental awareness of the owner further underscores the pivotal role of individual consciousness in shaping business approaches. This insight aligns with the proposed idea that environmental awareness is a key determinant in CE practices. Considering the limited empirical research on the transformation of environmental awareness at the firm level, the proposition suggests that this relationship may be more pronounced in international micro firms compared to their non-international counterparts. International micro firms, exposed to diverse environmental regulations and global sustainability trends, are likely to adopt innovative CE practices that exceed mere compliance. Margaret et al. [58] support this by showing that multinational firms develop higher environmental awareness due to international scrutiny. Additionally, Pronti, Zecca, and Antonioli [8] highlight that the strategies of micro-firms are heavily influenced by the environmental consciousness of their owners, underscoring the critical role of individual leadership in driving environmental initiatives within these enterprises. This inference is drawn from the recognized importance of environmental awareness in guiding strategies and policies across organizational levels, particularly in micro-enterprises, where effective communication and understanding of environmental issues are essential for implementing circular initiatives.

Proposition 1 Environmental awareness is more strongly related to circular economy practices in international micro-firms than non-international ones.

2.3 Circular economy orientation

The literature reveals that the exploration of CE orientation at the firm level is still in its early stages, with a limited number of relevant research articles identified [60, 61]. Despite its preliminary status, this construct has gained increasing attention from researchers, indicating its potential to serve as a catalyst for achieving competitive advantage [61, 62].

However, the absence of a definition for circular economy orientation necessitates clarification. Liu and Chang (p.7) [63] introduced the term "closed-loop orientation," which is defined as a reflection of the "strategic orientation toward the recyclability of materials/components/products throughout the entire supply chain loop." This term provides a

mechanism that may elucidate the translation of general strategic orientations into CE practices. Goyal et al. [64] offer another definition, for these authors CE orientation means: "involving the focus on setting up end-to-end processes for e-waste collection, sorting, and segregation into reusable metal extracts." Building upon the synthesis of existing literature [61–65], the current study defines CE Orientation as a strategic mindset and operational framework that surpasses mere waste minimization and recycling efforts. Instead, it encompasses comprehensive initiatives, internal comprehension of circular economy practices, and seamless coordination among all stakeholders. This definition aims to foster a holistic approach, embedding circular principles throughout the organizational fabric.

The discourse surrounding circular economy orientation is evolving, emphasizing the necessity for a nuanced comprehension of its multifaceted dimensions. The complexity prompts an examination of how circular economy orientation influences different organizational contexts, particularly in the realm of international micro-firms versus their non-international counterparts. Internationalization is a pivotal factor in this exploration, as it not only exposes firms to diverse market demands and competition, fostering innovation and customer-centric approaches [66], but also shapes their approach to CE opportunities, influencing aspects such as value activity integration, product diversification, and location choices [67]. By comparing international and non-international micro-firms in terms of their circular economy orientation, researchers can delve into the nuanced effects of internationalization on CE practices. This comparison allows for an in-depth analysis of how exposure to diverse market demands and competition impacts the strategic mindset and operational framework related to circular economy practices within these firms. Thus, proposing that CE orientation is more strongly associated with circular economy practices in international micro-firms than in non-international micro-firms is justified by the recognition of the varied influences of internationalization on organizational strategies and approaches to sustainability initiatives.

Proposition 2 Circular economy orientation is more strongly associated with circular economy practices in international micro-firms than in non-international micro-firms.

2.4 Stakeholder pressure

Institutional pressures play a pivotal role in facilitating CE practices in micro-manufacturing firms. A critical dimension of this institutional pressure is stakeholder influence, as highlighted in studies by Adomako and Tran [68] and Baah et al. [69]. Among the key stakeholder groups, customers emerge as a primary force [70, 71], exerting significant influence from a firm's perspective on circular economy practices. For instance, considerations such as carbon and other environmental emissions can critically shape customers' purchasing decisions [72].

Employees, as another crucial stakeholder group at the firm level, have been relatively under-researched in terms of their specific role in the implementation of circular economy practices. Recent studies, however, yield interesting insights into this aspect. Employees can exert substantial pressure on their respective firms, advocating for the adoption of a sustainable circular economy and other environmentally sound practices [73]. Investors, as a significant stakeholder group, wield potentially strong influence over a firm's CE practices. Their impact can manifest as both supportive and inhibiting pressures, guiding businesses in the implementation of specific practices [74]. Additionally, NGOs and competitors within the business landscape [75] also contribute to stakeholder pressures, urging firms to adopt or enhance circular economy practices. While governance and institutional pressures undeniably has an important role on the transition to a CE, their direct impact on micro-firms may be limited. Despite prior research showcasing the influence of regulatory frameworks [76–78], micro-firms often exhibit constrained responses due to factors like resource limitations and operational focus. Their heterogeneous environmental management behaviours and resource constraints hinder uniform responsiveness to institutional pressures [79], indicating a nuanced approach is necessary when considering their role in fostering CE practices at the micro level. Governance and institutional pressures contribute to meso-level impacts such as fostering a collaborative environment [2], which can potentially benefit micro firms. However, for micro-firms to actively engage in collaborative activities, internal stimuli are crucial, including employee motivation, investor support, and engagement with immediate stakeholders [73, 74]. Additionally, responsiveness to such pressures may require acknowledgment and interaction with direct external stakeholders such as consumers and competitors [70–72]. Due to the study's exclusive focus on micro-firms and their specific dynamics, including stakeholder pressures from employees, investors, NGOs, and competitors, governance and institutional pressures were not included as a focal point, acknowledging their potential impact on broader industrial transitions to CE practices.

The intricate interplay between stakeholders and the adoption of CE practices underscores the multifaceted nature of institutional pressures faced by micro-manufacturing firms. Both international and non-international micro firms

experience inherent stakeholder pressure to practice circular economy. This suggests a commonality in the challenges faced by micro-manufacturing firms, irrespective of their international status, emphasizing the universal nature of stakeholder influence on CE practices. Furthermore, international micro firms face heightened stakeholder pressure amplified by multifaceted interactions. The complexity of international business environments introduces additional layers of influence from stakeholders, intensifying the challenges and considerations for CE practices. This highlights the need for a more nuanced examination of the interactions between stakeholders and micro-manufacturing firms operating on an international scale, emphasizing the importance of considering the global context in understanding and implementing circular economy practices.

Proposition 3 Compared to non-international micro-firms, international micro-firms face heightened stakeholder pressure amplified by multifaceted interactions.

2.5 Internal barriers

A recent study by Takacs et al. [80] serves as a direct link to the construct of internal barriers identified in this literature review, aligning with the observations made by Masi et al. [67]. The body of literature addressing 'internal barriers' in the context of circular economy has witnessed significant growth in recent years. Noteworthy among these barriers are skilled manpower shortages, the need for staff training in circular practices, technological deficiencies, and challenges associated with the nature of rest and waste materials [81–83]. It is essential to highlight that these internal barriers exhibit a generic nature applicable across various manufacturing industries and firm size classes, including micro-enterprises [84].

As this review establishes the generic applicability of internal barriers across various industries and firm sizes, the proposition posits that both international and non-international micro-firms encounter internal barriers in circular economy practices. This suggests a shared experience among micro-enterprises, irrespective of their international status, reinforcing the idea that internal barriers are fundamental challenges that need to be addressed universally within the context of CE practices. International micro-firms, however, face an additional layer of complexity due to their global operations. Smaller firms often struggle with managerial barriers, such as inadequate knowledge and experience in handling foreign exchange fluctuations, which can severely impact their internationalization efforts [109]. Financial constraints are another critical internal barrier, particularly for highly productive firms that are more likely to expand abroad but face difficulties in securing the necessary external finance to shoulder the costs of entering foreign markets [110]. Moreover, the internal characteristics of small firms, such as financial and managerial constraints, personal objectives of the owners/managers, and the lack of formalized planning and control systems, act as greater constraints in shaping their exporting strategies compared to larger businesses [111]. The complexity of managing multiple markets and coordinating marketing strategies also poses a significant challenge, as firms must navigate geographic, cultural, and political barriers while maintaining a competitive advantage [112]. This study focuses on perceived internal barriers reported by firm management, potentially overlooking the complete range of challenges. While international firms face more challenges in adopting CE activities compared to non-international counterparts, international markets offer opportunities to absorb new knowledge, learn best practices, and gain crucial experience that firms solely operating domestically may lack.

These multifaceted interactions exacerbate the internal barriers faced by international micro-firms. This proposition recognises that the global nature of international business introduces additional layers of complexity to internal barriers, emphasising the need for a more nuanced examination of these challenges in the context of micro-enterprises operating on an international scale. This strategic lens provides insights into the unique contextual nuances influencing the successful integration of CE practices within the specific operational dynamics of international micro-enterprises.

Proposition 4 *Compared to non-international micro-firms*, *international micro-firms face more complex internal barriers in circular economy practices amplified by multifaceted interactions*.

The unique challenges faced by micro-firms underscore the need for a nuanced understanding of the practice of circular economy [2, 47]. This study, grounded in the fsQCA approach and utilising a complexity theory lens, conceptualizes a model (Fig. 1) to analyse data and address research propositions, explaining why different combinations of antecedent conditions can lead to CE practices in micro-manufacturing firms. The link between these factors is recognized as complex, with various configurations capable of altering the association. Complexity theory aids in specifying how CE orientation, internal barriers, environmental awareness, and stakeholder pressure interact to influence CE practices. The

integration of complexity theory into the research model emphasizes the non-linear and dynamic nature of relationships between variables [26]. This approach aligns with the contention that understanding the interplay of variables requires a configuration-based perspective rather than a linear one [85].

Based on the literature review, the four propositions regarding international micro firms and their adoption of CE practices can be succinctly summarized. Proposition 1 asserts that environmental awareness is notably more integral to CE practices in international micro-firms compared to their non-international counterparts. This distinction arises from international firms' exposure to diverse global sustainability trends and regulations, compelling them to adopt stringent environmental standards to enhance competitiveness and appeal to eco-conscious consumers [8, 58]. Proposition 2 posits that international micro-firms demonstrate a stronger alignment with CE orientation, characterized by strategic frameworks emphasizing material recyclability and comprehensive CE initiatives. This orientation is fostered by internationalization, which exposes firms to varied market demands and competitive pressures, incentivizing robust CE strategies [63, 64]. Proposition 3 highlights that international micro firms face heightened stakeholder pressures, including customer expectations, investor demands, and regulatory scrutiny, all of which drive the adoption of CE practices to maintain reputation and compliance [68, 69]. Finally, Proposition 4 underscores the complex internal barriers encountered by international micro-firms in CE implementation, such as financial constraints and managerial challenges intensified by global operations [80]. These propositions collectively illuminate the distinct challenges and strategic imperatives shaping how international micro-firms navigate and integrate CE practices within a global context.

3 Research method

3.1 Data description and sample

This study employed an online survey methodology, deployed through the Qualtrics platform, accompanied by an introductory email outlining the study's objectives. Data collection occurred in three phases—comprising the baseline survey and two subsequent follow-up surveys—spanning a period of three weeks. A representative sample of 1,500 SMEs was randomly selected from the Orbis Europe database list. The structured survey was administered on January 10th, and the target population for this research was firms operating in Estonia. A total of 234 responses were collected for the study. However, to ensure the robustness of the data, the "complete case analysis" method was utilized to manage missing data [86]. Consequently, incomplete, and missing data questionnaires were omitted from the analysis. Additionally, firms failing to meet the criteria for micro-enterprises (i.e., those with more than 10 employees) were excluded from the dataset. This data curation process yielded 128 usable questionnaires, resulting in a response rate of 8.5% (128 out of 1500). Notably, this response rate is consistent with comparable survey-based studies conducted at the firm level, as evidenced in research by Abernethy et al. [87] and Kitsis & Chen [88].

