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Article

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Exploring Pathways to Circular Economy Practices in Estonian Manufacturing SMEs: A Fuzzy-Set QCA Approach on Stakeholder Pressure and Collaboration

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Abstract

In response to global imperatives for sustainability, particularly within the framework of the circular economy (CE), this study examines the adoption of CE practices among manufacturing Small and Medium Enterprises (SMEs) in Estonia. Based on a sample of 78 responses using complete case analysis, this research aims to uncover the configurations of stakeholder pressure (business and social) and collaboration (supply and demand-side) pathways that facilitate successful CE adoption. Drawing on Fuzzy-set Qualitative Comparative Analysis (fsQCA) and Configurational Theory, the study explores how interactions among these factors influence the adoption of CE practices. The empirical investigation, grounded in the Estonian context, reveals three key pathways driving CE adoption: demand-side collaboration, social pressure without direct business pressure, and the combination of business pressure with supply-side collaboration. The findings not only contribute theoretically by advancing configurational approaches in CE research but also offer practical implications for SME managers seeking to adopt CE practice.

Keywords

Small And Medium Enterprises, Circular Economy Practices, Stakeholder Pressure, Collaboration, Fuzzy-Set Qualitative Comparative Analysis

JEL Classification

L25, M1, M21, Q01

Introduction

In recent years, global business discourse has increasingly emphasized sustainability as a fundamental imperative, driven by the urgent need to address pressing environmental challenges such as climate change, resource depletion, and environmental degradation (Shrivastava et al., 2020). Central to this discourse is the concept of the circular economy (CE), which advocates for sustainable business models that minimize waste, optimize resource use, and promote closed-loop production systems (Ahmadov et al., 2023; Kara et al., 2022).

Small and Medium Enterprises (SMEs), as dynamic engines of innovation and economic growth, are pivotal in this transition towards sustainable practices (Tsvetkova et al., 2020). They constitute a significant portion of the global economy and play a crucial role in fostering economic development (Gherghina et al., 2020). The transition towards a CE involves recirculating products, components, and materials through recovery routes such as reuse and recycling. This shift is economically beneficial and crucial for environmental sustainability (Mallick et al., 2023). The CE framework aims at the conscious and efficient use of products and resources, aiming for long-term value retention and closing loops in production and consumption (Morsetto, 2023). As SMEs play a vital role in the economy, understanding their organizational transformation towards circular practices is essential (Arranz et al., 2023). However, their adoption of CE practices within SMEs is hindered by various challenges including limited resources, operational constraints, and varying levels of environmental awareness (Govindan & Hasanagic, 2018;

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Korsakienė & Raišienė, 2022; Munaro & Tavares, 2023). Unlike larger corporations with dedicated sustainability departments and substantial financial capabilities, SMEs often face barriers that impede their ability to integrate CE principles into their operations (Rittershaus et al., 2023).

Despite these challenges, the integration of CE principles into SME operations is critical not only for enhancing environmental stewardship but also for advancing global sustainability agendas, such as those outlined in the United Nations Sustainable Development Goals (UN SDGs) (Dey et al., 2022; Gennari, 2023). The imperative to incorporate sustainability principles into SME operations is underscored by the growing recognition of SMEs' role in local economies and communities, where their actions significantly influence environmental outcomes and societal well-being (Ahmadov et al., 2023; Zucchella et al., 2022).

In understanding the dynamics of CE practices within SMEs, it is imperative to explore the influencing factors that shape their practices. These factors encompass various internal and external elements, from organizational dynamics to market forces and stakeholder pressures (Baah et al., 2023; Castro-Lopez et al., 2023). Internally, factors such as leadership commitment, organizational culture, and innovation capabilities play pivotal roles in enabling SMEs to embrace sustainability and integrate it into their core business strategies (Salvioni & Almici, 2020; Soni et al., 2023; Villet, 2021). Externally, regulatory frameworks, market demand for sustainable products, and access to financing emerge as significant drivers or constraints for SMEs' initiatives towards CE practices (Malik et al., 2022; Wang et al., 2023). Moreover, stakeholder pressure and collaboration emerge as critical determinants shaping sustainability practices within SMEs. Stakeholders, including customers, suppliers, and regulatory bodies, exert pressure on SMEs to adopt sustainable practices (Ernst et al., 2022; Mallick et al., 2023). In accordance with Karman et al. (2024), it is believed that CE practices promote flexibility, collaboration, and resource efficiency. For instance, customers increasingly prefer products and services from companies that demonstrate environmental responsibility, incentivizing SMEs to invest in sustainable production processes and green technologies (Pereira & Franco, 2023). Concurrently, collaboration pathways with stakeholders are essential for SMEs to navigate the complexities of transitioning towards circular practices (Arranz et al., 2023). For instance, collaborative efforts between SMEs and suppliers can lead to the development of eco-friendly supply chains, reducing carbon emissions and waste throughout the production process (Akpan et al., 2023).

While existing literature provides valuable insights into the multifaceted relationship between stakeholder pressure, collaboration, and CE practices in SMEs, it also underscores the presence of notable gaps and challenges that necessitate further exploration. Specifically, empirical studies contextualized within Estonia are notably lacking, despite its unique socio-economic landscape, pivotal role of SMEs in driving economic growth and innovation, and the government's commitment to green initiatives (Ahmadov, 2023; Ahmadov et al., 2022; Gerstlberger et al., 2023; Kekkonen et al., 2023). The manufacturing sector, which plays a crucial role in Estonia's economy by contributing to employment, exports, and industrial innovation, makes it an ideal setting for exploring CE challenges and opportunities (Kalvet, 2016; Küttim et al., 2023). Understanding how these factors interact and influence CE outcomes in SMEs within Estonia remains underexplored, calling for advanced methodological approaches and theoretical frameworks to unravel their intricacies comprehensively (Ahmadov et al., 2023; Alyahya et al., 2023).

In this context, Fuzzy-set Qualitative Comparative Analysis (fsQCA) and Configurational Theory emerge as promising research avenues, offering holistic perspectives and analytical tools to delve into the complexities of sustainability in SMEs. Kumar et al. (2022) highlight the potential of this methodology in providing nuanced insights into the interplay between stakeholder pressure, collaboration, and sustainable performance within SMEs. In this context, the primary objective of this study is to explore the synergistic effects of stakeholder pressure, collaboration, and CE practices within the manufacturing SMEs in Estonia. This study aims to answer the following research question (RQ):

RQ: What configurations of stakeholder pressure (business and social) and collaboration (supply and demand side) pathways lead to successful adoption of CE practices among manufacturing SMEs in Estonia?

