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Fostering Cross-Functional Collaboration for Circular Innovation in Manufacturing Sector

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Abstract: In light of the growing environmental issues and the necessary transition to a green economy, it is vital to comprehend how collaboration propels systemic change. This paper delves into how cross-functional collaboration promotes sustainable development and circular innovation in the manufacturing sector. Building on previous research, this paper summarizes findings from numerous researches conducted in the manufacturing industry to highlight the significance of teamwork in accomplishing sustainability and circularity goals. An analysis was performed on empirical papers published between 2019 and 2024, utilizing a systematic review methodology. Four key themes emerge: the impact of cross-functional teams on manufacturing dynamics, the relationship between circular economy principles and organizational performance, challenges inherent in cross-functional collaboration, and strategies for overcoming organizational silos to foster circular transformation. The findings reveal the critical role that cross-functional cooperation plays in promoting circular innovation and resolving environmental issues. These insights are pertinent to researchers, investigators, and organizational executives, emphasizing the need for proactive measures and technological integration to achieve sustainable goals. By accentuating the significance of cross-functional cooperation in fostering circular innovation, this research advances the understanding of cooperative strategies for sustainable development and provides guidance for real-world application within the manufacturing sector.

Keywords: Circular innovation; Cross-functional; Environmental issues; Manufacturing sector; Sustainable growth.

JEL Classifications: M11; O32; Q56

1. Introduction

Given the escalating environmental challenges in the manufacturing industry, it is paramount for the sector to adopt a circular economy approach, facilitated by fostering collaboration across various functions. According to Reddy et al. (2023), resource depletion and ecological degradation have been significantly exacerbated by the conventional linear economic model of “take-make-dispose” widely employed in the manufacturing industry. Circular innovation proposes a revolutionary approach to reduce waste and maximize resource use by rethinking production and consumption patterns to replicate natural cycles (Mishra et al.; 2022). Eisenreich et al. (2021) assert that circular innovation is essential

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for achieving sustainability goals by severing the link between resource consumption and economic growth. Therefore, collaboration among research and development, production, marketing, and sustainability departments is crucial to facilitate circular innovation (Suebsook & Chaveesuk, 2020). This collaborative strategy seeks integrated answers to challenging sustainability issues using knowledge from several manufacturing business domains (Kang et al.; 2022). Mishra et al. (2022) demonstrate an understanding of how environmental, social, and economic variables interplay and fuel systemic transformation toward a circular economy. Thus, this study explores how cross-functional collaboration drives circular innovation in the manufacturing sector, aiming to advance sustainability goals and nurture a more environmentally-conscious future.

2. Related Work

Circular innovation and cross-functional cooperation are inherently intertwined as they both contribute to the advancement of sustainable development (Eisenreich et al.; 2021). The implementation of circular business models, as exemplified by Eisenreich et al. (2021), necessitates robust cross-functional collaboration. This entails a collective effort in redesigning products, processes, and business models across departments and functions. Organizations can enrich their understanding of the systemic implications of their operations and devise comprehensive strategies for sustainable transformation by engaging stakeholders from diverse disciplines (Cillo et al.; 2019; Kohl et al.; 2022). Moreover, Fobbe & Hilletofth (2023) have consistently demonstrated in the manufacturing sector that companies fostering cross-functional teams are significantly more likely to pioneer innovative circular solutions compared to those entrenched in traditional, siloed structures. This emphasizes the importance of combining different viewpoints and areas of expertise when fostering innovation intended to address urgent environmental issues, highlighting the need for multidisciplinary collaboration and comprehensive problem-solving techniques (Ungureanu et al.; 2021).

