



Sustainability Related Supply Chain Risks: A Case of Multiple Organizational Strategic Networks

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The discipline of SC vulnerability is increasingly gaining recognition due to increased interest in the area of risk management as well as other related areas including commercial organisation and the management of public policy. There are limited studies on causes and consequences of supply chain risk across a range of organizational networks. Therefore, to bridge this gap, this current study is carried out to explain the relationship between supply chain management, supply chain risk, supply chain risk management and supply chain strategic networking. The study is a pioneer in that it investigates the mediating role of supply chain risk management and the moderating role of supply chain strategic network in the relationship between supply chain management and the supply chain risk. It is argued that the supply chain strategic network is a significant determinant of the relative supply chain risk. The author has employed SEM-PLS as a statistical tool to achieve the research objectives of the current study. The findings of the study are largely in line with the proposed or hypothesized results. This innovative will be helpful for policy makers, researchers and managers in understanding this issue and its plausible solutions.

Key words: *supply chain risk, supply chain strategic network, SEM-PLS.*



Introduction

According to Gunasekaran, et al (2001) SC vulnerability has been investigated during the past century. In recent times, this uncertain dimension has gained much recognition from consultants and academics globally (Carvalho et al 2010). Researchers including Anand and Kodali (2008) continue to assess ways through which concepts of risk management can be implied within contexts of SC.

The discipline of SC vulnerability is gaining recognition due to increased interest in the area of risk management as well as other related areas including commercial organisation and the management of public policy. Further areas that are witnessing increased growth of interest include national security and emergency setup, corporate governance, and management regarding business continuity (Souza, and Alves 2018) and (Govindan, et al 2015). Each discipline is creating a linkage with legal changes which explicitly outline SC vulnerabilities. The authorized integration of agendas related to security handling and risks calls for the need to develop greater understanding of the concepts that surround relationships among vulnerability, risk and supply chains (Chienwattanasook, & Jermstittiparsert, 2018). Discussions regarding the nature of the supply chain have been a topic over the years. It is quite accepted universally that supply chains do not exhibit untwisted chains but rather demonstrate complex network systems. Zsidisin et al. (2005) presented a new network-based SC definition i.e. a system of mutual dependence and connected firms, which jointly and mutually functions for controlling, improving and managing material and informational flow from service providers to customers. From the perspective of value-based variation, the term supply chain is thus defined as the system of firms that are associated through downstream and upstream relations involved in different activities and processes which add value to the customers through their services and products (Roberta Pereira et al 2014). Thus, SC encompasses provision of information, goods, and materials as well as money which circulates among the firms that are linked with intangible and tangible promoters, including relational activities, systems of integration and processes.

Practically, these flows are connected through distributional systems, physical transport, infrastructure of transport, and national as well as international transmission, but have gained limited attention by researchers in these areas. As a whole, a supply chain functions to connect firms with economies and industries. Since the nature of a SC system incorporates several elemental complex frameworks, researchers are inclined to arrange the system with



respect to its particular examination. In terms of a value adding view, (Glickman, and White 2006), suggested that the units could be bundled into several value streams, where all elements indicate a product family or a product itself. (Anand and Kodali 2008) proposed that setting these inter-organizational systems of networks in essence, generates scalable collections of unitized organizations of three or more firms, or (Carvalho, and Cruz-Machado 2011) to create a nexus within their contractual framework. Besides its functional legacies, SC is perceived differently by different people. Academics have argued about the definitions, but they have evolved within public sector and industry to create acceptance regarding understanding and implementation of new regulations. Moreover, it is necessary to consider an inference regarding doubt of terminology. Additionally, Carvalho and Cruz-Machado (2011) note that the barrier in identifying SC vulnerabilities and application of risk management techniques is the lack of awareness about supply chain.

Literature Review

Supply chain management (SCM)

The concept of managing supply chain surfaced in the 1980s, during a time when researchers explained the term as a re-labelling and fusion of traditional business operations, most prominently managing operations such as order and managing inventory, purchasing, and customer service and logistics such as warehousing, distribution and transportation activities (Onyinye, et.al 2018). The concept was renamed to include several basic assumptions already present for many decades like information sharing for the purpose of exchanging information regarding inventory as well as incorporating systems within the boundaries of organization. Ohno, (1988) anticipated a realization that the initial management of supply chains had fully relished the benefits of improvement of comprehension, about integration among individual company operations and among firms and their respective markets, industry as well as economy. According to Ohno (1988) the elements of SCM have further expanded in order to involve new dimensions such as product development, marketing, managing order and payment handling. Integrating main business processes i.e. from suppliers who deliver information, services, and products to the end users, is now recognized as responsible for value adding customers (Reichhart and Holweg 2007).

