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# Cooperating to Resist and Grow: Resilience as a Bridge to Sustainable Development in Mexican Manufacturing Firms

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**Abstract**

This study examines how supply chain cooperation influences corporate resilience and sustainable development in Mexican manufacturing firms. Drawing on dynamic capabilities theory, the research proposes that cooperation strengthens firms' adaptive capacity and that corporate resilience acts as a key mechanism linking collaboration with sustainability outcomes. A quantitative, cross-sectional design was used, based on survey data from managers in strategic manufacturing subsectors. The model was analyzed through partial least squares structural equation modeling (PLS-SEM). The findings show that supply chain cooperation positively influences corporate resilience, and corporate resilience positively contributes to sustainable development. However, the direct relationship between supply chain cooperation and sustainable development was not supported. These results suggest that cooperation alone is insufficient to achieve sustainability unless firms develop resilience capabilities that allow them to absorb and reconfigure collaborative resources. The study positions corporate resilience as a strategic bridge between supply chain cooperation and sustainable development.

**Keywords:** supply chain cooperation; corporate resilience; sustainable development; dynamic capabilities; Mexican manufacturing firms.

## 1. Introduction

Manufacturing firms currently operate in environments characterized by supply chain disruptions, technological change, environmental pressure, and increasing stakeholder demands for sustainable business practices. In this context, firms are expected not only to maintain

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operational continuity, but also to adapt their strategies toward economic, social, and environmental objectives. Sustainable development requires organizations to integrate broader responsibilities into their decision-making processes, moving beyond short-term efficiency toward long-term value creation (Elkington, 2018; Abbas, 2020; Algarni *et al.*, 2022). At the same time, firms rarely possess all the resources, knowledge, and capabilities required to respond effectively to uncertainty by themselves. Therefore, supply chain cooperation becomes a strategic mechanism through which organizations exchange information, coordinate actions, share resources, and develop joint responses to market and environmental challenges (Håkansson & Snehota, 1995; Pero *et al.*, 2017; Giglio *et al.*, 2023). From a dynamic capabilities perspective, such cooperation can help firms sense external pressures, seize collaborative opportunities, and reconfigure resources in response to changing conditions (Teece *et al.*, 1997; Teece, 2007, 2018). Despite the growing relevance of supply chain cooperation, corporate resilience, and sustainable development, the literature still offers limited understanding of how these constructs interact within manufacturing firms, particularly in emerging economy contexts. Prior studies have emphasized the importance of cooperation for improving coordination, innovation, and supply chain performance, while other research has highlighted resilience as a key capability for adaptation, recovery, and organizational renewal under disruptive conditions (Ortiz-de-Mandojana & Bansal, 2016; Williams *et al.*, 2017; Duchek, 2020). However, less attention has been given to whether supply chain cooperation directly promotes sustainable development or whether its contribution depends on the firm's capacity to transform cooperative resources into resilient organizational responses. This gap is relevant because cooperation may provide access to external knowledge and resources, but such resources may not automatically generate sustainability outcomes if firms lack the adaptive capabilities needed to absorb and deploy them effectively. Accordingly, this study addresses the following research question: *How does supply chain cooperation influence sustainable development in Mexican manufacturing firms, and what role does corporate resilience play in this relationship?*

To answer this research question, the study adopts a quantitative, cross-sectional research design focused on Mexican manufacturing firms. The empirical analysis is based on survey data collected from senior managers and decision-makers in manufacturing companies operating in strategic industrial subsectors, including automotive, aerospace, metal-mechanic, chemical, and textile industries. The proposed relationships were examined using partial least squares structural equation modeling, a methodological approach suitable for prediction-oriented models and the analysis of complex relationships among latent constructs (Hair *et al.*, 2017; Shmueli *et al.*, 2019). Through this approach, the study evaluates the extent to which supply chain cooperation contributes to corporate resilience and sustainable development, while also examining corporate resilience as a key mechanism linking interorganizational cooperation with sustainability-oriented outcomes.

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*1.1 Literature Review*

1.1.1 Dinamic Capabilities Theory

Under the perspective of the dinamic capabilities theory, firms do not achieve superior outcomes merely by possessing resources, but by continuously adapting, integrating, and reconfiguring internal and external competencies in response to environmental turbulence (Teece *et al.*, 1997; Teece, 2007, 2018). In volatile and uncertain markets, cooperation with supply chain partners becomes a strategic mechanism through which firms access complementary knowledge, technologies, operational capabilities, and relational resources that they could not develop independently (Håkansson & Snehota, 1995; Giglio *et al.*, 2023). This collaborative interaction improves communication, logistical integration, technological integration, and joint development, which are central elements for strengthening sustainability-oriented supply chain practices (Pero *et al.*, 2017). Therefore, supply chain cooperation can be understood as an external capability-building process that allows firms to sense environmental pressures, seize collaborative opportunities, and reconfigure resources toward more adaptive and sustainable business responses (Teece, 2007; Ramos *et al.*, 2023).