By addressing the research question on the configurations of stakeholder pressure and collaboration pathways leading to successful adoption of CE practices among manufacturing SMEs in Estonia, this study contributes to both theoretical advancements and practical insights. This study differentiates itself from previous research by focusing specifically on the Estonian context, employing fsQCA and Configurational Theory to provide holistic perspectives and analytical tools. By addressing the research question on the configurations of stakeholder pressure and collaboration pathways leading to the successful adoption of CE practices among manufacturing SMEs in Estonia, this study makes several contributions. Theoretically, this research enriches the literature by providing a nuanced understanding of how different combinations of business and social stakeholder pressures, along with supply and demand-side collaborations, influence the integration of CE practices within SME operations. It also demonstrates the utility of configurational approaches in exploring complex interactions among variables in CE research. Empirically, the study fills a significant gap in the literature regarding Estonia-specific contexts, offering detailed insights into the factors driving CE practices in Estonian SMEs. Practically, the findings provide actionable recommendations for SME managers aiming to enhance CE practices. By identifying effective configurations of stakeholder pressures and collaboration pathways, managers can better navigate the transition

towards sustainable business models. Moreover, by employing fsQCA and Configurational Theory, this study offers methodological contributions, demonstrating the utility of configurational approaches in exploring complex interactions among variables in CE research.

This article is structured as follows: Following the introduction section, the literature background is presented in section 2. The methodology is detailed in section 3 and followed by results and discussion of the results (section 4). Lastly, the section 5 summarizes key findings and offers recommendations for future research directions.

Literature Review

Circular Economy Practices in SMEs

The adoption of CE practices among SMEs represents a critical frontier in sustainable business strategies. SMEs, renowned for their agility and innovation, play a vital role in economies worldwide, contributing significantly to employment and fostering economic diversity (Ahmadov et al., 2023; Durst & Bruns, 2018; Tsvetkova et al., 2020). Integrating CE principles in SME operations not only enhances environmental stewardship by promoting resource efficiency and waste reduction but also aligns with global sustainability mandates set by the United Nations (Dey et al., 2022). The CE is an essential environmental strategy concept for waste minimization, nature recuperation (Bag et al., 2021), sharpening environmental conservation and efficient energy consumption for sustainable business (Gupta & Singh, 2021) by paying great attention to the environment and resources (Korhonen et al., 2018). CE practices provide new perspectives for developing efficient strategies and methodologies for sustainable environmental management (Sundar et al., 2023). Past studies underscore that such initiatives not only improve environmental outcomes but also bolster financial performance and enhance brand reputation (Journeault et al., 2021; Palea et al., 2023).

According to (Arsawan et al., 2024) the transition to CE within SMEs is supported by several factors. These factors include green economic incentives (GEIs) and environmental commitment (EC), which drive CE practices. These practices can be mediated by internal environmental management, eco-design, and corporate asset management and recovery (CAM&R). The research conducted by Arthur et al. (2023) revealed that government funding for R&D plays a substantial role in achieving the CE, particularly in OECD nations. However, the adoption of CE principles in SMEs is still nascent, and there is a need for systemic research from the SME perspective. In their studies, Rittershaus et al. (2023) note how SMEs often lack the financial and organizational resources to implement systemic changes to their business models. Moreover, there is usually a lack of clear legislation and support from the government and other legislative bodies to implement sustainable practices in SMEs successfully. The lack of regulatory frameworks hinders the implementation and promotion of such practices (Moursellas et al., 2023). Therefore, it is essential to provide SMEs with practical tools and methodologies that facilitate business model innovations towards circular value creation (Rittershaus et al., 2023).

Stakeholder Pressure and CE Practices

Stakeholder pressure is a key factor in driving SMEs to adopt CE practices. This is particularly important in industrial firms, where a transition from a linear to a circular approach to stakeholder engagement is essential (Fobbe & Hilletoft, 2023). A study by Jiao et al. (2020) demonstrates that primary stakeholder pressure significantly impacts the adoption of sustainable operations (SO), while governmental and secondary stakeholder pressure do not have a significant effect. Both business and social stakeholder pressures have a considerable impact on the adoption of CE practices. Business entities face pressure from stakeholders such as consumers, suppliers, and investors to adopt CE practices in order to enhance their brand image, financial outcomes, and competitive edge (Mazzucchelli et al., 2022). Hernández-Arzaba et al. (2022) argue that social stakeholders, including NGOs, the public, and the government, significantly affect environmental sustainability and pressure companies to embrace circular economy ideas. A study by Bello-Pintado et al. (2023) emphasizes the importance of involving all major stakeholders in advancing sustainability practices. Findings from Setiawanta and Purwanto (2019) shows that stakeholder power plays a significant role in influencing the implementation of Sustainability Reporting and corporate governance practices in manufacturing industries.

Pressures from government and regulations, NGOs, shareholders, customers, employees, and top management all play a role in determining the adoption and implementation of sustainability practices. According to Rodríguez-Espíndola et al. (2022), the influence of shareholder pressure varies across different types of organizations. It is noted that, in the context of SMEs, stakeholder pressure, particularly from government support and customer demand, plays a crucial role in the implementation of CE practices and sustainability-focused innovation. This, in turn, positively impacts the financial, environmental, and social performance of these enterprises. Studies conducted by Courrent and Omri (2022) demonstrate that stakeholder pressure benefits SMEs by enhancing their commitment to implementing sustainable business practices. Additionally, according to Kita and Šimberová, (2018) importance of catering to customer needs and preferences enhance the overall experience of customers.

Based on research that looks at the effect of stakeholder pressure on the adoption of CE practices, we propose the following ideas to explore their relevance in the context of Estonian manufacturing SMEs. Drawing from studies

that highlight the significant impact of stakeholder involvement, particularly from both business and social spheres, on driving organizational transformation towards sustainability (Fobbe & Hilletoft, 2023; Hernández-Arzaba et al., 2022), we argue that understanding the dynamics of stakeholder pressure is crucial for shedding light on the adoption of CE practices among manufacturing SMEs in Estonia.

