

The Impact of Environmental Collaboration on Sustainability Performance in Manufacturing Industry: A Content Analysis Based Literature Review



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ABSTRACT

Objective - Although environmental collaboration has emerged as a critical strategy for enhancing sustainability performance in the manufacturing industry, the factors influencing it, the specific practices, and their relationship with sustainability performance remain unclear.

Methodology/Technique: This study conducts a comprehensive literature review using a content analysis approach to examine the factors influencing environmental collaboration, its specific practices, and its relationship with sustainability performance. Drawing on an extensive analysis of publications from 2004 to 2024, this research identifies key success factors and practices for effective environmental collaboration.

Findings - It examines the relationship between ecological collaboration and sustainability performance. The findings reveal nine multifaceted, interconnected factors that advance environmental collaboration. Moreover, key practices of environmental collaboration with suppliers and customers mainly involve jointly setting sustainability goals, promoting green production and packaging, managing waste and take-back initiatives, and cooperating on environmental knowledge sharing and compliance.

Novelty - Furthermore, this study suggests that environmental collaboration directly impacts sustainability performance. By identifying these, this study provides a comprehensive understanding of environmental collaboration and its impact on sustainability performance in the manufacturing industry. Additionally, this study provides a path for future research.

Type of Paper: Review

JEL Classification: M40, M49.

Keywords: Environmental collaboration, sustainability performance, manufacturing industry, supply chain partner.

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1. Introduction

Manufacturing plays a vital role in driving global economic growth, accounting for a significant share of employment, technological innovation, and value creation (Gomes da Silva & Gouveia, 2019).

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However, it is also a major contributor to environmental degradation and resource depletion, making it a critical focus for achieving global sustainability goals (Chang et al., 2021). As manufacturing industries encounter increasing demands from regulatory bodies, customers, and key stakeholders to integrate eco-friendly initiatives (Henao & Sarache, 2022), there is a growing recognition that achieving sustainability performance - economic, environmental, and social dimensions-requires environmental collaboration practices (Al-Sheyadi et al., 2019) (Han & Huo, 2020).

Environmental collaboration refers to joint efforts among organizations, such as suppliers, customers, and other stakeholders, to achieve mutual sustainability objectives (Mishra et al., 2022). These efforts include resource sharing, environmental information exchange, joint environmental projects, and the co-development of green technologies (Syed et al., 2024). While prior studies highlight the potential of environmental collaboration practices to drive sustainability performance, the literature remains fragmented and lacks a unified perspective on the economic, environmental, and social benefits of such practices. Four core research questions emerge from this context: What factors contribute to effective environmental collaboration? What are the primary practices of environmental collaboration in the manufacturing industry? What is the relationship between environmental collaboration and sustainability performance? What are the future research directions?

To address these questions, this study conducted an inductive content-analysis-based literature review of studies published between 2004 and 2024. This study systematically explored the key success factors and practices for environmental collaboration and clarified the relationship between environmental collaboration and sustainability performance.

2. Literature Review

2.1 Environmental Collaboration

Environmental cooperation is a relational activity that cuts across organizational boundaries and involves setting environmental goals, co-planning the environment, and collectively mitigating adverse environmental consequences with partners of different backgrounds and natures (Ahmed et al., 2020) (Trujillo-Gallego et al., 2021). From the perspective of the firm, environmental cooperation denotes collaborative efforts between firms and diverse stakeholders to advance ecological sustainability and environmental responsibility (Zhang et al., 2022). Such cooperation encompasses various forms, including cooperation with suppliers and customers to promote environmentally friendly production and green supply chain management practices (Ahmed et al., 2020) (Mishra et al., 2022); Collaboration with government agencies to contribute to the formulation of environmental policies, regulations, and standards, thereby promoting effective environmental governance (Sudusinghe & Seuring, 2022); Collaboration with local communities and non-governmental organizations (NGOs) to undertake environmental protection initiatives, raise environmental awareness, and facilitate sustainable development endeavors (Sudusinghe & Seuring, 2022); Collaboration with competitors within the same industry to exchange best practices in environmental management, share innovative technologies, and collectively address environmental challenges confronting the sector (Carfi & Donato, 2021) (Tian et al., 2019).

