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THE EFFECT OF SUPPLY CHAIN RISK ON RESILIENCE : MEDIATION ROLE OF SUPPLY CHAIN INTEGRATION

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Abstract:
This study aims to examine the effect of supply chain risk on supply chain resilience through the mediation of supply chain integration. A sample was collected by purposive sampling, and the data was gathered by using an online survey for three company sectors: manufacturing, logistics, and supply chain management in Java, Indonesia. The data were analyzed with Analysis of Moment Structure structural equation modeling (AMOS-SEM) using AMOS-24. The Result shows that SCR has impact to 3 dimension of integration but only Internal integration impact positively to SCRE whereas supplier and customer integration have not any impact on SCRE. Despite that, SCR still has an effect on SCRE, mediated by SCI. It's suggest to improve the collaboration and coordination between Supplier and Customer Integration for Resilience of supply chain.

Keywords:
Supply Chain Risk, Supply Chain Resilience, Supply Chain Integration

1. Introduction

Risk associated with the supply chain has been a major concern for numerous businesses worldwide. Due to the fluctuating levels of raw material sourcing, hazy market conditions, rivalry, and consistently shifting client needs, the complexity of the supply chain has expanded. (Tummala et al. 2011) categorized risks into ten categories, including: demand delay, disruption, inventory, manufacturing, capacity, supply, system, sovereign, and transportation. Other supply chain risk categories are: delays in information, regulatory compliance, actions of competitors, environment, politics, market price fluctuations, cost uncertainty and market prices, and supplier quality (Olson and Desheng, 2011). Many cases occurred, such as the COVID pandemic, the most recent big one. This problem is a nightmare for all sectors, including the supply chain. Although it can be classified as a disruption or an external disturbance, the pandemic has also caused issues with internal supply chain operations. The most obvious thing is the limited space during the pandemic, which has resulted in many sectors experiencing setbacks and even some companies having to go out of business. As a result, the supply chain operation in its entirety is affected. Proper handling and coordination are expected to be able to minimize risk factors and can even be used as a moment to increase integration. This is an idea for researchers to analyze the risks that occur in the supply chain integration process and see their influence on the resilience of the supply chain. Whether these risks can be used as a way to increase integration, as in previous studies, Although risk has more negative connotations, the study also wants to provide views to companies or those related through this research on how to keep a conducive pace in the supply chain, maintain the supply chain, and gain a stable supply chain network.

2. Literature Review

In this section, we first describe the major constructs, including SCR (supplier risk and supply delivery risk), SCI (supplier, internal, and customer integration), and also SCRE. Then, we develop the conceptual framework and propose the research hypotheses.

2.1. Supply Chain Risk

There are many risk definitions in the SCRM literature and there are two important dimensions in discussing risk: the outcome of the risk impact and the expectation of the source of the risk. As in most literature, risk issues are associated with the negative consequences of impact (Christopher and Lee, 2004; Paulson, 2005; Spekman and Davis, 2005; Wagner, 2005). Internal supply chain risks contain capacity, information flow, suppliers, customers, and organizational factors, whereas external supply chain risks include political, environmental, social, and economic factors (Cucchiella and Gastaldi, 2006; Brusset and Teller, 2017). Supplier risk is critical for global sourcing firms, and several other frameworks have been developed to assist businesses in managing supplier risk (Sabine Matook, 2008). In addition to risks from suppliers, there are also risks from delivery supplies that can cause supply chain stability through disrupted delivery, inability to meet demand, and irregular supply (Zsidisin, 2003). High delivery supply risk usually occurs because factories do not like to share precise inventory information and instant customer orders with suppliers because their lead times are long and the delivery is unstable.

2.2. Supply Chain Integration

Supply chain integration (SCI) can be broadly defined as the extent to which supply chain members work together cooperatively to achieve mutually beneficial outcomes (O'Leary-Kelly and Flores, 2002). The company makes efforts to strengthen collaborative relationships with stakeholders who have interests and responsibilities relevant to supply chain operations at all stages (Wisner & Tan, 2000). Some studies measure SCI as a single dimension, but more and more studies now consider SCI to be multidimensional (Cousins and Menguc, 2006). Many studies identify internal integration, customer integration, and supplier integration as the three main types of SCI (Narasimhan and Jayaram, 1998). Supplier integration involves core competencies associated with coordination with critical suppliers (Flynn et al., 2010). Customer integration refers to the extent of coordination between manufacturers and their customers in making decisions related to demand forecasting, production planning, order tracking, and product delivery (Wong, C.Y., 2011). The extent to which a producer integrates its own organizational strategies, procedures, and processes into a collaborative and coordinated process to satisfy the needs of its consumers" is referred to as internal integration. Collaborative and synchronized processes to meet its customers' needs and effectively communicate with its suppliers (Flynn, 2010).