Proposition 1. Business Pressure is positively associated with adopting CE practices in Estonian manufacturing SMEs.

In Proposition 1, we propose that Business Pressure, which includes pressures from consumers, suppliers, and investors, has a positive relationship with CE adoption in manufacturing SMEs. This is because businesses need to enhance their competitiveness and meet market demands through sustainability practices (Mazzucchelli et al., 2022).

Proposition 2. Social pressure is positively associated with adopting sustainability practices in Estonian manufacturing SMEs.

In Proposition 2, we argue that Social Pressure arising from socially conscious stakeholders, including NGOs and the public, has a positive impact on CE practices. This reflects the growing influence of environmental and social responsibility considerations on firms' decision-making processes, as highlighted by Hernández-Arzaba et al. (2022). By situating our propositions within the context of existing literature, we aim to establish a robust basis for future empirical research into the influence of stakeholder pressure on CE adoption among Estonian manufacturing SMEs.

Collaboration for CE Practices

The role of collaboration, both on the supply and demand sides, is pivotal in adopting CE practices in manufacturing SMEs. It plays a crucial role in improving sustainability performance in circular supply chains (CSCs) and implementing CE strategies (Sudusinghe & Seuring, 2022). Collaboration, supported by knowledge management, encourages innovation by allowing SMEs and stakeholders to leverage collective insights and expertise, leading to the development of new ideas and solutions (Valencia-Arias et al., 2024). According to Köhler et al. (2022) and Luthra et al. (2022), cross-sectoral collaboration can support advancing CE practices by developing knowledge-sharing routines and ecocentric dynamic capabilities. Soni et al. (2023) suggest that collaboration, including power-sharing, delegation, decision-making, authority-sharing, and a collaborative mindset, facilitates the adoption of CE practices. Therefore, distributed leadership, which emphasizes collaboration and collective vision, can be a catalyst for building a collective and aligned vision of CE implementation.

Supply network collaboration is crucial in transitioning to a circular economy (Berlin et al., 2022). On the supply side, collaboration can facilitate the integration of CE principles by enabling access to shared resources, expertise, and technologies that individual SMEs may lack. For instance, multi-stakeholder cooperation within the supply chain drives CE adoption, as it can lead to resource efficiency and cost savings (Elia et al., 2020). Moreover, sustainable supply chain management practices are crucial, as they can lead to adopting similar practices among suppliers and sub-suppliers, creating a trickle-down effect that enhances overall sustainability (Allenbacher & Berg, 2023). Collaboration in supply chains is key to innovation for a CE, as it provides the combination of knowledge and capabilities necessary for product and process innovation (Berardi & de Brito, 2021). Collaboration among partners along supply chains has frequently been used as a core activity for successfully implementing sustainability-related strategies. Engagement of external parties such as governmental and non-governmental organizations, entrepreneurs, and research institutes complements the managerial understanding of collaboration to improve the sustainability performance of CSCs (Sudusinghe & Seuring, 2022). According to Journeault et al. (2021), stakeholders play five different and complementary collaborative roles in supporting sustainability practices within SMEs: trainer, analyst, coordinator, specialist, and financial provider. These roles contribute to overcoming barriers to integrating sustainability practices within SMEs.

On the demand side, customer pressure significantly influences SMEs' adoption of CE practices. Customers' growing awareness and demand for sustainable products can motivate SMEs to adopt CE principles to maintain their competitive advantage and meet market expectations (Chowdhury et al., 2022; N. R. Khan et al., 2023). Additionally, in the study of SMEs across multiple sectors, Howard et al. (2022) revealed that capturing value through circular practice is facilitated by emerging service markets and digital technologies, often driven by customer needs and preferences.

Collaboration with government and non-government organizations can also support SMEs transitioning towards CE by providing access to tools and methods that assist in CE adoption (Howard et al., 2022). Furthermore, the adoption of green technology and CE principles is positively influenced by circular economy entrepreneurship and customer pressure, which can enhance sustainable supply chain practices (Khan et al., 2023). A study by Luthra et al. (2022) suggests that collaborative networks and partnerships can help SMEs overcome barriers and challenges associated with CE adoption, such as lack of resources, expertise, and market access. Moreover, collaborative initiatives can also enhance the visibility and reputation of SMEs as they demonstrate their commitment to sustainability and environmental responsibility.

Based on the literature highlighting the pivotal role of collaboration in adopting CE practices, particularly within manufacturing SMEs, we propose the following propositions to investigate the applicability of collaboration dynamics in the context of Estonian manufacturing SMEs.

Proposition 3. Supply Side Collaboration is positively associated with adopting sustainability practices in Estonian manufacturing SMEs.

Proposition 4. Demand-side collaboration is positively associated with adopting sustainability practices in Estonian manufacturing SMEs.

By framing our propositions within the context of existing literature, we aim to provide a solid foundation for examining the relationship between collaboration and the adoption of CE practices in Estonian manufacturing SMEs.

Configurational Theory and Conceptual Model Development

Configurational theory, drawing on complexity theory, predicts and explains real-world business phenomena by considering the asymmetrical nature of the business environment (Kumar et al., 2022). It emphasizes the importance of fit among various environmental and organizational system elements for firm success (Kreiser et al., 2021) and the interconnections and dependencies among different elements within an organization. Configurational research, including qualitative comparative analysis (QCA), can produce formal propositions and untangle complex interplays among factors, enhancing theory development (Ketchen Jr et al., 2022).

Configurational theory offers a valuable lens for studying CE practices in SMEs by emphasizing the unique combinations of factors that can lead to successful adoption. This approach recognizes that there is no one-size-fits-all solution and that the interplay of various organizational elements can influence the effectiveness of CE practices (Gligor & Bozkurt, 2020; Pattij et al., 2022; van de Wetering et al., 2021). Configurational theory suggests that organizational outcomes result from complex interactions between various factors rather than the influence of isolated variables. In the context of CE practices in SMEs, this theory can be applied to understand how different factors influence the adoption of CE practices.

Based on the above literature background, the section below presents the conceptual model that elucidates the interconnected variables influencing the adoption of CE practices within manufacturing SMEs in Estonia. The model delineates the roles of business stakeholder pressure, social stakeholder pressure, demand-side collaboration, and supply-side collaboration in shaping CE outcomes, providing a theoretical framework for empirical investigation.