Ont the other hand, resilience is not limited to passive recovery after disruptions; rather, it involves proactive adaptation, resource reallocation, organizational renewal, and the capacity to sustain growth under adverse conditions (Ortiz-de-Mandojana & Bansal, 2016; Duchek, 2020). This interpretation supports the mediating role of corporate resilience because firms with higher resilience are better able to internalize the benefits derived from cooperation and convert them into environmental, social, and economic performance improvements (Williams *et al.*, 2017; Duchek, 2020). In this sense, supply chain cooperation provides access to shared resources and knowledge, while corporate resilience determines whether those resources are effectively absorbed, recombined, and deployed in response to changing sustainability demands (Ge & Bao, 2024; Xue & Zhu, 2025). Accordingly, the proposed model is theoretically justified because supply chain cooperation acts as an antecedent of adaptive capacity, corporate resilience operates as the dynamic mechanism of resource conversion, and sustainable development emerges as the strategic outcome of this reconfiguration process (Tian *et al.*, 2024; Yan *et al.*, 2023; Singh & Modgil, 2025).

1.1.2 Supply Chain Cooperation and Corporate Resilience

In complex and uncertain environments, firms rarely possess all the capabilities and activities required to achieve strategic objectives independently (Gebrekidan & Awuah, 2002; Håkansson & Snehota, 1995). Therefore, cooperation becomes an interorganizational strategy through which firms coordinate resources, exchange information, and develop joint responses to environmental disruptions (Berends & Sydow, 2019; Oliveira & Lumineau, 2019; Giglio *et al.*, 2023). From a supply chain perspective, cooperation may occur vertically between upstream and downstream firms or horizontally among similar firms, allowing organizations to share risks, improve coordination, and strengthen collective problem-solving capabilities (Albino *et al.*, 2007; Chen *et al.*, 2017; Solaimani & van der Veen, 2022; Soylu *et al.*, 2006). This is particularly relevant for resilience because firms facing supply disruptions require rapid access to alternative knowledge,

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resources, and partners (Puerta-Lopez *et al.,* 2023). Cooperation thus enables firms to anticipate operational vulnerabilities, coordinate responses, and reduce the negative effects of uncertainty. In this sense, supply chain cooperation acts as a relational foundation for corporate resilience by improving the firm's capacity to adapt, recover, and maintain continuity under disruptive conditions (Ortiz-de-Mandojana & Bansal, 2016; Duchek, 2020).

In addition, when uncertainty increases across supply, demand, and business conditions, firms become more dependent on reciprocal relationships with supply chain partners, making external integration indispensable (Gulati *et al.,* 2012). These reciprocal interdependencies raise coordination costs, but they also create opportunities for deeper integration, shared values, and collective supply chain identity (Alchian & Demsetz, 1972; Gulati *et al.,* 2012; Flynn *et al.,* 2016). Such integration is essential for resilience because disruptions often require coordinated decisions, flexible resource allocation, and timely information sharing among partners. Cooperation mechanisms help align incentives, reduce opportunistic behavior, and improve the quality of bilateral relationships within the supply chain (Poppo & Zenger, 2002; Dyer & Singh, 1998). As products, transactions, and environmental conditions become more complex, cooperative supply chain relationships become increasingly important for responding to contingencies and supporting interorganizational learning (Williamson, 2008; Hult *et al.,* 2006; Wang & Wei, 2007). Accordingly, firms embedded in cooperative supply chain networks are more likely to develop the adaptive routines and relational flexibility required to sustain resilience during disruptions.

Supply chain cooperation further contributes to corporate resilience by facilitating innovation, learning, and capability development. R&D cooperation within supply chains has been identified as a promising model for stimulating new product development and collectively mitigating supply disruption risks (Kosasih *et al.*, 2022; Lv & Qi, 2019; Yang *et al.*, 2024). These cooperative arrangements allow firms to combine complementary expertise and accelerate the development of solutions that would be difficult to achieve in isolation. In resilience terms, such collaboration enhances the organization's ability to adjust technologies, redesign processes, and respond to structural changes in the business environment (Steggemann, 2023). The literature suggests that firms operating in turbulent contexts need flexibility in supply chain design and management, including the capacity to detect and respond to changes in supply, demand, and competitive conditions (Lee, 2004; Christopher & Holweg, 2017). Cooperation with partners strengthens this flexibility by supporting shared experimentation, knowledge transfer, and joint adaptation. As corporate resilience involves the ability to recover from shocks through resource reallocation, process optimization, and relationship reshaping, supply chain cooperation provides the relational and informational inputs required for these adaptive processes (Mondragon *et al.,* 2022; Williams *et al.,* 2017; Duchek, 2020). Thus, cooperation does not merely improve operational efficiency; it strengthens the dynamic capabilities that enable firms to remain viable and competitive under disruption.