Environmental collaboration in this study refers to an organization's active engagement with its suppliers and customers in the joint planning and implementation of environmental initiatives, as emphasized by (Miller et al., 2017). Similarly, (Pero et al., 2017) describe environmental collaboration as the coordinated planning and execution of sustainability-driven projects, necessitating direct participation from organizations alongside their supply chain partners, either suppliers or customers, to develop effective environmental solutions. Collaboration with supply chain partners is crucial for enhancing environmental sustainability, as it

enables the sharing of resources, knowledge, and technologies to foster eco-friendly practices (Syed et al., 2024). This collaboration can take various forms, including technological partnerships (López-Cózar-Navarro et al., 2024), eco-industrial networks (Kumar et al., 2023), and green logistics strategies (Jazairy et al., 2021), each contributing to the overall goal of reducing environmental impact and promoting sustainable development.

2.2 Sustainability Performance

The concept of sustainability emerged in 1987, establishing a broad international consensus by emphasizing the importance of addressing contemporary demands while ensuring that future generations retain the capacity to satisfy their own needs (Hajian & Kashani, 2021). As noted by (Niedlich et al., 2020), sustainability is widely recognized as the effort to balance economic, environmental, and social priorities to address both current and future human demands. Evaluating the performance of manufacturing activities is essential for advancing sustainability objectives while mitigating their environmental, economic, and societal impacts (Cagno et al., 2019). The Triple Bottom Line (TBL) approach functions as a core paradigm for structuring sustainability performance evaluation mechanisms. In the context of the manufacturing industry, sustainability performance should be measured across the three key dimensions of TBL, including economic, environmental, and social dimensions, to ensure a harmonized approach to development (Ashrafi et al., 2018) (Neri et al., 2021). (Baba et al., 2019) found that companies prioritizing all three sustainability dimensions, rather than concentrating on one or two, achieve superior economic outcomes. Therefore, the TBL framework serves as a comprehensive model for assessing sustainability in manufacturing enterprises, ensuring a balanced approach across environmental, economic, and social aspects.

Environmental performance evaluates how effectively a company mitigates and oversees its ecological footprint across manufacturing processes and corporate activities (Abrams et al., 2021) (Trumpp et al., 2015). It reflects an organization's commitment to minimizing ecological harm by reducing pollution, protecting biodiversity, optimizing resource utilization, and promoting environmental awareness (Su et al., 2021). Beyond addressing the immediate effects of industrial activities, such as resource and energy consumption, as well as waste and pollutant generation, environmental performance also encompasses long-term consequences for ecosystems, local communities, and future generations (Hu et al., 2019) (Javaid et al., 2021).

The effectiveness of economic performance is fundamental to sustaining long-term corporate viability and expansion (Bartolacci et al., 2020). It encompasses the benefits derived from an enterprise's economic activities, primarily including financial performance, market success, and profitability (T. Liu et al., 2021). From a long-term perspective, economic value emphasizes the significance of essential financial metrics, including stock valuation, revenue growth, sales performance, and competitive positioning, while concurrently embedding corporate social and environmental commitments (Nadae et al., 2019). Within the manufacturing sector, economic performance serves as a measure of operational efficiency and profitability, forming a fundamental pillar for an enterprise's sustainable development (García-Alcaraz et al., 2021).

Social performance reflects the extent to which an organization fulfills its social objectives and generates value for the communities it aims to serve (Bohinc & Schwartz, 2021). The management of social performance focuses on integrating an organization's social objectives into its operational frameworks, including administrative systems, workflow mechanisms, and product development strategies (Lu, 2020). From a stakeholder perspective, social performance encompasses the broader social impact of business activities, affecting multiple interest groups such as employees, local communities, suppliers, and other partners (Silva et al., 2019). By prioritizing stakeholder needs and expectations, enterprises not only advance

their own sustainability objectives but also contribute positively to the broader social development (Rasheed & Ion, 2022).

2.3 Conceptual Framework

Following the literature review, this study proposes a conceptual framework (see Figure 1) to elucidate the relationships between the drivers of environmental collaboration, collaborative practices, and sustainability performance. This framework serves as the theoretical foundation for the subsequent content analysis and provides a structured lens through which to interpret the findings of this review.

