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Original Article

Prioritizing Supply Chain Resilience Over Collaboration: Evidence from Pharmaceutical Manufacturing Firms in Indonesia

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Abstract: *This study examines the effects of Green Supply Chain Collaboration (GSCC) and supply chain resilience (SCR) on sustainable performance (SP) in pharmaceutical manufacturing firms in the Jabodetabek region, Indonesia. Data are collected from 425 managerial employees and analyzed using partial least squares structural equation modeling. The results provide empirical evidence that both GSCC and SCR have significant positive effects on SP. The findings further demonstrate that SCR exerts a stronger effect than GSCC, indicating its greater importance in driving SP. These results suggest that firms should prioritize strengthening resilience capabilities over developing collaboration initiatives to achieve higher SP. This study contributes by providing a comparative understanding of key supply chain capabilities in improving SP within a highly regulated manufacturing context.*

Keywords: *Green Suppy Chain Collaboration, Pharmaceutical Manufacturing, Supply Chain Resilience, Sustainable Performance.*

I. INTRODUCTION

Demand for sustainable performance (SP) is mounting across industries, but the pharmaceutical manufacturing industry also has very specific pressures arising from an increased regulatory demand, operational complexity and stakeholders who expect greater environmental responsibility. Whatever the sources of capital investment must be fed by rough processes which consume energy (largely from the fossil faction) and are heavily regulated in terms of quality management bearing high environmental devious (Bade et al., 2024). Concurrently, the tight regulation structure in pharmaceutical supply chains and reliance on single-source supplier contracts render firms less responsive to environmental change (Badejo & Ierapetritou, 2024; Mastrantonas et al., 2024). These conditions make the achievement of SP a complex challenge, as firms must balance regulatory compliance, environmental sustainability, and operational continuity within a relatively rigid system.

These challenges are further intensified in emerging economies such as Indonesia, where the pharmaceutical industry remains highly dependent on imported active pharmaceutical ingredients, with more than 85–90 percent of raw material needs sourced from overseas (Arief et al., 2022). This dependence increases vulnerability to global supply chain disruptions, price volatility, and geopolitical risks, which directly affect production continuity and SP (Khan & Rauf, 2024; Mastrantonas et al., 2024). Under such conditions, firms tend to rely on reactive approaches such as increasing safety stock, searching for alternative suppliers on an ad hoc basis, or adjusting production after disruptions occur, which have proven insufficient to maintain stability and SP (Silva et al., 2023; Taris & Ardi, 2023). Therefore, firms require supply chain capabilities that strengthen coordination across partners while enhancing adaptability to disruptions within a highly constrained operational environment (Belhadi et al., 2024; Zhou et al., 2024).

In this context, green supply chain collaboration (GSCC) and supply chain resilience (SCR) are considered critical capabilities in improving SP. GSCC focuses on aligning environmental objectives through information sharing, coordination, and joint resource utilisation across supply chain partners (Cheng et al., 2024), whereas SCR emphasises firms' ability to anticipate, respond to, and recover from disruptions in increasingly uncertain environments (Belhadi et al., 2024; Zhou et al., 2024). While both capabilities contribute to SP, prior studies have largely examined them in isolation, providing a limited understanding of which supply chain capability delivers greater impact on SP and should therefore be prioritised, particularly in highly regulated industries such as pharmaceutical manufacturing, where supply chain effectiveness directly determines sustainability outcomes. More importantly, existing research has not sufficiently addressed how relational capabilities, such as GSCC and dynamic capabilities, such as SCR, differ in their roles and relative importance in shaping SP under such constraints. This gap creates uncertainty for managers in allocating limited resources between collaboration-driven and resilience-driven strategies. Therefore, this study aims to compare the effects of GSCC and SCR on SP in pharmaceutical manufacturing firms in the Jabodetabek region, Indonesia. This study advances the literature by demonstrating that, within highly regulated

pharmaceutical supply chains, dynamic capabilities in the form of SCR exert a more dominant influence on SP than relational capabilities such as GSCC, thereby redefining strategic capability prioritisation under regulatory constraints.

II. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

A) Resource-Based View Theory

The Resource Based View explains that sustainable competitive advantage arises from a firm's ability to manage valuable, rare, inimitable, and well-organized resources and capabilities (Barney, 1991, 2001). In the supply chain context, GSCC and SCR can be understood as strategic capabilities, as they enable firms to manage processes, information, and relationships more effectively to support sustainable performance (Patrucco et al., 2022; Sirmon et al., 2007). However, in dynamic environments, the mere possession of resources is insufficient, requiring firms to continuously adapt and reconfigure their resources to remain competitive (Teece, 2007; Teece et al., 1997)

B) Dynamic Capability View

The Dynamic Capabilities View highlights that the ability to sense, seize, and reconfigure resources is essential for responding to environmental changes and uncertainties (Eisenhardt & Martin, 2000; Teece, 2007). In this perspective, SCR reflects a dynamic capability, as it represents a firm's ability to anticipate, respond to, and recover from supply chain disruptions in an adaptive manner (Belhadi et al., 2024; Zhou et al., 2024). GSCC also aligns with this view, as it requires continuous adjustment of coordination, information sharing, and joint resource utilization across supply chain partners in response to evolving conditions (Cheng et al., 2024; Teece, 2007).