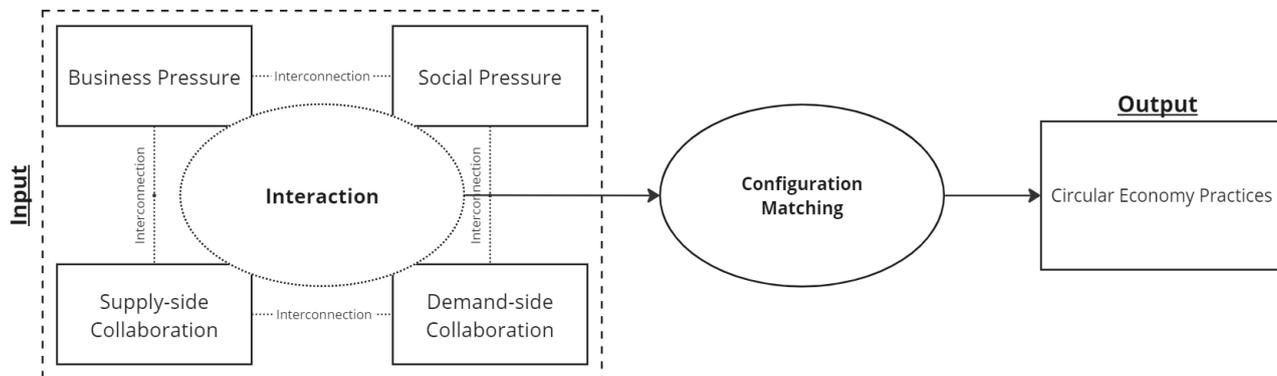


Fig. 1. Conceptual Model
Source: Author's own.

This model is developed within the framework of fsQCA, which allows for a nuanced examination of the complex interactions between these variables and their impact on the adoption of CE practices. Previous studies have predominantly adopted a linear focus when examining the adoption of CE practices, often isolating individual factors such as stakeholder pressure or collaboration without considering the complex interdependencies among these elements (Courrent & Omri, 2022; Mazzucchelli et al., 2022; Rittershaus et al., 2023). However, the benefits of using fsQCA lie in its ability to capture the configurational nature of these interactions, providing a more comprehensive understanding of how different combinations of factors can lead to successful CE adoption. FsQCA allows researchers to identify multiple pathways to a desired outcome, acknowledging that different configurations of pressures and collaborations can be equally effective (Kumar et al., 2022). This approach not only enhances the theoretical robustness of the study but also offers practical insights for SMEs by highlighting diverse strategies for CE implementation. By employing fsQCA, this research model seeks to unravel the complex interactions among these variables and their configurations that lead to the outcome of CE practices in SMEs. The proposed model draws upon existing literature to develop propositions that guide empirical investigation into the role of stakeholder pressure and collaboration dynamics in shaping CE adoption among SMEs, providing a solid foundation for further research.

Methods

This section provide insight into the research design and methodology utilized, including the data collection process and the data preparation for analysis. The research process, detailed in Figure 2. shows that the flow chart begins with defining the problem, aim, and objectives, followed by a comprehensive literature review. This step sets the stage for formulating research questions and developing a conceptual model. Identifying the appropriate methodology is crucial before data collection, where information is gathered. Subsequently, rigorous data analysis is conducted to derive meaningful insights, leading to a discussion of findings. From there, the study can offer practical and theoretical recommendations, implications, and conclusions, encapsulating the study's contributions and significance.

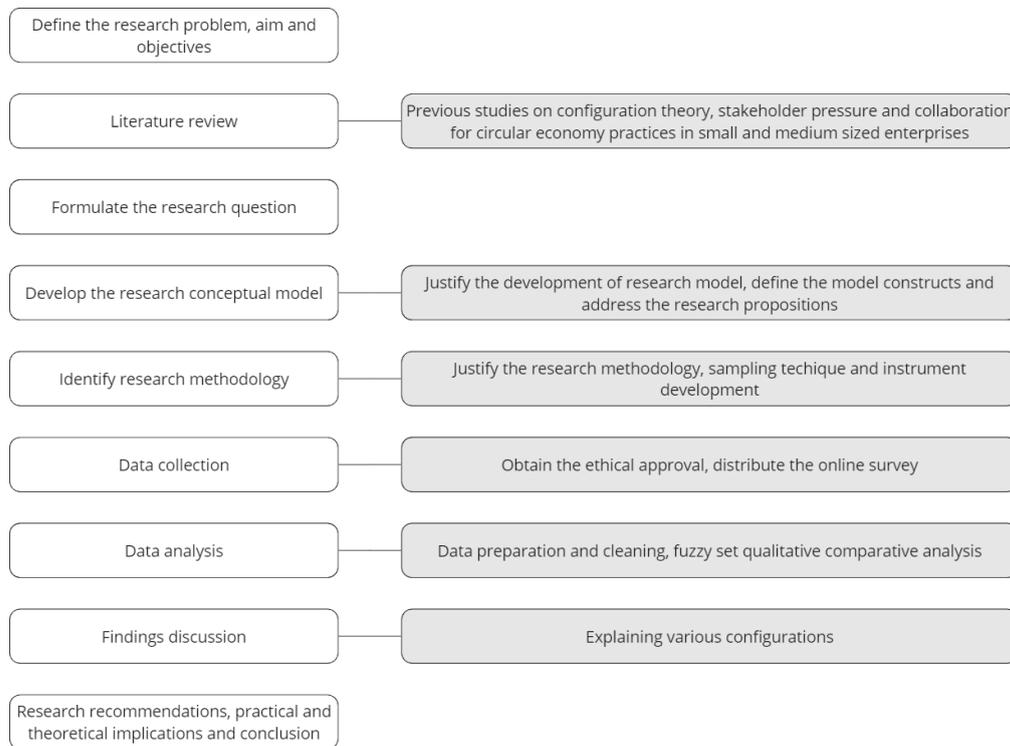


Fig. 2. Flow Chart of Research Process.

Source: Author's own.