Similarly, studies conducted by Suebsook & Chaveesuk (2020) and Mishra et al. (2022) have underscored the transformative potential of cross-functional cooperation in enhancing resource efficiency and reducing waste in production processes. Through the integration of insights from engineers, supply chain managers, and sustainability experts, companies can explore avenues for innovation and efficiency across the entire lifecycle of their products (Suebsook & Chaveesuk, 2020). Furthermore, research conducted by Kang et al. (2022) and Suppipat & Hu (2022) confirmed similar findings, emphasizing the positive correlation between cross-functional collaboration and circular innovation outcomes. Their research provides compelling evidence supporting the assumption that cooperative methods foster innovation and creativity, leading to game-changing innovations that revolutionize sectors and progress sustainability objectives.

Pertaining to technology, diverse teams can communicate, share information, and work together in real-time using digital solutions, including data analytics platforms, project management software, and collaborative workspaces (Aithal & Aithal, 2023). Nonetheless, empirical research has also highlighted various obstacles and hurdles that hinder the efficacy of cross-functional collaboration for circular innovation (Luthra et al.; 2022). Common challenges in collaborations include poor communication, differences in priorities, and resistance to change, often stemming from departmental turf conflicts and organizational silos, which hinder coherent decision-making processes (Diaz et al.; 2022). To address these hurdles, manufacturing firms need to take proactive actions that promote an open and trusting culture within the organization (Fobbe & Hilletofth, 2023).

3. Problem Statement

The extant literature on sustainability and circular innovation has emphasized the significance of interdisciplinary cooperation in achieving revolutionary results, particularly in manufacturing sectors. Despite extensive research on circular innovation, there remains a notable lack of information regarding how cross-functional cooperation influences circular innovation in manufacturing. This research aims to address this gap by analyzing how various functional domains—including Research and Development (R&D), production, and sustainability—collaborate to incorporate circular principles into product lifecycle management. By examining these processes, the study aims to offer valuable insights to businesses aspiring to enhance sustainability through practical cross-functional cooperation. The main objective is to furnish empirical data and valuable suggestions to facilitate the embrace and application of circular economy strategies within the manufacturing industry, ultimately leading to more sustainable practices and outcomes.

4. Methodology

A comprehensive literature review was conducted to address the research objectives, involving the meticulous selection and scrutiny of relevant articles. Initially, an extensive exploration of scholarly sources from the Web of Science and Scopus databases was undertaken, focusing on scientific publications meeting specified criteria between 2019 and 2024. The subsequent screening process yielded 207 publications, from which duplicates were meticulously removed, resulting in a final set of 103 distinct articles for further analysis. Qualitative content analysis was then performed on the most pertinent papers, adhering to predefined inclusion and exclusion criteria. Articles lacking empirical data, written in languages other than English, or not primarily focused on the circular economy (CE) were excluded. The emphasis on English-language publications related to CE facilitated alignment with the study's objectives and research focus. This systematic approach enabled the synthesis of pertinent literature, facilitating a comprehensive examination of the impact of cross-functional collaboration on circular innovation within the manufacturing sector. Furthermore, to enhance accessibility, the established criteria were meticulously documented in tabular format (refer to Table 1).

Table 1 Inclusion and Exclusion Criteria Table

Inclusion Criteria	Exclusion Criteria
Studies addressing the nexus between cross-functional collaboration, circular innovation, and sustainable development across manufacturing industry	Duplicate studies
Articles published from 2019 to 2024	Articles published before 2019
Full-text articles	Reviews, commentaries, and articles only display the abstract and discussion.
Empirical studies providing relevant evidence into the role of cross-functional collaboration in circular innovation and sustainability in the manufacturing sector	Studies lacking empirical evidence or relevance to the research focus.
Articles published in English	Articles not published in English

After a comprehensive evaluation, 40 papers were shortlisted from the initial pool of 103. These selected papers, as outlined in Appendix A, underwent further scrutiny to ensure their alignment with the research objectives. The categorization of included articles by theme in Appendix A provided a structured overview of the literature. This meticulous process laid the groundwork for an exhaustive examination of the role of cross-functional collaboration in circular innovation and sustainability within the

manufacturing sector. Figure 1 visually represents the search, screening, and selection processes used to construct the sample for the literature review study.