C) Relational View

The Relational View emphasizes that competitive advantage is also generated through inter-organizational relationships that create shared value (Dyer & Singh, 1998; Fawcett et al., 2015). In this context, GSCC and SCR can be seen as capabilities that are both internal and relational, as they depend on the quality of coordination and interaction among supply chain partners in managing uncertainty (Belhadi et al., 2024; Dyer et al., 2018; Dyer & Singh, 1998)

D) The Effect of Green Supply Chain Collaboration on Sustainable Performance

GSCC has been widely recognized as a key driver of SP, as collaboration across supply chain partners enables the alignment of environmental objectives and the integration of operational activities (Cao & Zhang, 2011; Carter & Rogers, 2008). Empirical evidence shows that GSCC practices, including information sharing, joint planning, and resource integration, significantly improve environmental and operational performance, leading to enhanced SP outcomes (Ahmed et al., 2020; Uddin & Akhter, 2022).

The relational perspective, which holds that collaboration provides a means for firms to obtain complementary resources and capabilities that enhance joint performance (Dyer & Singh, 1998), supports this relationship. Several pieces of empirical evidence support that GSCC enhances coordination and decreases uncertainty among supply chain partners, and have equipped firms to achieve SP from economic, environmental and social dimensions simultaneously (Billah et al., 2023; Javed et al., 2024; Lee & Ha, 2020). The theoretical and empirical arguments provided suggest that GSCC will have a positive impact on SP.

Therefore, the following hypothesis is formulated: H1: GSCC has a positive and significant effect on SP.

E) The Effect of Supply Chain Resilience on Sustainable Performance

SCR enables firms to maintain operations, recover from disruptions, and sustain performance under uncertainty, thereby supporting SP outcomes (Nartey, 2024; Opoku et al., 2025). Empirical evidence shows that SCR improves efficiency, coordination, and responsiveness, which are essential for achieving SP in supply chains (Sharma et al., 2024).

From a capability perspective, SCR allows firms to adapt and reconfigure resources in dynamic environments, leading to improved SP (Rodríguez-González et al., 2023). In addition, SCR strengthens resource utilization and environmental performance through better integration and recovery mechanisms within supply chains (Altan et al., 2024; Metwally et al., 2024).

Therefore, SCR is expected to enhance firms' ability to achieve SP. Accordingly, the following hypothesis is proposed: H2: SCR has a positive and significant effect on SP.

III. RESEARCH METHODOLOGY

This study adopts a quantitative research design using a structured questionnaire to examine the relationships among GSCC, SCR, and SP in pharmaceutical manufacturing firms. Data were collected from 425 managerial employees working in injection pharmaceutical manufacturing companies located in the Jabodetabek region, Indonesia. Respondents were selected to ensure they possess relevant knowledge of supply chain practices and operational processes.

SCR was measured using indicators adapted from Zhou et al. (2024), GSCC was measured based on Cheng et al. (2024), and SP was adapted from Jayashree et al. (2021) and Martínez-Falcó et al. (2024). All constructs were assessed using multiple indicators to ensure reliability and validity. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM), which is appropriate for examining complex relationships between constructs and predictive research models.