Adhering to Podsakoff et al. [89], guidelines to mitigate potential common method bias, various procedures were implemented, ensuring the confidentiality and anonymity of respondent information. The study emphasises the exclusive use of results for research purposes, with randomised question ordering. The study gathered responses from a predominantly male respondent base (69.53% male). Educational backgrounds varied, with 43.75% holding a Diploma/Certificate, and the rest with university degrees. Most participants held positions as owners (82.03%), while 10.94% were managers, and 7.03% identified as having other roles within their respective firms. The respondents in the study represent various sectors of manufacturing, with the highest participation from the manufacture of furniture (14.06%), followed by the manufacture of fabricated metal products (12.50%) and the manufacture of wood and cork products (11.72%). The demographic characteristics are further detailed in Table 1.

3.2 Fuzzy-set qualitative comparative analysis (fsQCA)

The fuzzy set qualitative comparative analysis (fsQCA) is a derivative of the broader family of qualitative comparative analysis (QCA), which includes other variations such as crisp-set comparative analysis (csQCA) and multi-value qualitative comparative analysis (mvQCA). QCA is an analytical technique that combines the strengths of both qualitative and quantitative approaches to data analysis [90, 91], offering a systematic way to analyse complex relationships [91]. Thus, QCA provides a methodological middle ground that overcomes the limitations of purely qualitative or quantitative approaches to data analysis. By adopting a set-theoretic logic, QCA acknowledges the multifaceted nature of causation and allows for the exploration of equifinality—the idea that different combinations of conditions may lead to the same

Table 1 Respondents' Profile

Attributes	Description	Frequency (n)	
		(n)	%
Gender	Male	89	69.53
	Female	39	30.47
	Prefer not to say	0	0
Education	Doctorate	0	0
	Master's	33	25.78
	Undergraduate	39	30.47
	Diploma/Certificate	56	43.75
Position in the firm	Owner	105	82.03
	Manager	14	10.94
	Other	9	7.03
Industry/sector	Manufacture of furniture	18	14.06
	Manufacture of fabricated metal products, except machinery and equipment	16	12.50
	Manufacture of wood and of products of wood and cork	15	11.72
	Manufacture of wearing apparel	13	10.16
	Manufacture of machinery and equipment	12	9.37
	Manufacture of food products and beverages	12	9.37
	Manufacture of rubber and plastic products	7	5.47
	Manufacture of textiles	6	4.69
	Others	29	22.66

outcome. This is particularly advantageous in empirical research where causal pathways are intricate and varied. QCA's ability to recognise complex patterns and identify conditions that are jointly sufficient or necessary for an outcome positions it as an invaluable tool for researchers seeking a nuanced understanding of their phenomena of interest.

Among the QCA techniques, such as csQCA, conditions are typically binary coded as either 1 (present) or 0 (absent), offering a straightforward representation but lacking consideration for degrees or levels. In contrast, fsQCA introduces fuzzy logic, allowing for degrees of membership within sets, transcending rigid binary distinctions. While mvQCA expands QCA by permitting conditions to have multiple values, fsQCA goes further by incorporating fuzzy logic, facilitating the use of continuous data and improving data accuracy [91].

Considering the context of this study, circular economy practices often exist on a continuum, with organisations differing in their extent of implementation. FsQCA is particularly advantageous in this case because it allows for the representation of conditions with varying degrees of membership. This means that it can recognise different levels of circular economy practices rather than enforcing a rigid classification system, as is the case with csQCA and mvQCA [92, 93]. This flexibility makes fsQCA well-suited for capturing the variations in how organisations adopt and implement circular economy practices.

Moreover, fsQCA has been widely applied in recent years [25, 94], particularly in this research field [95–98], showcasing its adaptability and reliability. Unlike traditional regression analysis, fsQCA offers a unique advantage in handling omitted variables [99]. While regression models can introduce bias when relevant variables are omitted, particularly if the omitted variable is correlated with the included ones, fsQCA, utilising Boolean algebra, identifies causal relationships without the same bias concerns. This distinction eliminates the need for control variables, simplifying the model while maintaining its ability to robustly capture causal configurations. In fsQCA, causality is expressed through conditions being either sufficient or necessary for the outcome of interest [100]. A condition is deemed sufficient if its presence alone leads to the outcome, while it is necessary if its absence prevents the outcome [90, 91]. Unlike traditional regression analysis, which focuses on the effects of independent variables on a dependent variable, fsQCA emphasises understanding the causes of effects [100]. In other words, fsQCA examines how combinations of conditions contribute to the occurrence or absence of the outcome, rather than analysing the direct effects of individual variables on the outcome.

Thus, by applying fsQCA, we can accurately identify how environmental awareness, stakeholder pressure, CE orientation, and internal barriers combine to influence CE practices without methodological constraints in regression analysis.

Importantly, fsQCA performs relatively well with smaller datasets [91], making it practical for dividing the dataset into subsets—specifically, international and non-international micro-firms—while still ensuring robust and reliable results.

3.3 Measures

3.3.1 Outcome variable

To measure circular economy practices (CEP), we adapted Rodriguez-Espindola et al. [5] measures, which comprise 5 items. Examples include: In our company, "we have replaced non-recyclable raw materials with renewable, recyclable, or biodegradable inputs," "we work with clients/suppliers for the ecological design of products" "we are using recycled materials as inputs in our processes" and "we have policies and practices in place to dispose of machinery and equipment on time". Both the outcome variable and the condition variables were evaluated on a five-point Likert scale from 1 = totally disagree to 5 = totally agree.

3.3.2 Condition variables

To measure circular economy orientation (CEO), we developed five items based on the study of Papadas et al. [101]. For example, "My organisation provides circular economy/sustainability related training (e.g., waste minimisation, improve recycling) to our employees", "My organisation recruits new employees who understand circular economy/sustainability practices", and "We use external help for environmental sustainability support (such as sustainability consultants or support)".

We used a four-item scale adapted from Sharma et al. [102] to measure internal barriers (IB). Among these are "We have a lack of skilled manpower for the implementation of circular/sustainability practices", "We face problems related to training staff for circular practices" and "We face problems related to technological deficiencies".

To measure environmental awareness (EA), a three-item scale was used based on a study by Dey et al. [103], examples include the following: "Increasing environmental pollution (e.g., carbon emissions) poses a major threat to our society", "Firms are primarily responsible for environmental pollution" and " Adopting circular (e.g., reduce, reuse, and recycle) initiatives reduce the environmental pollution".

A six-item scale adapted from Adomako and Tran [68] was used to measure stakeholder pressure (SP). A few examples include "Employees put pressure on our company to pursue sustainable environmental practices", "Investors put pressure on our company to pursue sustainable environmental practices", "NGOs put pressure on our company to pursue sustainable environmental practices", and "Competitors put pressure on our company to pursue sustainable environmental practices".

3.4 Measurement model and descriptive statistics

We applied Harman's one-factor test to determine whether the data derived from the questionnaire survey were susceptible to common method bias [104]. Utilising STATA 17.0 statistical software, we conducted exploratory factor analysis. The results (see appendix Table 5) revealed that the first factor accounted for only 20.5% of the total variance, falling below the 50% threshold. This suggests that common method bias was not a significant concern in our dataset. Following this evaluation, we proceeded to assess the validity and reliability of the constructs.

The reliability and validity results for our constructs are presented in Table 2. All Cronbach's α values surpassed the 0.7 threshold, with the exception of "Environmental Awareness". Despite its lower Cronbach's alpha indicating less than optimal internal consistency ($\alpha = 0.573 < 0.7$), a stronger case for consistency among these items was supported by an average interitem covariance coefficient of 0.287. Recognising that Cronbach's alpha can be sensitive to latent constructs with few items [105], we supplemented this information with interitem covariances, typically seeking values ranging from 0.15 to 0.50 [106]. Additionally, we assessed the Kaiser–Meyer–Olkin (KMO) measure, which ranges from 0 to 1, indicating the degree of intercorrelations among variables. As per Hair et al. [107], KMO values above 0.5, both for the entire matrix and individual variables, signify appropriateness. In our analysis, all values exceeded this threshold, affirming the reliability and validity of most constructs under examination. Table 2 also provides a summary of descriptive statistics for the constructs, encompassing correlations, means, and standard deviations.

Table 2 Correlation matrix and measurement validity assessment

Variable	1	2	3	4	5
1. Circular Economy Practices	1.000				
2. Circular Economy Orientation	0.241	1.000			
3. Internal Barriers	−0.135	−0.118	1.000		
4. Environmental Awareness	0.036	0.120	−0.007	1.000	
5. Stakeholder Pressure	0.066	0.454	−0.011	0.084	1.000
Mean	3.788	2.588	3.035	3.784	2.206
Standard Deviation	0.082	0.078	0.075	0.062	0.070
KMO	0.776	0.739	0.674	0.584	0.825
Cronbach Alpha	0.746	0.783	0.705	0.573	0.841
Average Inter-item Covariance	0.636	0.605	0.508	0.287	0.529

4 Analysis and results

In this study, we utilised fsQCA to analyse the data, which was initially divided into two datasets, differentiating between international and non-international micro-firms. The analysis followed a three-step fsQCA process: data calibration, truth table building and truth table minimisation. In the calibration phase, we aggregated the values of indicators for each variable. We then computed the thresholds for each variable using the maximum value, average values, and minimum values in Excel. Next, we imported the dataset into the fsQCA software and calibrated using the calibration command by assigning maximal values for full membership, average values for the cross-over point, and minimal values for non-membership. Full membership indicates the extent to which a case aligns with specified characteristics, with higher values indicating a stronger alignment. Cross-over reflects cases that simultaneously belong and do not belong, represented by average values for intermediate membership. Non-membership signifies the degree to which a case lacks specified characteristics, with minimal values indicating a strong absence of association. The calibration process was performed separately for each sample (i.e., international and non-international micro-firms' dataset). In Table 3, we summarise the values used in this study.

Our next step involved building a truth table. This table presents all potential configurations, generating 2^k rows, where k denotes the number of outcome predictors, with each row representing a distinct combination. Similarly, for each sample or dataset, we developed a truth table incorporating the four specified conditions. The construction of the truth table was guided by two key criteria: by setting the frequency threshold and the level of consistency. As recommended by Pappas and Woodside [108], when dealing with a small sample, a low-frequency threshold is advised. Therefore, we set our frequency threshold to 1, indicating that a configuration must be present in at least one empirical instance to be considered. Additionally, we opted for the minimum recommended threshold of 0.75 for the consistency level [108].

Finally, we performed the data minimisation to simplify the truth table by utilising the standard analysis command. This involved identifying and merging similar configurations, thereby reducing complexity and identifying core configurations most likely to explain the desired outcome. Through this process, three distinct sets of solutions emerged: complex, parsimonious, and intermediate. The complex solution presents all the possible combinations of conditions when traditional logical operations are applied. The parsimonious solution set is a simplified version of the complex solution, based on simplifying assumptions, and presents the most important conditions which cannot

Table 3 Calibration for outcome and conditions

Threshold Variable	International micro-firms			Non-international micro-firms		
	Full membership	Cross over	Full non membership	Full membership	Cross over	Full non membership
Circular economy practices	30	18.78	5	30	19.07	11
Circular economy orientation	20	10.73	4	17	10.03	4
Internal barriers	19	12.69	4	20	11.67	4
Environmental awareness	15	11.07	6	15	11.59	3
Stakeholder pressure	20	13.20	6	23	13.26	6

be left out of any solution. The intermediate solution is obtained when performing counterfactual analysis on the complex and parsimonious solutions including only theoretically plausible counterfactuals.