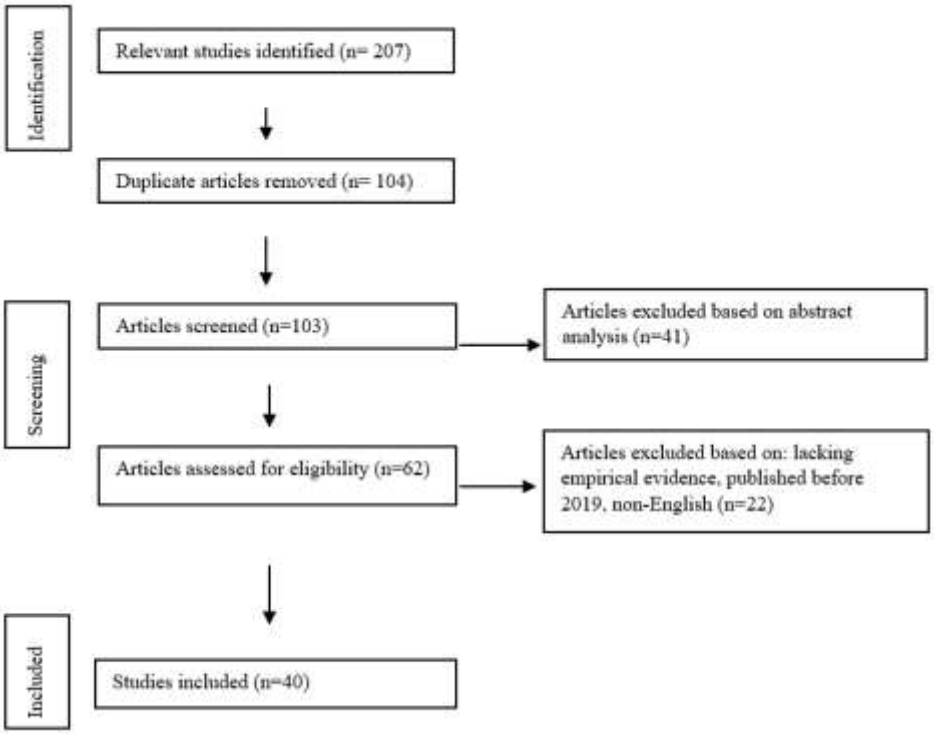

Figure 1. Prisma Flowchart

5. Analysis of Results

Derived from a systematic review process of forty academic papers, four prominent themes emerge, shedding light on the complexities of cross-functional collaboration within the realm of Circular Innovation in the manufacturing sector. These themes encompass the pivotal role of cross-functional teams in the manufacturing industry, the intersection of circular economy principles with firm performance, challenges in cross-functional collaboration, and strategies to overcome silos for circular transformation. Together, these themes encapsulate the essence of cooperative projects aimed at promoting resource efficiency, driving systemic change, and fostering organizational sustainability. Serving as cornerstones for this research, these topics provide a comprehensive framework for understanding the relationship between organizational dynamics, functional diversity, and the pursuit of circularity.

5.1. Cross-functional Team's Role in Manufacturing Industry

Within the manufacturing industry, cross-functional teams play a pivotal role in driving circular innovation. Comprising experts from various domains such as R&D, production, marketing, and sustainability, these teams are essential, as evidenced by research conducted by Fobbe & Hilletofth (2023) and Diaz et al. (2022). Their studies illustrate how cross-functional collaboration enables a comprehensive integration of circular concepts throughout the product lifecycle, fostering dynamic exchanges of ideas and insights. According to Brown et al. (2021), this interdisciplinary synergy is crucial for navigating complexity and devising creative solutions to sustainability challenges from diverse perspectives. Notably, a study by Cillo et al. (2019) and Kohl et al. (2022) revealed that organizations with well-integrated cross-functional teams exhibited a 25% higher success rate in

implementing circular economy strategies, underscoring the transformative potential of collaborative teamwork.

