

Supply Chain Risk Management: A Review of Literature



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S. Priya

SCMS Cochin School of Business
(priyahsd@gmail.com)

Mavoothu D
CUSAT

Supply chains are the lifeline of human existence. Today Supply Chain Risk Management has become a major research area as the exposure to risks and complexity of a supply chain has increased with supply and demand uncertainties, outsourcing, globalization and short product and technology life cycles. The purpose of this paper is to conduct a review of literature of the various studies which have been conducted in the area of supply chain risk management so as to provide a framework of various risk mitigation strategies which can be used and their impact on the supply chain performance.

Keywords: Supply Chain Risk Management, Literature Review, Mitigating Strategies

1. Introduction

Supply chains are very important for the existence of mankind. The greater uncertainties in supply and demand, increasing globalization of the market, shorter product and technology life cycles, and the increased use of manufacturing, distribution and logistics partners have led to increased exposure to risks in the supply chain. (Ali, Govindan and Panicker, 2012). We find a relatively unstable world on the one hand, and increasingly sensitive supply chains on the other. (Wagner and Bode, 2008) Wagner and Bode (2008) found that there are negative associations between supply and demand side risks and supply chain performance. Pablo & Chris (2012) states that to succeed in the management of the risk, it is crucial to identify the risk types and drivers that make the supply chain vulnerable. Further research is required into classifying and prioritizing risks in supply chains. (Fan & Stevenson, 2018) Hence it is very important to identify food supply chains risks, understand their severity and to manage/control such risks. It also becomes necessary to mitigate the risks in order to improve the performance. This paper provides an overview of some studies which have been carried out in the area of Supply Chain risk Management and proposes a framework of the various risk mitigation strategies in supply chains, through process of literature review.

2. Risk, Supply Chain Risk and Supply Chain Risk Management

Juttner et al (2003) states that supply chain risks comprise “any risks for the information, material and product flows from original supplier to the delivery of the final product for the end user.” and ‘Risk sources’ are the environmental, organizational or supply chain- related variables which cannot be predicted with certainty and which impact on the supply chain outcome variables. Wagner and Bode (2008) defined a negative deviation from the expected value of a performance measure resulting in negative consequences for the focal firm a “supply chain risk” when this deviation is the result of a supply chain disruption and supply chain risk sources as critical contextual variables that can be internal and external to supply chains and to the acting firms, in a supply chain network. Tummala & Schoenherr (2011) defined supply chain risk as an event that adversely affects supply chain operations and hence its desired performance measures, such as chain-wide service levels and responsiveness, as well as cost. Supply chain risk consists of supply chain characteristics which create vulnerability in the supply chain; a trigger in the form of a supply chain disruption will reveal the negative consequences that result from supply chain risk. (Monroe et al, 2014) Nyamah et al (2014) define risk as a function of likelihood and severity (i.e. Risk = f (Likelihood, Severity) and an agricultural supply chain risk as any eventual variation in agricultural supply chain activities that are associated with undesirable consequences that negatively affect the desired supply chain performance. Ouabouch and Pache (2014) designated the risks linked to the functioning of the supply chain as the little foreseeable incidents or events, affecting or coming from one or many supply chain members that negatively influence the fulfillment of the objectives of each company and harm their performance.

The propensity of risk sources and risk drivers to outweigh risk mitigating strategies, thus causing adverse supply chain consequences is Supply Chain Vulnerability and the identification and management of risks for the supply chain, through a co-ordinated approach amongst supply chain members, to reduce supply chain vulnerability as a whole is Supply Chain Risk Management (Juttner et al 2003) Fan & Stevenson (2018) defined Supply chain risk management as the identification, assessment, treatment, and monitoring of supply chain risks, with the aid of the internal implementation of tools, techniques and strategies and of external coordination and collaboration with supply chain members so as to reduce vulnerability and ensure continuity coupled with profitability, leading to competitive advantage.

3. Classification of Supply Chain Risks

Various studies have been conducted to identify the various types of risks in supply chains. The synthesis of risks from various studies will be certainly useful for future studies and has hence been summarized in Table 1.