Although supply chain cooperation can strengthen corporate resilience, this relationship may be constrained by several organizational and interorganizational barriers. As uncertainty increases,

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firms become more dependent on reciprocal relationships with supply chain partners, which can raise coordination costs and complicate joint decision-making (Alchian & Demsetz, 1972; Gulati *et al.*, 2012). Cooperation may also be weakened by incentive conflicts, opportunistic behavior, and hold-up problems, especially when partners pursue individual benefits rather than collective resilience outcomes (Williamson, 2008; Poppo & Zenger, 2002). In addition, trust issues, legal constraints, financial limitations, and conflicts of interest can prevent firms from fully sharing resources and knowledge (Oliveira & Lumineau, 2019). These problems are particularly relevant for firms with limited absorptive capacity, rigid organizational routines, or insufficient resource reserves, since they may struggle to internalize the benefits derived from cooperation (Lepoutre & Heene, 2006; Li & Han, 2025). Consequently, supply chain cooperation does not automatically produce corporate resilience; its effectiveness depends on mutual trust, complementary capabilities, aligned objectives, and governance mechanisms that reduce uncertainty and facilitate coordinated adaptation (Bichinho *et al.*, 2026; Flynn *et al.*, 2016). Based on this reasoning, the following hypothesis is proposed:

H1. Supply chain cooperation has a positive and significant effect on corporate resilience of mexican manufacturing companies.

1.1.3 Supply Chain Cooperation and Corporate Resilience

Sustainable development involves the simultaneous achievement of economic, social, and environmental objectives, which implies that firms must integrate broader impacts into their strategic and operational decisions (Elkington, 2018; Abbas, 2020; Algarni *et al.*, 2022). However, companies rarely possess all the resources, knowledge, and capabilities required to address sustainability challenges independently (Gebrekidan & Awuah, 2002; Håkansson & Snehota, 1995). For this reason, cooperation among supply chain members becomes a strategic mechanism for aligning objectives, sharing knowledge, and coordinating practices that support sustainable outcomes (Maldonado-Guzman, 2026). Through collaborative relationships, firms can improve communication, logistical integration, technological integration, and joint development, which are considered key elements for advancing sustainability in supply chains (Pero *et al.*, 2017). Thus, supply chain cooperation provides the relational infrastructure needed to transform sustainability from an isolated organizational intention into a coordinated interorganizational practice.

Current environmental pressures, stricter regulations, and consumer preferences for low-carbon products have increased the need for firms to coordinate sustainability-oriented actions across their supply chains (Meng *et al.*, 2022a,b; Zhang *et al.*, 2024). Cooperation allows suppliers, manufacturers, customers, and other partners to jointly plan environmental goals, exchange operational knowledge, and reduce the ecological impact associated with material and information flows (Salamanca, 2022; Pinzon-Castro, 2024)). In this context, environmental cooperation is based on mutual learning, shared planning, and collective goal setting for improving environmental activities. These collaborative practices can support the adoption of green technologies, resource-efficient processes, and sustainable product development (Battaglia *et al.*, 2020; Johansen & Akay, 2022; Trenerry *et al.*, 2021). Consequently, supply chain

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cooperation contributes to sustainable development by enabling firms to coordinate environmental innovation, reduce waste, improve resource utilization, and respond more effectively to stakeholder expectations.

In addition, cooperative networks allow firms to access complementary capabilities, reduce costs, increase efficiency, and improve organizational performance through partnerships with other actors (Wei *et al.*, 2019; Xie *et al.*, 2016). From a sustainability perspective, these networks facilitate the development of innovative activities, knowledge transfer, and the implementation of sustainable processes that may be difficult to achieve individually (Zheng *et al.*, 2013; Hemphälä & Magnusson, 2012). In closed-loop and low-carbon supply chains, cooperation has been associated with better economic and environmental performance because it improves remanufacturing capabilities, reduces carbon-related burdens, and supports profit coordination among supply chain members (Gu *et al.*, 2018). Moreover, direct involvement with suppliers and customers in planning, forecasting, and product development can enhance the accuracy of sustainability decisions across the value chain (Yan *et al.*, 2016). Therefore, supply chain cooperation supports sustainable development by combining economic efficiency, environmental responsibility, and stakeholder-oriented value creation.

Despite its potential benefits, the relationship between supply chain cooperation and sustainable development faces several barriers that may limit its effectiveness. Cooperation does not automatically generate sustainable outcomes because partners may experience conflicts of interest, legal restrictions, and financial limitations (Williamson, 2008; Gulati *et al.*, 2012; Oliveira & Lumineau, 2019). These barriers can discourage firms from sharing strategic information, investing in joint sustainability initiatives, or coordinating long-term environmental objectives. In addition, some firms, particularly smaller ones, may lack absorptive capacity, financial resources, or managerial awareness to implement environmental responsibility practices effectively (Lepoutre & Heene, 2006; Lewis *et al.*, 2015). The effectiveness of cooperation therefore depends on specific conditions, including mutual trust, complementarity of resources and skills, and public policies that encourage sustainable innovation (Bichinho *et al.*, 2026). Accordingly, while supply chain cooperation can promote sustainable development, its impact is contingent on governance mechanisms and relational conditions that reduce opportunism, align incentives, and facilitate the effective sharing of knowledge and resources. Based on this reasoning, the following hypothesis is proposed:

H2. Supply chain cooperation has a positive and significant effect on the Sustainable Devlopment of mexican manufacturing companies.