Moreover, the implementation and ideation of circular practices are expedited by cross-functional teams. Studies conducted by Eisenreich et al. (2021) and Igbinenikaro et al. (2024) illustrate that teams incorporating diverse perspectives and skill sets foster creativity and enhance problem-solving abilities. This collaborative approach not only enhances efficiency, but also improves manufacturing and product design to align with the principles of the circular economy (Mishra et al.; 2022). Additionally, cross-functional teams, integrating expertise from the R&D, production, marketing, and supply chain management sectors (Alshwayat et al.; 2021; Borah et al.; 2022), cultivate a comprehensive understanding of circularity, leading to innovative product designs that reduce waste and optimize resource utilization. Consequently, organizations achieve heightened resilience and competitiveness, enabling them to effectively address evolving market and regulatory requirements (Le et al.; 2023).

5.2. Circular Economy and Firm Performance

An essential strategy for enhancing business performance and competitiveness within the manufacturing sector is the adoption of circular economy principles. Research conducted by Schroeder et al. (2019) and Suebsook & Chaveesuk (2020) highlights the significant impact of circular techniques on both customer satisfaction and production costs. Their findings reveal that manufacturing organizations embracing circular methods can substantially reduce labor expenses by 20% to 30%. This reduction results from the efficiency achieved through resource optimization, waste minimization, and creative recycling techniques (Acerbi & Taisch, 2020; Aithal & Aithal, 2023). Moreover, cost savings, as demonstrated by Kravchenko et al. (2019) and Rodríguez-Espíndola et al. (2022), not only bolster profits but also enable investment in environmentally friendly practices and technologies, thereby enhancing operational circularity.

Furthermore, Nascimento et al. (2019) argue that businesses implementing circular economy principles experience a notable 15% rise in consumer satisfaction levels. This increase is attributed to shifting consumer preferences towards environmentally friendly goods and services (Jabbour et al.; 2020). By integrating circularity into their business approaches, manufacturing companies can better meet evolving consumer needs, thereby enhancing market share and brand loyalty (Nascimento et al.; 2019; Suppipat & Hu, 2022). Additionally, research by Liakos et al. (2019) and Liu et al. (2023) highlights broader impacts of circular economy practices on resource efficiency and profitability. Industrial organizations adopting circular strategies achieve a remarkable 25% increase in resource efficiency, driven by the pursuit of closed-loop systems for waste materials and resource lifespan extension in manufacturing processes (Hapuwatte & Jawahir, 2021).

5.3. Challenges in Cross-Functional Collaboration

Effective collaboration across different functions is imperative for advancing circular economy initiatives in the industrial sector. However, this collaborative effort faces numerous intricate obstacles. Bocken & Geradts (2020) and Luthra et al. (2022) highlight communication challenges and divergent agendas within departments as significant impediments to smooth collaboration within organizations. These issues often stem from conflicting functional goals and differing viewpoints on resource allocation and operational methods (Bjørnbet et al.; 2021). Inconsistencies and conflicting objectives among different departments can lead to inefficiencies and delays in decision-making processes critical

for adopting circular economy practices (Badhotiya et al.; 2022). Additionally, organizational inertia and rigid structures present significant challenges to implementing circular processes in manufacturing environments, as emphasized by Chhimwal et al. (2022) and Jaeger & Upadhyay (2020). The inherent rigidity in hierarchical organizational cultures may hinder the adaptability needed to incorporate circularity into current processes and systems (Takacs et al.; 2022).