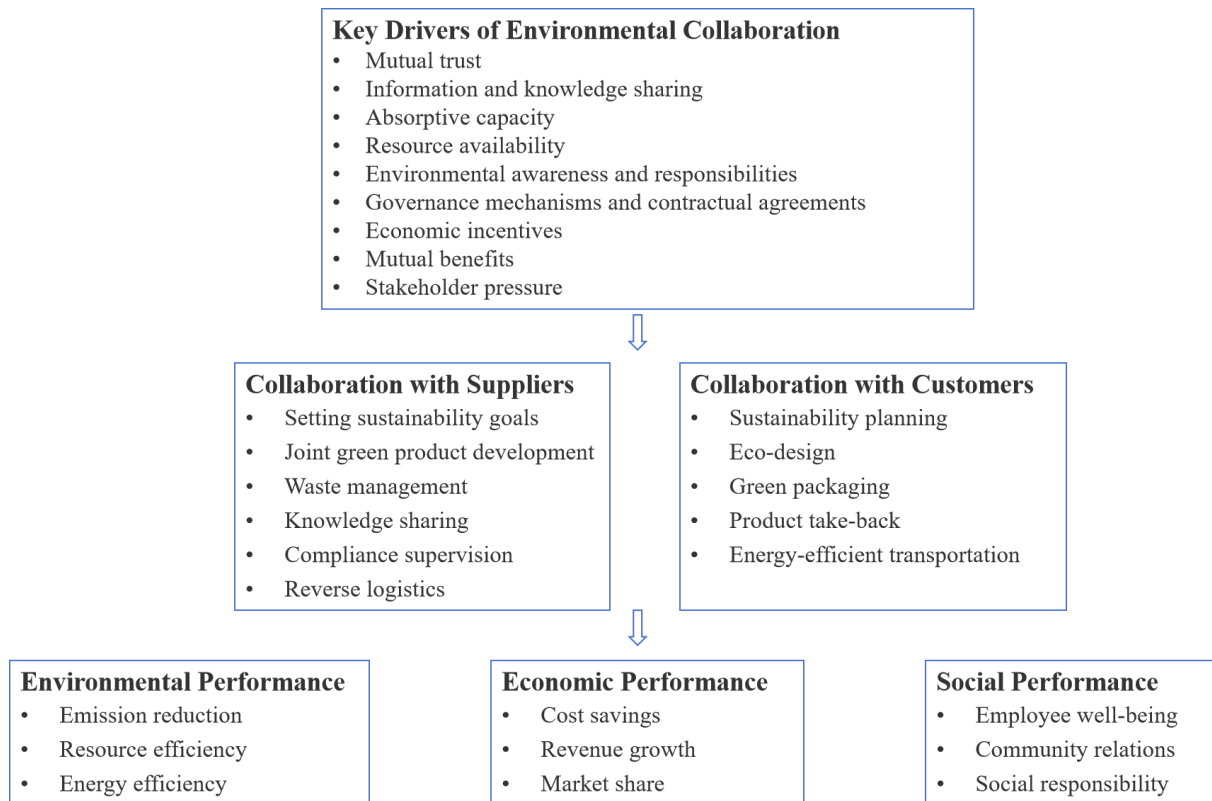


Figure 1. Conceptual framework of environmental collaboration impact on sustainability performance

3. Research Method

This study employs content analysis to investigate how environmental collaboration practices correlate with sustainability performance in the manufacturing industry. The literature search was conducted systematically using two major academic databases: Web of Science and Scopus. For this study, relevant papers were extracted from English-language peer-reviewed journals and conference proceedings published between 2004 and 2024. Article inclusion and exclusion criteria are shown in Table 1, and the selection process is shown in Table 2.

Table 1. Article inclusion & exclusion criteria

Criteria Type	Description
Inclusion criteria	1. Studies that explicitly address environmental collaboration practices and their impact on sustainability performance. 2. Research conducted within the context of the manufacturing industry.

	3. Publications with a focus on at least one type of environmental collaboration practices: suppliers, customers, and other stakeholders. 4. Publications with a focus on at least one sustainability performance dimension: economic, environmental, or social responsibility. 5. Empirical and theoretical studies published in high-quality peer-reviewed journals.
Exclusion criteria	1. Studies unrelated to environmental collaboration practices or sustainability performance. 2. Research focused on industries outside the manufacturing sector. 3. Articles not published in English or falling outside the 2004–2024 time frame.