### 1.1.4 Corporate Resilience and Sustainable Development

Sustainable development requires firms to balance economic, social, and environmental performance rather than focusing only on short-term profitability (Elkington, 2018; Abbas, 2020; Algarni *et al.*, 2022). However, this balance is difficult because the three dimensions are complex and highly interdependent (Yao & Wang, 2024). In this context, corporate resilience allows organizations to maintain functionality, reorganize internal resources, and continue

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pursuing long-term objectives when facing turbulence. Resilient firms are better prepared to absorb shocks without abandoning sustainability commitments, since resilience involves adaptation, recovery, and strategic renewal (Ortiz-de-Mandojana & Bansal, 2016; Duchek, 2020). Therefore, corporate resilience supports sustainable development by helping firms preserve operational continuity while adjusting their strategies to environmental and social demands.

From a dynamic capability perspective, resilient organizations can adjust routines, redesign processes, and mobilize resources in response to changing environments (Teece, 2007, 2017; Duchek, 2020). This capacity is particularly relevant for sustainability because environmental and social initiatives often require continuous learning, innovation, and organizational flexibility. When firms face external stress, resilience enables more efficient resource allocation and use, which can improve performance across environmental, social, and economic dimensions (Williams *et al.,* 2017; Duchek, 2020). In manufacturing and supply chain contexts, these capabilities may be reflected in faster market responses, more precise strategic planning, and more efficient operational decisions. Thus, corporate resilience functions as an internal mechanism through which firms transform uncertainty into adaptive action that supports sustainable development.

Therefore, the relationship between corporate resilience and sustainable development is further justified by the role of resilience in strengthening stakeholder trust, legitimacy, and long-term competitiveness. Sustainability-oriented practices can enhance stakeholder commitment, improve access to resources, and reduce firms' vulnerability to crises (Bansal & Clelland, 2004; Wagner & Svensson, 2014). At the same time, resilient firms are better positioned to sustain these practices during disruptive periods because they can adapt, withstand, and recover from crises while maintaining core operations (Kahn *et al.,* 2018; Williams & Shepherd, 2016). This is relevant because sustainable development depends not only on environmental performance, but also on the firm's ability to preserve relationships with employees, customers, suppliers, investors, and communities. By maintaining responsible behavior under pressure, resilient firms reinforce legitimacy and become more capable of mobilizing capital, knowledge, and stakeholder support when these resources are most needed (Arvidsson & Dumay, 2021; Williams *et al.,* 2017). Consequently, corporate resilience enhances sustainable development by protecting stakeholder relationships and enabling firms to sustain responsible strategies over time.

Nevertheless, the relationship between corporate resilience and sustainable development may face important barriers. During crises, firms often experience resource constraints and may prioritize urgent financial survival over environmental or social investments (Aragón-Correa & Sharma, 2003; Kim *et al.,* 2019; Broadstock *et al.,* 2021). This creates tension between short-term recovery needs and long-term sustainability commitments. In addition, some firms may struggle to adapt because of rigid organizational routines, limited capabilities, or misalignment between existing resources and new environmental demands (Zhang et al., 2023). Although resilience can help firms reorganize resources, it does not guarantee sustainable outcomes if managers lack strategic orientation, stakeholder commitment, or sufficient financial flexibility.

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The literature also suggests that reinforcing sustainability during crisis periods may be difficult when resources are scarce and investors expect immediate stabilization (DesJardine *et al.,* 2019; Sajko *et al.,* 2021). Therefore, corporate resilience supports sustainable development only when firms can balance adaptive recovery with sustained investment in economic, social, and environmental priorities. Based on this reasoning, the following hypothesis is proposed:

H3. Corporate Resilience has a positive and significant effect on the Sustainable Devlopment of mexican manufacturing companies.

Figure 1, presented below, shows the formulation of the three hypotheses in the research model.

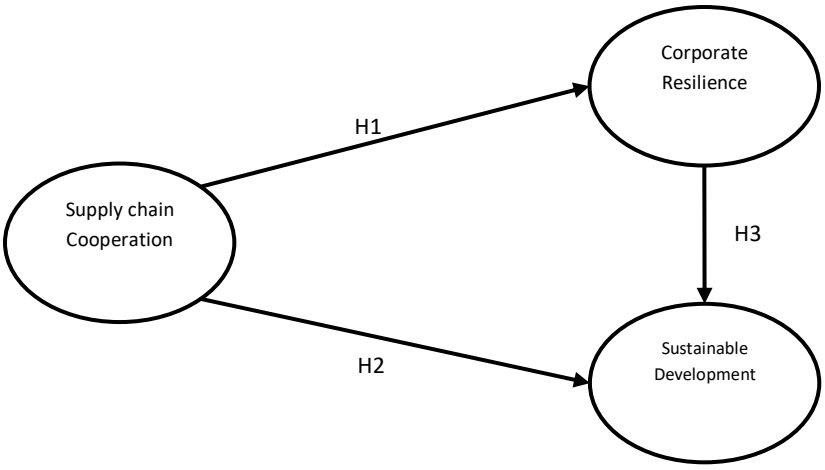


Figure 1. Research Model

## 2. Methods

*2.1 Sample*

This research adopted the National Statistical Directory of Economic Units (DENUE) as the sampling frame. According to official records, in 2022 the directory reported 38,583 manufacturing firms employing more than ten workers across all industrial subsectors (INEGI, 2021). The empirical scope of the study was delimited to five strategic subsectors: automotive, aerospace, metal-mechanic, chemical, and textile industries. Primary data were gathered through a structured questionnaire specifically developed for this investigation. The instrument was administered to senior managers and decision-makers of the selected firms via face-to-face interviews conducted from April to December 2022. Initially, 580 firms were invited to participate. The effective response rate reached 52.41%, yielding a final sample of 304 valid observations. A simple random sampling procedure was implemented, ensuring a maximum sampling error of ±5% at a 95% confidence level. Fieldwork and survey administration were carried out by a specialized firm with expertise in industrial data collection processes.