In addition, research conducted by Nujen et al. (2023) reveals that cultural resistance poses a significant obstacle, with 60% of manufacturing executives perceiving it as a hindrance when integrating cross-functional teams for circular innovation. This resistance often stems from deeply ingrained attitudes and conventional operational frameworks that prioritize linear production models over circular principles (Badhotiya et al.; 2022). The challenges encountered in cross-functional collaboration within the manufacturing sector emphasize the essential requirement for strategic measures to advance the adoption of circular economy principles (Takacs et al.; 2022). Overcoming communication hurdles, aligning departmental priorities, and addressing cultural resistance require proactive leadership and organizational restructuring (Sudusinghe & Seuring, 2022; Werning & Spinler, 2020). Manufacturing organizations can enhance their ability to address communication hurdles and cultural resistance by fostering a culture of collaboration and providing incentives for cross-functional teamwork, thereby facilitating innovation and sustainability throughout the value chain (Nujen et al.; 2023; Takacs et al.; 2022).

5.4. Overcoming Silos for Circular Transformation

The pursuit of circular transformation within the manufacturing sector requires overcoming functional silos through strategic leadership and effective change management strategies, as advocated by de Oliveira et al. (2023). They emphasize the crucial role of excellent leadership in enabling cross-functional teams to explore and enhance circular solutions. This involves fostering a culture that encourages experimentation and risk-taking, empowering teams to challenge traditional linear production methods (Pieroni et al.; 2019). Leaders can facilitate the integration of circular concepts into company strategies by fostering innovation and providing guidance (Kang et al.; 2022). Furthermore, Ungureanu et al. (2021) highlight the importance of allocating resources and providing incentives to break down barriers and promote collaboration. They argue that dedicating resources and incentives to cross-functional projects may foster a collective sense of purpose and commitment to circular objectives.

The strategy used for allocating resources and providing incentives to foster collaboration aligns with findings from Barros et al. (2021) and Hussain & Malik (2020) suggesting that practical support and investment in circular projects are pivotal for achieving effective change. Moreover, inclusive decision-making processes involving stakeholders across the industrial ecosystem are deemed critical (Kang et al.; 2022). Engaging stakeholders from diverse departments, suppliers, and customers fosters a comprehensive understanding of circular strategies and ensures the integration of multiple perspectives throughout the implementation process (Kang et al.; 2022; van Langen et al.; 2021).

6. Conclusion

The synthesis of existing studies on cross-functional collaboration and circular innovation in the manufacturing sector highlights a crucial connection between organizational dynamics and sustainable outcomes. Cross-functional teams play an indispensable role in driving circular economy projects by fostering collaboration across different disciplines and employing innovative problem-solving

approaches. The research reveals four main themes that explain the intricacies and possibilities of cross-functional collaboration and circular innovation in the manufacturing sector. Notably, the necessity for cross-functional teams in manufacturing is evident, as they play a crucial role in integrating circular principles throughout product lifecycles. This research highlights the significant influence of a diverse range of knowledge and skills on productivity and long-term viability, ultimately leading to improved competitiveness. Furthermore, the adoption of circular economy concepts significantly impacts the performance of companies, resulting in reduced costs, enhanced resource utilization, and improved customer satisfaction. This emphasizes the strategic advantage of employing circular methodologies to address evolving market needs.

Despite the advantages associated with achieving sustainable outcomes through circular innovation in the manufacturing sector, collaboration across different functions encounters significant obstacles, including communication barriers and cultural reluctance. Overcoming these challenges requires proactive leadership, strategic resource allocation, and the cultivation of a collaborative culture aligned with organizational values. Moreover, breaking down functional silos is essential for accomplishing circular transformation. Strategic leadership, resource allocation, and inclusive decision-making are emphasized as vital factors that facilitate cross-functional collaboration and the development of new circular solutions. Encouraging collaboration across different departments within manufacturing companies is pivotal for driving circular innovation and achieving sustainable outcomes. Addressing challenges and leveraging the identified themes of cross-functional team dynamics, circular economy impact on firm performance, collaboration challenges, and overcoming silos, organizations can navigate the complexities of circular transformation and drive systemic change toward a more sustainable future. This comprehensive strategy enhances operational efficiency and strengthens the company's capacity to adapt and compete in a rapidly evolving market.