Research Setting and Sample

The choice to focus on Estonian manufacturing SMEs is driven by several factors. Estonia, with its unique socio-economic landscape and pivotal role of SMEs in economic growth and innovation, offers a compelling case for exploring sustainability practices (Ahmadov, 2023,2024a; Kekkonen et al., 2023). The manufacturing sector is crucial to Estonia's economy, significantly contributing to employment, export revenues, and industrial innovation, making it an ideal focus for studying CE challenges and opportunities (Kalvet, 2016; Küttim et al., 2023). Additionally, the Estonian government's commitment to sustainable development and green innovation, through initiatives supporting SMEs in adopting environmentally friendly practices, underscores the relevance of this study (Ahmadov, 2023; Ahmadov et al., 2022, 2024a, 2024b; Kirejev et al., 2024; Küttim et al., 2023). This context provides valuable insights for policymakers, industry stakeholders, and academic researchers.

To achieve the research aim, this study utilized an online survey methodology, which was carried out through the Qualtrics platform, along with an introductory email that explained the study's objectives. The survey was distributed to 318 companies listed in the Orbis Europe database, limiting the search to Estonia, SMEs, and operating manufacturing firms. It was sent out on November 14th, 2023, followed by two reminder emails on December 1st and 11th, and was closed after the holidays in January. Considering the multilingual composition of the Estonian population, characterized mainly by three languages – Estonian, Russian, and English, the questionnaire was translated into mentioned languages to provide options, ensure comfort, and increase the response rate. Following the “complete case analysis” method for handling missing data (Hughes et al., 2019), 78 responses were deemed suitable for the fsQCA analysis. Table 1 shows the respondents profile, providing insight into characteristics of studied companies. In accordance with Podsakoff et al. (2003) recommendations, several measures were taken to minimise the possibility of common method bias, including safeguarding the confidentiality and anonymity of the respondent data.

Table 1. Sample profile.

	count	%		count	%
Respondents profile			Firm size		
Female	26	33	Micro	20	26
Male	49	63	Small	40	51
Prefer not to say	3	4	Medium	18	24
Education level			Business type		
Diploma/certificate	24	31	B2B	29	37
Undergraduate	17	22	B2C	9	12
Master's degree	35	45	Both	40	51
Doctorate	2	3	Environmental certificates		
Position			ISO 14000 family	21	27
Owner	35	45	EMAS	4	5
Production manager	10	13	Don't have	47	60
Marketing manager	2	3	Other	10	13
Supply chain manager	2	3	Internationalisation		
Quality manager	4	5	Internationalised	57	73
Other	25	32	Non-internationalised	21	27

Most respondents identify as male (63%), with 33% female and 4% preferring not to disclose their gender. The sample includes 51% small enterprises, 26% micro-enterprises, and 24% medium-sized firms, reflecting an inclusive range of business sizes. Regarding education, 45% hold a master's degree, 31% have a diploma/certificate, 22% possess undergraduate degrees, and 3% have doctorates, showcasing varied educational backgrounds. In terms of business type, 37% operate Business to Business (B2B), 12% Business to Consumer (B2C), and 51% in both, indicating diversified market engagement. Owners comprise 45% of respondents, with production managers and marketing managers at 13% and 3%, respectively, highlighting leadership involvement in sustainability. Environmental certifications show 27% ISO 14000 adherence, 5% EMAS certification, and 60% without certifications, indicating areas for improvement in sustainability standards. Internationalization reveals that 73% have global market engagement, while 27% remain domestic, reflecting different strategic approaches within the sector. Regarding the industry focus, the surveyed companies span various manufacturing sectors, with the "Other" category making up the largest proportion at 36%. "Manufacture of wood and products of wood and cork" follows closely at 18%. The complete list of industry focus can be found in the Appendix A.

Variables

In this study, we have selected the CE practices as our main variable (outcome condition) and identified business stakeholder pressure, social stakeholder pressure, demand-side collaboration, and supply-side collaboration as the causal conditions influencing this outcome. A detailed list of questions is available in Appendix B.

Circular economy practices: The six items offer a comprehensive view of CE practices in manufacturing SMEs, including the use of renewable materials, designing recyclable products, and reusing products, materials, and packaging. They focus on resource optimization and waste reduction throughout the product lifecycle, emphasizing efficiency and environmental stewardship in production (Chowdhury et al., 2022; Dey et al., 2022).

Business pressure: This includes the influence of key stakeholder groups such as customers, suppliers, shareholders, employees, and competitors on sustainability practices. Customers drive efforts through preferences and purchases, suppliers through their practices, shareholders via financial support and expectations, employees through engagement, and competitors by market actions (Nguyen & Adomako, 2022; Tian et al., 2023).

Social pressure: Various stakeholders, including government bodies, NGOs, local communities, and media, shape firms' sustainability efforts. Governments enact laws and policies, NGOs influence corporate behaviour, communities impact reputation, and media raises awareness (Nguyen & Adomako, 2022; Tian et al., 2023).

Supply-side collaboration: Involving five items, this collaboration focuses on working with supply chain actors to advance sustainability. It includes working with suppliers on ecological product design, joint sustainability planning, and shared responsibility for sustainability performance (Tian et al., 2023; Yousaf, 2021).

Demand-side collaboration: Also with five items, this involves engaging consumers in sustainability efforts. It includes designing sustainable products with consumer input, joint planning, and shared responsibility for sustainability performance (Tian et al., 2023; Yousaf, 2021).

Qualitative Comparative Analysis

This study employs Qualitative Comparative Analysis (QCA) to investigate the relationship between stakeholder pressure, collaboration, and CE practices within Estonian manufacturing SMEs. The choice of QCA is grounded in theoretical expectations, as it is anticipated that stakeholder pressure and collaboration together produce CE practices rather than acting independently. Unlike conventional quantitative and qualitative methods that focus on assessing the effect of a single variable on a dependent variable, QCA allows for identifying conditions or sets of conditions that are either necessary or sufficient for an outcome (Schneider & Wagemann, 2012).

The main advantage of QCA, particularly fuzzy-set QCA, is its ability to accommodate qualitative nuances and empirical differences in data. Unlike crisp-set QCA, which operates on binary or categorical values, fsQCA allows for the inclusion of varying degrees of membership in conditions. FsQCA enables the incorporation of these empirical differences into the analysis by establishing the degree of membership or non-membership in conditions, thereby providing a more nuanced understanding of the relationships under investigation (Ragin, 2009). Additionally, variance-based methods assess the impact of variables in a competing environment by evaluating the net effect between them in a model, while fsQCA focuses on the intricate and asymmetric connections between the outcome and its underlying causes (Pappas & Woodside, 2021). In this study, fsQCA was the most appropriate approach to explore the intricate and non-linear relationships between the input (stakeholder pressure and collaborations) that led to the adoption of CE practices (outcome) in manufacturing SMEs in Estonia.

