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The Resilience of Supply Chain: The Case of Vietnamese Pharmaceutical Companies

Nguyen Thi Mai Anh[1*], Le Van Chinh[2], Pham Mai Chi[1], Vu Dinh Nghiem Hung[1]
[1]School of Economics and Management, Hanoi University of Science and Technology, Ha Noi, Vietnam
[2] International SEPT Competence Center, Leipzig University, Leipzig, Germany
[*]Corresponding author email: anh.nguyenthimai@hust.edu.vn

Abstract

The COVID-19 pandemic has highlighted the crucial importance of supply chain resilience (SCR), especially in pharmaceutical companies. The disruptions exposed vulnerabilities compounded by the industry's globalized and complex nature. In Vietnam, the pharmaceutical sector is vital, serving approximately 97.33 million people. Despite significant growth, the industry faces challenges like heavy reliance on imported drugs, which make up nearly half of total consumption. The pandemic further strained supply chains, causing shortages and price hikes due to demand spikes and logistical issues. This study explores the perceptions of Vietnamese pharmaceutical companies regarding their supply chain capabilities and competencies and their impact on resilience. Using a survey methodology, data was collected from 109 pharmaceutical companies in Vietnam through convenience sampling, considering company size, ownership, and types. The analysis involved descriptive statistics, Cronbach's Alpha reliability testing, and multiple regression analysis. Findings reveal that "Information System Capabilities (ISC)" and "Supply Chain Management Strategies (SMS)" significantly and positively influence both the agility and Robustness (RO) of supply chains. "Risk Management Capabilities (RMC)" positively and significantly affect RO alone. The study emphasizes the need for strategic investments in technology and risk management to enhance SCR, allowing companies to effectively handle uncertainties and disruptions while maintaining operational excellence.

Keywords: Supply chain, supply chain management, resilience, pharmaceutical companies, Vietnam

1. Introduction

The COVID-19 pandemic, with its global impact and numerous fatalities, has underscored the critical importance of understanding resilience, particularly within pharmaceutical supply networks [1]. Scholars and practitioners agree that supply chains are becoming increasingly fragile and prone to disruption due to their growing complexity, global nature, shorter product lifecycles, and a strong focus on organizational efficiency [2]. Christoph (2014) highlighted the significant influence of supply chain capabilities and strategies on resilience [3].

The vulnerability of the pharmaceutical supply chain is exacerbated by the geographical separation of raw material production, manufacturing, and distribution sites. The COVID-19 pandemic has particularly challenged this industry, with sudden demand spikes for certain drugs leading to shortages of raw materials and finished products, which in turn drove up prices. Lockdowns and transportation difficulties further disrupted supply chains. International shipping disruptions and export restrictions on raw materials compounded these challenges. Additionally, major raw material-producing countries like China and India experienced reduced production capacity during the pandemic.

According to the World Bank [4], in Vietnam, the pharmaceutical sector is a significant socioeconomic segment, serving the health needs of approximately 97.33 million people with an average lifespan of around 75.49 years. Health expenditure in Vietnam accounted for 5.03% of its GDP in 2018, with drug consumption continuously increasing. In 2019, the total value of drugs consumed was 5.62 billion US dollars. Despite the rapid growth of the pharmaceutical industry, there is a significant reliance on imported drugs, which constitute nearly 50% of total drug consumption. The domestic drug production sector has expanded significantly, with numerous factories meeting international quality standards. Export sales of pharmaceutical companies increased sharply over the past years, from USD 55.2 million in 2015 to USD 130.9 million in 2019 and reached USD 1.1 billion in 2022 [4, 5]. The pharmaceutical industry has experienced strong growth with an average annual growth rate of 10% during the period 2016-2022. The industry's total value reached USD 6.2 - 6.4 billion, and it is projected to reach USD 16.1 billion by 2026. [5]

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Overall, the pharmaceutical industry in Vietnam has shown robust growth but faces new challenges and opportunities in the context of advancing technology and changing healthcare demands. Understanding the influence of supply chain resilience (SCR) is essential for improving supply chain performance. Despite the rapid expansion of SCR research in recent years, there remains a noticeable gap in studies dedicated to this domain. This study aims to explore the perceptions of companies regarding supply chain capabilities and competencies and evaluate their influence on the SCR of pharmaceutical companies in Vietnam. The findings of this research will offer actionable strategies to enhance the SCR of pharmaceutical companies in Vietnam, contributing to improved overall business performance.