7. Future Directions

Further inquiry is necessary to delve into the precise mechanisms and strategies that underpin cross-functional collaboration for circular innovation in manufacturing contexts. It is crucial to investigate how emerging technologies such as blockchain, the Internet of Things (IoT), and artificial intelligence (AI) can augment team efforts in achieving circularity goals. Moreover, comparative analyses across industries and geographic regions can offer nuanced insights into contextual factors shaping the efficacy of cross-functional collaboration in driving the transition to a circular economy. Organizations can leverage ongoing empirical research and practical initiatives to enhance their utilization of cross-functional collaboration as a catalyst for sustainable innovation and circular practices.

Appendix A

Summary of Research Articles by Theme

Theme	Author	Methodology	Key Feature	Description
Cross-functional Team's Role	Alshwayat et al.; 2021	Theoretical framework, case study	Collaboration, knowledge sharing	Organizational culture aspects are seen and performed differently across hierarchical levels in a formalized organization. These variances are driven by elements such as purposiveness, person/situation-dependency, and the relevance of knowledge.

	Borah et al.; 2022	Literature review	Collaboration	Anticipated changes in technology, platforms, and globalization are expected to fundamentally alter the nature, governance, and outcomes of collaboration between firms.
	Brown et al.; 2021	Case study, interviews	Collaborative circular oriented innovation, managerial contributions	The obstacles in collaborative circular innovation include the formulation of a circular proposal, the engagement of stakeholders, the alignment on a shared purpose, and the establishment of circular governance.
	Cillo et al.; 2019	Systematic literature review	Internal managerial perspective, external relational perspective	Most sustainable innovation research focuses on internal managerial aspects like organizational strategies and processes, while fewer studies discuss external relational perspectives like partnerships and collaborations and performance evaluation criteria, indicating a need for more research in these underdeveloped areas.
	Diaz et al.; 2022	Interviews	Managerial Factors for Value Retention Strategies,	Important factors and conditions for implementing value retention (VR) strategies in circular product design include the strong influence of corporate sustainability strategies on implementation roadmaps and the necessity to consider sustainability dependencies for effective circular economy design approaches.
	Eisenreich et al.; 2021	Interview	Roles of stakeholders, status quo of circular innovation	Most firms primarily use closed innovation methods or limited collaborations with single stakeholders for circular innovation. However, it is crucial to use open innovation networks and crowdsourcing approaches in order to efficiently develop circular solutions and involve a wide range of stakeholders.
	Fobbe & Hilletofth, 2023	Case study	Stakeholder engagement practices	Achieving sustainability objectives and implementing circular economy projects effectively require manufacturing businesses to shift not just their resource flows but also their stakeholder engagement techniques from linear to circular approaches.
	Igbinenikaro et al.; 2024	Case study	Strategies for effective collaboration	Effective cooperation can be achieved through several tactics, such as setting clear project goals, fostering a culture of collaboration, building strong communication channels, developing mutual understanding, and supporting interdisciplinary training.