A value-adding relational view was also considered in 1998 by Christopher, he explained it as managing downstream and upstream association between the customers and suppliers for the purpose of conveying superior values to the customers with minimum cost along the supply chain. Several writers have formulated differing forms for the concept of SCM such as applying an ideology of management, or processes associated with management (Vonderembse, et al 2006). They also noted that management of the supply chain is basically

employed for discussing two concepts that are quite different in nature. These are the recognition at strategic level and functional scope of SCM. The first concept is required in order to collaborate and coordinate across the whole SC which is needed to take place among at least three connected firms. While the latter revolves around strategic management related to elements of SC processes and logistics, as well as across functions of businesses.

In addition, it is the agenda of functional implementation which they used for defining supply chain management (Chiou, et al 2011) that must be consider. However, to explain the doctrine of strategic SCM, the concept of supply chain orientation was introduced including the claim that successful functioning of SCO demand management from connected firms to acknowledge implications of downstream and upstream flows of management. If only upstream flow of supply is undertaken by the firms' management, it is referred to as procurement orientation. On the other hand, if the management only caters downstream supply for its customers, it is known as channel orientation. However, in spite of considerable efforts by researchers who attempted to examine and shed light on the purpose as well as scope of supply chain management (Miles and Russell 1997), a global survey about specialist educators, presented that both the concepts of SCM and logistics are two different terms representing similar processes, or part of each other, or two varied sets having mutual or overlapped aspects (Orji, Ogbuabor and Anthony-Orji 2018).

Considered from a practitioners' point of view, a similar dilemma can be witnessed from the renaming of the previous council as the Council for Supply Chain Management Professionals (CSCMP). This recent phenomenon clearly represents an acceptance logistic of a SCM's subset while defining SCM as management and designing of processes that are part of procurement, conversion, sourcing and other practices related to logistics management. It also encompasses collaboration and association with trading partners, such as intermediaries, suppliers, customers, and service providers of third parties. In the same context, the concept unites management of demand and supply along the companies.

Supply chain risk (SCR) and vulnerability

In the literature regarding vulnerability and risks in supply chain, the term risk implies downside implications. Rondinelliand Berry (2000) place supply chain vulnerability and other concepts of reliability, risk, and uncertainty within a wider term i.e. contingency planning. He further referred to vulnerability as disclosure to severe disruptions that generally comes from risks either from inside or outside of SC, moreover it is a situation that arises from dependence over relationship and time in processes of SC. Gunasekaran, et al (2001) presented a study regarding outbound and inbound flows by assemblers from an automotive



industry, the findings suggested that vulnerability of SC is a dual design that involves disruptions or negative disturbances and its consequences.

Correspondingly, in a research study regarding cross-industry practitioners, (Christmann and Taylor 2001) explored that concept of SC vulnerability is associated with risk or vulnerability i.e. possible damage or loss. Since supply chains connect firms, economies, and industries, it is therefore proposed that vulnerability of SC must be taken into consideration at different levels. Supply chain is an interactional and integrative system which spreads beyond macroeconomic level in an economy (Linton, et al 2007) while the term resilience is associated with vulnerability and risk because it acknowledges the fact that some risks or threats are unavoidable, or uncontrolled. It is then a systems' ability to restore to its desired or original state after disruption, and ability of mitigating disruption effects that is under consideration.

A further point is that risk assessment must consider that a design has several dimensions as argued by academics and practitioners in a number of forms (Fortes, 2009). In Zhu, et al. (2008) a risk similar to what was noted for managers i.e. formula by March and Shapira was presented. They described risk management as: *Risk = Probability (of a given event) × Severity (negative business impact)*. Alternatively, another definition of risk management in SC, is direct vibration of decision theory adopted from Tang, et al. (2006). In this context, variance-based formula by March and Shapira was remodified and re-described as changes in distribution of potential results of SC, its subjective values and probability. The concept of risk is also discussed in terms of end-to-end SC, particularly the unexpected disruptions or changes involving impact on material, product and information flows along the boundaries of firms. Thus, risks arise in any forms, such as obstacles that can arise in the flow of product, material and information i.e. from supplier of product to the end user and is demonstrated as the impacts and potential of possible mismatch among demand and supply. It is further posed by the above authors that consequences which arise from risks or threats are variables of SC in the form of quality or cost. Therefore, variance-based formula by March and Shapira was restored along with the principles of process-engineering of SCM.