2. Literature Review and Theoretical Framework

2.1. Literature Review

2.1.1. Supply chain resilience

Christopher *et al*, [6] conceptualized a supply chain as a network of enterprises engaged in various activities that, through upstream and downstream linkages, deliver additional value to the end consumer in the form of products or services. Similarly, Chopra & Meindl [7] argued that all stakeholders directly or indirectly involved in satisfying consumer demands are part of a supply chain. Ponomarov & Holcomb's [8] multidisciplinary definition of SCR is widely accepted in theoretical frameworks. They defined SCR as the ability to respond to disruptions, adapt to unforeseen events, and maintain appropriate levels of connectivity, structural integrity, and operational control.

Most studies on SCR distinguish between two stages: the reactive dimension, encompassing reaction and recovery, and the proactive dimension, encompassing readiness and adaptation. This research adopts this framework, dividing resilience into proactive (agility) and reactive (robustness) dimensions.

2.1.2. Agility

Agility is defined as the ability to swiftly adapt to disturbances caused by disruptions in the supply chain, facilitating earlier and more effective recovery [9]. Manuj & Mentzer [10] emphasize that a rapid response to disruptions allows the supply chain to recover quickly and significantly mitigate negative impacts. Agility is measured based on four indicators proposed by Wieland & Wallenburg [11], with an additional fifth indicator from Ponomarov [12] that focuses on supply chain performance post-interruption. According to Hohenstein *et al*. [9], agility ensures adequate reaction and adaptability to disruptions, enabling the supply chain to commence recovery procedures as promptly as possible.

Agility, a part of the proactive dimension, is characterized by flexibility and reactivity. It is characterized by a demand for information enrichment and consultative forecast mechanisms. Key components of agility include visibility and velocity, crucial for achieving responsiveness and recovery.

2.1.3. Robustness

Wieland & Wallenburg [11] define the "Robustness (RO)" of a supply chain as its ability to endure external disruptions and maintain performance under various conditions. To achieve resilience, companies proactively develop capabilities to absorb and mitigate disruptions, not only restoring the initial state but also surpassing it through specialized factors and competencies. Hohenstein *et al*. [9] suggest that a robust supply chain configuration reduces the likelihood and negative impacts of disturbances, emphasizing RO as the foundation of resilience. Resilience enables a supply chain to continue operating in the face of interruptions and maintain high performance under various conditions.

Hohenstein *et al.* [9] consider RO as the fundamental basis of SCR, stating that a robust configuration reduces the probability of disruption and absorbs its potential negative effects. To minimize disruption risks and reduce negative impacts on performance, companies must implement sustainability strategies, such as safekeeping measures, as recommended by Zsidisin & Wagner [13].

2.1.4. Factors affecting the SCR

Wieland and Wallenburg [11] investigate the impact of logistics and supply chain competencies and capabilities on the resilience of supply chains, as well as the effect of resilience on customer value. They distinguish between the proactive and reactive dimensions of resilience and empirically test the effects of communication, cooperation, and integration on agility and RO. Their findings indicate that both communication and cooperation positively influence agility, while RO is supported solely by communication capabilities. Integration, however, does not significantly affect either dimension of resilience.

Ponomarov [12] developed a conceptual model of SCR and examined the relationship between the antecedents of resilience and their impact on supply chain performance at the company level. He focused particularly on the influence of certain capabilities on overall resilience and performance, and incorporated moderating factors into the holistic framework. Ponomarov's [12] research demonstrated that supply chain capabilities and information-sharing capabilities have a direct positive influence on SCR, which in turn positively impacts supply chain performance. In Vietnam, there is very little research in this field.