Table 2. Screening and Selection Process

Steps	Number	Process
Confirm search strategy	>250	The search strategy employed Boolean operators and a combination of keywords to identify relevant studies. The search terms were categorized into three key domains: Environmental Collaboration Practices: Keywords: “environmental collaboration,” “environmental cooperation,” “supply chain collaboration,” “supply chain integration.” Sustainability Performance: Keywords: “sustainability performance,” “economic performance,” “environmental performance,” “social performance.” Manufacturing Industry: Keywords: “manufacturing industry.”
Searching Articles	265	Searched articles in the databases of Web of Science and Scopus with keywords.
Title and Abstract Screening	168	Each article’s title and abstract were reviewed for relevance. Studies that did not meet the inclusion criteria were excluded.
Full-Text Review:	111	The remaining articles were subjected to a detailed review. Studies that did not meet the inclusion criteria were excluded.
Final Data Extraction and Analysis	78	The selected articles were analyzed using content analysis.

The content analysis involved a systematic coding procedure. Initially, thematic identification was conducted, in which articles were coded according to themes related to key influencing factors, environmental collaboration practices, and sustainability outcomes. The primary coding categories and their descriptions are summarized in Table 3. This table enhances the transparency and replicability of the analytical process. The coding was performed iteratively, with themes being validated through discussion between the authors to ensure consistency and reliability. Following this, a comparative analysis was performed to examine findings across different collaboration types, particularly supplier collaboration and customer collaboration, to identify trends, gaps, and emerging research directions. Finally, a synthesis of key findings was conducted, highlighting dominant research areas and pinpointing underexplored topics requiring further investigation.

Table 3. Content analysis coding categories and thematic structure

Main Category	Sub-category/Code	Description/Definition
Environmental Collaboration Drivers	F1: Mutual Trust	Trust relationships between supply chain partners as foundation for long-term cooperation
	F2: Information & Knowledge Sharing	Exchange and dissemination of environmental management techniques and best practices
	F3: Environmental Awareness & Responsibility	Awareness of environmental issues and willingness to assume environmental responsibilities
	F4: Governance Mechanisms	Contracts, agreements, and institutional frameworks ensuring cooperative norms
	F5: Absorptive capacity	The ability to identify, assimilate, and utilize external knowledge and technology
	F6: Resource availability	Availability of financial, human, and technological resources
	F7: Mutual benefits	The perception of shared advantages and value creation from environmental practices
	F8: Stakeholder pressure	External demands and expectations from customers, regulators, communities, and other stakeholders
	F9: Economic Incentives	Financial benefits, cost savings, subsidies and other economic motivations
Supplier Collaboration Practices	P1: Setting Sustainability Goals	Jointly establishing environmental objectives and strategies with suppliers
	P2: Joint Green Product Development	Collaborative R&D for eco-friendly products and cleaner production technologies
	P3: Waste Management	Joint planning to reduce or eliminate waste
	P4: Knowledge Exchange	Sharing environmental management techniques and experiences
	P5: Compliance supervision	Joint monitoring, auditing, and ensuring adherence to environmental regulations and standards
	P6: Reverse logistics	Collaborative management of the return flow of products, materials, and packaging for recycling, remanufacturing, or proper disposal
Customer Collaboration Practices	C1: Sustainability Planning	Setting environmental goals and plans with customers
	C2: Eco-design	Collaborative design of eco-friendly products and cleaner production
	C3: Green Packaging	Joint development of environmentally friendly packaging solutions
	C4: Product take-back	collecting used products, components, or materials from customers for recycling, refurbishment, or

Sustainability Performance		proper disposal
	C5: Energy-efficient transportation	optimizing transportation routes, modes, and vehicle efficiency to reduce energy consumption and emissions during product distribution
	SP1: Environmental Performance	Environmental indicators such as emission reduction, resource efficiency
	SP2: Economic Performance	Cost savings, revenue growth, profitability, etc.
	SP3: Social Performance	Employee well-being, community relations, social responsibility

4. Results and Discussion

4.1 Key Factors for Successful Environmental Collaboration

Table 3 presents key factors essential for effective environmental collaboration, alongside their descriptions and corresponding sources. These factors encompass a broad spectrum of elements critical to fostering successful collaboration, from trust and information sharing to economic incentives and stakeholder pressure (Duong & Chong, 2020) (Jimenez-Jimenez et al., 2019) (Panigrahi et al., 2019). Table 4 identifies nine fundamental factors contributing to environmental collaboration, with environmental awareness and responsibilities emerging as the most significant, supported by evidence from seven studies. Other key determinants include information and knowledge sharing and governance mechanisms, each cited in five studies. While mutual trust, resource availability, economic incentives, and shared benefits are also vital, they have been examined in fewer studies, highlighting potential avenues for future research.