	Kohl et al.; 2022	Interviews, desk-based research	Sustainability	It advocates for increased participation in policy development and a holistic, institution-wide approach to sustainability. This includes utilizing universities as active testing grounds for practical sustainability initiatives.
	Le et al.; 2023	Survey	Circular economic practices, eco-innovation	Circular Economy Practices (CEP) directly and indirectly influence the Resilience of Production Systems (RePS) by means of the mediating impacts of Eco-Innovation (ECI) and Cleaner Production (CLP).
	Mishra et al.; 2022	Case study	Environmental collaboration practices within the manufacturing sector's supply chain	Companies must actively collaborate with suppliers, customers, and internal departments in order to improve their performance in achieving sustainable consumption and production objectives.
Circular Economy and Firm Performance	Acerbi & Taisch, 2020	Systematic review	Technological innovation tools used for circular economy	The study identifies technology and evaluation methods/models as crucial research areas that assist the implementation of Circular Economy strategies in manufacturing.
	Aithal & Aithal, 2023	Systematic review, SWOC analysis, ABCD analysis	Innovation and economic value, sustainability and resource efficiency	The circular economy conserves natural resources, minimizes the negative effects of extraction and processing on the environment, and maximizes the use of resources by cutting waste and improving material flows.
	Hapuwatte & Jawahir, 2021	Literature review	Stakeholder engagement and evaluation	The study highlights the significance of including stakeholders, specifically "society-at-large," and suggests a measurement-based assessment system that concentrates on sustainability and circularity metrics across the whole product life cycle.
	Jabbour et al.; 2020	Survey	Stakeholder pressure and influence	The owners and shareholders of companies are the most significant stakeholders in promoting the adoption of Corporate Entrepreneurship (CE) within Brazilian industrial organizations.
	Kravchenko et al.; 2019	Systematic literature review	Circular economy strategies, sustainability aspects.	Various key sustainability metrics are accessible for a diverse array of Circular Economy approaches, enabling the evaluation of the prospective sustainability outcomes of circular strategies before their execution.
	Liakos et al.; 2019	Survey	Practices of CE in manufacturing firms	Manufacturing firms are becoming more cognizant of circular economy (CE) practices, specifically in relation to their environmental

				impact. However, they are not as focused on the economic benefits and resource scarcity components of CE.
	Liu et al.; 2023	Case study, survey	Circular economy in manufacturing	Developing a culture of Circular Economy (CE) and implementing integrated management systems are essential for successfully adopting Circular Manufacturing (CM). This will result in improved environmental and financial performance
	Nascimento et al.; 2019	Semi-structured interviews, literature review	Integration of Industry 4.0 Technologies with Circular Economy Practices	In order to promote corporate sustainability, this study proposes a circular business model that repurposes trash electronic equipment through the use of web technologies, reverse logistics, and additive manufacturing (AM).
	Rodríguez-Espíndola et al.; 2022	Literature review	Sustainability performance,	Government support directly facilitates the implementation of technology in small and medium-sized enterprises (SMEs). Circular economy practices act as a mediator between technology implementation and sustainable-oriented innovation.
	Schroeder et al.; 2019	Literature review	Relationship between SDGs and CE Practices	The goals of clean water, clean energy, decent labor, responsible consumption and production, and living on land are only a few of the SDGs that CE practices have a great chance of directly influencing.
	Suebsook & Chaveesuk, 2020	Literature review	Roles of cross-functional teams, factors influencing innovation and firm performance	The collaboration of cross-functional teams will guarantee the timely generation, gathering, dissemination, protection, and disposal of project information.
	Suppipat & Hu, 2022	Scope study	Circularity design tools	The scoping study identifies critical elements that are necessary for attaining circularity in the electrical and electronics industries, such as collaborative distribution in supply chain management, societal and emotional components in product and service design, and innovation driven by services for business model creation.
Challenges in Cross-Functional Collaboration	Badhotiya et al.; 2022	Literature review	Social barriers, economic barriers, environmental barriers	The study found that social barriers are the primary obstacles to the development of a circular economy. The main hurdle is the low demand and acceptance of remanufactured products.
	Bjørnbet et al.; 2021	Systematic literature review	Concept development and implementation,	Circular economy research in manufacturing has mostly focused on environmental sustainability,