2.3 Supply Chain Resilience

Supply chain resilience is the capacity of a company or set of business entities to survive, adapt, and grow in the face of turbulent changes (Fiksel et al., 2015). Supply chain management is defined as "the ability to react to, cope with, adapt to, or withstand unexpected events (i.e., risks"). withstand unexpected events (i.e., risks) and suggests four stages: preparedness, response, recovery, and growth. Hohenstein et al. (2014) Resilience enables supply chains to prepare for events, reducing the impact of disruptions and strengthening the ability to recover quickly from them by maintaining continuity of operations at the desired level of connectedness and control over the structures and functions that drive competitive advantage (Ponomarov and Holcomb, 2009; Pettit, 2013).

3. Research Model and Hypothesis

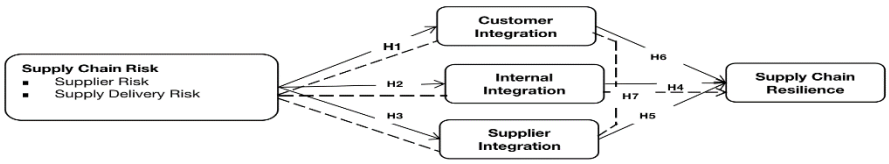

Figure 1 Research framework of Study

In order to measure the concept or model of the research, several scales from the literature were adapted, then it became a hypothesis about the research. In the supply chain risk management literature, some researchers have presented a reverse argument that integrative practices are the way to reduce supply chain risk, thus presenting the direction of the relationship from integration to risk (Faisal et al., 2007; Nishat Faisal et al., 2006; Abrahamsson et al., 2015). Active cooperative relations and attractive, long-term, and mutually beneficial relationships motivate suppliers to extend cooperation even under adverse circumstances (Paulraj and Chen, 2007a). This type of understanding and this relationship allow the buyer to explore and reconfigure its key suppliers' resources and capabilities to manage the resources and capabilities of its key suppliers to manage supply chain risks (Lau et al., 2007a). Knowledge sharing of demand-side changes from marketing and sales units, as well as supply-side changes from purchasing units, is critical for organizational analysis and decision making (Lee et al., 2007).This is accomplished by engaging directly with internal customers to understand needs, codifying these requirements into coherent statements of need, and effectively communicating them to the supply market (Handfield et al., 2007).
Thus, the following hypotheses were proposed:
H1: Supply chain risk has positive effect to Supplier Integration
H2: Supply chain risk has positive effect to Internal Integration
H3: Supply chain risk has positive effect to Customer Integration
In addition, there is a greater need when companies want to proactively address supply chain disruptions. Organizations that are effectively internally integrated have a smooth and structured information exchange mechanism between departments. Internal integration improves the coordination mechanism between functional areas, resulting in improved communication across departments, improved business performance, and the achievement of organizational goals (Schoenherr, T., and Swink, M. 2012). Then, it is imperative for companies to align and synchronize their supply chain business processes and activities with supply chain partners to improve the continuity of supply chain operations (Mandal, S., Sarathy, R., Korasiga, V.R., Bhattacharya, S., and Dastidar, 2012).
Based on this, the following hypothesis is proposed:
H4: Internal integration has positive effect to supply chain resilience
H5: Supplier integration has positive effect to supply chain resilience
H6: Customer integration has positive effect to supply chain resilience
Furthermore, risks associated with suppliers, manufacturers, and customers may affect the company's ability to handle risks and benefit from SC resilience (Brusset and Teller, 2017). For example, providers of products that are innovative and highly customized with short life cycles and unpredictable demand environments focus on SC flexibility and agility (Stavrulaki and Davis, 2010), which can increase SC resilience. Based on this, the hypothesis is written as follows:
H7: Supply chain risk effect supply chain resilence mediate by supply chain integration.