Two main reasons can explain the difference in research focus. First, the prominence of factors like stakeholder pressure and governance mechanisms likely reflects the manufacturing industry's inherent exposure to stringent regulatory environments and complex global supply chains (Henao & Sarache, 2022). These factors are easier to observe and measure through policies, certifications, and contractual agreements, making them more accessible for empirical research. Conversely, the factors like mutual trust and mutual benefits, as intangible social capital that is challenging to quantify and often develops over extended periods (Yu et al., 2019). This methodological challenge may lead researchers to prioritize factors that are more easily operationalized in survey instruments or case studies. Second, the focus on specific factors may vary across different manufacturing sub-sectors. For instance, in capital-intensive industries (e.g., automotive, electronics), governance mechanisms and resource availability might be paramount due to high technological and compliance requirements (X. Chen et al., 2019). In contrast, in consumer goods manufacturing, factors like consumer pressure and brand reputation may take precedence (Centobelli et al., 2020). The current literature, however, often treats manufacturing as a single entity, potentially obscuring these important sectoral nuances.

Table 4. Key factors for successful environmental collaboration

Factor	Description	Sources
Mutual Trust	Essential for building strong relationships and successful environmental collaboration.	Yu et al. (2019); (Duong & Chong, 2020); (Jimenez-Jimenez et al., 2019)
Information and Knowledge Sharing	Facilitates better decision-making, sustainable practices, and coordination among supply chain partners.	(C. Wang & Hu, 2020); (Jimenez-Jimenez et al., 2019); Alzoubi et al. (2020); (Z. Yang & Lin, 2020); (Panigrahi et al., 2019)
Absorptive Capacity	The ability to absorb and utilize external knowledge and technology boosts collaborative innovation for environmental sustainability.	(Duong & Chong, 2020); (J. Hong et al., 2019); (Z. Yang & Lin, 2020); (Panigrahi et al., 2019)
Resource Availability	Availability of resources, including financial and human, supports effective environmental collaboration.	(Allaoui et al., 2019); (Tseng et al., 2019); (Panigrahi et al., 2019)
Environmental Awareness and Responsibilities	Awareness of and responsibility for environmental issues among partners drives collaborative efforts.	Yu et al. (2019); (Duong & Chong, 2020); (Jimenez-Jimenez et al., 2019); (Panigrahi et al., 2019); (Tseng et al., 2019); (Z. Hong & Guo, 2019); (Alshurideh et al., 2022)
Governance Mechanisms and Contractual Agreements	Proper governance frameworks enhance collaboration by providing clear guidelines and accountability.	(Um & Kim, 2019); (Duong & Chong, 2020); (Jimenez-Jimenez et al., 2019); Chen et al. (2019); (Panigrahi et al., 2019)
Economic Incentives	Financial incentives and cost savings motivate supply chain partners to engage in environmental collaborations.	Centobelli et al. (2020); Chen et al. (2019); (Panigrahi et al., 2019)
Mutual Benefits	Partners collaborate more effectively when they perceive mutual benefits from environmental practices.	Alzoubi et al. (2020); (Z. Yang & Lin, 2020); (Panigrahi et al., 2019)
Stakeholder Pressure	Pressure from stakeholders, including customers and regulators, drives environmental collaboration.	(Panigrahi et al., 2019); Alzoubi et al. (2020); (Duong & Chong, 2020); (Al-Doori, 2019); Centobelli et al. (2020)

The factors influencing environmental collaboration with supply chain partners are multifaceted and interconnected. Mutual trusts are foundational, as building strong relationships based on trust is essential for successful collaboration. Yu et al. (2019) emphasized that trust fosters long-term cooperation and commitment to environmental goals. Sharing relevant information based on trust facilitates better alignment of environmental objectives, as discussed by (C. Wang & Hu, 2020) and (Jimenez-Jimenez et al., 2019). Technological tools, such as blockchain, enhance transparency and trust, improving traceability and accountability in supply chains (Centobelli et al., 2020). The interaction between mutual trust and governance mechanisms is critical, as trust can create a foundation for effective governance. In contrast, governance mechanisms (e.g., formal agreements, clear policies) help formalize the expectations and responsibilities of each partner.

Pressure from stakeholders, including customers and regulators, compels supply chain partners to adopt sustainable practices. Consumer demand for sustainable products further incentivizes partners to collaborate

on environmental initiatives (Centobelli et al., 2020) (Panigrahi et al., 2019). Awareness and commitment to environmental issues among partners, as highlighted by Yu et al. (2019) and (Panigrahi et al., 2019), motivate proactive engagement. Strong leadership commitment and a culture prioritizing sustainability foster better collaboration, ensuring all partners actively contribute to environmental goals (Jimenez-Jimenez et al., 2019) (Tseng et al., 2019).