Following Pappas and Woodside's [108] recommendation, we considered the intermediate solutions to determine the causal configurations. Comparing these with the parsimonious solution, we determined both core and peripheral conditions within the configurations. Core conditions are determined when conditions consistently appear across both the parsimonious and intermediate solutions. Conversely, conditions present solely in intermediate solutions, but absent in the parsimonious solution, are regarded as peripheral conditions. The following subsections present the fsQCA results.

4.1 Causal configuration for circular economy practices in international micro firms

Three distinct configurations are identified to explain CE practices in international micro-firms, all exceeding the required minimum consistency threshold (> 0.75). The results indicate that CE orientation, as represented by configuration A1, functions as a core condition. In this specific configuration, it stands independently, emphasizing the central role of circular economy orientation in practicing circular economy. In addition, this configuration exhibits a high degree of consistency (0.841), which covers 21.5% of the membership in the outcome. The configuration A2, indicates that the coexistence of stakeholder pressure and environmental awareness, both in a peripheral state, are sufficient to drive these firms to adopt circular economy practices. This configuration exhibits a fair level of consistency (0.763) and covers 1.4% of the membership in the outcome. In the final configuration (A3), stakeholder pressure appears as a core condition, offsetting the presence (albeit in a peripheral role) of internal barriers to circular economy practices. This configuration exhibits a significant level of consistency (0.803) and accounts for 1.1% membership in the outcome.

4.2 Causal configuration for circular economy practices in non-international micro firms

For non-international micro firms, two configurations are observed, both exceeding the required minimum consistency threshold (> 0.75). Configuration B1, requires the absence of internal barriers and, at a minimum, CE orientation and environmental awareness as peripheral conditions for circular economy practices. This configuration exhibits a high consistency level of 0.829 and covers 9.1% membership in the outcome. The second configuration (B2) three conditions—CE orientation, environmental awareness, and stakeholder pressure—are identified as core conditions for non-international firms to adopt circular economy practices. This configuration, characterised by a robust consistency level of 0.817, covers 5.4% membership in the outcome (Table 4).

Table 4 fsQCA analysis of the configurational combinations between international and non-international micro-firms

	International micro-firms			Non-international micro-firms	
Conditions	A1	A2	A3	B1	B2
Circular Economy Orientation	●			•	●
Internal Barriers			•	○	
Environmental Awareness		•		•	●
Stakeholder Pressure		•	●		●
Raw coverage	0.781	0.522	0.524	0.571	0.534
Unique coverage	0.215	0.014	0.011	0.091	0.054
Consistency	0.841	0.763	0.803	0.829	0.817
Solution coverage	0.835			0.625	
Solution consistency	0.762			0.798	

Black dots indicate the presence of causal conditions and white dots indicate the absence or negation of causal conditions. Large dots; core conditions, small dots, peripheral conditions, blank space; "don't care" conditions. Sample size: International micro-firms = 59; non-international micro-firms = 69

5 Discussion

The identification of the conditions driving CE practices aligns with existing research emphasizing the importance of factors such as CE orientation, environmental awareness, internal barriers and stakeholder pressure [10, 11]. The findings of this study shed light on the complex interplay of organizational aspects influencing CE practices in micro-manufacturing firms, both at the international and non-international levels, adding nuance to these findings and emphasizing the unique challenges and opportunities faced by micro-enterprises in embracing CE practices. Each identified causal configuration offers valuable insights into the nuanced dynamics shaping CE adoption, building upon prior literature while introducing new perspectives.

In international micro-firms, Configuration A1 underscores the pivotal role of CE orientation as a core condition driving the adoption of circular practices. This finding aligns with prior literature highlighting the strategic importance of embracing circular economy principles [60, 62]. Firms with a strong CE orientation are likely to integrate circularity into their business models, emphasizing resource efficiency and sustainable production processes [63, 64]. Configuration A2, which emphasizes the coexistence of stakeholder pressure and environmental awareness, suggests that external influences play a significant role in shaping CE practices in international micro-firms. This finding resonates with studies emphasizing the importance of stakeholder engagement and environmental consciousness in driving sustainability initiatives [68, 69].

Interestingly, Configuration A3 highlights the prominence of stakeholder pressure as a core condition, even in the presence of internal barriers. This finding underscores the influence of external pressures, such as regulatory mandates and consumer expectations, in compelling firms to adopt circular practices [70, 71]. Moreover, the presence of internal barriers, albeit in a peripheral role, suggests that while challenges may exist, they can be mitigated by external stimuli and organizational commitment to sustainability [72, 73].

In contrast, non-international micro-firms exhibit distinct patterns of CE adoption. Configuration B1 emphasizes the importance of the absence of internal barriers (or overcoming them) and embracing CE orientation and environmental awareness as peripheral conditions for CE practices. This finding suggests that non-international micro firms may face internal challenges in adopting circular practices, but these barriers can be overcome with a strong organizational commitment to sustainability and awareness of environmental issues [74, 75]. Configuration B2 highlights the core role of CE orientation, environmental awareness, and stakeholder pressure in driving CE practices in non-international micro-firms. This finding underscores the multifaceted nature of influences shaping CE initiatives in micro-enterprises, emphasizing the need for a holistic approach to addressing internal and external factors.

Overall, the identified causal configurations offer nuanced insights into the pathways through which organizational aspects influence CE practices in micro-manufacturing firms. By integrating these findings with prior literature, we gain a deeper understanding of the complex interplay between internal dynamics and external pressures in driving CE practices. These insights are crucial for informing policy interventions and managerial strategies aimed at promoting CE practices in micro-firms, ultimately contributing to the broader transition towards a more sustainable economic model [82, 83].

5.1 Theoretical implications

Even though there is an increasing number of research that has tried to understand what internal and external factors influence activities towards CE in general [31, 32, 55] and SMEs [48, 50], there is to our knowledge a shortage of studies that have examined the influence of selected organizational aspects on CE practices in firms, and micro-firms in particular. By utilising a configurational fsQCA, we examined the role of the selected organisational aspects in conjunction with CE practices in international and non-international micro-firms. Figure 1 offers a comprehensive understanding of the multifaceted nature of CE practices, emphasizing the need for a nuanced approach to address the challenges faced by micro-firms in adopting CE practices. The study's findings are relevant for ongoing debates in the areas of sustainable business development and strategy management dedicated to small firms and advance our understanding of the readiness of micro-firms regarding CE practices.

The theoretical significance extends further through the use of a nonlinear method, the fsQCA method. This approach enables a comprehensive exploration of the factors influencing circular economy practices, providing deep insights into the realm of international and non-international micro-manufacturing firms. The application of fsQCA

unveils multiple pathways, elucidating how diverse combinations of constructs impact circular economy practices in these firms. Furthermore, the integration of complexity theory into the research model underscores the dynamic nature of these relationships, emphasizing the non-linear and emergent patterns that influence CE practices over time. This perspective acknowledges that the effectiveness of CE initiatives is contingent upon various contextual factors and interactions between organizational elements. Through Fig. 1, this study provides insights into how different configurations of antecedent conditions influence the adoption and implementation of CE practices in micro-manufacturing firms. Beyond theoretical implications, the study's findings from causal models offer practical guidelines for managers, empowering them to take informed actions concerning the factors influencing the adoption of circular economy practices. Overall, the theoretical contributions of this research extend beyond mere identification, offering a nuanced understanding and practical insights that enrich the scholarly discourse on circular economy practices in micro-manufacturing firms.

5.2 Practical implications

The results of the study have practical implications for micro-firms as they can help them to better understand different influencing factors and their importance for the introduction of CE practices. The identified configurations provide relevant insights that can be used to promote CE practices in international and non-international micro-manufacturing companies. Decision makers in these companies can learn a lot from configurations about the necessary internal, external or mixed conditions for the practicing of CE.

Micro-enterprises should carefully analyse the paths and take the one that is best suited to their specific organisational context. The findings underline that there is not just one solution, but that a micro-enterprise can take different paths depending on the situation to achieve the desired goal. Decision makers should recognise that the introduction of CE practices may not solely depend on one aspect but on the interplay between multiple conditions.

Path A1: The key to the implementation of successful CE practices lies in developing and cultivating a strong sustainability orientation. This approach underscores the importance of fostering a culture where environmental considerations are integrated into daily operations and decision-making processes. Managers should emphasize sustainability education and training to ensure all employees understand, acknowledge and hence actively contribute to the firm's CE related goals. At the same time, managers should focus on integrating sustainability principles into their organisational culture and strategy.

Path A2: Internationally operating micro-enterprises can promote successful CE practices by simultaneously considering the role of environmental awareness and stakeholder pressure. These companies are aware of the importance of external factors and try, within their means, to keep abreast of global sustainability trends. They comply with the various environmental regulations. As these companies proactively respond to the expectations and demands of stakeholders, this allows them to build and strengthen their reputation. Internal barriers or sustainability orientation may not be as critical in this context.

Path A3: This path emphasises the need for building strong stakeholder relationships while simultaneously addressing internal obstacles. For micro-firms opting for this path, success in CE practices depends on developing and maintaining constructive dialogues and relationships with the relevant stakeholders. Sustainability orientation and environmental awareness may not be as crucial for adopting successful CE practices.

Path B1: Non-international micro-firms aiming for effective CE practices should prioritise sustainability orientation and environmental awareness. Non-international micro-enterprises aiming for CE practices should prioritise sustainability orientation and environmental awareness. These companies prioritise measures aimed at embedding sustainability awareness throughout the company and engaging employees on environmental issues and their impact on business operations. By fostering a culture of environmental responsibility and awareness, these companies can lay the foundation for successful CE adoption, even in the face of potential internal barriers. Stakeholder pressure does not play a significant role in this path. Managers should concentrate on developing a sustainability-oriented mindset.

Path B2: This path calls for a holistic approach. These non-international micro-firms recognise the interconnectedness of different factors, i.e., sustainability orientation, environmental awareness, and stakeholder pressures. By taking these three core conditions into account at the same time, managers can develop a balanced strategy. This approach enables the creation of a robust basis for the integration of CE principles into corporate activities and, ideally, the improvement of long-term sustainability performance.

6 Conclusion

In conclusion, this study delves into the complex interplay of key constructs—namely circular economy practices, environmental awareness, circular economy orientation, stakeholder pressure, and internal barriers—in the context of internationally and non-internationally operating micro-manufacturing firms. In addition, the empirical findings of this research unveil five distinct pathways toward circular economy practices, with three pathways identified in international micro-manufacturing firms and two in non-international micro-manufacturing firms. This nuanced exploration contributes valuable insights into the contextual variations shaping the adoption of sustainable practices within micro-enterprises, further enriching the understanding of circular economy dynamics in the manufacturing sector, by offering theoretical and practical implications.

The study is limited by the exclusive use of the fsQCA method. While fsQCA provides a robust framework for analysing complex causal configurations [55], it is essential to acknowledge that every analytical technique has its constraints. For instance, fsQCA does not explicitly account for temporal order, which may pose challenges in establishing the directionality of causal relationships. Future research could explore incorporating temporal elements or combining fsQCA with other analytical approaches to provide a more comprehensive understanding of causal relationships. Additionally, the study's focus on specific configurations within micro-manufacturing firms in Estonia raises concerns about the generalizability of findings to other geographical, industrial and business contexts. Acknowledging this limitation, future research should prioritize investigating circular economy practices in different contexts, aiming to refine and broaden our understanding of the factors supporting or hampering the transition toward CE. Future research should also delve into both the perceived and actual internal barriers that international micro firms face when adopting CE practices. It should explore how operating in international markets allows these firms to not only confront challenges but also absorb new knowledge, learn best practices from diverse regulatory environments, and adapt to varying cultural and competitive landscapes. In addition, research should investigate how the internationalization of micro firms influences the development of CE orientation and environmental awareness. International firms are exposed to diverse stakeholder pressures and regulatory environments across different markets, which may catalyse the adoption of CE practices and sustainability strategies. By examining these dynamics, researchers can uncover how internationalization fosters CE practices.