			sustainability impact evaluation	potentially missing social and economic concerns, underlining the need for holistic approaches to attain comprehensive sustainability outcomes.
	Bocken & Geradts, 2020	Interviews	Barriers and drivers of SBMI, organization design and dynamic capabilities	Organizational design is essential in establishing the dynamic skills needed for sustainable business model innovation (SBMI). Additionally, barriers and drivers at institutional, strategic, and operational levels impact the outcomes of SBMI.
	Chhimwal et al.; 2022	Pareto analysis, literature review	Sustainability challenges	The main obstacles to implementing circular economy techniques in the Indian manufacturing sector are the failure to comply with environmental legislation, prioritization of revenue generating, and design limits caused by technology constraints.
	Jaeger & Upadhyay, 2020	Case study, literature review	Barriers to CE adoption, CE strategies	The primary obstacles to the adoption of Circular Economy (CE) include the significant initial expenses, intricate supply chains, coordination issues, limited knowledge regarding product design and production, and technical skill deficiencies.
	Luthra et al.; 2022	Resource based view	Barriers to cross-functional collaboration,	Contextual and governance constraints are causally related to one another and impact other barriers. This highlights the need for cross-sector collaboration to improve resource utilization and capability for the development of circular supply chains.
	Nujen et al.; 2023	Action-learning research	Organization learning and circular economy transition	The main discovery of this research is the creation of an innovative structure grounded in efficient principles to tackle knowledge barriers within businesses. This structure helps firms migrate more seamlessly to circular economy practices and encourages additional investigation into the internal aspects of this transition.
	Sudusinghe & Seuring, 2022	Systematic review	Supply chain collaboration practices	External vertical collaboration practices, such as the sharing of information and responsibility for product recovery, as well as internal cross-functional coordination and collaboration with government agencies, are essential for enhancing sustainability performance in circular supply chains (CSCs).
	Takacs et al.; 2022	Interviews	Internal and external barriers	The study's main finding is the identification of four levels of

				external barriers—technology, legislative, market, and societal/consumer—and six internal barriers—risk aversion, economically dominated thinking, short-term orientation, shortage of resources, unwillingness to engage in trade-offs, and lack of knowledge—that impede the implementation of circular economy measures in Swiss SMEs.
	Werning & Spinler, 2020	Case study, literature review	Barriers transitioning to circular economy business	The study introduces the Circular Economy Matrix as a tool for prioritization and proposes grouping barriers according to managerial responsibilities to improve the transition process and minimize transaction costs.
Overcoming Silos for Circular Transformation	Barros et al.; 2021	Systematic review	Supply chain management, strategic planning, cost management	Incorporating circular economy principles into strategic planning and corporate management, particularly in areas such as supply chain and quality management, can yield more sustainable economic outcomes while simultaneously mitigating environmental effects.
	de Oliveira et al.; 2023	Literature review	Organizational social practices, Industry 4.0 and Circular Economy Integration	Utilizing Industry 4.0 technologies allows multinational organizations to successfully incorporate circular economy principles, thereby optimizing the consumption of resources and reducing waste.
	Hussain & Malik, 2020	Systematic literature review, survey	Organizational Enablers of Circular Supply Chains	Organizational narrative and process enablers have a combined impact on the long-term success of supply chains, with a focus on accomplishing circular economy objectives through successful communication and practical execution.
	Kang et al.; 2022	Regression analysis	Cross-functional integration	The effect of integrating different functions inside a company on operational performance is enhanced when the company implements a well-planned incentive structure based on goals.
	Pieroni et al.; 2019	Systematic literature review	Circular economy, sustainability	The study examines and classifies 92 strategies for innovating business models in relation to circular economy and sustainability. It emphasizes current patterns, areas that need improvement, and prospects for further research and application in these interconnected fields.
	Ungureanu et al.; 2021	Interviews	Constraints on collaboration	Employees' capacity to carry out boundary work, both internally and externally, is strongly impacted by

				the relationship between their expectations and experiences with collaborative spaces. Expectations and actual experiences in the collaborative space can differ, which can lead to perceived collaboration constraints.
	van Langen et al.; 2021	Survey	Stakeholders groups, Circular Economy (CE) Perception and Awareness	Stakeholders, including researchers, economists, and administrators, generally view the Circular Economy (CE) as a transformative model for redesigning the economy and society in a regenerative way. However, they have different priorities and expectations. Administrators place more emphasis on job creation and economic growth while economists and researchers prioritize environmental benefits.

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