Moreover, proper governance frameworks, formal agreements, and supportive policies ensure compliance and commitment to environmental objectives (X. Chen et al., 2019) (Duong & Chong, 2020) (Um & Kim, 2019). When partners perceive clear benefits, such as cost savings or enhanced reputation, they are more likely to engage in collaborative practices (Alzoubi et al., 2020) (Z. Yang & Lin, 2020). Financial incentives and cost savings further drive participation in sustainable initiatives (Centobelli et al., 2020) (X. Chen et al., 2019). Economic incentives act as an amplifier of stakeholder pressure, making them more effective at motivating partners to engage in environmental collaboration. When economic benefits align with environmental goals, stakeholders' pressure becomes more compelling, as partners are more likely to see the long-term value in sustainability efforts.

4.2 Specific Practices in Environmental Collaboration

Numerous studies have examined specific practices related to environmental cooperation with suppliers. Such strategies encompass evaluating suppliers' ecological performance, enforcing sustainability measures to maintain product environmental standards, and analyzing waste-related expenses within manufacturing operations (Akman & Pışkın, 2013). Additionally, collaborating with suppliers on eco-friendly product innovation, conducting awareness seminars, and aiding suppliers in developing environmental plans are considered essential practices within green supply chain management (Y. Wang & Ozturk, 2023). Moreover, joint environmental initiatives with suppliers contribute to expanding sustainability-driven practices throughout the supply network, including initiatives like eco-conscious procurement and customer sustainability partnerships, which enhance overall environmental outcomes (Yu et al., 2019). Furthermore, firms stand to benefit from enhancing their green supply chains by engaging in collaboration with upstream suppliers to adopt environmentally friendly production techniques and exchange environmental information (Santos et al., 2019).

Table 5. Practices of environmental collaboration with suppliers

	Grekoval et al. (2016)	Gorane and Kant (2017)	Bae and Grant (2018)	Santos et al. (2019)	Tseng et al. (2019)	Ahmed et al. (2020)	Afium et al. (2020)	Li et al. (2020)	Arora et al. (2020)	Govindan et al. (2021)	Kitsis and Chen (2021)	Barbosa et al. (2022)	Andalib Ardakani et al. (2023)	Akhtar et al. (2023)	Bouguerra et al. (2023)	Liu et al. (2023)	Total
Set and realize sustainability goals and strategies together			√			√	√	√	√		√	√		√	√	√	11
Develop environmental products and cleaner production together						√		√	√			√			√		5
Develop planning to minimize or eradicate waste together	√	√		√	√			√	√	√	√	√	√		√		11

Exchange environmental management techniques and knowledge together		√		√	√	√				√			√		√	8
Supervise environmental compliance status and operational flow together	√	√		√	√								√	√		7
Monitor the reversal of material flows together		√			√								√			3

Table 5 presents various studies on environmental collaboration practices with suppliers, highlighting six main practices. In Table 5, the most frequently mentioned practices are setting sustainability goals and minimizing waste, each cited in 11 studies, demonstrating a strong emphasis on these areas within supplier collaborations. Exchanging environmental management techniques is mentioned in 8 studies, reflecting the importance of knowledge sharing. Supervising environmental compliance is noted in 7 studies, indicating the need for regulatory adherence. In contrast, developing environmental products is referenced in only 5 studies, and monitoring the reversal of material flows in just 3 studies, suggesting these areas receive less focus. Overall, the data indicate a trend towards strategic goal-setting, waste management, and knowledge exchange in environmental collaborations with suppliers.

Several scholars have advocated various environmental initiatives involving collaboration with customers. For instance, (Afshar Jahanshahi & Brem, 2018) advocate collaborating with customers to establish shared environmental goals and objectives aimed at promoting sustainability performance. (Pessot et al., 2020) propose the adoption of collaborative product and service customization practices with customers to adapt to market demands and enhance environmental performance. (Lee & Joo, 2020) Suggest collaborating with customers to drive green innovation across product design, manufacturing processes, and supply chain operations, engaging customers in the green design process, and offering environmentally friendly products to meet sustainability requirements. (Pekovic et al., 2016) propose gathering customer feedback on environmental practices and utilizing it to enhance products and services. Yu et al. (2019) recommend collaborating with customers to develop green packaging solutions and recycling programs to mitigate environmental impacts. (Akhtar et al., 2023) propose enhancing internal green collaboration to facilitate collaboration with customers and suppliers in selecting green materials and co-designing green products and packaging.