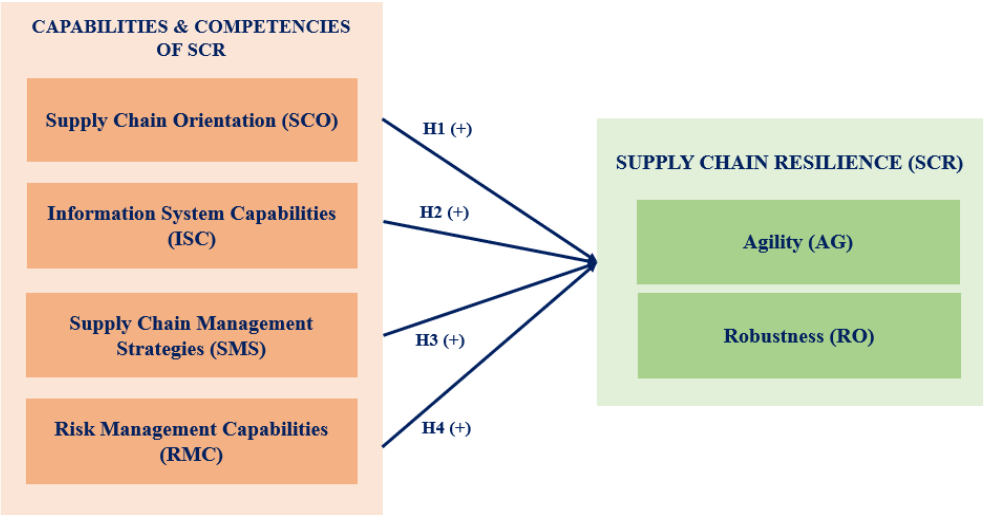

Fig. 1. A conceptual model of SCR
Source: Adopted from Christoph (2014)

Recently research by Xuan *et al.* (2021) showed that 'supply chain integration has a statistically significant positive impact on supply chain risk resilience'. [14]

2.2. Research Model and Hypotheses

This research utilizes the conceptual framework developed by Christoph [3], emphasizing company perspectives. It integrates four key components of SCR capabilities and competencies: Supply Chain Orientation (SCO); Information System Capabilities (ISC); Supply Chain Management Strategies (SMS); and Risk Management Capabilities (RMC).

Additionally, it incorporates two critical dimensions of SCR: agility and RO. The research model is illustrated in Fig. 1.

2.2.1. Supply chain orientation

Supply chain orientation (SCO) is defined as "the recognition by a company of the systemic, strategic implications of the activities and processes involved in managing the various flows in a supply chain" [15]. SCO emphasizes the strategic awareness and adoption of Supply Chain Management (SCM) within an individual firm. It is a necessary antecedent to effective SCM, suggesting that an organization must first develop internal strategic insights before it can effectively manage supply chain processes [16].

Mentzer *et al.* state that supply chain-oriented companies can detect and appreciate the systematic tactical operations, strategic impact, and scope needed to control the flow of goods, information, and finances within the supply chain. An organization with a strong SCO perceives and understands the importance and impact of managing these flows along its entire supply chain [15].

SCO is a multi-layered system that includes elements such as trust, commitment, cooperation, organizational compatibility, and top management support [15]. These components are essential for fostering a collaborative and efficient supply chain environment.

- H1-1: SCO positively influences the agility of SCR.

- H1-2: SCO positively influences the RO of SCR.

2.2.2. Information System Capabilities

ISC in a supply chain refers to the degree of information sharing, information quality, and connectivity among its members, as described by Zhao *et al.* [17]. For organizations to effectively adapt to future changes and respond swiftly, they require visibility into their supply chains. The exchange of information among companies is crucial for recognizing changes or disruptions and facilitating prompt management responses. Research indicates that agility capabilities significantly enhance supply chain performance by enabling quicker adaptation and recovery in the face of disruptions.

- H2-1: ISC positively influences the agility of SCR.