3.1. The Analysis and Results

The sample for the study was collected by purposive sampling, and the data was gathered by using an online survey to reach 173 respondents from three company sectors: manufacturing, logistics, and supply chain management in Java, Indonesia, and The data were analyzed with Analysis of Moment Structure structural equation modeling (AMOS-SEM) using AMOS-24. A several-step analysis process was followed to test the model. In the first step, the validity and reliability of the constructs were evaluated using the measurement model. The model was then subjected to a goodness of fit test to determine its suitability for the research, and finally, the hypotheses were examined in the structural model.

3.2. Measurement Model

In this study, the construct validation test was carried out to assess whether the statements in the questionnaire were well understood by the respondents. The validity test is used to determine whether the test tool used is correct. The validity test in this study will use factor loading, with a determination of factor loading > 0.5 (statement items are said to be valid) and factor loading 0.5 (statement items are said to be invalid). The following table shows the results of validity testing for variable instruments:

Construct	Factor Loading
Supply Chain Risk	
SR_1	0.57
SR_2	0.721
SR_3	0.667
SDR_1	0.774
SDR_2	0.661
SDR_3	0.656
Customer Integration	
CI_1	0.718
CI_2	0.783
CI_3	0.706
CI_4	0.669
CI_5	0.716
CI_6	0.584
CI_7	0.53
Supplier Integration	
SI_1	0.751
SI_2	0.766
SI_3	0.739
SI_4	0.721
SI_5	0.796
SI_6	0.68
SI_7	0.615
SI_8	0.658
SI_9	0.53

Internal Integration	
II_1	0.741
II_2	0.666
II_3	0.683
II_4	0.643
II_5	0.679
II_6	0.653
Supply Chain Resilience	
SCR_1	0.875
SCR_2	0.955
SCR_3	0.939
SCR_4	0.876

Based on the validity test table for all instruments with variables, it can be said to be valid based on the factor loading value of 0.50. In other words, there is internal consistency in these statements so that they can form the constructs of each of these variables. Then the reliability result is shown as below:

Table 2: Realiability of construct

Variable	Cronbach's Coefficient Alpha
Supply Chain Risk (SCR)	0.703
Supplier Integration (SI)	0.812
Internal Integration (II)	0.749
Customer Integration (CI)	0.684
Supply Chain Resilience (SCRE)	0.931

Based on the reliability test table, it can be said to be reliable if the Cronbach's alpha value is less than 0.60. In other words, there is internal consistency in these statements so that they can form constructs for each variable. Further, the goodness of fit test's purpose is to determine how exactly the observed frequency matches the expected frequency. The following table shows the results of the goodness of fit of this study:

Table 3: Goodness of fit

Goodness of Fit Index	**Cut Off Value**	**Result**	
Sig. Probability	< 0,05	0	*Good Fit*
RMSEA	≤ 0,10	0,106	*Marginal Fit*
GFI	0,80 ≤ GFI < 0,90	0,705	*Poor Fit*
NFI	0,80 ≤ NFI < 0,90	0,659	*Poor Fit*
RFI	≥ 0,90	0,620	*Poor Fit*
TLI	0,80 ≤ TLI < 0,90	0,712	*Poor Fit*
CFI	≥ 0,90 or close to1	0,742	*Poor Fit*
IFI	≥ 0,90 or close to1	0,746	*Poor Fit*
CMIN/DF	Lower limit 1, upper limit 5	2,928	*Good Fit*
AGFI	≥ 0,90	0.649	*Poor Fit*

Based on the results of testing the feasibility of the model above, it is obtained that, based on the sig. prob., RMSEA, and CMIN/DF, it is concluded that this is a goodness-of-fit model. Therefore, testing of the theoretical hypotheses can proceed.

3.3. Structural Model

AMOS-SEM was performed to test research hypotheses. In this study, hypothesis testing was done by comparing the p-value and the confidence level (alpha) of 5% (= 0.05) with the following conditions:
- If the p-value is less than 0.05, the hypothesis is supported.
- If the p-value is greater than 0.05, the hypothesis is not supported.