However, there are some limitations of employing fsQCA method. Only a limited number of factors or conditions can be considered in fsQCA, which can constrain the comprehensiveness of the analysis (Sehring et al., 2013). Additionally, since fsQCA is based on pre-defined input and output determined by the author's knowledge, this introduces subjective bias into the study (Pappas & Woodside, 2021).

Analysis

In conducting the fsQCA, three distinct steps are followed to produce results: testing for necessary conditions for the outcome, testing for sufficient sets of conditions for the outcome, and testing for the absence of the outcome (Pappas & Woodside, 2021). Unlike traditional quantitative methods, fsQCA does not assume causal symmetry, so analysing both the presence and absence of conditions is crucial for understanding the complexity of causal relationships.

In the first step, the analysis focuses on identifying necessary conditions for the outcome of interest. Essential conditions are those factors that must be present for the outcome to occur. This step involves examining each variable to determine its importance in contributing to the outcome. The coverage and consistency scores are calculated to assess how the identified conditions explain the outcome (Ketchen Jr et al., 2022).

The second step involves testing for sufficient sets of conditions for the outcome. Sufficient sets are combinations of conditions that, when present together, are sufficient to produce the result. This step entails exploring various combinations of conditions to identify which combinations are associated with the outcome (Ketchen Jr et al., 2022). Again, coverage and consistency scores are calculated to evaluate the explanatory power of the identified sufficient sets.

Lastly, the third step involves testing for the absence of the outcome. This step is essential for understanding the conditions necessary for the absence of the outcome. Like the first two steps, coverage and consistency scores are calculated to assess the explanatory power of the identified conditions for the absence of the outcome (Ketchen Jr et al., 2022).

Ragin's and Davey's software, developed specifically for fsQCA, is utilized to conduct the analysis. This software is widely used for its user-friendly interface and transparent decision-making process (Ragin & Davey, 2022). It facilitates the exploration of various combinations of conditions and provides accurate coverage and consistency scores, aiding researchers in making informed interpretations of the results.

Cronbach's Alpha Analysis

Cronbach's alpha measures a scale or questionnaire's internal consistency or reliability (Vaske et al., 2017). It assesses the extent to which items within a scale are correlated and measures the same underlying construct. In this study, Cronbach's alpha was calculated for each variable included in the analysis (Tab. 2).

The values indicate a high level of internal consistency among the items within each variable. Generally, Cronbach's alpha values above 0.7 are considered acceptable for research purposes, indicating that the items within each variable reliably measure the intended construct (Taber, 2018). Therefore, the questionnaire used in this study demonstrates good reliability in capturing stakeholder pressure, collaboration, and CE practices among Estonian manufacturing SMEs.

Table 2. Correlation analysis.

	1	2	3	4	5
1. CEP					
2. BP	0.1961				
3. SP	0.1401	0.4484			
4. SCOL	0.6747	0.4275	0.2218		
5. DCOL	0.5584	0.2749	0.2309	0.6848	
Cronbach alpha	0.7503	0.7475	0.7148	0.9105	0.8925
Mean	2.908	3.259	2.564	2.441	2.374
S.D.	0.107	0.097	0.106	0.121	0.116

Note: CEP- Circular Economy Practices; BP- Business Pressure; SP- Social Pressure; SCOL- Supply side collaboration; DCOL- Demand side collaboration.

Results

fsQCA Configurations

Table 3 present the analysis of sufficient conditions for achieving CE practices within manufacturing SMEs in Estonia, and each pathway presents a unique combination of conditions that are deemed sufficient for CE practices. The section below provides detailed insight into each pathway, discusses its implications in light of existing literature, and critically analyses the findings.

Table 3. Analysis of sufficient conditions for achieving CE practices.

Pathway	BP	SP	SCOL	DCOL	Raw Coverage	Unique Coverage	Consistency	Solution coverage	Solution consistency
1				●	0.723	0.101	0.832	0.851	0.786
2	○	●			0.467	0.045	0.815		
3	●		●		0.657	0.061	0.900		

Note: 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.

Pathway 1 underscores the significance of demand-side collaboration in fostering CE practices. With a raw coverage of 72.3% and a consistency score of 83.2%, this configuration demonstrates a strong link between demand-side collaboration and CE practice adoption. This pathway indicates that engaging stakeholders on the demand side is crucial for driving the adoption of CE practices. SMEs that actively engage with customers and market partners to integrate sustainability into their operations are more likely to adopt CE practices. This supports Proposition 4, highlighting that collaborative efforts with customers drive SMEs' CE practices, enhancing competitiveness, brand reputation, and environmental responsibility.

Pathway 2 highlights the role of social pressure and the absence of business pressure in fostering CE practices. This pathway suggests that SMEs are more likely to embrace sustainability initiatives when influenced by social rather than business pressures. Despite a lower raw coverage of 46.7%, the configuration's high consistency score of 81.5% underscores the strong relationship between social pressure and sustainability practices. This finding aligns with Proposition 2, indicating that socially conscious stakeholders, including consumers and communities, drive sustainability initiatives among SMEs. The absence of direct business pressure implies that SMEs may be motivated more by ethical considerations and aligning with societal values than by immediate economic imperatives.

Pathway 3 highlights the importance of business pressure and supply-side collaboration in driving CE practices. This pathway suggests that business pressures, coupled with supply-side collaboration, are crucial for promoting CE initiatives. With a raw coverage of 65.7% and a consistency score of 90.0%, this configuration demonstrates a significant relationship between these factors and the adoption of sustainability practices. This finding aligns with Propositions 1 and 3, suggesting that SMEs facing business pressure are more inclined to adopt sustainability practices. Collaboration with suppliers fosters knowledge exchange and innovation, facilitating the adoption of

sustainability practices. By collaborating with suppliers, SMEs can access shared resources, expertise, and technologies, enhancing their sustainability performance.

Discussion

The discussion section is organized to examine each pathway individually, comparing and contrasting the findings with prior literature, highlighting the theoretical contributions, and subsequently outlining the practical implications for managers of SMEs.