The research also underscores the importance of contact and information sharing among various supply chain stakeholders in establishing RO. Communication and information sharing among these stakeholders is important. Initiatives aimed at increasing supply network openness, particularly through the exchange of risk information, help reduce risk and enhance the overall RO of the supply chain, as noted by Lavastre *et al.* [18]. Effective information management and communication within supply chains are vital for improving agility, resilience, and overall risk reduction.

- H2-2: ISC positively influences the RO of SCR.

2.2.3. Supply Chain Management Strategies

SMS is defined as the degree to which businesses implement and apply complex strategies aimed at enhancing their resilience. Various supply chain strategies, as categorized by Tang [19], help businesses manage their resources and demands efficiently under normal circumstances and ensure operational continuity during significant disruptions. Companies can enhance SCR by creating redundancy and improving flexibility.

Redundancy-focused strategies include maintaining safety stocks, excess inventory, multiple supply sources, backup locations, and redundant capacities. Although these strategies increase operational costs, they also enhance resilience and reduce overall supply chain risk, as supported by the research of Tang [19]. Moreover, employing supply chain techniques that offer greater flexibility—despite higher short-term costs compared to lean, efficient processes—can mitigate the likelihood and impact of disruptions, ultimately leading to long-term savings, as highlighted by Christopher & Peck [6].

- H3-1: SMS positively influences the agility of SCR.

Research by Zsidisin & Wagner suggests that businesses adopt RO strategies, such as maintaining slack competency or stockpiling safe quantities of goods, to mitigate the risks of disruptions and their negative impacts on supply chain performance [13]. Yang *et al.* emphasize the importance of anticipating and preparing for potential future disruptions [19]. The studies by Zsidisin & Wagner [13] indicate that supply chain partners must proactively predict various scenarios and implement reliable options and methods to protect the supply network from future adverse effects [13]. This proactive approach aims to reduce threats and interruptions through a sturdy setup. Therefore, preparation, readiness, and the tactics supporting these capabilities are crucial for resilience, as highlighted by Wieland & Wallenburg [11].

- H3-2: SMS positively influences the RO of SCR.

2.2.4. Risk Management Capabilities

Supply chain risk management, as defined by Lavastre *et al*., involves the execution of strategies to control both day-to-day and ad hoc risks within a company's supply network. This includes assessing risks, making decisions to mitigate them, and ensuring supply chain continuity [18]. Christopher & Peck highlight the role of risk management in enhancing SCR, noting that establishing a risk management culture within a business can increase resilience by reducing cascading supply chain disruptions [6]. Strong RMC promote learning from past incidents and the development of proactive risk controls, as demonstrated by Lin & Wang [21].

- H4-1: RMC positively influences the agility of SCR.

Future risk is a crucial aspect of a robust supply chain strategy, positively affecting overall supply chain performance. According to Wieland & Wallenburg, companies with anticipatory capabilities have more time and flexibility to respond to unplanned disruptions [11]. They suggest that promoting a risk management mindset contributes to greater supply chain RO. Christopher & Peck [6] also emphasize the importance of using a variety of risk management tools to enhance the detection and control of supply chain risks, ultimately promoting resilience.

- H4-2: RMC positively influences the RO of SCR.

3. Research Methodologies and Measurement

This study aims to investigate how four dimensions of capabilities and competencies influence the SCR of pharmaceutical companies in Vietnam. The research population comprises pharmaceutical companies in Vietnam. To ensure the study's reliability and representativeness while minimizing bias, a combined snowball and convenience sampling method was employed, considering factors such as company ownership, years of operation, number of employees, and types of operation.

A structured questionnaire was developed in Google Form and distributed mainly through web-based and telephone-based platforms from May 2023 to September 2023. In total, 109 valid responses were collected. The questionnaire was crafted in Vietnamese to ensure participant comprehension and facilitate responses. It consists of two main sections:

Demographic Data: This section gathers information on the position of respondents, years of operation, company ownership, number of employees, and other relevant details.