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Data availability The datasets generated during and/or analysed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate An ethics approval was not required for this study as the data is not considered to be sensitive or confidential in nature. Vulnerable or dependent groups were not included. The subject matter was limited to topics that are strictly within the professional competence of the participants. Participants gave their informed consent by conducting the study, i.e., by starting (completing) the online questionnaire.

Competing interests The authors have no competing interests to declare that are relevant to the content of this article.

Appendix

See Table 5

Table 5 Exploratory factor analysis

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	4.51487	1.77127	*0.2052	0.2052
Factor2	2.7436	0.58305	0.1247	0.3299
Factor3	2.16055	0.34331	0.0982	0.4281
Factor4	1.81723	0.29947	0.0826	0.5107
Factor5	1.51776	0.46563	0.069	0.5797
Factor6	1.05213	0.04433	0.0478	0.6276
Factor7	1.00781	0.11967	0.0458	0.6734
Factor8	0.88814	0.05852	0.0404	0.7137
Factor9	0.82962	0.13729	0.0377	0.7514
Factor10	0.69233	0.02441	0.0315	0.7829
Factor11	0.66792	0.08863	0.0304	0.8133
Factor12	0.57929	0.03542	0.0263	0.8396
Factor13	0.54387	0.05419	0.0247	0.8643
Factor14	0.48968	0.08848	0.0223	0.8866
Factor15	0.4012	0.00875	0.0182	0.9048
Factor16	0.39246	0.04027	0.0178	0.9227
Factor17	0.35219	0.02429	0.016	0.9387
Factor18	0.3279	0.0228	0.0149	0.9536
Factor19	0.3051	0.04772	0.0139	0.9674
Factor20	0.25738	0.02174	0.0117	0.9791
Factor21	0.23563	0.01229	0.0107	0.9898
Factor22	0.22334		0.0102	1

*Should be < 0.50 (Podsakoff and Organ, 1986)

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Appendix 5

Publication V

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Unveiling Success Factors for Implementing and Sustaining Circular Economy Practices in Small and Medium-sized Firms: Multi-Level Perspective

Structured abstract

Purpose - This study aims to identify and understand critical success factors for implementing and sustaining circular economy (CE) practices in manufacturing small and medium-sized enterprises (SMEs). More precisely, this study examines the complex interplay between micro, meso, and macro-level success factors that are deemed critical for implementing and sustaining CE practices.

Design/methodology/approach - The study is based on a two-stage methodology that combines a comprehensive literature review and an interview study with 12 Swedish manufacturing SMEs that implement CE practices.

Findings - The study identifies and categorizes success factors for implementing and sustaining CE practices in manufacturing SMEs. Based on the findings, a holistic framework is proposed that takes into account multiple perspectives, i.e. at the micro, meso and macro levels. This framework enables a deeper understanding and thus a more nuanced discussion of the complexity inherent in the transition to a CE from the perspective of manufacturing SMEs.

Originality/value - This study contributes to the growing body of research on CE transition. By focusing on SMEs in particular, the paper adds the needed diversity to the study of CE practices and influencing factors at different levels.

Article classification – Research paper

Keywords – Circular economy, circular economy practices, small and medium-sized enterprises (SMEs), success factors, transition, Sweden

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1. Introduction

Circular economy (CE) practices entail sustainable production strategies geared toward waste reduction, resource optimization, and prolonged product and material lifecycles. This involves transitioning from the linear "take-make-dispose" model to a regenerative approach, emphasizing resource reuse within closed loops (Ahmadov et al., 2023; Arsawan et al., 2024). Past studies have extensively delved into the success factors influencing the effective adoption of CE practices across different industries and sectors such as agriculture, construction, or logistics. For instance, Lahane et al. (2020) and Mahroof et al. (2022) shed light on the enablers and drivers that facilitate the uptake of circular supply chain management for sustainable CE implementation. Likewise, Koc et al. (2023) took a closer look at barriers within the construction value chain to identify additional success factors that can overcome these hurdles. In the logistics realm, Gupta and Singh (2021) identified specific success factors for integrating emerging technologies to advance CE objectives while the specific context of the food grain supply chain prompted Das et al. (2023) to explore success factors in artificial intelligence (AI) adoption for CE. Rocca et al. (2023) contributed to the understanding of the challenges and opportunities in implementing circular business models, by identifying good practices of CE in an Italian scenario. Lastly, Kayikci et al. (2022) point towards the exploration of success factors tailored to blockchain-enabled circular supply chains, offering valuable insights into effectively merging blockchain technology.

This research to date is welcome; however, there appears to be a lack of research in the existing literature focussing on small and medium-sized enterprises (SMEs) and their implementation of CE practices. The identified limitations of existing research can be summarized as follows: While past research has explored success factors in various areas, there seems to be a shortage of studies specifically focusing on SMEs (Benz, 2022; Govindan, 2023; Kannan et al., 2022; Salmenperä et al., 2021). This situation could stem from a tendency of existing studies to predominantly focus on large corporations or specific industries, overlooking the unique challenges and opportunities faced by SMEs in transitioning to CE. Moreover, while some studies have emphasized the importance of understanding the intricate interactions between challenges and critical success factors in promoting green manufacturing and CE practices, there is a lack of research that considers the interconnected nature of barriers, drivers, and critical success factors (Kannan et al., 2022). Existing research usually examines these factors in isolation, which means that the combined influence on the success of the introduction of CE, especially in SMEs, cannot be understood (Benz, 2022; Govindan, 2023). As a result, our understanding of the topic is very fragmented, which in turn makes a differentiated discussion difficult and underestimates the complexity that the transition to a CE entails, especially for SMEs.

Building on the findings of previous studies, this paper aims to propose a more holistic framework that captures the interplay of success factors at the micro, meso, and macro levels. This framework thus enables a more nuanced understanding of the challenges and opportunities associated with the introduction and maintenance of circular practices in SMEs. By a holistic framework, we mean a framework that brings together different elements into a coherent whole and transfers existing knowledge into a new perspective (MacInnis, 2011).

Understanding CE adoption is crucial, as emphasized by multiple scholars (Benz, 2022; Govindan, 2023; Kannan et al., 2022; Salmenperä et al., 2021). Kannan et al. (2022), for example, underscores the importance of delving into the intricate interactions between challenges and critical success factors in promoting green manufacturing and CE practices.

Similarly, Salmenperä et al. (2021) call for future research to uncover interlinkages between different barriers and actions, acknowledging the necessity of addressing barriers at multiple levels for effective CE adoption. Benz (2022) amplifies this theme by advocating for research that acknowledges the interconnected nature of barriers, drivers, and critical success factors, recognizing their combined influence on the success of transitioning to a circular business model. Moreover, Govindan (2023) emphasizes the demand for an integrated and holistic analysis of the relationship between digitalization and the CE, while pointing out the lack of such comprehensive studies. This underlines the need for a more holistic view regarding CE adoption in SMEs, where interconnectedness is acknowledged, complexities are navigated, and research outcomes are more accurately aligned with real-world dynamics as found in SMEs.

By adopting the Multi-Level Perspective (MLP) framework and Complexity Theory as a lens authors want to respond to this situation. The MLP framework, as described by Geels (2002, 2020) and Walrave et al. (2018), is aimed at explaining social transformations by considering both bottom-up and top-down dynamics and the multi-level nature of change. According to Trevisan et al. (2023), the MLP framework offers a holistic view of the complex relationships and interactions that influence SMEs' transition to a CE, hence, authors consider this framework useful for achieving the aim. The theory of complexity, stemming from chaos theory, adds to the nonlinear dynamics and the interactions of a large number of antecedents to produce an outcome (Urry, 2005). The complexity, as defined by Hatch and Cunliffe (2012, p. 1204) “consists of many different elements with multiple interactions and feedback loops between elements” used in the exploration of how diverse elements at different levels interact, shaping the overall dynamics of CE implementation.

Thus, by shifting the research focus from single-level aspects (i.e., focusing either on micro, meso or macro perspective) to the underlying notion of MLP and complexity theory, our study aims to identify and examine macro-, meso-, and micro-level success factors and gain profound insights into the interactions of factors for CE implementation and sustaining within smaller manufacturing firms from Sweden.

The distinct context of the manufacturing industry magnifies the significance of this research. According to Acerbi and Taisch (2020), the manufacturing sector stands as one of the most polluting and resource-intensive industries. This emphasizes the need to address its environmental impact, making it a critical sector for driving the CE agenda (Chaurasia et al., 2020; Riesener et al., 2019). Additionally, existing literature suggests the importance of conducting research in diverse contexts and regions (Govindan, 2023; Koc et al., 2023; Sohal & De Vass, 2022). To achieve the paper’s aim, this study takes a comprehensive approach. Firstly, it identifies success factors for adopting CE practices in SMEs through a literature review. These factors shape the questions for a series of semi-structured interviews involving twelve smaller manufacturing in Sweden. The findings lead to the proposal of a holistic framework that enables more comprehensive insights and thus discussions regarding the implementation of CE practices in manufacturing SMEs.

The paper's structure is as follows. Section 2 reviews prior research to identify success factors for implementing CE practices and introduces MLP as a theoretical lens. Section 3 outlines research design and methodologies. In Section 4, study findings and analysis are presented, followed by proposing the framework in Section 5. Finally, Section 6 concludes by offering theoretical and practical insights, and addressing research limitations.

2. Conceptual Background

This section discusses CE within the context of manufacturing SMEs and covers extant literature on success factors involved in implementing circular practices. In addition, the MLP framework is introduced as the framework to structure success factor literature on CE adoption.

2.1 Small and medium-sized enterprises transition to circular economy

The concept of CE has gained substantial attention recently. Numerous studies underscore its manifold advantages, highlighting its ability to minimize waste, encourage sustainable development, and enhance efficient resource utilization (Bowen et al., 2023; D'Angelo et al., 2023; Droege et al., 2023; Neri et al., 2023; Shao et al., 2023). In this study, circular practices are defined as sustainable strategies encompassing waste reduction, resource optimization, and the promotion of prolonged product and material lifecycles through resource reuse within closed loops (Broccardo & Zicari, 2020; Ferasso et al., 2023). By embracing circular practices, SMEs can not only enhance their brand reputation, reduce operating costs, and stimulate business growth but also contribute to environmental recovery and sustainability while reaping economic benefits from resource reuse and waste minimization (Lahti et al., 2018; Lüdeke-Freund et al., 2019; Prieto-Sandoval et al., 2018; Riesener et al., 2019).

Using CE practices is considered pivotal in attaining sustainability objectives, offering economic, environmental and social benefits (D'Angelo et al., 2023). The application of CE practices in SMEs is seen as a swifter pathway to realizing sustainable development targets, showcasing its potential benefits for the environment and economy (Massari and Giannoccaro, 2023). Given that over 99% of businesses in the European Union are SMEs (European Commission, 2022), their pivotal role in driving this transition is evident.

The shift from linear to circular practices necessitates a comprehensive overhaul of industries encompassing development, management, operations, supply chains, business strategies and customer relationships (Bocken and Geradts, 2020; Frishammar and Parida, 2019). Previous research suggests that organizations embracing CE principles gain a competitive edge over conventional linear models (Rizos et al., 2016; Tsvetkova et al., 2020). While larger enterprises and policymakers have initiated the adoption of CE practices (Garces-Ayerbe et al., 2019; Ghisellini et al., 2016), SMEs face distinctive challenges due to their limited resources and expertise (Bhatia et al., 2022; Dey et al., 2019; Mura et al., 2020). Here, regulatory frameworks, public sector involvement, financial support, ecosystem innovation and technological infrastructure provided by the state play a crucial role in driving SMEs towards the CE (Ahmadov et al., 2022; Kirchherr et al., 2018; Koc et al., 2023; Konietzko et al., 2020; Patala et al., 2022). Embracing the CE is vital for SMEs, not only to enhance their environmental commitment and practices but also to contribute significantly to sustainability (Arsawan et al., 2023).