*2.2 Variables*

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The measurement instrument was constructed through the adaptation of previously validated scales to ensure methodological rigor and suitability for subsequent statistical analysis. To operationalize Supply Chain Cooperation the scale proposed by Chowdhury & Quaddus (2017) was adopted. Corporate Resilience was assessed using the scale developed by Rapaccini et al., (2020), Sustainable Development was measured based on the instrument proposed by D'Amato et al., (2019). According to Harman's test, common method bias does not appear critical because the first factor explains 48.19%, below 50%. However, the result is close to the threshold (Podsakoff et al., 2003).

*2.3 Measurement Model Assessment*

The measurement model was evaluated by examining internal consistency reliability, convergent validity, and discriminant validity (Table 1). Internal consistency reliability was assessed using Cronbach's alpha, Dijkstra–Henseler's rho, and the composite reliability index (CRI). The results indicate strong reliability, as Cronbach's alpha values ranged from 0.902 to 0.945, exceeding the recommended threshold of 0.70 (Hair *et al.*, 2014). Similarly, Dijkstra–Henseler's rho values ranged from 0.901 to 0.945, while CRI values ranged from 0.903 to 0.946, further confirming the internal consistency of the constructs (Dijkstra & Henseler, 2015; Hair *et al.*, 2022).

Convergent validity was assessed through the average variance extracted (AVE). The AVE values ranged from 0.532 to 0.649, exceeding the minimum recommended value of 0.50 (Table 1). This indicates that each construct explains more than 50% of the variance of its associated indicators, thereby supporting convergent validity (Fornell & Larcker, 1981; Hair *et al.*, 2014).
Discriminant validity was evaluated using the Fornell–Larcker criterion and the heterotrait–monotrait ratio of correlations (HTMT). According to the Fornell–Larcker criterion, the square root of the AVE for each construct should be greater than its correlations with other constructs (Fornell & Larcker, 1981). The results generally support discriminant validity; however, a potential concern is observed between Corporate Resilience and Sustainable Development. Specifically, the correlation between these two constructs was 0.813, which is higher than the square root of AVE for Corporate Resilience, 0.767, and slightly higher than that of Sustainable Development, 0.805 (Table 1). This suggests that discriminant validity between these two constructs is not fully established under the Fornell–Larcker criterion.

Nevertheless, the HTMT results provide additional support for discriminant validity. All HTMT values were below the commonly recommended thresholds of 0.85 and 0.90 (Henseler *et al.*, 2015). The highest HTMT value was 0.806, observed between Corporate Resilience and Sustainable Development (Table 1), indicating that although these constructs are strongly related, they remain empirically distinguishable according to the HTMT criterion. Therefore, the measurement model demonstrates strong reliability and adequate convergent validity, while discriminant validity is largely supported, with a minor concern regarding the conceptual and empirical overlap between Corporate Resilience and Sustainable Development.

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Table 1. Measurement Model. Reliability, Validity and Discriminant Validity

| **PANEL A. Reliability and Validity** | | | | | | |
|---|---|---|---|---|---|---|
| **Variables** | **Cronbach's Alpha** | | **Dijkstra-Henseler rho** | **CRI** | **AVE** | |
| **Supply Chain Cooperation** | 0.902 | | 0.901 | 0.903 | 0.532 | |
| **Corporate Resilience** | 0.945 | | 0.945 | 0.946 | 0.588 | |
| **Sustainable Development** | 0.929 | | 0.928 | 0.931 | 0.649 | |
| **PANEL B. Fornell & Larcker Criterion** | | | | **Heterotrait–Monotrait ratio (HTMT)** | | |
| **Variables** | **1** | **2** | **3** | **1** | **2** | **3** |
| **1. Corporate Resilience** | **0.767** | | | | | |
| **2. Supply Chain Cooperation** | 0.619 | **0.73** | | 0.614 | | |
| **3. Sustainable Development** | 0.813 | 0.529 | **0.805** | 0.806 | 0.523 | |

**Note: PANEL B:** Fornell & Larcker Criterion: Diagonal elements (bold) are the square root of the variance shared between the constructs and their measures (AVE). For discriminant validity, diagonal elements should be larger than off-diagonal elements.