Independent and Dependent Factors: This section is subdivided into four independent factors and two dependent constructs, measured using a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

The collected data were analyzed using SPSS version 26, a statistical analysis software. Various analytical techniques, including descriptive statistics, Cronbach's Alpha reliability test, and multiple regression analysis, were employed to achieve the research objectives.

4. Results and Discussion

4.1. Sample Profile

About half (49.5%) of the respondents are CEOs or Vice CEOs, while the rest (50.5%) are managers, primarily from departments such as supply chain, purchasing, risk, or area management. Nearly half (45.8%) of the companies have been operating for

more than 15 years. Additionally, 21.1% have been in operation for 5 to 10 years, 18.4% for 10 to 15 years, and only 14.7% have been established within the last 5 years.

Regarding company size, 39.4% have between 11 and 100 employees, while 28.4% have more than 200 employees. Companies with 101 to 200 employees make up 11.9%, equal to the proportion of very small companies with fewer than 10 employees.

In terms of ownership, more than half of the responding companies are joint-stock companies (50.5%), 41.3% are private companies, and a small portion (8.3%) are foreign-owned or joint ventures. 40% of companies engage in both manufacturing and commerce, while 14% solely focus on manufacturing, and 56% exclusively operate in commerce.

4.2. Reliability of the Research Constructs

The Cronbach's alphas of all constructs were computed to test their reliability. The Cronbach's Alphas of all constructs in this research score high and between 0.908 SMS to 0.962 (Agility) (Table 1). According to Nunnally (1978), reliability is achieved when Cronbach's alpha reaches scores of 0.7 or higher. Hence, since Cronbach's alpha of constructs in this study is all higher than 0.7, the reliability of it is assured.

4.3 Findings and Discussions

4.3.1. Perception of capabilities & competencies and SCR

Table 2 presents the perceptions of pharmaceutical companies regarding various supply chain attributes and SCR based on their mean scores and the distribution of responses into three categories: totally disagreed and disagreed, neither disagreed nor agreed, and totally agreed and agreed.

The mean scores for all four impact factors are all above the average and range from 4.78 to 5.65, indicating overall strong performance in these activities within pharmaceutical companies. Particularly SCO has the highest mean score (5.65), indicating strong agreement among respondents that their companies are oriented towards supply chain management. The overwhelming majority (82.6%) totally agreed or agreed with this orientation, while a small percentage (12.8%) disagreed. This indicates that the majority of organizations have a well-developed SCO, which is a critical foundation for building resilient supply chains. This suggests that SCO is a strength for these organizations.

Table 1. Cronbach's Alpha of research constructs

Constructs	Number of Variables	Cronbach's Alpha
SCO	5	0.947
ISC	5	0.910
SMS	6	0.908
RMC	5	0.956
AG	5	0.962
RO	5	0.937

Source: Authors' calculation

Table 2. Perception SCR and Its Impact Factors

Items	Mean	Totally disagreed and disagreed (%)	Neither disagreed nor agreed (%)	Totally agreed and agreed (%)
SCO	5.65	12.8	4.6	82.6
ISC	5.14	11.0	21.1	67.8
SMS	4.78	19.3	20.2	60.5
RMC	4.78	20.2	20.2	59.6
AG	5.35	11.0	18.3	70.7
RO	4.92	14.7	24.8	60.5

Source: Authors' calculation

ISC has a mean score of 5.14 (second highest), showing positive perceptions of ISC. A notable portion (67.8%) agreed or totally agreed with the statement, showing that most organizations have strong ISC, which is essential for effective supply chain management and resilience. However, the relatively high percentage of neutral responses (21.1%) and the fact that nearly a third of respondents were neutral or disagreed indicate some uncertainty or variability in experiences and there is still room for improvement.

SMS has a lower mean score (4.78) compared to ISC and SCO. While a majority (60.5%) agreed or totally agreed, nearly one-fifth (19.3%) disagreed, and another 20.2% were neutral, suggesting mixed views on the effectiveness of SMS. The relatively low mean score and high percentage of disagreement or neutral responses suggest that strengthening SMS should be a priority for these organizations to enhance SCR.