2.2 Review of success factors for circular practices through multi-level perspective theoretical framework and complexity theory lens

The transition towards a CE necessitates a comprehensive theoretical understanding of the underlying success factors that drive its successful implementation across various levels of the socio-economic landscape. These factors may enable firms to ensure and improve organizational performance (Sugiarti et al., 2018). Within every organization, numerous elements impact the process of making strategic choices for the organization. Hence, it is crucial to pinpoint the predominant factor that drives this process. This is where success factors become valuable, aiding businesses in concentrating on the pivotal element and effectively

progressing towards their objectives. Recognizing these success factors can aid companies in developing strategic approaches aimed at attaining their organizational objectives. To elucidate the complex interactions among success factors across socioeconomic levels, the authors used the MLP, a widely used tool for analysing sustainability transitions (El Bilali, 2019; Geels, 2002, 2011; Walrave et al., 2018) and the lens of complexity theory (Sun et al., 2022). The MLP serves as both an analytical and heuristic approach, simplifying the understanding of sustainability transitions. It categorizes analysis into three tiers: macro (landscape), meso (socio-technical regime) and micro (niche) (Geels, 2002), while complexity theory proves instrumental in studying the dynamics of multiple interactions and feedback loops across various levels. The development of the MLP framework in the past two decades and in this context CE-related research have been influenced by several theoretical perspectives, in particular, Giddens (1984) theory of structuration, social constructivism, evolutionary economics and neo-institutional theory (Geels, 2011, 2020). While these theoretical perspectives belong to different social science disciplines (sociology, economics, management science), complexity theory is also inspired by natural science studies, which investigate uncertainty and non-linearity, for example, in natural ecosystems (e.g. Grobman, 2005).

Theoretical inspirations like MLP or complexity theory are, however, still quite rare in the wider CE literature. The majority of recent and current CE-related (journal) publications are still rather descriptive (e.g., Acerbi & Taisch, 2020).

Therefore, the chosen framework can help dissect the dynamics among different perspectives and their collective impact on driving CE transitions. The steps taken to identify the success factors for the adoption of CE practices based on a comprehensive literature review are outlined in the methods section.

3. Methods

3.1 Research design

This study was based on a two-stage methodology that combines a literature review and an interview study. Below the steps taken to identify success factors contributing to the adoption of CE practices based on an extensive literature review are described (a more detailed description can be found in Appendix 1):

- Relevant keywords such as success factors, enablers, drivers and facilitators of the CE were formulated and used as search criteria to identify relevant academic papers.
- The databases Web of Science and Scopus were used to collect relevant articles. All collected articles were refined based on specific inclusion criteria: articles needed to be in English, peer-reviewed and relevant to the present research aim.
- Finally, the authors jointly selected the success factors from the identified articles and categorized them at the micro, meso and macro levels.

The result of this work is shown in Table 1. The table lists the success factors by level and provides a brief description of each factor.

Table 1. Success factors for circular economy implementation at different levels within the MLP

Micro-level	
Organizational education and employee training	Providing structured learning opportunities and skill development programmes to employees within a company. This practice enhances their knowledge, capabilities and adaptability, contributing to improved job performance and organizational effectiveness
(Chaurasia *et al.*, 2020; Choudhary *et al.*, 2022; Gupta and Singh, 2021; Knoth *et al.*, 2022; Kumar *et al.*, 2021; Mahroof *et al.*, 2022; Moktadir *et al.*, 2020; Mondal *et al.*, 2023; Rodrigues *et al.*, 2022)	
Top management support	Active endorsement, commitment and involvement of the highest-ranking executives in an organization towards CE practices. Their backing is essential for aligning resources, setting priorities and fostering a culture that promotes successful implementation and achievement of objectives
(Benz, 2022; Bhatia *et al.*, 2022; Das *et al.*, 2023; Govindan, 2023; Kumar *et al.*, 2021; Lahane *et al.*, 2020; Moktadir *et al.*, 2020; Rodrigues *et al.*, 2022; Sohal and De Vass, 2022)	
Organizational R&D	Activities carried out within a company to innovate, improve products, processes or services. These efforts drive technological advancements, foster innovation and contribute to the organization's CE practices
(Gupta and Singh, 2021; Mondal *et al.*, 2023; Rese *et al.*, 2022)	
Role of technology	Technological advancements in promoting CE practices. Industry 4.0 technologies, such as IoT, play a pivotal role in optimizing material flows, closing material loops and enabling more efficient engineering processes
(Benz, 2022; Das *et al.*, 2023; Gupta and Singh, 2021; Kayikci *et al.*, 2022; Koc *et al.*, 2023; Mahroof *et al.*, 2022; Mondal *et al.*, 2023; Riesener *et al.*, 2019)	
Organizational culture	Encompasses the shared values, beliefs, norms and behaviours that foster a corporate culture that promotes circular thinking and sustainability. It greatly influences employees' attitudes, decision-making and overall work atmosphere, thereby impacting the success of CE adoption
(Gupta and Singh, 2021; Mondal *et al.*, 2023; Rodrigues *et al.*, 2022)	
Visibility of economic benefits	Demonstrating the economic advantages of circular approaches, such as cost reductions, improved resource utilization and enhanced financial performance, serves as a compelling incentive for organizations to transition towards circular business models
(Benz, 2022; Lahane *et al.*, 2020; Mahroof *et al.*, 2022; Mondal *et al.*, 2023; Salmenperä *et al.*, 2021)	
Knowledge of circular practices	Acquiring a comprehensive understanding of CE principles and strategies enables organizations to effectively plan and execute sustainable initiatives. This knowledge empowers decision makers to design products, processes and systems that minimize waste, optimize resource use and align with CE objectives, contributing to overall success in adopting circular practices
(Bhatia *et al.*, 2022; Govindan, 2023; Gupta and Singh, 2021; Koc *et al.*, 2023; Lahane *et al.*, 2020; Rese *et al.*, 2022; Riesener *et al.*, 2019; Salmenperä *et al.*, 2021; Stelmaszczyk *et al.*, 2023)	
Meso-level	

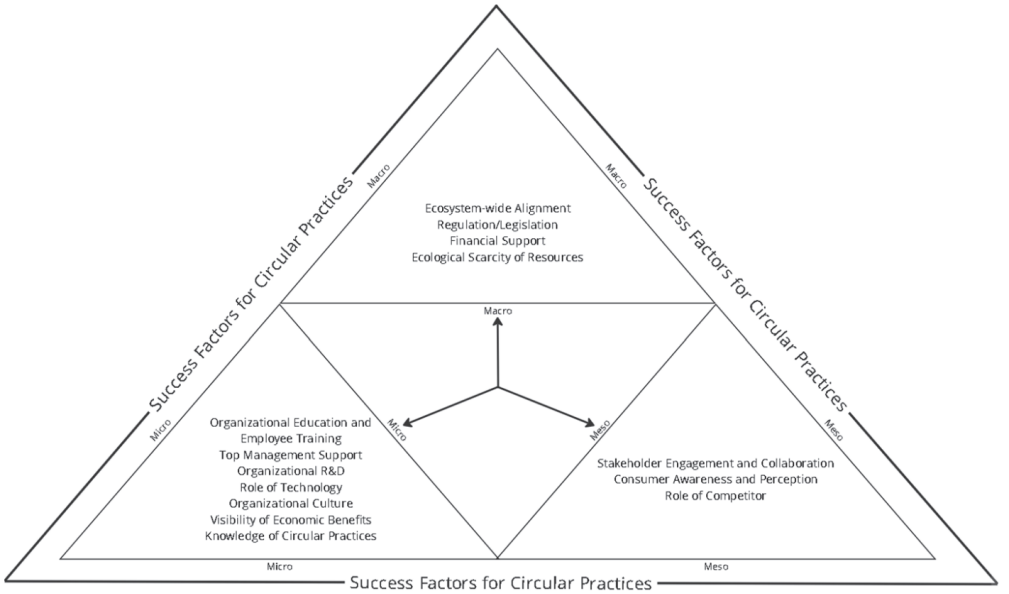
(*continued*)

Table 1. Continued

Stakeholder engagement and collaboration	Emphasizes the significance of partnerships among various entities, including public, private and academic sectors, to address challenges associated with CE implementation. Effective engagement and collaboration facilitate knowledge sharing, resource pooling and innovative problem-solving, enabling a more comprehensive and holistic approach to driving CE principles across industries and sectors (Benz, 2022; Chaurasia *et al.*, 2020; Das *et al.*, 2023; Kayikci *et al.*, 2022; Knoth *et al.*, 2022; Koc *et al.*, 2023; Lahane *et al.*, 2020; Mondal *et al.*, 2023; Rodrigues *et al.*, 2022; Salmenperä *et al.*, 2021; Sohal and De Vass, 2022)
Consumer awareness and perception	A heightened understanding of circular practices and their environmental benefits can shape consumer preferences, encouraging the demand for products and services that align with sustainability goals, thus fostering the growth of CE practices (Benz, 2022; Gupta and Singh, 2021; Lahane *et al.*, 2020; Rese *et al.*, 2022; Sohal and De Vass, 2022)
Role of competitor	Competitive pressures influence organizations to adopt circular practices as a means to remain relevant and innovative in the market. The presence of competitors embracing circular models can motivate businesses to explore sustainable solutions, drive continuous improvement and enhance their overall competitiveness, ultimately contributing to the broader adoption of CE principles (Govindan, 2023; Moktadir *et al.*, 2020; Rese *et al.*, 2022)
Macro-level	
Ecosystem-wide alignment	Significance of aligning various stakeholders, including industry players, government bodies, academic institutions and more, towards a unified vision of circularity. This alignment fosters coordinated efforts, collaborative solutions and a conducive environment for the adoption of circular practices across sectors, thereby enhancing the overall effectiveness and impact of CE initiatives (Benz, 2022; Govindan, 2023; Sohal and De Vass, 2022)
Regulation/ legislation	Importance of supportive legal frameworks and regulatory practices that facilitate the transition towards circular business models. Clear and harmonized regulations, can significantly encourage organizations to adopt circular practices, aligning their operations with sustainability goals and fostering a more favourable environment for CE implementation (Das *et al.*, 2023; Govindan, 2023; Kannan *et al.*, 2022; Knoth *et al.*, 2022; Koc *et al.*, 2023; Lahane *et al.*, 2020; Moktadir *et al.*, 2020; Mondal *et al.*, 2023; Rese *et al.*, 2022; Salmenperä *et al.*, 2021)
Financial support	Financial support can alleviate financial burdens associated with sustainable initiatives, incentivize innovation and promote the adoption of circular practices, ultimately contributing to the successful implementation of CE principles and fostering a more sustainable economic landscape (Benz, 2022; Govindan, 2023; Kannan *et al.*, 2022; Knoth *et al.*, 2022; Koc *et al.*, 2023; Moktadir *et al.*, 2020; Mondal *et al.*, 2023; Rodrigues *et al.*, 2022)
Ecological scarcity of resources	In the face of ecological constraints, recognizing the scarcity of resources motivates businesses to shift towards sustainable practices, optimizing resource use and contributing to the overall resilience and sustainability of their operations and the broader ecosystem (Govindan, 2023; Lahane *et al.*, 2020; Moktadir *et al.*, 2020)

Note: IoT = Internet of things
Source: Table by authors

Figure 1 shows the research framework developed and used in this study. It is the result of the literature review on the most important success factors for the transition to a CE, i.e. the first stage of the study. The developed framework informed the second stage of the study, more precisely the interview study. The interview study was based on semi-structured interviews, as this type of interview allows for a deeper understanding of a topic, which is particularly promoted through personal interaction. The interviewees are invited to express and justify their views and opinions (Tracy, 2019). This approach is considered suitable to learn how participants perceive the world around them (Henn et al., 2009). More specifically, the interview study enabled the authors to gain necessary insights into the relevant success factors necessary for the implementation and maintenance of CE practices in manufacturing SMEs from the perspective of the people concerned. The combined findings of both stages supported the development of the proposed framework.