### 3. Results

The structural model was assessed by examining the standardized path coefficients, t-values, p-values, bootstrapped 95% confidence intervals, effect sizes ($f^2$), adjusted $R^2$ values, and model fit índices (Table 2). Following the recommended procedures for PLS-SEM, the significance of the structural paths was evaluated using bootstrapping, while effect sizes were interpreted based on Cohen's guidelines (Hair *et al.*, 2017).

Table 2. Structural Model

| **Paths** | **Path (*t-value; p-value*)** | **95% Confidence Interval** | **$f^2$** | **Support** |
|---|---|---|---|---|
| **SCC → CR** | 0.619 (12.545 - 0.000) | [0.521 - 0.717] | 0.621 | Yes |
| **SCC → SD** | 0.042 (0.741 - 0.459) | [-0.067 - 0.155] | 0.003 | No |
| **CR → SD** | 0.786 (14.348 - 0.000) | [0.676 - 0.891] | 1.126 | Yes |
| **SCC→CR →SD** | 0.487 (9.292 – 0.000) | [0.393 – 0.599] | | Yes |
| **Endogenous Variable** | **Adjusted $R^2$** | **Model Fit** | **Value** | **HI99** |
| | | SRMR | 0.085 | 0.096 |

| | | | | |
|---|---|---|---|---|
| **Corporate Resilience** | 0.383 | dULS | 2.702 | 2.797 |
| **Sustainable Development** | 0.661 | dG | 2.124 | 2.551 |

**Note:** *SCC:* Supply Chain Cooperation; *CR:* Corporate Resilience; *SD:* Sustainable

Development. One-tailed t-values and p-values in parentheses; bootstrapping 95% confidence intervals (based on n = 10,000 subsamples) *SRMR:* standardized root mean squared residual; dULS: unweighted least squares discrepancy; *dG:* geodesic discrepancy; *HI99:* bootstrap-based 99% percentiles.

The results indicate that the relationship between Supply Chain Cooperation and Corporate Resilience was positive and statistically significant, $\beta = 0.619$, $t = 12.545$, $p < 0.001$, with a 95% confidence interval ranging from 0.521 to 0.717. Since the confidence interval did not include zero, this hypothesis was supported. Moreover, the effect size was substantial, $f^2 = 0.621$, indicating that Supply Chain Cooperation has a strong effect on Corporate Resilience.

In contrast, the direct relationship between Supply Chain Cooperation and Sustainable Development was not statistically significant, $\beta = 0.042$, $t = 0.741$, $p = 0.459$, with a 95% confidence interval ranging from -0.067 to 0.155. Because the confidence interval included zero and the p-value exceeded the conventional significance level, this hypothesis was not supported. In addition, the effect size was negligible, $f^2 = 0.003$, suggesting that Supply Chain Cooperation does not exert a meaningful direct effect on Sustainable Development.

The relationship between Corporate Resilience and Sustainable Development was positive and statistically significant, $\beta = 0.786$, $t = 14.348$, $p < 0.001$, with a 95% confidence interval ranging from 0.676 to 0.891. Since the confidence interval did not include zero, this hypothesis was supported. The effect size was very strong, $f^2 = 1.126$, indicating that Corporate Resilience is a key predictor of Sustainable Development. Based on Cohen's (1988) benchmarks, $f^2$ values of 0.02, 0.15, and 0.35 are commonly interpreted as small, medium, and large effects, respectively; therefore, the effects of SCC on CR and CR on SD can be considered large, whereas the effect of SCC on SD is negligible.

The adjusted $R^2$ values further demonstrate the explanatory power of the model. Supply Chain Cooperation explained 38.3% of the variance in Corporate Resilience, while Supply Chain Cooperation and Corporate Resilience jointly explained 66.1% of the variance in Sustainable Development. These findings suggest that the model has adequate explanatory capacity, particularly for Sustainable Development.

Regarding model fit, the SRMR value was 0.085, which is slightly above the commonly recommended threshold of 0.080 proposed for covariance-based model fit assessment (Hu & Bentler, 1999). However, in the context of PLS-SEM, model fit can also be evaluated through bootstrap-based exact fit criteria such as dULS and dG (Henseler *et al.*, 2016). In this study,

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SRMR = 0.085 was below its HI99 threshold of 0.096, dULS = 2.702 was below its HI99 threshold of 2.797, and dG = 2.124 was below its HI99 threshold of 2.551. Therefore, the model fit can be considered acceptable.

Overall, the hypothesis testing results show that two hypotheses were supported and one was not supported. Specifically, Supply Chain Cooperation significantly enhances Corporate Resilience, and Corporate Resilience significantly contributes to Sustainable Development. However, the direct effect of Supply Chain Cooperation on Sustainable Development was not significant, suggesting that Corporate Resilience may play an important mediating role in the relationship between Supply Chain Cooperation and Sustainable Development.

*3.1 Predictive Relevance Assessment*

The predictive relevance of the model was assessed using the PLSpredict procedure (Table 3). PLSpredict is recommended in PLS-SEM because it evaluates the model's ability to predict new observations through out-of-sample prediction, rather than relying only on explanatory measures such as path coefficients and $R^2$ values (Shmueli *et al.*, 2016; Shmueli *et al.*, 2019). A positive $Q^2$predict value indicates that the PLS-SEM model outperforms a naive benchmark based on mean predictions, thereby suggesting predictive relevance for the endogenous construct (Shmueli *et al.*, 2019).