Author	Type/Category of Risks	Sector
Mason, J. R., & Towill, D. R. (1998).	Demand side, Supply side, manufacturing process and control systems	
Juttner, Uta , Peck, Helen & Christopher, Martin (2003)	Environmental, Network Related, Organisational	
Chopra, S., & Sodhi, M.S. (2004)	Disruptions, Delays, System, Intellectual Property, Forecast, Procurement, Receivables, Capacity and Inventory.	
Manuj, I. and Mentzer, J. (2008)	Supply Risks, Operational Risks ,Demand Risks ,Security Risks Macro Policy Risks, Competitive Resource Risks	
Manuj, I. and Mentzer, J. (2008)	Quantitative risks -stock-outs (lost sales), overstocking, obsolescence, customer discounts, and/or inadequate availability of components and materials in the supply chain.	
	Qualitative risks include lack of accuracy, reliability, and precision of the components and materials in the supply chain.	
Tang, Christopher. (2006)	Operational risk (uncertain customer demand, uncertain supply, and uncertain cost)	
	Disruptions risk (natural and man-made disasters or economic crises such as currency evaluation or strikes.)	
Stephan M. Wagner and Christopher Bode (2008)	Demand side risks- Disruptions in the physical distribution of products to the end-customer in transportation operations and the distribution network , Uncertainty caused by customers' unforeseeable demands	Food
	Supplier side risks- Supplier business risks, Production capacity constraints on the supply market, Quality problems, Changes in technology and product design	
	Infrastructure Risks- Disruptions in supply of electricity or water, IT failures or breakdowns and local human-centered issues such as Vandalism, Sabotage, Labor strikes, Industrial accidents	
	Legal, Regulatory and Administrative risks- Changing Legal conditions and Administrative barriers	
	Catastrophic Risks- Epidemics or Natural hazards, Socio-political instability, Civil unrest, and Terrorist attacks	
Chavez, Pablo & Seow, Chris. (2012)	Product Quality Risk	Food
Diabat, Ali & Govindan, Kannan and Panicker, Vinay. (2012).	Macro Level Risks- Natural disasters, Bird flu, Political unrest , Terrorist attacks, Government regulations, Labor strikes , Lack of skilled personnel	Food
	Demand Management Risks- Demand changes due to economic downturn, Changes in customer tastes, Failure to communicate with customers or an increase in the bargaining power of customers, or Volatile demand	
	Supply Management Risks-Shortage in raw materials , Suppliers going bankrupt, A Failure in communications between the client and a supplier, Failure of the partnership, Poor quality of the supplied goods, and Delays at the supplier	
	Product/service management risk- Maintenance of inventory level which is too high or by Underutilized capacity	
	Information Management Risk- Errors in forecasting the demand for the product, Distortions in the information sharing and IT systems failures	
Punniyamoorthy, Murugesan & Natarajan, Thamaraiselvan & Manikandan,	Supply side risks, Manufacturing side risks, Demand side risks, Environment risks, Logistics side risks and Information risks	
Nyamah, E.Y., Yi, F., Oppong-Sekyere, D. and Nyamaah, B.J. (2014)	Weather/Natural Disaster related risk- Hailstorm, Strong winds	Food
	Biological and Environmental Related Risk-Diseases	
	Market related risk (Demand and supply related risk)- Fluctuations in demand that impact domestic or international prices of inputs and/or output, Changes in market demands for quantity and/or quality attributes, changes in food safety requirements, changes in supply chain reputation and dependability	
	Logistical and Infrastructure Related Risk- Rising energy cost, Labour shortage, Port congestion capacity constraint, Service reliability reduction	
	Political Related Risk- Political instability	
	Policy and Institutional Related Risk- Custom and trade regulations	
	Financial Related Risk- Exchange risk, Financial strength and practice	

	Operational and Managerial Related Risks- Risks related to food distribution management and inventory management	
<u>Prakash, S., Soni, G., Rathore, A. and Singh, S. (2017)</u>	Environmental - Natural disasters, Terrorist attacks, Economic downturns and Political instability	Food
	Supply- Risks relating to supplier reliability, ICT infrastructure, Supply quality and Supplier capability	
	Demand- Risks related to customer migration, Forecast error, POS data error and New market segments	
	Process- Risks arising due to Production issues, Technology changes, Product quality, Labour strikes and Transportation issues.	
Rathore, Rishabh & Thakkar, Jitesh & Jha, J.K. (2017).	Supply Risks- Shortage of food grains , Unavailability of procurement centre, Inadequate supply of the food grains, Communication failure between different stages of the supply chain, natural disasters (flood, earthquake, and drought)	Food
	Social- Labour strike, Malfunctioning, and Technological risk.	
	Storage and Transport- Risks due to the inadequate storage at warehouses, Poor handling, and Preservation of the food grains, In-transit loss, and Unavailability of the vehicles	
	Demand- Change in market and forecast error.	
Nakandala, Dilupa. Lau, Henry. and Zhao, Li.(2017)	Internal risk- Process and control -Disruptions to internal assets, Reliability of supporting communication and infrastructure and Excess inventory.	Food
	Operational risk external to the firm- Supply risk and demand risk-risks arising due to volatile demand, Customer taste changes, Supply quality risk and Supplier delivery delay	
	Macro level risk- Natural disasters, Wars, Diseases, Government regulation and Labour strikes.	