Source: Figure by authors.

Figure 1. Research framework built based on literature mapping of success factors for circular economy practices

3.2 Company selection and sampling strategy

The sampling procedure focused on manufacturing SMEs that are implementing CE practices. To identify suitable SMEs for the study, the authors used a three-phase purposive sampling logic based on specified screening criteria (Patton, 2015). The pre-screening phase commenced in November 2022 with an extensive online search, focusing on the Web pages and listings of various Swedish CE-focused organizations. At this stage, authors used relatively broad criteria to capture as rich, diverse and inclusive a sample as possible and to understand the scope and breadth of the available data. Thus, the authors focused on identifying all the digital platform firms with a circular resource strategy (e.g. reuse, reduce, recycle, recover) embedded in their business model. This process identified around 55 SMEs as potential participants. In the next phase, initial study group selection, authors shortlisted the identified SMEs according to the extent and impact of their business models. In practice, the authors only included companies

that had existing and viable circular business models according to their circular practices (the authors checked the company's websites and social media platforms to verify that the company fit the scope of this study). This resulted in a shortlist of 32 SMEs located in Sweden that implement CE practices. In January 2023, all these firms were invited to participate in the research. Twelve SMEs (their characteristics are summarized in Table 2 and the CE practices, motivation and transition process of each participating company provided in Appendix 2) agreed to participate.

Table 2. Overview of the interviewed companies

Company	Industry	Company size	Year founded	Time	Date
A	Manufacture of industrial machinery and equipment	Small	1980	34:28	05.01.2023
B	Machines, cables, motors, generators and ventilation	Small	1974	40:57	05.01.2023
C	Manufacture of motor vehicles and engines	Medium	1957	42:37	09.01.2023
D	Manufacture of pipes, wires and plastic	Small	1986	40:40	20.01.2023
E	Manufacture of heat pumps, water heaters, solar cells and electric boilers	Medium	1989	56:30	25.01.2023
F	Manufacture of metals	Small	1940	50:13	26.01.2023
G	Manufacturing of lifting and goods handling devices	Medium	1959	32:07	27.01.2023
H	Manufacture of steel barrels	Small	1907	38:00	27.01.2023
I	Manufacturing of plastic parts	Medium	1941	29:34	30.01.2023
J	Manufacturing of rubber goods, accessories and engines	Medium	1963	32:25	30.01.2023
K	Manufacturing of different metal	Medium	1995	28:12	02.02.2023
L	Manufacture of trucks, heavy motor vehicles	Medium	1917	33:53	02.02.2023

Source: Table by authors

3.3 Data collection

Data were collected through a series of semi-structured interviews (Kvale and Brinkmann, 2009) involving the executive managers with decision-making power in each firm. Semistructured interviews allowed the researchers to gain a rich picture of strategic decisions that determined why and how the SMEs involved implemented and continued their CE practices. Additionally, this type of interview helped to gather in depth insights into the current situation in the firms studied. The authors developed a broad thematic interview guide, using open-ended questions to allow the interviewees to answer the questions based on their knowledge and understanding (Corbin and Strauss, 2014). The interview questions centred on the transition process of SMEs towards CE and built on the prior developed research framework (Figure 1) (see the interview guide in Appendix 3).

The interviews were conducted between January 2023 and February 2023. They were all conducted online using Microsoft Teams and lasted on average 40 min. They were digitally recorded and subsequently transcribed. The decision to conduct 12 interviews was guided by the principle of theoretical saturation, as evidenced by the redundancy of information observed after the 10th interview, indicating that further data collection would yield minimal additional insights. The interviewees were assured that all data would be treated confidentially and used exclusively for the study.

As for the validity of the study, although the internal processes and respondents “answers could not be independently verified, the companies” CE practices were checked in advance using sources such as company websites and social media.

3.4 Data analysis

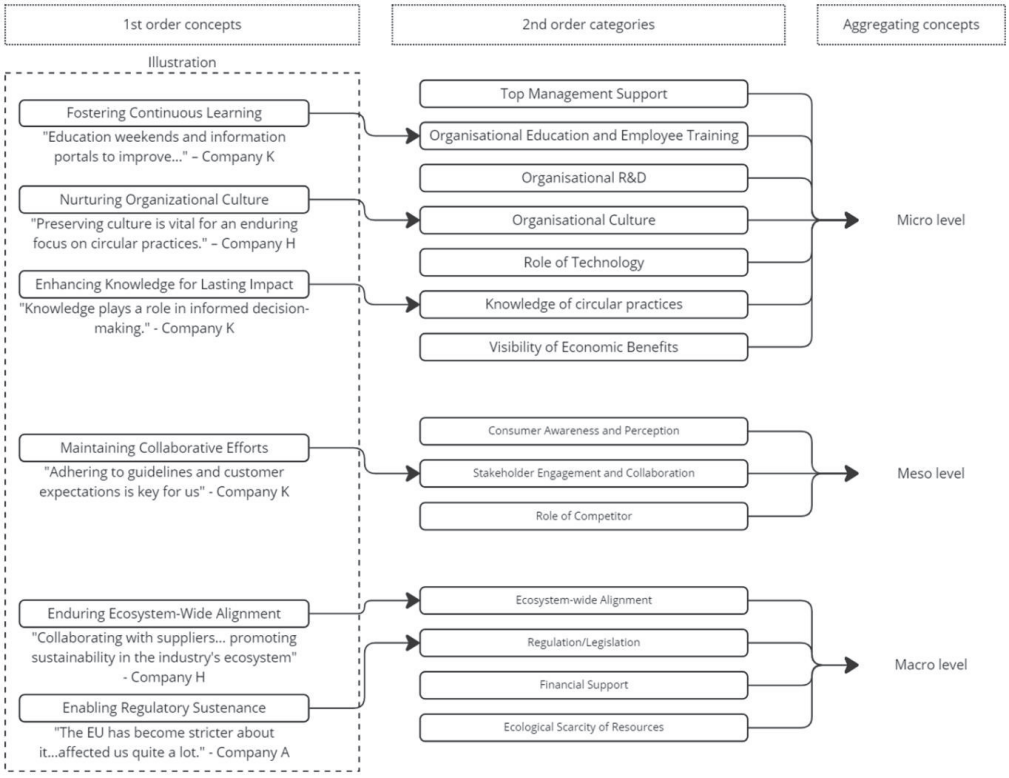
Thematic analysis, a widely recognized method in psychology, business and management research, was used to analyse rich and nuanced data collected through interviews (Hussain et al., 2023). Following the guidelines proposed by Braun and Clarke (2006), the analysis included a thorough examination of the collected data to uncover underlying themes and patterns.

The abductive research approach used helped the authors validate and refine existing knowledge on success factors to develop a framework with enhanced clarity and empirical support (Knight et al., 2022). The success factors were pinpointed using a comprehensive coding framework established from existing literature (Table 1 and Figure 1), which had already highlighted success factors. The analysis process involved an iterative collaboration among the authors. Initially, one author conducted a preliminary analysis of all interviews, presenting their findings to the other authors. Through multiple discussions, the authors deliberated on the results, refining subcategories whenever differences in interpretation arose and working towards a shared understanding. Moreover, while coding the data, the author used both inductive and deductive approaches, allowing themes to emerge organically from the data while also aligning with pre-established coding categories derived from the literature. The process involved multiple rounds of coding, with codes being refined and revised iteratively as new insights emerged from the data.

To ensure the rigour and reliability of the analysis, the authors used the Gioia method, which is an established and reputable technique for data analysis, particularly known for its inductive approach (Gioia et al., 2013). This approach, as defined by Thomas (2006, p. 238), “primarily uses detailed readings of raw data to derive concepts and themes”, with codes being assigned to text or paragraph segments. This method is known for its adherence to the rigourous

standards of qualitative research and provides a structured procedure for analysing qualitative data (Gioia et al., 2013).

The data analysis was supported by the NVivo software, which the authors used on the manually transcribed interviews. More specifically, the analysis method was an iterative process involving all authors and following a structured approach. Initially, one author conducted a preliminary analysis of all interviews and carefully examined the data for new ideas and patterns. Thereafter, the outcomes of this initial step were presented to the remaining authors for review and discussion. In numerous consultations, the authors defined and refined subcategories and themes and thus developed a picture of the situation (see Figure 2). This analysis was carried out in three separate phases.



Source: Figure by authors

Figure 2. Data analysis process

The authors began by identifying first-order concepts from the interview transcripts, they assigned initial codes. This work resulted in 22 concepts. Next, the authors categorized these concepts into 14 second-order categories through broader theoretical classifications; this was supported by the results of the literature review (first stage of the study). They then refined them by examining their interconnections as described by Given (2008). Finally, the outcomes were consolidated into three core categories taking advantage of aggregate coding (Gioia et al., 2013) based on MLPs.

To reduce researcher biases in qualitative research, Morse et al. (2002) proposed ensuring methodological coherence and rigour. Following this recommendation, the authors conducted semi-structured interviews to complement and validate the results of the literature review and thus better approach the aim of this paper to propose a holistic framework. During the iterative process of coding and discussing the results, the research team continuously moved between micro-level insights and theoretical conceptualizations to create a solid foundation of first- and second-order codes; as suggested by Morse et al. (2002).

In the subsequent analysis phase, the authors included specific examples of statements or quotes from participants that illustrate alignment or divergence in their perspectives on success factors for CE practices in SMEs. These statements are available in the findings section (Tables 3, 4 and 5), where alignment and divergence are presented systematically, providing readers with a clearer understanding of the range of viewpoints expressed by participants and the nuances inherent in their responses.

Table 3. Micro-level success factors in circular economy implementation and sustaining

Success factor	Company response	Needed for sustaining CE practices
Organizational education and employee training	Companies prioritize continuous education during implementation. For instance, Company A: "We have hired external speakers to handle the workshops…familiarize our employees with circular economy principles"	The transition to sustaining reveals a recognition of education's role. Company K emphasizes, "education weekends and information portals to improve […]"
Top management support	Leadership commitment drives sustainability initiatives during implementation. Company D highlights "management support is key…sustainability is part of our DNA"	Ongoing leadership engagement is crucial for sustaining. Company C stresses, "leadership is crucial…adapting to changing guidelines"
Organizational R&D	R&D efforts drive circularity during implementation. Company B enhances product durability and reusability through R&D	No longer needed for sustaining CE practices, as SMEs acknowledge resource constraints
Role of technology	Technology optimizes circular practices during implementation. "technology becomes integrated…implicit in ongoing operations". – Company E	Technology becomes implicit in operations post-implementation. Companies focus on refining established practices
Organizational culture	Culture fosters circular thinking during implementation. "culture is a good fit for circularity…innovative and flexible". – Company G	Cultural support remains essential for sustaining. Company H notes, "preserving culture is vital for an enduring focus on circular practices"
Visibility of economic benefits	Economic gains motivate circular practices during implementation. Company a aligns sustainability with profitability	Financial advantages persist post-implementation. Company J emphasizes, "continued belief in financial benefits and addressing financial barriers"
Knowledge of circular practices	Understanding guides implementation during initial phase. "knowledge plays a role in informed decision-making". – Company K	Understanding is pivotal for sustainability. Company L underscores, "collaboration and continuous education ensure longevity of initiatives"

Source: Table by authors

Table 4. Meso-level success factors in circular economy implementation and sustaining