SCM as risk management

An extensive arrangement of research guided literature is available regarding SCM operations which encourages risk management variance-based perspective, especially based on process control and measures of internal performance. Various authors have pointed out need for developing measures for removing, minimizing and handling uncertain conditions from business processes, for the purpose of enhancing, coordination, effectiveness and



practicing control in decision making. Falasca and Zobel (2011), noted that all the extensive work related to total quality management i.e. methodologies related to statistical control and business functions, were latter named 'Six Sigma'.

Haimes, et al. (2008) suggested that initially Six Sigma was employed as a procedure to improve manufacturing operations, productivity in transactions and reliability as well as for enhancing service operations within firms. Christopher and Peck (2004) proposed a new Agile Six Sigma context as a method for minimizing risk as well as enhancing resilience in SC, through complete crushing of time-related divergence. This procedure is deeply embedded in statistical material, and is in accordance with principles and treatments of traditional risk and scientific management approaches. With respect to SCM, cycle time across the supply chain can be reduced with the increase in reliability along multiple processes of SC, resulting in minimization of cost and enhanced responsiveness of end users. Christopher and Rutherford identified that in a recent case of redundancy i.e. additional capacity, it was suggested to keep it as a reserve for overcoming or counteracting against unusual disruptive situations.

Iakovou, et al (2007) used the theory by Christopher and Rutherford as a basis of initiation for his empirical research regarding Six Sigma's relevance with the measure of risk management, for managing time of materials along UK defense SC. The study presented better measures for implementing practices of SC, thus facilitating firm organisation by keeping it closer in eliminating delivery doubt to the end users. Practically, the research exhibited that exceptional events which are external factors exhibited obstacles during baseline data gathering in Six Sigma. Vonderembse, et al. (2006), and Srivastava (2007) highlighted some issues such as absence of effective supply chain orientation and various responsibility centres, that need to be eliminated even in central firms. Carvalho and Cruz-Machado (2011) identified this issue, and suggested that complete control over operations of supply chain is not likely to happen.

Corporate risk management and business strategy

Strategic management and corporate risk management are based on a common legacy. According to Espadinha-Cruz, et al. (2011) these concepts are embedded in a firm's macroeconomic theory, in which a firm is considered as a main function of manufacturing, thus stressing much upon allocation and control over a firms' internal resources. They also suggested that these assumptions be incorporated into the legal network with respect to accounting, taxation, and ownership. Therefore, during the late 1990s, corporate governance practices were implemented in the UK and other areas. As traditionally, an individual firm



expands to conceptualizing a firms' structure, Basheer, et al. (2019) named it as a managed economic system, Laosirihongthong, et al. (2013) and Anderson (1998) called this an intended strategic system, and O'Neil and Sackett (1994) proposed extended production entities, while Hair, et al (2011) mentioned that managing corporate risk could not keep pace with modern development and further, that it had not come in line with a membership criterion proposed in Julie (2001) for spreading firms' managerial control and its boundaries across the boundaries of classical hierarchy. Briefly, the criterion does not establish any supply chain orientation.

Supply chain risk in strategic networks (SCSNW)

Only few empirical research studies are available related to multiple organizational network (Carvalho et al 2010). Rather most studies in this dimension were based on purchasing organization or analytic conceptual studies which tend to handle managerial matters of SC risk, or studies that demand risk sharing mathematical designing of agreements. Julie (2001) identifies this as a key requirement while developing strategic networks of manufacturing such as managed networks or extended firms. Julie also encourages trust among firms thus supporting extended viability and efficiency of the system. He further emphasized focus on the managed system on the priority risk related with external operations such as altering costs from market risks and technological evolution.