Table 6 presents data from various studies, listing different practices of environmental collaboration with customers. The results highlight the different aspects of environmental collaboration that various studies have focused on, with sustainability-related goals and planning being the most frequently addressed (Afum et al., 2020) (Kitsis & Chen, 2021) (Yang Liu et al., 2023). Similarly, a substantial number of studies have delved into specific practical applications such as eco-design, cleaner production, and green packaging (Akhtar et al., 2023) (Pessot et al., 2020) (Santos et al., 2019). This pattern suggests that academic attention is predominantly directed towards examining the influence of enterprise-customer cooperation at the strategic planning level on sustainable performance. It provides a clear overview of the focus areas in environmental collaboration research and helps identify where more research might be needed, particularly in less commonly addressed indicators such as product take-back and energy reduction in transportation (Andalib Ardakani et al., 2023) (Kitsis & Chen, 2021) (Yu et al., 2019).

Table 6. Practices of environmental collaboration with customers

	Sustainability-related goal and planning	Eco-design and cleaner production	Green packaging	Product & Materials take-back	Less energy during product transportation
(Grekova et al., 2016)	√		√		√
(Chavez et al., 2016)	√				
(Laari et al., 2016)	√				
(Afshar Jahanshahi & Brem, 2018)	√				
(Bae & Grant, 2018)	√				√
(Santos et al., 2019)		√	√		
(Tseng et al., 2019)				√	
Yu et al. (2019)	√	√	√	√	√
(Gill et al., 2019)		√			√
(Pessot et al., 2020)		√			
(Ahmed et al., 2020)	√	√			
(Afum et al., 2020)	√	√	√		
(Lee & Joo, 2020)	√				
(Kitsis & Chen, 2021)	√			√	
Andalib Ardakani et al. (2023)		√	√	√	
(Akhtar et al., 2023)		√	√		
(Y. Liu et al., 2023)	√				
Total	12	9	7	4	4

4.3 Environmental Collaboration on Sustainability Performance

Notably, environmental collaboration not only mitigates the costs associated with natural resource utilization but also enhances productivity, efficiency, and financial performance (Annapoorna, 2019). This synergistic approach engenders a harmonious alignment between operational, economic, and environmental metrics, thereby providing organizations with a competitive edge (Barbosa et al., 2022). Previous investigations have predominantly examined the individual or interactive impacts of environmental collaboration on diverse facets of sustainable performance, encompassing economic (Chen et al., 2022; Kitsis & Chen, 2021); (Kong et al., 2021), environmental (Andalib Ardakani et al., 2023) (Kitsis & Chen, 2021) (Li et al., 2020) and social dimensions (Han & Huo, 2020) (Karia & Davadas Michael, 2022) (Q. Yang et al., 2020), aimed at assessing its overarching influence.

Table 7 summarizes research studies examining the positive relationship between environmental collaboration and sustainability performance. The table analysis reveals that suppliers play a critical role in environmental collaboration, as they are the most frequently mentioned partners across all performance

categories. Environmental and economic performances are the most studied outcomes, with environmental performance appearing most frequently. Social performance is the least examined, indicating a need for more research in this area. Other performance metrics, such as operational, business, and carbon performance, while less frequently studied, provide valuable insights.

Table 7. Positive relationship between environmental collaboration and sustainability performance

Reference	Partner	Environmental performance	Economic performance	Social performance	Other performance
(Grekova et al., 2016)	Suppliers		√		
	Customers				
(Li et al., 2020)	Suppliers	√			
(Ahmed et al., 2020)	Suppliers		√		
	Customers	√	√		Operational performance
(Arora et al., 2020)	Suppliers		√		
(Kitsis & Chen, 2021)	Supplier	√	√		
	Customers				
(Q. Chen et al., 2022)	Customers		√		
(Sijing, 2022)	Companies	√			
(Karia & Davadas Michael, 2022)	Suppliers			√	
(Mishra et al., 2023)	Suppliers				Business performance
	Customers				
	Logistics providers				
(Wei et al., 2023)	Suppliers				Carbon performance
	Customers				
Andalib Ardakani et al. (2023)	Suppliers	√			
	Customers	√	√		
(Akhtar et al., 2023)	Suppliers	√			
	Customers		√		