IV. RESULTS

A) Reliability and convergent validity

Table 1 : Construct Reliability, Validity, and Collinearity Test Result

Dimension	Constructs, details of measures, and results of validity and reliability tests	Outer Loading	VIF
	Green Supply Chain Collaboration (AVE= 0.514, Rho_a = 0.934, CR = 0.941, CA =0.932)		
Green Information Collaboration	Our company has shared knowledge and information related to green technologies with upstream and downstream partners.	0.696	2.103
	Our company has shared knowledge and information related to green production and processing with upstream and downstream partners.	0.724	2.141
	Our company has shared experience, knowledge and information related to green product operations and management with upstream and downstream partners.	0.723	2.039
	Our company has shared knowledge and information related to green product marketing with upstream and downstream partners.	0.743	2.316
	Our company has shared the latest research reports and trends in the industry with upstream and downstream partners.	0.733	2.343
Green Resource Collaboration	Our company has shared equipment, technology, talent and other resources with upstream and downstream partners.	0.706	2.037
	Our company has made full use of existing green resources to expand the business field with upstream and downstream partners.	0.756	2.576
	Our company has developed new green resources in new business fields jointly with upstream and downstream partners.	0.711	2.077
	Our company has developed new products or provided new services using new green resources jointly with upstream and downstream partners.	0.739	2.203
	Our company has obtained new green resources from the outside to grow existing business fields jointly with upstream and downstream partners.	0.721	2.001
Green Strategic Collaboration	Our company maintains long-term and stable cooperative relations with upstream and downstream partners.	0.704	2.045
	Our company has achieved a common strategic goal of environmental protection with upstream and downstream partners.	0.637	1.771
	Our company has formulated strategic plans for green production, sales, research and development jointly with upstream and downstream partners.	0.735	1.989
	Our company has made strategic decisions and developed solutions to problems jointly with upstream and downstream partners.	0.708	1.962
	Our company has formed a common coordination mechanism in terms of costs, benefits and risks with upstream and downstream partners.	0.714	2.110
	Supply chain resilience (AVE= 0.530, Rho_a = 0.827, CR = 0.871, CA =0.823)		
External Resilience	We and our main supplier are able to maintain high situational awareness at all times	0.685	1.561
	We and our main supplier are able to provide a quick response to the supply chain disruption	0.729	1.552
	We and our main supplier are able to adapt to the supply chain disruption easily	0.701	1.457
Internal Resilience	Our firm's supply chain is able to adequately respond to unexpected disruption by quickly restoring its product flow	0.734	1.580
	Our firm's supply chain can move to a new, more desirable state after being disrupted	0.785	1.751
	Our firm's supply chain has the ability to maintain the desired level of control over structure and function at the time of disruption	0.731	1.667
Economic Sustainability	Sustainability performance *(AVE= 0.584, Rho_a = 0.946, CR = 0.952, CA =0.945)*		
	Our company's average return on investment is above the industry average over the past five years	0.757	2.232
	Our company's average profit is above the industry average over the last five years	0.736	2.221
	Our company's profit growth is above the industry average over the last five years.	0.791	2.530

	Our company's average sales profitability is above the industry average over the last five years	0.722	2.093
	Our company has decreased the cost of energy consumption by implementing industry 4.0	0.780	2.622
Social Sustainability	Our company has improved the well-being of its stakeholders compared to its competitors over the last five years	0.757	2.158
	Our company has improved the health and safety of the community in which it operates relative to its competitors over the past five years	0.730	2.133
	Our company has reduced its environmental impact and risks to the general public relative to its competitors over the past five years	0.778	2.412
	Our company has provided health and safety requirements for the employees to achieve sustainability	0.742	2.059
	Our company has developed new products that reduces health risk for consumers to achieve sustainability by implementing industry 4.0	0.798	2.682
Environment Sustainability	Our company has reduced waste and emissions from operations relative to its competitors over the past five years	0.779	2.448
	Our company has reduced the environmental impact of its products/services relative to its competitors over the past five years	0.791	2.556
	Our company has reduced energy consumption to achieve sustainability by implementing industry 4.0	0.782	2.565
	Our company has decreased the consumption materials to achieve sustainability by implementing Industry 4.0	0.753	2.326

All constructs demonstrate outer loading values above the acceptable threshold, and the AVE, CR, and CA values meet the required criteria, indicating that the measurement instruments have good convergent validity and reliability. In addition, the VIF values are below the critical threshold, suggesting no multicollinearity issues, and thus the model is appropriate for further structural analysis.

B) Discriminant Validity

Discriminant validity was evaluated using the Heterotrait–Monotrait Ratio (HTMT). The results indicate that all HTMT values are below the conservative threshold of 0.85, confirming sufficient discriminant validity and indicating that each construct is empirically and conceptually distinct (Hair et al., 2022).

Table 2: Heterotrait-Monotrait Ratio (HTMT)

Variable	1	2
GSCC		
SCR	0.432	
SP	0.442	0.721

C) Hypothesis Test Results

Table 3: Hypothesis Testing Result

Path	Coefficient β	*t*-values	*p*-values	Results
H1 GSCC → SP	0.113	2.008	0.022	Supported
H2 SCR → SP	0.335	4.762	0.000	Supported

Based on the hypothesis testing results, GSCC has a positive and significant effect on SP with a coefficient of 0.113, a t-value of 2.008, and a p-value of 0.022, indicating that H1 is supported. Furthermore, SCR also has a positive and significant effect on SP with a coefficient of 0.335, a t-value of 6.153, and a p-value of 0.000, indicating that H2 is supported. These findings suggest that SCR has a stronger influence on SP compared to GSCC, highlighting its more dominant role in enhancing sustainable performance.