From a perspective of centrally focused CRM, it is difficulty for risk sharing to be justified. Passing threats or risks to other adjoining parties make better understanding within a supply chain. Risk sharing is also compatible along the existing view of strategic management, in terms of specialization view of key capabilities. With respect to managing inventory its implementations seems to be captivating in this research. Supported reasoning for risk outsourcing is linked with pooling of risk. The risk is shifted towards that partner who could handle it through specialized capabilities and skills. In terms of SC, it encompasses integrated high-value inventory items, vendor-managed inventory, and minimizing risks that arises from discontinuance and forecasting. Thus, this could only be a successful principle if the combination is heterogenous for the full spread of risk. If a pool comprises certain parties which are capable to handle specific hazards in time, in that situation, risk is not considered to be spread along SC but is rather concentrated.

H1: SCM has significant impact on SCR.

H2: SCRM has significant impact on SCR.

H3: SCSNW has significant impact on SCR.

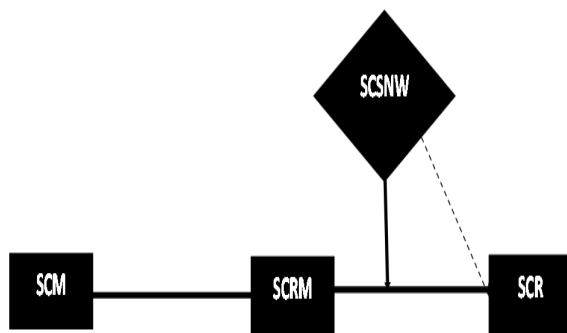
H4: SCM has significant impact on SCRM.

H5: *SCRM mediates the relationship between SCM and SCR.*

H6: *SCSNW moderates the relationship between SCRM and SCR*

The theoretical framework of the current study is shown in the figure 1 below. The coordination theory along with the resource-based view are used as underpinning theories of the current study. These theories have been widely used to explain the factors and phenomena in explaining the issues related to supply chain management

Figure 1. Conceptual framework



Methodology

Survey-based methodology is employed for present research. Pallant (2001) mentioned it as an extremely reliable method. Basically, currently research incorporated survey is the commonest procedure for developing business-related primary data. This study directed two ways for managing survey i.e. through hand or email. Sending questionnaires by mail along with a letter involving reasons and objectives for present research to each respondent was done. However, in case of handing out questionnaires, objectives of research are clearly mentioned as well as the expected responses to the respondent. The questionnaires for the study were handled through self-administration or using a face to face technique. Hair, et al (2009) suggested that if it is easy to approach respondents then it is more likely that the data is successfully collated. The gathered information survey was then diagnostically processed as directed by the literature regarding e.g. multiple regression. It is however important to screen first hand data, as it aids researchers to assess any violation of underlying assumptions in terms of multivariate data analysis implementation. A total number of 646 instruments i.e. questionnaires distributed, while 331 responses were gathered through courier and mail. 293 responses were complete from 331 responses with a response rate of 45.4%. From 12892

values, 512 are missed which is less than the predetermined level i.e. 5 percent (Sekaran and Bougie 2010).

Research Analysis and Discussion

Partial least squares structural equation modelling, is referred to as a second-generation structural equation technique by Zikmund-Fisher et al. (2009) and Tabachnick and Fidell (2007) as a new method which combines with the model of structural equations, consisting of latent series related variables and to cause and effect relation. This technique is appropriate for developing statistical models as well as in forecasting. According to Russ and McNeilly (1995) PLS modelling is useful and appropriate in generating complex models and in real-time sets of applications. An assumption of soft modelling is an attribute of PLS which helps researchers in authenticating and establishing complex models, and thus provides measures for complex and multifaceted model estimators. PLS-SEM can be used in valid forecasting. It estimates error model and enables analysts to incorporate predictors and number of outcome variables in one model. Moreover, it allows researchers to add and estimate moderating effects.

Current research assures reliability and validity of the model, which can be guaranteed by assessing average variance extracted, composite reliability and outer loading Whisman and McClelland (2005) Whereas, convergent validity explains internal consistency among variables, see Table 1 below.