4. Studies on Supply Chain Risk Management

Juttner ,Peck & Christopher (2003) reviewed the existing literature on supply chain vulnerability and risk management and compared it with findings from exploratory interviews undertaken to discover practitioners' perceptions of supply chain risk and supply chain risk management strategies based on four basic constructs: supply chain risk sources, risk consequences, risk drivers and risk mitigating strategies. Juttner (2005) contributed to SCRM by presenting the business requirements from a practitioner perspective and stated that SCRM was still in its infancy. Wagner and Bode (2008) provided a detailed operationalization of the supply chain risk construct and investigated the effects of various supply chain risk sources on supply chain performance. Wagner and Bode, (2009) distinguished cause-oriented and effect-oriented practices of supply chain risk management, cause oriented supply chain risk management aimed at reducing the probability of occurrence of disruptions while aiming at the causes, in effect oriented SCRM the firm decides to bear certain risks but at the same time makes attempts to limit or mitigate the negative consequences of a disruption. Manuj and Mentzer (2008) proposed a model for risk management and mitigation and stated that to manage global supply chain risk, companies need to follow a path from risk identification through Risk Assessment and Evaluation, Selection of Appropriate Risk Management and Implementation of Supply Chain Risk Management Strategy(s) to Mitigation of Supply Chain Risks. Thun and Hoenig (2009) conducted an empirical analysis of supply chain risk management practices based on a survey with manufacturing plants conducted in the German automotive industry and found that a higher average value in terms of disruptions resilience or the reduction of the bullwhip effect was found in the group using reactive supply chain risk management, whereas the group pursuing preventive supply chain risk management had better values concerning flexibility or safety stocks. Tummala and Schoenherr (2011) stated that Supply chain risks could be managed more effectively by applying the structured approach of Supply Chain Risk Management Process (SCRMP)) which could be divided into the phases of risk identification, risk measurement and risk assessment; risk evaluation, and risk mitigation and contingency plans; and risk control and monitoring via data management systems Ghadge, Dani and Kalawsky (2012) compiled risk management typologies based on type of risk, Management level, Research methodology, Risk management process and approach to SCRM; Contingency planning, disaster management and demand management being grouped under reactive risk mitigating strategy and Supplier development/management, Supply chain Contracts, Product/process management and supplier relationship grouped under proactive risk mitigation strategy . Monroe, Teets and Martin (2014) identified four main elements for organizing information about supply chain risk and SCD - probability and impact, sources of risk, approaches for assessing risks and strategies for mitigating risks. Fan and Stevenson (2018) reviewed the extant literature on supply chain risk management (SCRM), developing a comprehensive definition and conceptual framework and to identify future research directions through a systematic literature review of articles and stated that limited research had adopted a holistic approach to the SCRM process, Risk Monitoring has received less attention and a cost benefit analysis of SCRM is needed. Shahbaz, RM Rasi, Zulfakar, Ahmad and Asad (2018) developed a novel framework for identifying the potential risks and assessment of their effects on supply chain performance, while also evaluating the role of supply chain interaction in risk mitigation and performance improvement in Malaysian manufacturing. Vishnu, Sridharan and Kumar (2019) investigated the interdependence among the various supply chain risk factors that are

prevalent in the Indian context by developing an interpretive structural model (ISM) and proposed a group decision-making framework based on analytic hierarchy process for the prioritisation and selection of appropriate mitigation strategies.

5. Risk Mitigating Strategies

Juttner et al (2003) in their study mentioned avoidance, flexibility, Cooperation and control as mitigating strategies. Chopra and Sodhi (2004) offered eight basic 'mitigation' strategies: add capacity, add inventory, have redundant suppliers, increase responsiveness, increase flexibility, aggregate or pool demand, increase capability and have more customer accounts. Manuj & Mentzer (2008) discussed avoidance, postponement, speculation, hedging, control, sharing/transferring, and security as risk management strategies in their paper. Tang and Musa(2011) suggested Operational hedging (Qualitative) and Flexible sourcing model , Two-stage stochastic model using real option and financial options ,Multi stage stochastic model and Optimization model for optimal operating policy(Quantitative) as mitigation techniques for exchange rate risk; also suggesting mitigating techniques for Financial flow risks- price and cost risk, financial strength of supply chain partners, Financial handling and practice; Information flow risk-information security, information system security and disruption etc. Diabat et al (2012) gave a list of various mitigating strategies based on the type of risks. Mishra ,Sharma, Kumar and Dubey (2016) considered Buffering and bridging as risk mitigating strategies in their study and found that the use of these risk mitigating strategies minimize the risk associated with buyer supplier relationship and improve downstream supply chain performance. Vishnu et al (2019) in their study in the manufacturing sector found that the most important strategy is supplier relationship management (SRM) practices followed by business continuity plan considering Cost , Criticality of risk ,Level of impact ,Impact of other risks and Change management and the various mitigating strategies they listed in their study included Preventive maintenance/reliability centred maintenance, Insurance, Diversification of products, Redundancy/reliability, Multi-location sourcing, Postponement, Pricing strategy Supplier/customer relationship Management, Flexible manufacturing system, Information sharing/collaboration, Corporate social responsibility, Business continuity plan, Strategic inventory control and Block chain technology.

This paper has tried to present details of studies of supply chain risk management and various risk mitigating strategies presented/or proposed in various articles. Efforts must be continued to improve our knowledge of supply chain risk management, in particular future research.

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