The results show that the model has predictive relevance for both endogenous constructs. Specifically, Corporate Resilience obtained a $Q^2$predict value of 0.317, while Sustainable Development obtained a $Q^2$predict value of 0.224. Since both values are greater than zero, the findings indicate that the model demonstrates acceptable out-of-sample predictive power for these constructs. The descriptive statistics further show that the prediction errors are centered around zero, as reflected in the mean and median values for Corporate Resilience, Mean = -0.001 and Median = -0.040, and Sustainable Development, Mean = 0.000 and Median = 0.037.

In addition, the Cramér–von Mises test was used to assess the distributional characteristics of the data. The results were statistically significant for both Corporate Resilience, statistic = 1.643, $p < 0.001$, and Sustainable Development, statistic = 3.117, $p < 0.001$. These findings indicate that the distributions significantly deviate from normality. However, this does not represent a major concern in the context of PLS-SEM, as the method is prediction-oriented and commonly relies on non-parametric procedures, such as bootstrapping, to assess statistical inference (Hair *et al.*, 2017; Shmueli *et al.*, 2019). Therefore, the results support the predictive relevance of the model, while also suggesting that non-parametric estimation and inference procedures are appropriate for the analysis.

Table 3. PLS-SEM Q2predict and prediction error (descriptives)

| | $Q^2$predict | Mean | Median | Observed Min. | Observed Max. | Cramér-von Mises Test Statistics | Cramér-von Mises p-value |
|---|---|---|---|---|---|---|---|
| **Corporate Resilience** | 0.317 | -0.001 | -0.04 | -2.669 | 3.089 | 1.643 | 0.000 |
| **Sustainable Development** | 0.224 | 0 | 0.037 | -3.138 | 2.996 | 3.117 | 0.000 |

Overall, the positive $Q^2$predict values indicate that the model has predictive relevance for Corporate Resilience and Sustainable Development. The predictive capacity is stronger for Corporate Resilience than for Sustainable Development, as shown by the higher $Q^2$predict value. Nevertheless, both constructs exhibit acceptable predictive performance, supporting the model's ability to generate meaningful out-of-sample predictions.

## 4. Discussion

The findings contribute to the literature by reinforcing the role of supply chain cooperation as a relational capability that supports organizational adaptation in uncertain environments. From the perspective of dynamic capabilities theory, firms develop competitive responses not only through internal resources but also through their ability to integrate, reconfigure, and mobilize external competencies (Teece *et al.*, 1997; Teece, 2007, 2018). In this sense, cooperation with supply chain partners enables firms to access complementary knowledge, operational resources, and relational assets that may be difficult to generate independently (Håkansson & Snehota, 1995; Giglio *et al.*, 2023). This is especially relevant for manufacturing firms, where disruptions, market volatility, and operational interdependence require coordinated responses across organizational boundaries. The evidence suggests that cooperation strengthens resilience because it improves information exchange, coordination, joint problem solving, and flexibility among supply chain actors (Berends & Sydow, 2019; Oliveira & Lumineau, 2019). Such collaborative mechanisms allow firms to anticipate vulnerabilities, absorb disruptions, and reorganize resources when facing adverse conditions (Ortiz-de-Mandojana & Bansal, 2016; Duchek, 2020).
Therefore, supply chain cooperation should not be understood merely as an operational arrangement, but as a strategic process through which firms build adaptive capacity. This interpretation is consistent with the view that interorganizational relationships can become sources of learning, innovation, and collective resilience (Dyer & Singh, 1998; Hult *et al.*, 2006). Consequently, the discussion supports the idea that resilient manufacturing firms are those capable of transforming cooperation into routines for adaptation, recovery, and continuity. This reinforces the relevance of cooperation as a key antecedent of corporate resilience in turbulent industrial contexts.

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The absence of a direct contribution of supply chain cooperation to sustainable development can be interpreted as evidence that collaboration alone may be insufficient to generate sustainability outcomes. Although cooperation provides access to resources, knowledge, and coordinated practices, its benefits depend on the firm's ability to absorb, recombine, and deploy those resources toward long-term sustainability objectives (Teece, 2007; Ramos *et al.*, 2023). Sustainable development requires firms to balance economic, social, and environmental priorities, which often involves strategic commitment, innovation, stakeholder engagement, and organizational transformation (Elkington, 2018; Abbas, 2020; Algarni *et al.*, 2022). Thus, cooperative relationships may create favorable conditions for sustainability, but they do not automatically produce sustainable outcomes. This interpretation is consistent with prior literature showing that cooperation may be limited by opportunistic behavior, coordination costs, incentive misalignment, and conflicts of interest (Williamson, 1985, 2008; Poppo & Zenger, 2002). In addition, firms may face internal restrictions such as limited absorptive capacity, scarce financial resources, rigid routines, or insufficient managerial awareness regarding environmental and social responsibilities (Lepoutre & Heene, 2006; Lewis *et al.*, 2015). These barriers may prevent firms from converting collaborative arrangements into concrete sustainability practices.