V. DISCUSSION

SCR is more effective than GSCC over SP, suggesting that adaptive organizational capabilities are more dominant than collaborative mechanisms in improving sustainable performance. Hence, this finding implicitly denotes that internal resilience is much more important compared to external resilience as the capability of responding speedily, recovering processes and achieving continuity becomes a major factor in minimal infiltration against disruptions. SCR, then in this context, not only reflects inter organizational relationship but also demonstrates itself as a dynamic capability enabling the firms to convert resources for effective operational response. On the other hand, GSCC represents a collective relational capability that acts as an infrastructure to enable coordination, information exchange, and alignment among supply chain partners. But in the absence of

robust internal capacity, that kind of collaboration does not translate automatically into the adaptive responses needed to maintain performance in a world of uncertainty.

In the context of highly regulated pharmaceutical manufacturing, these limitations become more evident. The findings of this study indicate that GSCC is more strongly manifested in green information sharing, while resource collaboration remains relatively weak. This suggests that although firms have established coordination and information exchange with supply chain partners, deeper forms of collaboration, such as resource integration and joint operational practices, are still constrained. This condition can be explained by the fact that operational processes in the pharmaceutical industry are strictly regulated with high compliance standards, such that any change requires lengthy and costly validation processes, particularly when involving external parties, which in turn limits firms' flexibility in integrating resources with supply chain partners. As a result, although GSCC has a positive effect on SP, its contribution tends to be limited as it has not fully developed at a more substantive level of collaboration. This finding challenges the common assumption that inter organizational collaboration alone is sufficient to drive sustainable performance, by showing that in highly regulated environments, without strong internal capabilities, the impact of collaboration remains limited and is less influential than supply chain resilience in improving sustainable performance.

VI. IMPLICATIONS

A) Theoretical Contribution

These findings reinforce the dynamic capabilities perspective (Teece et al., 1997), which emphasizes the importance of leveraging and integrating internal and external firm-specific competencies to respond to environmental changes, by demonstrating that SCR represents this capability in the context of supply chain disruptions. SCR reflects not only inter-organizational coordination but also the firm's internal adaptive capacity to transform resources into effective operational responses under uncertainty.

In addition, these findings also support the Relational View (Dyer & Singh, 1998) by showing that collaborative mechanisms such as GSCC play a role in facilitating coordination, information sharing, and alignment among supply chain partners. While collaboration contributes to performance improvement, its effect tends to be less substantial than that of dynamic capabilities in driving sustainable performance. Thus, relational capability functions as a complementary driver, whereas dynamic capability serves as the primary mechanism through which collaboration is translated into sustainable performance.

B) Managerial Implications

The findings indicate that pharmaceutical manufacturing firms need to prioritize strengthening SCR as the primary focus in improving SP, particularly by enhancing response capability to disruptions, accelerating recovery processes, and ensuring operational continuity. At the same time, managers should not overlook GSCC as a supporting mechanism to strengthen coordination among supply chain partners. Therefore, managers need to implement *resource orchestration* by integrating SCR and GSCC simultaneously, so that strong internal resilience can reinforce the effectiveness of external collaboration and ultimately lead to more optimal SP.

VII. CONCLUSION

This study shows that GSCC and SCR have positive and significant effects on SP, with SCR exhibiting a more dominant effect than GSCC. The findings confirm that, in the context of highly regulated pharmaceutical manufacturing, internal adaptive capabilities reflected in SCR serve as the primary determinant within the supply chain in maintaining and enhancing sustainable performance under conditions of uncertainty. Meanwhile, GSCC remains important as a collaborative mechanism that supports performance, although its contribution is not as strong as that of resilience capabilities.

VIII. LIMITATION AND FUTURE RESEARCH

This study has several limitations that should be considered. First, it adopts a cross-sectional design, which limits the ability to capture the dynamic evolution of capabilities and performance over time. Second, the research context is restricted to pharmaceutical manufacturing firms with injectable production facilities in the Jabodetabek region, which may limit the generalizability of the findings to other industries or geographical settings. In addition, the study focuses only on GSCC and SCR without incorporating other factors that may also influence SP.

Future research is encouraged to employ longitudinal approaches to better capture the development of organizational capabilities over time. Further studies may also expand the research context to different industries or regions to enhance the generalizability of the findings. Moreover, future research could incorporate additional variables such as regulatory pressure, supply chain complexity, or the level of technology adoption to provide a more comprehensive understanding of the determinants of SP. The use of mixed method approaches may also offer deeper insights into how organizational capabilities are developed and implemented in practice.

Interest Conflicts

The author(s) declare that there is no conflict of interest concerning the publication of this paper.

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