Table 4 : Hypothesis Result

Hypothesis	Path	Estimate	P-Value
H1	SCR->SI	0,937	0.000
H2	SCR->II	0,402	0.000
H3	SCR->CI	0,312	0.000
H4	II->SCRE	0,719	0.000
H5	SI->SCRE	0,143	0.079
H6	CI->SCRE	-0,022	0.404

As shown in Table 4, all the direct paths of the model H1, H2, and H3 are statistically supported, and SCR is positively related to SI (0,000), II (0.000), and CI (0.000). Also, H4 is supported, and II is positively related to SCRE (0.000); however, H5 and H6 are rejected because there is no significant effect related to SCRE for both variables SI (0,143) and CI (-0,022). Furthermore, the mediation test showed that H7 is statistically supported as a finding that SCI mediates the relationship between SCR and SCRE (0.000).

Table 5: Mediation Effect

Hypothesis	Path	Estimate	P-Value	Result
H7	SCR->SCI->SCRE	0,238	0.000	Supported

4. Conclusion

The results show that if risk can be positive towards improving supply chain integration, then management can see the risk as a way to improve integration between all dimensions.

Management can see the risk as a way to increase cooperation and integration between suppliers, customers, and internal companies, which can minimize the negative impact. As a result, the company must be more proactive in improving cooperation and communication, which is one of the integration indicators, in order to run a stable supply chain even when there are unknown risks or problems.Collaborative relationships with suppliers as well as internal capabilities for integration can promote transparency in the system. It also helps companies create visibility across the entire supply chain network. As a result, the company is better equipped to deal with unforeseen changes in advance, thus enabling the company to increase resilience in the supply chain.

As with all survey-based studies, this one has some limitations. There are only two external risk variables in the supply chain (supplier risk and delivery risk). There are also measurement limitations for each variable, such as supply chain resilience variables that can be measured with other indicators such as company performance that has an impact on these variables, and the coverage of respondents is limited to only three company sectors. As a result, future research should be conducted on a larger scale or in more sectors, utilizing other variables and indicators that have a significant impact on supply chain resilience.

Appendix

The survey are evaluated using a 5-point Likert ranging from 1 (strongly disagree) to 5 (strongly agree).

Supplier Risk (SR)

SR1 A key supplier failed to supply which affected our operations.

SR2 We can depend on timely deliveries from our suppliers.

SR3 The supplier often sends us materials.

Supply Delivery Risk (SDR)

SDR1 Disrupted manufacturing operations may affect our deliveries

SDR2 We expect short lead times for our supply chain design.

SDR3 Our company strives to shorten supplier lead times to avoid inventory and stock-outs.

Supplier Integration (SI)

SI1 We maintain cooperative relationships with suppliers.

SI2 We share information with key suppliers (on sales forecasts, production plans, order tracking, traceability, delivery status and stock levels)

SI3 Suppliers are actively involved in our new product development process

SI4 We strive to build long-term relationships with suppliers.

SI5 We actively engage suppliers in our quality improvement efforts.

SI6 We combine systems with key suppliers (e.g. vendor-managed inventory, Kanban, continuous improvement).

SI7 We make decisions together with key suppliers. (About product design/modification/design/modification process, quality development and cost management)

SI8 Key suppliers provide feedback on our products

SI9 We help suppliers to improve their quality.

Internal Integration (II)

II1 We share information with the purchasing department (about sales forecast, production plan, production progress and stock levels)

II2 We take decisions together with the purchasing department (on sales forecasts, production plans, and stock levels)

II3 The functions in our company work together to resolve conflicts between them, when they arise.

II4 We share information with the sales division (Sales forecast, production plan, production progress and stock levels)
II5 We make decisions together with the sales division. (Sales forecast, production plan, production progress and stock level)
II6 Each function in our factory coordinates its activities.
Customer Integration (CI)
CI1 We are often in close contact with customers.
CI2 We develop collaborative approaches with key customers (e.g. risk/revenue sharing, long-term agreements)
CI3 We take joint decisions with key customers (on product design/modification, design/modification process, quality improvement and cost control)
CI4 We combine systems with key customers (e.g. vendor-managed inventory, Kanban, Continuous addition).
CI5 Customers give us feedback on the quality and performance of our deliveries.
CI6 We strive to be highly responsive to customer needs.
CI7 We usually survey customer needs
Supply Chain Resilience (SCR)
SCR1 Our company's supply chain is well prepared for unexpected events
SCR2 Our company's supply chain is able to adequately handle unexpected disruptions and restore operations quickly
SCR3 Our company's supply chain has a good degree of connectedness among its members during disruptions.
SCR4 Our company's supply chain has the ability to maintain control over structure and function during disruptions.

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