The first pathway, highlighting the importance of demand-side collaboration, underscores how engaging with customers and market partners is pivotal for fostering CE practices. This aligns with the broader literature emphasizing stakeholder engagement as a pivotal driver for sustainable business practices (Fobbe & Hilletoft, 2023; Jiao et al., 2020). Specifically, demand-side collaboration enables SMEs to align their operations with market demands and consumer preferences, thereby enhancing their competitiveness, improving brand reputation, and meeting evolving expectations for environmental responsibility (Chowdhury et al., 2022; Khan et al., 2023). Furthermore, active engagement with customers and market partners can lead to co-creation of sustainable solutions and foster innovation. This collaborative approach not only addresses immediate market needs but also anticipates future trends, positioning SMEs as leaders in sustainability (Howard et al., 2022). The literature consistently supports the view that proactive demand-side collaboration is instrumental in achieving and sustaining competitive advantages through CE practices.

The second pathway, which highlights the role of social pressure and the absence of business pressure, reflects the growing emphasis on corporate social responsibility (CSR) and ethical business practices. Studies have shown that companies are increasingly driven by ethical considerations and societal values rather than solely by economic imperatives (Moursellas et al., 2023). By demonstrating a commitment to sustainability, SMEs can build trust and credibility with their stakeholders, enhance their reputation, and gain a competitive edge (Sudusinghe & Seuring, 2022). Additionally, the role of social pressure reflects a broader societal shift towards sustainability and environmental responsibility. Increasing consumer demand for sustainable products and practices pressures businesses to adapt (Bello-Pintado et al., 2023). For SMEs, aligning with these societal values can lead to long-term benefits, including improved stakeholder relations, enhanced corporate image, and better access to sustainable markets (Mazzucchelli et al., 2022). This pathway underscores the importance of addressing societal expectations and highlights the ethical dimensions of sustainability in business practices, illustrating that societal values can be a strong motivator for SMEs to adopt CE practices even in the absence of direct business pressures.

The third pathway emphasizes the significance of business pressure coupled with supply-side collaboration in driving CE practices. Studies have shown that supply-side collaboration facilitates knowledge exchange, innovation, and access to shared resources, expertise, and technologies, all of which are essential for implementing CE practices (Allenbacher & Berg, 2023; Berlin et al., 2022). This collaborative approach not only enhances the sustainability performance of individual SMEs but also promotes overall sustainability throughout the supply chain. The literature also supports the notion that business pressure compels SMEs to innovate and adopt sustainable practices to maintain their market position and comply with regulatory standards. Such pressures can drive significant advancements in CE practices, leading to improved environmental outcomes and competitive advantages (Courrent & Omri, 2022; Palea et al., 2023). This pathway underscores the interconnectedness of external pressures and collaborative efforts in driving CE practices, highlighting the need for a holistic approach to sustainability where SMEs integrate external demands with internal capabilities to achieve sustainable growth.

In summary, the fsQCA analysis identifies three distinct pathways through which manufacturing SMEs in Estonia can achieve CE practices: demand-side collaboration, social pressure without business pressure, and business pressure combined with supply-side collaboration. These findings align with the primary objective of this study, which aimed to explore the synergistic effects of stakeholder pressure and collaboration on the adoption of CE practices within manufacturing SMEs. By delineating the specific configurations of stakeholder pressure (both business and social) and collaboration (both supply and demand side) that lead to successful CE practice adoption, the study effectively answers the research question. The pathways identified provide a comprehensive understanding of how different combinations of pressures and collaborative efforts influence the implementation of CE practices, thereby achieving the study's objective of uncovering the synergistic effects in this context.

Theoretical contribution

This study makes theoretical contributions by applying configurational theory to the adoption of CE practices in SMEs. Configurational theory, which emphasizes the interplay of various factors in achieving organizational outcomes, provides a robust framework for understanding the complex dynamics of CE adoption (Gligor & Bozkurt, 2020; Kumar et al., 2022). By using fsQCA, this study captures the nuanced interactions between stakeholder pressures -both business and social and collaborative efforts - supply-side and demand-side. This methodological approach provides a comprehensive perspective on how different configurations can lead to successful CE practices (Ketchen Jr et al., 2022).

The findings extend the existing literature by demonstrating that multiple pathways can lead to the adoption of CE

practices, each characterized by unique combinations of demand-side collaboration, social pressure, and supply-side collaboration. This configurational approach challenges the traditional linear models of CE adoption and highlights the importance of considering the holistic interplay of various factors (Pattij et al., 2022; van de Wetering et al., 2021). By identifying and analysing these diverse pathways, the study provides new insights into how different configurations can drive CE practices.

Additionally, this study underscores the role of stakeholder pressures and collaboration in driving CE adoption, providing empirical support for theoretical propositions related to business and social pressures, and collaborative dynamics (Fobbe & Hilletoft, 2023; Hernández-Arzaba et al., 2022). By framing these insights within the context of Estonian manufacturing SMEs, the study offers valuable contributions to the broader discourse on sustainable business practices and CE adoption in SMEs.

Practical contribution

The findings have several practical implications for SMEs seeking to adopt CE practices, providing actionable insights that can facilitate the successful implementation of sustainability initiatives. Firstly, the study highlights the importance of engaging actively with customers and market partners as a strategic approach for integrating CE practices into business operations. SMEs that focus on aligning their practices with market demands and consumer preferences can enhance their competitiveness and reputation. By building strong relationships with customers and partners who prioritize sustainability, SMEs can not only meet but exceed market expectations, positioning themselves as leaders in sustainable practices. This alignment can lead to increased customer loyalty, better market positioning, and enhanced brand value.

Second, addressing societal expectations and ethical considerations is essential for building trust and credibility with stakeholders. SMEs that demonstrate a genuine commitment to sustainability and align their operations with societal values can gain a competitive edge. By embracing and promoting ethical business practices, SMEs can foster stronger relationships with their customers, communities, and other stakeholders, which can translate into improved stakeholder engagement and long-term business success. This commitment to ethical practices also helps SMEs navigate regulatory environments and enhance their corporate image.

Finally, collaboration with suppliers and responding to business pressures can significantly enhance sustainability performance. SMEs should leverage collaborative partnerships to gain access to shared resources, expertise, and technologies that are crucial for the successful adoption of CE practices. By engaging in supply-side collaboration, SMEs can facilitate knowledge exchange, foster innovation, and improve their sustainability performance. This approach also enables SMEs to address external business pressures, such as regulatory requirements and competitive forces, by integrating these pressures into their strategic planning. This holistic approach to sustainability, which integrates external demands with internal capabilities, can lead to long-term success and growth.