Based on the literature, there is a general consensus that environmental collaboration positively impacts firms' environmental performance (Han & Huo, 2020) (Syed et al., 2024). Collaborative initiatives such as joint waste management programs, green technology co-development, and resource-sharing agreements have been found to reduce emissions and improve energy efficiency (Ahmed et al., 2020). However, some studies question the relationship between collaboration and environmental performance. For example, (Centobelli et al., 2020) argue that the effectiveness of environmental collaboration is contingent on firms' internal capabilities, such as absorptive capacity and environmental leadership. Firms that lack technological expertise or financial resources may struggle to implement collaborative strategies effectively, limiting their impact on sustainability outcomes. Moreover, while many studies suggest that collaboration enhances environmental performance, it is also possible that firms with better environmental records are more likely to engage in collaborative efforts (Kitsis & Chen, 2021). This calls for longitudinal studies to establish clearer causal links.

The link between environmental collaboration and economic performance is more ambiguous. Some scholars (Bartolacci et al., 2020) (García-Alcaraz et al., 2021) highlight the cost-saving potential of joint sustainability initiatives, citing examples where firms reduced operational expenses through shared logistics and resource optimization. Others, however, argue that environmental collaboration incurs additional costs in the short term due to investments in sustainable technology and compliance with environmental regulations

(Nadae et al., 2019). A key unresolved question is whether the economic benefits of environmental collaboration are immediate or long-term. While large multinational firms may be able to absorb short-term costs and achieve long-term financial gains, SMEs with limited financial resources may struggle to sustain such initiatives (T. Liu et al., 2021). Future research should investigate the financial trade-offs of environmental collaboration across firms of different sizes and industries.

Unlike environmental and economic performance, social performance has received less academic attention. Most studies focus on corporate social responsibility (CSR) initiatives, such as employee well-being programs and community engagement (Silva et al., 2019). However, there is limited empirical evidence linking environmental collaboration directly to social outcomes such as labor rights, gender equality, and local community development (Rasheed & Ion, 2022). Furthermore, existing studies tend to overlook the potential negative social consequences of environmental collaboration. For example, outsourcing green production to suppliers in developing countries may improve environmental performance while exacerbating labor exploitation and wage disparities (Henao & Sarache, 2022). This highlights the need for more comprehensive frameworks that integrate social justice considerations into environmental collaboration research.

5. Conclusion

This study provides a comprehensive review of the relationship between environmental collaboration and sustainability performance in the manufacturing industry, using a content analysis to synthesize findings from existing literature. The findings identify nine multifaceted, interconnected factors driving environmental collaboration, such as economic incentives, mutual benefits, and stakeholder pressure. Moreover, this study identifies six key practices of environmental collaboration with suppliers, such as setting sustainability goals, developing green products, minimizing waste, sharing environmental knowledge, ensuring compliance, and monitoring reverse material flows—and five with customers, including setting sustainability plans, promoting eco-design, adopting green packaging, supporting take-back initiatives, and reducing transportation energy use. Furthermore, the study indicates that environmental collaboration directly enhances sustainable performance in the environmental, economic, and social dimensions.

While environmental collaboration significantly enhances sustainability performance, certain areas remain less explored. First, despite its importance, social performance remains the least examined dimension of sustainability in this context. The literature offers limited empirical evidence on how environmental collaboration translates into tangible social outcomes, such as community development, and more worryingly, often overlooks potential negative social consequences like labor exploitation in global supply chains (Henao & Sarache, 2022). Second, there is a noticeable scarcity of studies focusing on the dynamics of environmental collaboration within Small and Medium-sized Enterprises (SMEs). Firms with resource constraints and capabilities may experience different drivers and barriers (T. Liu et al., 2021). Finally, the field would greatly benefit from comparative studies across cultures and nations. The influence of varying institutional frameworks, regulatory environments, and cultural norms on the effectiveness of environmental collaboration practices is largely unexplored.

In conclusion, environmental collaboration is vital for driving sustainability in the manufacturing industry. By strengthening collaborative efforts, manufacturing firms can achieve a competitive advantage and a positive sustainability impact. Future research should prioritize empirically investigating the identified gaps, specifically, the social implications of collaboration, the unique context of SMEs, and the moderating role of cultural and institutional settings, to develop a more nuanced and inclusive understanding of this field.

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