Table 1: CFA

	Indicators	Loadings	CR	AVE
SCM	SCM1	.722	0.915	0.812
	SCM2	.955		
	SCM4	.990		
	SCM6	.825		
	SCM7	.822		
	SCM8	.755		
	SCM9	.990		
	SCM10	.825		
SSRM	SCRM1	.843	0.895	0.772
	SCRM2	.855		
	SCRM4	.802		
	SCRM7	.925		

SCSNW	SCSNW1	.884	0.932	0.617
	SCSNW3	.955		
	SCSNW5	.903		
SCR	SCR1	.987	0.832	0.737
	SCR3	.975		
	SCR4	.923		

However, Russ and McNeilly (1995) stated that discriminant validity explains the level where specific variables are different from others. It can be determined through inspecting cross loadings, based on the principle which states that there must be higher association among latent variables and items (Cramer, et al 2003). Each variables' AVE's root is employed in analysis (Whisman and McClelland 2005). The AVE coefficients' square roots are supposed to be exhibited in the form of a correlation matrix. If the value of AVE square root turns out to be higher than other correlation estimates, then these outcomes confirm discriminant validity. Moreover, rechecking all the elements or coefficients of diagonals is expected to return higher results as compared to elements or coefficients that are off-diagonal along the columns and rows. The calculated values that ensure discriminant validity are mentioned in Table 2 below.

Table 2: Discriminant Validity

	1	2	3	4
SCM	0.948			
SSRM	0.731	0.798		
SCSNW	0.518	0.550	0.801	
SCR	0.623	0.672	0.701	0.981

Direct relations for the present research are obtained from the analyses of validity and reliability. A value of 0.05 is set as a threshold for accepting direct hypothesis according to the literature. Results indicated that all direct proposed hypotheses (H1, H2, H3, and H4) for this research are significantly accepted see Table 3 below.

Table 3: Direct Effect

	(β)	SD	T-value	P-Values
H1	0.111	0.035	3.161	0.002
H2	0.207	0.043	4.810	0.000
H3	0.321	0.051	3.161	0.000
H4	0.327	0.052	3.610	0.000

Moreover, Table 4 below highlights the mediating effect of SCRM and the moderating effect of SCSNW in the relationship between the SCM and SCR. These mediation results show that for both mediation hypotheses, the t-value is above 1.96 and p-value is below 0.05 which accept H5. The outcomes of moderating effect indicate that the t value for social network and family ties is higher than 1.96, while its p-value is less than 0.05, thus representing the fact that respondents highly accept the underlying hypotheses. Therefore, H6 is accepted.

Table 4: In-Direct Effect through Mediation and moderation

	(β)	SD	T-value	P-Values
H5	0.109	0.018	4.319	0.000
H6	0.431	0.062	3.361	0.000

The size of effect explains knowledgeable effect on endogenous variables by exogenous variables, through R-square alterations. It computes the growth of R-square for latent variables which is linked with path, parallel to the proportion of unexplained variance of latent variables. R² or coefficient of determination is presented as a main criterion by PLS-SEM, to assess the structural model (Whisman and McClelland 2005). The value of 0.67 is considered as good, 0.33 is moderate, while 0.19 value for R-square is considered weak. From the present study the R-square for endogenous variable is 68 percent, which is a good value see Table 5 below.

Table 5: Expected Variance

	R ²
SCR	68.0%

The results of the current study show a great deal of agreement with the initial hypothesis.

Conclusion

Areas that are witnessing increased growth involve national security and emergency setup, corporate governance and management regarding business continuity. SC encompasses provision of information, goods, and materials as well as money which circulates among the firms that are linked with an intangible and tangible promoter, including relational activities, systems of integration and processes. The elements of SCM have further expanded in order to involve new dimensions such as product development, marketing, managing order and payment handling. Integrating main business processes i.e. from suppliers who deliver



information, services, and products to the end users, which is responsible for value adding customers. Strategic management and corporate risk management are based on common legacy. Only a few empirical research publications are available related to multiple organizational network. Rather, most studies in this dimension were based on purchasing organization or analytic conceptual studies which tend to handle managerial matters of SC risk, or studies that demand risk sharing mathematical designing of agreements.

The discipline of SC vulnerability is increasingly gaining recognition due to increased interest in the area of risk management as well as other related areas including commercial areas and management of public policy. There are limited studies on the causes and consequences of supply chain risk in a multiple organizational network. Therefore, to bridge this gap, the current study was carried out to explain the relationship between supply chain management, supply chain risk, supply chain risk management and supply chain strategic network. The study is a pioneer in the investigation of the mediating role of supply chain risk management and the moderating role of supply chain strategic in the relationship between supply chain management and supply chain risk. It is argued that the supply chain strategic network is a significant determinant of the supply chain risk.



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