In essence, adopting a comprehensive strategy that incorporates these practical insights—engagement with stakeholders, addressing societal and ethical expectations, and leveraging collaborative partnerships—can significantly enhance the effectiveness and sustainability of CE practices in SMEs. This approach not only aligns with current market and societal trends but also equips SMEs with the tools and strategies needed to thrive in an increasingly competitive and environmentally conscious business landscape.

Conclusion, limitations, and future directions

This study investigated the adoption of Circular Economy (CE) practices among manufacturing SMEs in Estonia, revealing three key pathways that significantly impact CE implementation: (1) demand-side collaboration, (2) social pressure in the absence of business pressure, and the combination of (3) business pressure with supply-side collaboration.

1. demand-side collaboration emerged as a critical pathway, emphasizing the importance of SMEs engaging actively with customers and market partners. This finding aligns with existing literature highlighting stakeholder engagement as crucial for promoting sustainable business practices (Fobbe & Hilletoft, 2023; Jiao et al., 2020).
2. the pathway driven by social pressure in the absence of direct business pressure underscores the influence of societal expectations on CE adoption. This aligns with studies emphasizing the impact of socially conscious stakeholders, including NGOs and the public, in motivating firms to adopt sustainable practices (Hernández-Arzaba et al., 2022; Rodríguez-Espíndola et al., 2022).
3. business pressure coupled with supply-side collaboration emerged as another significant pathway influencing CE practices. This pathway highlights the role of external pressures, such as market competition and regulatory requirements, in driving SMEs to adopt sustainability initiatives. Collaborative efforts with suppliers facilitate knowledge exchange and innovation, enabling SMEs to implement efficient CE practices (Fobbe & Hilletoft, 2023; Köhler et al., 2022)

The findings underscore the critical role of engaging with customers and market partners, responding to societal

expectations, and leveraging collaborative efforts with suppliers under external pressures. These insights align with existing literature and highlight the importance of strategic stakeholder engagement, supply chain partnerships, and contextual adaptation in fostering CE practices.

Despite the valuable insights gained from this study, several limitations warrant consideration, which suggest avenues for future research to enhance our understanding of CE adoption among manufacturing SMEs. Firstly, this study focused exclusively on manufacturing SMEs in Estonia, which may limit the generalizability of the findings to other industries and geographical contexts. Future studies could explore CE adoption across diverse industries and regions to provide a more comprehensive understanding of the contextual factors influencing adoption rates. Additionally, the reliance on self-reported survey data introduces potential biases and inaccuracies inherent in such data collection methods. To strengthen the validity of findings, future research could employ mixed-method approaches, combining surveys with methods like interviews and case studies. This triangulation of data sources would provide deeper insights into the complexities of CE adoption processes. While this study identified pathways to CE adoption, it did not extensively explore the barriers and challenges SMEs encounter in implementing CE practices. Future research could focus on identifying and addressing these barriers, considering factors such as financial constraints, lack of awareness, and regulatory hurdles. Understanding these challenges is crucial for developing targeted strategies to facilitate CE adoption among SMEs. Furthermore, external factors such as macroeconomic trends, technological advancements, and policy frameworks were not examined in this study. Future research could investigate how these external factors interact with internal organizational dynamics to influence CE adoption. Such an approach would provide a more holistic understanding of the broader ecosystem within which SMEs navigate their sustainability journeys. Finally, conducting longitudinal studies will help track the long-term impacts of stakeholder pressures and collaborative strategies on the sustainability and effectiveness of CE practices, while investigating stakeholder interactions, such as those among customers, suppliers, and regulators, will shed light on their collective influence on SMEs' adoption strategies.

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Appendices

Table A1. Field of activity.

	Count	Percentage
Other	28	36%
Manufacture of wood and of products of wood and cork	14	18%
Manufacture of fabricated metal products, except machinery and equipment	9	12%
Printing and reproduction of recorded media	4	5%
Manufacture of furniture	4	5%
Manufacture of textiles	3	4%
Manufacture of chemicals and chemical products	3	4%
Manufacture of wearing apparel	2	3%
Manufacture of paper and paper products	2	3%
Manufacture of rubber and plastic products	2	3%
Manufacture of electrical equipment	2	3%
Manufacture of food products	1	1%
Manufacture of leather and related products	1	1%
Manufacture of basic metals	1	1%
Manufacture of machinery and equipment	1	1%
Manufacture of other transport equipment	1	1%

Table A2. Items for each variable.

Variable	Items	Source
Circular economy practices	Use of renewable raw materials in products	Chowdhury et al., 2022; Dey et al., 2022
	Reuse of post-consumer products/parts in production	
	Reuse of leftover material for new products	
	Reuse of product packaging materials	
	Use of least energy/resources in production stage	
	Consideration of recyclability in product design	
Business pressure	Impact of Customers on firm's sustainability efforts	Nguyen & Adomako, 2022; Tian et al., 2023
	Impact of Suppliers on firm's sustainability effort	
	Impact of Shareholders on firm's sustainability efforts	
	Impact of Employees on firm's sustainability efforts	
Social pressure	Impact of Competitors on firm's sustainability efforts	
	Impact of Government and regulatory bodies on firm's sustainability efforts	Nguyen & Adomako, 2022; Tian et al., 2023
	Impact of NGOs on firm's sustainability efforts	
	Impact of Communities and social groups on firm's sustainability efforts	
Impact of Media on firm's sustainability efforts		
Supply side collaboration	Degree of cooperation with suppliers to achieve sustainability goals	Tian et al., 2023; Yousaf, 2021
	Degree of cooperation with suppliers for ecological design of products	
	Degree of conducting joint planning to anticipate and resolve sustainability issues with suppliers	
	Degree of developing a mutual understanding of responsibilities with suppliers regarding sustainability performance	
	Degree of collaboration with suppliers in sustainable product development	
Demand side collaboration	Degree of cooperation with consumers to achieve sustainability goals	Tian et al., 2023; Yousaf, 2021
	Degree of cooperation with consumers for ecological design of products	
	Degree of conducting joint planning to anticipate and resolve sustainability issues with consumers	
	Degree of developing a mutual understanding of responsibilities with consumers regarding sustainability performance	
	Degree of collaboration with consumers in sustainable product development	