RMC shares the same mean score as SMS (4.78) and has a similar agreement percentage (59.6%). The identical percentages for neutrality and disagreement (20.2%) reflect similar levels of mixed perceptions and uncertainty about RMC.

From the overall perspective, the data suggests that the majority of pharmaceutical organizations in the sample have relatively strong SCO, ISC, agility, and RO. However, there is room for improvement in the areas of SMS and RMC.

4.3.2. Perception of SCR

Agility has a relatively high mean score of 5.35 indicating that respondents generally perceive their supply chain to be agile. The high agreement percentage (70.7%) suggests a strong positive perception of agility within the supply chain. The neutrality percentage (18.3%) and disagreement percentage (11.0%) show that while most respondents agree on agility, a notable minority are either uncertain or disagree with the perception of agility. This could indicate areas where agility can be improved or better communicated.

RO has a mean score of 4.92 indicating a moderate perception of RO within the supply chain. With an agreement percentage of 60.5%, a majority of respondents view their supply chain as robust, but this percentage is lower compared to the agreement for agility. The higher neutrality percentage (24.8%) and disagreement percentage (14.7%) compared to agility indicate more uncertainty and disagreement among respondents regarding the RO of the supply chain. This suggests that RO is seen as an area needing more attention or improvement.

In general, the two factors related to SCR perform well, with both "agility" and "RO" receiving relatively high mean scores. However, "agility" appears to be performing slightly better than "RO," indicating a stronger capability to respond quickly to changes and disruptions in the business environment.

4.3.3. Relationship of capabilities & competencies and SCR

Multiple regression analysis was conducted to examine the relationship between four independent variables and agility “AG” and robustness “RO”. The results are summarized in Table 3.

Table 3. Multiple regression model summary

Dependent variables	Independent variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		β	Std. Error	β		
AG	Constant	1.223	.307		3.982	.000
	SCO	.105	.069	.122	1.522	.131
	ISC	.173	.086	.190	2.010	.047
	SMS	.224	.090	.251	2.489	.014
	RMC	.328	.080	.373	4.122	.000
	R = 0.825 R^2 = 0.680 Adjusted R^2 = 0.667 F= 55.200 Sig.= 0.000					
RO	Constant	1.545	.376		4.108	.000
	SCO	-.015	.084	-.018	-.180	.858
	ISC	.105	.105	.115	.993	.323
	SMS	.296	.110	.331	2.683	.008
	RMC	.316	.097	.360	3.244	.002
	R = 0.722 R^2 = 0.521 Adjusted R^2 = 0.503 F= 28.281 Sig.= 0.000					

Source: Authors' calculation

- Relationship of independent variables to Agility

The high multiple correlation coefficient (R = 82.5%) indicates a strong fit of the model to the data, suggesting that the combined independent variables collectively explain a substantial portion of the variance in AG. The coefficient of determination (R^2) of 0.68 reveals that 68.0% of the variance in agility can be predicted by the four factors examined in the study: SCO, ISC, SMS, and RMC. The adjusted R^2 is 0.667, providing a more accurate estimate of the proportion of variance explained by adjusting for the number of predictors in the model. Moreover, the significant F value (F = 55.200, p = 0.000) indicates that the combination of predictors significantly predicts the agility of the pharmaceutical companies, confirming the overall significance of the regression model.

Individually, all four independent factors demonstrate positive relationships with agility. Three of these factors—ISC (β = 0.173), SMS (β = 0.224), and RMC (β = 0.328). All these three factors have statistically significant effects since their p-values are less than 0.05. Consequently, hypotheses H2-1 *"ISC positively influences the agility of SCR"*, H3-1 *"SMS positively influences the agility of SCR"*, and H4-1 *"RMC positively influences the agility of SCR"* are accepted. These results align with the findings of Zhao *et al*. [17], Tang [19], Christopher & Peck [6], and Lin &Wang [21]. However, SCO (β = 0.105) does not show a significant influence due to the p-value of 0.131, which is greater than 0.05, leading to the rejection of hypothesis H1-1 "*SCO positively influences the agility of SCR".*