Success factor	Company response	Needed for sustaining CE practices
Stakeholder engagement and collaboration	Companies demonstrate proactive engagement with stakeholders, recognizing the importance of collaboration for circular practices	The shift to post-implementation reveals a continued emphasis on customer expectations and engagement for maintaining stakeholder relations. Company K asserts, "adhering to guidelines and customer expectations is key for us"
Consumer awareness and perception	Consumer influence in shaping strategies, and adapting decisions based on market pressures and consumer demands are acknowledged by companies	Post-implementation, the influence of consumers on circular consumption strategies persists. Company D notes, "…customers are evaluating their products more and making demands related to sustainability"
Role of competitor	Responses indicate varied perspectives on competitors' influence during implementation, with some recognizing the need to adapt to industry rivals. Company E emphasizes adapting to competitors: "swift adaptation due to competitor activities is a challenge"	Post-implementation, no company directly considers competitors' influence, potentially indicating a shift towards internal goals and broader industry trends

Source: Table by authors

Table 5. Macro-level success factors in circular economy implementation and sustaining

Success factor	Company response	Needed for sustaining CE practices
Ecosystem-wide alignment	Companies emphasize alignment with ecosystem goals and stakeholder demands during implementation. Company D emphasizes, "the development towards a more sustainable society… judged by our stakeholders and the overall public"	Post-implementation, continued collaboration and alignment with ecosystem goals are vital. Company H states, "collaborating with suppliers[…] promoting sustainability in the industry's ecosystem", highlighting the ongoing need for coordination
Regulation/legislation	Regulations play a role in shaping approach during implementation. Company a notes, "The EU has become stricter about it…affected us quite a lot"	Post-implementation, some companies shift focus from regulations, while others maintain their importance. Regulatory adherence remains a consideration for sustaining circular practices
Financial support	Financial backing crucial during implementation. Company G actively pursued financial support, stating, "…received funding … for specific circular economy initiatives"	After implementation, financial support remains necessary for sustaining efforts, as observed by company J and company K. Balancing financial feasibility and sustainability remains a challenge
Ecological scarcity of resources	Resource scarcity drives adoption during implementation. Company E pivots towards recycling due to potential shortages. Company F emphasizes the imminent scarcity of resources like gold and water	The importance of resource scarcity remains salient. Company E's commitment to circular practices persists due to their recognition of potential shortages. Their perspective is reinforced by company J, where limited resource availability spurred an initial shift towards circularity and continues to influence their ongoing dedication to efficient resource utilization

Source: Table by authors

4. Findings

In this section, the study's findings on the micro, meso and macro levels are first presented and then discussed in conjunction with the literature. These findings are supported by specific tables (Tables 3, 4 and 5) that highlight key success factors and interview responses during both the implementation and sustaining phases of CE practices. This approach ensures a thorough examination and contextualization of the results within existing research. Following this, the proposed framework is presented that incorporates the insights from all three levels.

4.1 Micro-level perspective

Table 3 highlights the evolving priorities between implementing and sustaining CE practices at the micro level. During the implementation phase, companies prioritize various success factors identified in the literature to facilitate the adoption of circular practices. For instance, organizational education and employee training are emphasized to familiarize employees with CE principles (Company A), aligning with findings in the literature that highlight the importance of workforce training for successful CE implementation (Benz, 2022; Govindan, 2023). Top management support emerges as another critical factor during implementation, with leadership commitment driving sustainability initiatives (Company D). This finding aligns with previous research emphasizing the role of top management in championing sustainability efforts within organizations (Kannan et al., 2022; Salmenperä et al., 2021). Additionally, organizational research and development (R&D) efforts play a crucial role in driving circularity during the implementation phase (Company B). This finding is consistent with literature highlighting the significance of innovation and R&D in developing sustainable solutions (Koc et al., 2023). Moreover, the role of technology in optimizing circular practices is underscored during implementation, with technology becoming integrated into operations (Company E). This finding resonates with research emphasizing the importance of technological innovation in facilitating CE adoption (Gupta and Singh, 2021; Das et al., 2023). Furthermore, organizational culture emerges as a key factor fostering circular thinking during the implementation phase (Company G). This finding aligns with literature emphasizing the role of organizational culture in driving sustainable behaviour within firms (D'Angelo et al., 2023; Frishammar and Parida, 2019). Finally, the visibility of economic benefits motivates circular practices during implementation, with companies aligning sustainability with profitability (Company A). This finding is consistent with research highlighting the economic incentives driving CE adoption (Rocca et al., 2023; Chaurasia et al., 2020).

However, in the sustaining phase, the emphasis shifts towards preserving organizational culture, ensuring ongoing leadership engagement and acknowledging the persistent economic benefits (Companies K, C, H, J, L). This transition reflects the nuanced approach required to ensure the long-term viability of circular practices within SMEs. These findings align with existing literature emphasizing the continued importance of education, leadership engagement, cultural support and economic viability for sustaining CE practices (Benz, 2022; Govindan, 2023; Kannan et al., 2022; Salmenperä et al., 2021; D'Angelo et al., 2023; Frishammar and Parida, 2019). They highlight the dynamic nature of the transition process and the need for ongoing adaptation to sustain circular practices over time.

4.2 Meso level perspective

During the implementation of CE practices, meso-level factors seem to guide smaller firms in establishing and deepening already existing collaborative networks with stakeholders, such as their suppliers in adapting to consumer preferences and responding to competitor dynamics.

This emphasis on stakeholder engagement and collaboration aligns with existing literature highlighting the importance of partnerships and alliances in driving circular practices (Benz, 2022; Govindan, 2023; Kannan et al., 2022; Salmenperä et al., 2021; D'Angelo et al., 2023; Frishammar and Parida, 2019). As the practices transition to the sustaining phase, stakeholder engagement, which already exist in the implementation stage becomes more about continuous to be crucial, particularly in meeting customer expectations and adhering to sustainability guidelines (Companies K, D). Moreover, consumer influence remains important, driving companies to adapt their strategies and products to meet evolving demands (Companies D). While competitor dynamics may have influenced adaptation strategies during implementation, post-implementation, companies prioritize internal goals and industry trends rather than direct competitor influence (Company E). This shift reflects a focus on internal optimization and broader sustainability goals (Benz, 2022; Govindan, 2023; Kannan et al., 2022; Salmenperä et al., 2021) (Table 4).

4.3 Macro-level perspective

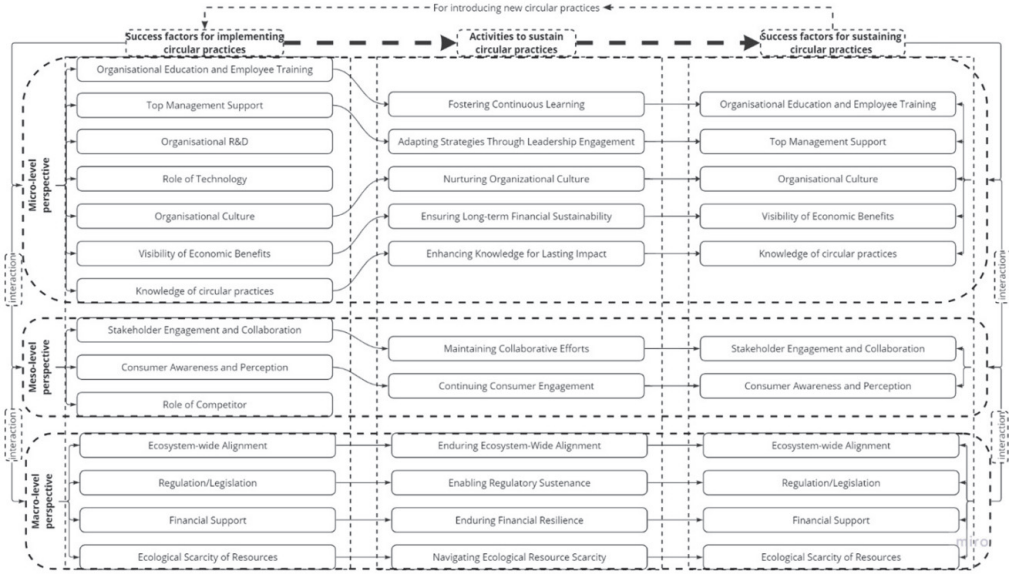
In the implementation phase, macro-level factors drive CE adoption through stakeholder alignment, regulatory compliance, financial backing and addressing resource scarcity (Table 5). Existing literature underscores the significance of ecosystem-wide alignment and stakeholder engagement in driving sustainable practices, aligning with the emphasis on collaboration and stakeholder demands during implementation (Benz, 2022; Govindan, 2023; Kannan et al., 2022; Salmenperä et al., 2021; D'Angelo et al., 2023; Frishammar and Parida, 2019). Regulations also play a crucial role in shaping approaches, as highlighted by Company A's acknowledgement of European Union (EU) regulations (Company A). Post-implementation, companies recognize the continued importance of regulatory compliance for sustaining circular practices, reflecting the literature's emphasis on ongoing regulatory adaptation (Benz, 2022; Govindan, 2023; Kannan et al., 2022; Salmenperä et al., 2021). Financial support is pivotal during both the implementation and sustainability phases, with literature supporting the importance of sustained financial backing for circular initiatives (Benz, 2022; Govindan, 2023; Kannan et al., 2022; Salmenperä et al., 2021). Additionally, resource scarcity drives adoption efforts, with companies pivoting towards circularity to address potential shortages (Companies E, F). Post-implementation, the importance of resource scarcity persists, influencing companies' ongoing dedication to efficient resource utilization, echoing findings in the literature (Benz, 2022; Govindan, 2023; Kannan et al., 2022; Salmenperä et al., 2021).

5. Proposal of framework "Multi-Level framework for implementing and sustaining circular economy practices in the manufacturing small to Medium-Sized firms"

As mentioned before, to develop a framework that considers multiple perspectives, this study combined findings from a literature review that covered studies that investigated success factors from different focus points and an interview study. The proposed framework recognizes and addresses the complexities inherent in the transition to CE. The multiple perspectives taken, involving micro, meso and macro levels, also allow the proposed framework to capture the interwoven threads of diverse success factors (Figure 3).

Throughout the transition process, the interaction between these three levels remains critical. At the micro level, the establishment of a strong culture of circularity within an organization is supported by research emphasizing the role of organizational culture in driving sustainable behaviour (D'Angelo et al., 2023; Frishammar and Parida, 2019). This culture not only fosters internal commitment but also enhances stakeholder engagement at the meso level, aligning

with findings that highlight the importance of stakeholder collaboration in driving circular practices (Benz, 2022; Govindan, 2023; Kannan et al., 2022; Salmenperä et al., 2021). Moreover, regulatory changes at the macro level can necessitate adjustments in organizational education and R&D efforts at the micro level, as observed in the findings. This aligns with literature emphasizing the impact of regulatory frameworks on organizational strategies and operations (Benz, 2022; Govindan, 2023).



Source: Figure by authors

Figure 3. Multi-level framework for implementing and sustaining circular economy practices in the manufacturing of small to medium-sized firms

The iterative and dynamic nature of the CE journey is evident in the feedback loops between micro, meso and macro levels. Micro-level decisions, such as workforce training and technological integration, influence meso-level relationships, such as stakeholder engagement and collaboration. Similarly, meso-level dynamics, such as consumer influence and competitor dynamics, can impact macro-level alignment with ecosystem goals and regulatory frameworks. This interconnectedness highlights the importance of a holistic approach where efforts at each level are guided by collaboration and alignment across levels to achieve sustainable circular outcomes, consistent with literature emphasizing the need for multi-level approaches to circularity (Benz, 2022; Govindan, 2023; Kannan et al., 2022; Salmenperä et al., 2021).