Accordingly, supply chain cooperation appears to require an internal organizational mechanism capable of translating external collaboration into sustainable value creation. Corporate resilience may perform this function by allowing firms to maintain continuity, reorganize resources, and sustain strategic priorities under pressure (Williams *et al.*, 2017; Duchek, 2020). Therefore, the discussion suggests that cooperation contributes to sustainable development more effectively when it is mediated by resilience-oriented capabilities. The relationship between corporate resilience and sustainable development highlights the strategic importance of resilience as a bridge between adaptation and long-term value creation. Resilient firms are better prepared to respond to environmental turbulence without abandoning their economic, social, and environmental commitments (Ortiz-de-Mandojana & Bansal, 2016; Duchek, 2020). This is important because sustainable development requires continuity over time, particularly when firms face disruptions that may otherwise force them to prioritize short-term survival over broader stakeholder responsibilities. From a dynamic capability perspective, resilience enables organizations to redesign routines, reallocate resources, and renew strategies in response to changing external conditions (Teece, 2007, 2017; Williams *et al.*, 2017).

These capabilities are central to sustainability because environmental and social initiatives frequently demand learning, flexibility, innovation, and long-term investment. Resilient organizations may also be better positioned to preserve stakeholder trust and legitimacy during periods of uncertainty (Bansal & Clelland, 2004; Arvidsson & Dumay, 2021). This supports the argument that sustainability depends not only on responsible practices, but also on the organizational capacity to maintain those practices when facing crises. At the same time, the discussion recognizes that resilience does not automatically guarantee sustainable development if firms lack strategic orientation or sufficient resources (Aragón-Correa & Sharma, 2003; Kim *et al.*, 2019). However, when resilience is aligned with sustainability objectives, it can help firms transform disruption into adaptive renewal and responsible growth. Overall, the findings position

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corporate resilience as a central mechanism through which manufacturing firms can convert cooperative capabilities into sustainable development.

*4.1 Practical Implications*

The findings offer relevant practical implications for managers of manufacturing firms. First, managers should recognize that supply chain cooperation is valuable not merely as a transactional mechanism, but as a strategic capability for strengthening corporate resilience. This implies that firms should invest in long-term collaborative relationships with suppliers, customers, and logistics partners through information sharing, joint planning, technological integration, and coordinated risk management. However, cooperation alone may not be sufficient to produce sustainable development outcomes unless firms develop internal capabilities to absorb and transform external resources into adaptive and sustainability-oriented practices. Therefore, managers should strengthen resilience by improving organizational flexibility, developing contingency plans, diversifying critical resources, and promoting cross-functional decision-making. In addition, sustainability strategies should be integrated into resilience planning so that firms can maintain environmental, social, and economic commitments even during periods of disruption. For Mexican manufacturing firms, this means that collaborative supply chain practices should be deliberately aligned with resilience-building processes, allowing companies to respond more effectively to uncertainty while advancing long-term sustainable development goals.

*4.2 Conclusions*

This study concludes that supply chain cooperation plays an important role in strengthening corporate resilience and that corporate resilience, in turn, contributes to sustainable development in manufacturing firms. The findings suggest that cooperation among supply chain actors is especially valuable when it is translated into adaptive organizational capabilities, such as flexibility, resource reconfiguration, continuity planning, and coordinated responses to disruption. However, the absence of a direct effect of supply chain cooperation on sustainable development indicates that collaborative relationships do not automatically generate sustainability outcomes. Instead, sustainable development appears to depend on the firm's ability to internalize cooperative benefits and transform them into resilient organizational responses. In this sense, corporate resilience operates as a strategic bridge between external cooperation and long-term sustainability. This conclusion reinforces the relevance of dynamic capabilities theory by showing that firms achieve sustainable outcomes not simply by accessing external resources, but by developing the capacity to absorb, recombine, and deploy those resources under conditions of uncertainty.

Despite these contributions, the study has several limitations that open opportunities for future research. First, the analysis was based on manufacturing firms located in Mexico, which may limit the generalizability of the findings to other countries, sectors, or institutional environments. Future studies could replicate the model in different industrial contexts and compare results across emerging and developed economies. Second, the study used cross-sectional data, which

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restricts the ability to examine changes over time or establish causal dynamics among supply chain cooperation, corporate resilience, and sustainable development. Longitudinal research could provide deeper insight into how cooperative relationships evolve and how resilience capabilities are developed during and after disruptions. Third, future research could examine additional mediating or moderating variables, such as digital transformation, green innovation, organizational learning, environmental uncertainty, institutional pressure, or supply chain complexity. Finally, qualitative or mixed-method approaches could complement the quantitative findings by exploring how managers actually transform cooperation into resilience and sustainability-oriented practices within manufacturing supply chains.

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**Authors' contributions**

Dra. Vianney Judith Robledo Herrera was responsible for study design, review and data collection. Dra. Verónica Gabriela Valdivia-Plaza writo the original draft. Dr. Gonzalo Maldonado Guzmán y el Dr. Rubén Michael Rodríguez González[4] refined, validated, reviewed, and edited it. All authors read and approved the final manuscript.

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