- Relationship of independent variables to RO

The findings show that there is a strong fit of the model to the data since the high multiple correlation coefficient (R = 72.2%). This indicates that the combined independent variables collectively explain a substantial portion of the variance in RO. The coefficient of determination (R^2) of 0.521 reveals that 52.1% of the variance in RO can be predicted by the four factors examined in the study. The adjusted R^2 is 0.503, providing a more accurate estimate of the proportion of variance explained by adjusting for the number of predictors in the model. Moreover, the significant F value (F = 28.281, p = 0.000) indicates that the combination of predictors significantly predicts the RO of the pharmaceutical companies, confirming the overall significance of the regression model.

There are two of four independent variables having positive and significant effect on RO: SMS and RMC, both with p-values smaller than 0.05, supporting Hypotheses H3-2 *"SMS positively influences the RO of SCR"* and H4-2 "RMC positively influences the RO of SCR". These results align with the findings of Yang *et al.* [19], Zsidisin & Wagner [13], Wieland & Wallenburg [11], Christopher & Peck [6], and Lin &Wang [21]. The other variables, SCO and ISC, have p-values greater than 0.05, indicating that although they also impact RO, these effects are not significant, thus Hypotheses H1-2 *"SCO positively influences the RO of SCR"* and H2-2 *"ISC positively influences the RO of SCR"* are not supported.

5. Conclusions and Recommendations

In conclusion, the analysis of SCR and its influencing factors offers valuable insights into the operational landscape of pharmaceutical companies in Vietnam. Overall, the findings indicate a commendable level of performance across various facets of supply chain management. Particularly noteworthy is the robust commitment to effective supply chain practices demonstrated by the high mean score in SCO, suggesting a strong foundation for operational excellence within the industry.

However, there are discernible areas for improvement, notably in SMS and RMC. These domains exhibit lower mean scores and higher percentages of neutrality or disagreement among respondents, underscoring the need for targeted interventions to enhance operational effectiveness and resilience. Strengthening these aspects could better equip pharmaceutical companies to navigate uncertainties and disruptions in their operating environments more effectively.

Moreover, the regression analysis highlights the critical role of information systems and proactive risk and SMS in fostering agility and RO within pharmaceutical supply chains. While all four independent variables demonstrate positive relationships with agility, only ISC, SMS, and RMC show statistically significant effects. This underscores the importance of strategic investments in technology infrastructure and risk management protocols to enhance operational responsiveness and adaptability.

In light of these findings, pharmaceutical companies in Vietnam must prioritize specific, actionable strategies to strengthen their SCR.

Enhancing Supply Chain Strategies: Companies should focus on refining supply chain management (SCM) and risk management practices (RMP) to better handle uncertainties and disruptions. This includes investing in robust planning, monitoring, and mitigation strategies tailored to the unique challenges faced by the Vietnamese pharmaceutical industry.

Leveraging Technology and Innovation: Embracing advanced technology and innovation is essential. Companies should invest in integrated supply chain (ISC) systems, technology infrastructure, and data analytics to optimize operational efficiency, improve decision-making, and increase responsiveness to market changes.

Fostering Collaboration and Partnerships: Collaboration across the supply chain is vital. Pharmaceutical companies should cultivate strong partnerships with suppliers, distributors, and regulatory authorities to ensure a coordinated and effective response to challenges. This collective approach can significantly bolster SCR.

Government Support and Regulatory Enhancements: The Vietnamese government should play a supportive role by providing incentives for companies to invest in SCR, particularly in technology adoption and capacity building. Strengthening the regulatory framework to enforce compliance with supply chain standards, transparency, and accountability is also crucial. Additionally, fostering public-private partnerships can enhance collaboration and knowledge-sharing across the industry.

Investing in Infrastructure and Innovation: To modernize operations and improve agility, resources should be allocated towards developing infrastructure and adopting cutting-edge technologies. Supporting research and development (R&D) initiatives focused on SCR will further empower the pharmaceutical industry in Vietnam to adapt to evolving challenges and maintain a competitive edge.

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