The interplay between these factors is not unidirectional; it is a dynamic and iterative process. Micro-level decisions influence meso-level relationships, which then impact macrolevel alignment and vice versa. This interdependence reflects the complexity of the CE journey within SMEs. It underscores the importance of a holistic approach where micro-level efforts are guided by meso-level collaboration and macro-level alignment to achieve sustainable circular outcomes. This intricate interplay underpins the organization's journey towards circularity, making it a multi-dimensional effort that requires thoughtful integration and adaptation across levels. Beyond the initial implementation and successful sustenance of circular practices, companies must understand that the transition process is not linear but rather a cyclical one.

This means that after achieving a certain level of circularity within the organization, it becomes necessary to revisit and re-evaluate the success factors and strategies that drove the initial transition. In essence, the transition process towards circularity is iterative, which involves a continuous loop of implementing, assessing, refining and scaling circular practices. This circular approach not only maintains the relevance and effectiveness of circularity efforts but also reinforces the organization's commitment to longterm circular practices and its role in building a more sustainable future.

6. Conclusion

6.1 Literature advancement

It is known from existing literature that the adoption of CE practices faces notable challenges in SMEs due to inherent limitations in resources and expertise (Kayikci et al., 2022; Koc et al., 2023; Rotar et al., 2019). While existing research has explored certain success factors that enable the adoption or implementation of circular practices (e.g. Geissdoerfer et al., 2017; Acerbi and Taisch, 2020), there remains a dearth of comprehensive and detailed insights regarding success factors that support the implementation of CE practices in SME. In response to this situation, this study proposes a holistic framework that synthesizes various elements into a cohesive whole, transforming existing knowledge into a new perspective. The study contributes to the literature by providing a multi-dimensional view of the CE transition process that captures the interplay of success factors at micro, meso and macro levels from a small firm perspective. This framework stresses that to increase the successful implementation and maintenance of CE practices in smaller firms one needs to consider the dynamic interactions between success factors across different levels. The findings presented in this study can be differentiated from those in the existing literature, which typically focuses either on the micro level (e.g. Choudhary et al., 2022), the meso level (e.g. Das et al., 2023) or the macro level (e.g. Govindan, 2023). The interplay of factors at different levels highlighted in this study, including their importance evolving at different stages of the transition process, is consistent with several scholars emphasizing the need to address the complex interactions between challenges, critical success factors and barriers to effective CE implementation (e.g. Benz, 2022; Govindan, 2023).

6.2 Managerial implications

Based on the findings, practical implications for SMEs can be derived as well. To sustain the CE practices, a multifaceted approach is required. This involves fostering continuous learning among employees to keep up with evolving CE principles. Engaging leadership remains pivotal, guiding the organization and addressing emerging challenges. Nurturing and maintaining an organizational culture that emphasizes the benefits of circularity of the organization and each organization member can help in overcoming resistance to change. Striking a balance between circular ideals and economic viability is crucial for long-term financial sustainability. Additionally, having access to recent and relevant knowledge plays a pivotal role in decision-making and development in this regard. Stressing collaborative efforts and engaging different stakeholders are further ways to support the CE transition process in smaller firms.

6.3 Societal and social implications

The underlying MLP framework of this study enabled also the consideration of societal and social implications of the presented findings. Firstly, the implementation of sustaining CE practices in SMEs interacts with changing consumer preferences in a wider sense. Besides environmental and health-related product and production aspects, socially relevant product

aspects like, for example, SMEs purchasing from local/regional suppliers are increasingly preferred by consumers. Secondly, the CE transition of SMEs is also accompanied by increasingly changing regulatory (legal) rules at different administrative levels, which can accelerate the process. In addition, to stimulate the improvement and adoption of CE practices, policymakers could consider several measures and policies, such as grants and tax deductions, to reduce the investment burden for SMEs. In addition, the establishment and promotion of shared services and digital platforms for the exchange of information, knowledge and resources could facilitate cooperation, which, in turn, could lead to a more resource-efficient use of raw materials, energy and water and, on the other hand, positive social effects such as improved working conditions or the strengthening of local/regional value chains.

6.4 Research limitations and suggestions for future research

The implications of this study can pave the way for future research on CE transition in SMEs. Future research could examine the effectiveness of continuous learning, understanding leadership roles and strategies to overcome organizational barriers, balancing circularity and profitability, elaborating the impact of knowledge management, the dynamics of stakeholder engagement, sustainable change in consumer behaviour, the impact of regulatory frameworks or innovative approaches to address resource scarcity.

Acknowledging the need for further validation of the proposed framework, future research could apply quantitative approaches to test and thus enhance the framework's robustness and relevance. In addition, studies comparing different types of SMEs are needed to gain a deeper and more nuanced understanding of the elements of the framework. While this study has focused on small and medium-sized manufacturing companies in Sweden, an extension to a broader range of industries and geographical locations could provide further important insights. Such an expansion would enrich the body of knowledge surrounding the implementation and sustainability of CE practices in SMEs, and hence contribute to a more holistic comprehension of CE transition in different contexts.

The current study also acknowledges the limitations of the research, including the use of a two-step approach comprising a literature review and an interview study, which may have inherent biases and limitations in capturing the full range of success factors for CE implementation in SMEs. To dispel possible doubts about the reliability and validity of the results presented in this study, replication studies are welcome to validate and possibly extend the results. Additionally, the heterogeneity found within SMEs, including variations in size, industry focus and organizational culture, may introduce complexities that were not fully accounted for in the study. Considering the limitations acknowledged, future research could explore alternative methodologies to mitigate biases and enhance the understanding of success factors in CE implementation. Using mixed-methods approaches, longitudinal studies or cross-industry comparisons may provide a more comprehensive view.

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Appendix 1. Detailed description of the review process

Step 1: identification of relevant keywords

Initial keyword formulation:

Drawing from the extensive prior knowledge and expertise of the authors in the field of CE, as well as a thorough review of existing literature, a list of relevant keywords was generated. The primary focus was on identifying key terms that are pivotal to the success and facilitation of CE initiatives. Keywords such as “success factors”, “enablers”, “drivers” and “facilitators” were selected due to their relevance in the context of CE.

Search query (the finalized search string used for database queries was):

“circular economy” AND (“success factor*” OR “enabler*” OR “driver*” OR “facilitator*”).

Step 2: records search in databases

Database selection:

Two comprehensive academic databases, Web of Science (WOS) and Scopus, were selected for the literature search. These databases are renowned for their extensive coverage of peer-reviewed journals and high-quality academic papers, making them ideal for this study.

Initial search results (the initial search yielded a substantial number of articles from both databases):

Scopus: 1,650 articles.

Web of Science (WOS): 1,743 articles.

Implementation of inclusion criteria:

Document type (to ensure the relevance and quality of the sources, only articles classified as “Article”, “Review Article” or “Early Access” were considered):

Scopus: Reduced to 1,240 articles.

WOS: Reduced to 1,618 articles.

Language filter (articles were filtered to include only those published in English, ensuring accessibility and consistency in the analysis):

Scopus: Further reduced to 1,232 articles.

WOS: Further reduced to 1,608 articles.

Subject category (to narrow the focus to relevant fields, articles were filtered by specific categories, namely, business and management).

Scopus: Further reduced to 274 articles.

WOS: Further reduced to 148 articles.

Duplicate removal (duplicates across both databases were identified and removed to ensure each article was unique):

This step removed 64 articles, resulting in a total of 358 unique articles.

Step 3: final selection process

Abstract and title review: a review of the abstracts and titles of all 358 articles was conducted to assess their relevance to the research aim. This process involved removing articles that did not meet the study’s specific focus on success factors, enablers, drivers and facilitators of the CE. This review process resulted in the exclusion of 264 articles, leaving a total of 94 articles.

Consensus and final list: the remaining 94 articles were then subjected to a final review and selection process, which involved joint sessions with all authors. This collaborative approach ensured that each selected article was relevant and of high quality, aligned with the research objectives. Through these joint sessions, 72 additional articles were removed based on further scrutiny and consensus among the authors. The final list comprised 22 articles that were deemed most relevant for the study and its aim.

Assignment to levels: the success factors identified from the final list of articles were categorized into the three distinct levels, i.e. micro, meso and macro. This categorization facilitated a structured analysis and understanding of the different factors influencing CE initiatives at various scales.

Table A1. Company profiles on CE engagements

Company	Circular practices	Motivation	Transition process
A	Reduction	Address environmental concerns, comply with regulations	Analysed impact, sought waste reduction, extended product lifecycles
B	Redesign, reuse	Belief in sustainability, customer demands, profitability	Shifted to circularity, product durability, stakeholder engagement
C	Reuse, reduction	Belief in sustainability, circular thinking	Focused on circular practices, collaboration, sustainable mindset
D	Reuse, recycle	Sustainability goals, stakeholder demands	Aligned with sustainability goals, offered sustainable products
E	Reuse, recycle	Belief in sustainability, strategic importance	Gradual shift, education, collaboration, regulatory alignment
F	Recycle	Positive environmental impact, profitability	Adopted closed-loop system, aligned with Agenda 2030
G	Refurbishment recycle	Environmental concerns, cost savings	Multi-faceted approach, workshops, circular material use
H	Recycle, reduction	Environmental preservation, belief in sustainability	Focus on recyclability, stakeholder collaboration
I	Reuse, recycle	Customer demand, industry differentiation	Responded to customer demands, adopted circular practices
J	Reuse, recycle	Environmental commitment	Comprehensive approach, R&D, stakeholder collaboration
K	Recycle, reduction	Environmental concerns, regulations	Recycling in response to regulations, partnerships
L	Reuse, recycle	Environmental impact reduction, belief in sustainability	Evolved from economic focus to sustainability emphasis

Note: Practices; motivations and transition strategies
Source: Table by authors

Appendix 3.

Interview guideline

(1) Motivation and initial implementation:

• What motivated your organization to implement a circular business model (CBM)?

• Were there any specific incidents or causes that influenced this decision?

• How did you decide to transition from a linear to a circular business model?

(2) Process of circular economy implementation:

• Describe the circular business model your organization has implemented.

(3) Transition process and success factors:

• How did you incorporate education and employee training into the transition?

• Were there any challenges in educating employees about circular practices?

• How vital was top management support in driving the circular economy implementation? Did top management provide resources or incentives to facilitate the transition?

• What role did organizational R&D play in implementing circular practices?

• How did technology contribute to the successful integration of circular practices?

• How did you align your organizational culture with circular economy principles?

• Were there challenges in fostering a culture supportive of circular practices?

• How did you engage stakeholders (e.g. suppliers, customers, industry associations, non-governmental organization, etc.) during the implementation?

• Did you encounter difficulties in aligning stakeholder interests with circular goals?

• How have you made the economic benefits of circular practices visible to stakeholders?

• Has this visibility positively impacted stakeholder engagement?

• How well-versed were your employees and stakeholders in circular practices before implementation?

• Did you provide any specific training or resources to enhance this knowledge?

• How did you work on consumer awareness regarding your circular initiatives?

• Did you face any challenges in aligning consumer demands with circular goals?

• Did competitors' actions or initiatives influence your decision to adopt circular practices?

• How did you differentiate your circular practices from competitors?

• How did you ensure alignment with broader ecosystem goals and circular economy principles? Did you collaborate with other businesses or organizations?

• Did regulatory or legislative factors impact your circular economy implementation?

• How did you navigate any regulatory challenges that arose?

• Was financial support critical for the successful implementation of circular practices?

• Did you face any financial constraints during the transition?

• Did concerns about resource scarcity influence your decision to implement circular practices? How did your circular practices address these concerns?

(4) Success factors for sustaining the process:

• How have you continued to focus on the points we discussed already to sustain circular practices over time?

• Have you encountered any new challenges during the sustaining phase?

(5) Concluding remarks:

• Is there anything else you would like to add about your organization's journey towards circular economy implementation?

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