SUPPLY CHAIN MANAGEMENT – REVIEW ON RISK MANAGEMENT FROM SUPPLIER'S PERSPECTIVE

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Abstract: *Supply Chain Management is the integration of business processes from end user through original suppliers that provides products, services and information that add value for the customers. Due to increased globalization, higher customer expectations and environment volatility, supply chains are more easily exposed to risks. Disruptions can occur anywhere along the supply chain-at the inbound or supplier side, during the internal processes inside the company's facilities, or at the outbound or customer-facing side. There has been increasing dependence on suppliers that leads companies to be more exposed to uncertain events. Various costs such as transportation costs, penalty costs, etc. are associated from supplier's side that also vary due to uncertain conditions. The impact of these variations on uncertainties needs to be minimized from supplier's side. Supply chain risk management (SCRM) from supplier's perspective has emerged as an important area of study. The chapter reports to review literature from various authors which addresses risk from supplier's perspective in supply chain management. It emphasizes on various strategies and models used to mitigate the risks from supplier's perspective.*

Key words: *Supply chain management, supplier's, risk, uncertainty, literature review*

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1. Introduction

Supply chain plays the most important role in managing business in today's competitive world. Supply Chain Management has observed a tremendous growth during the last two decades. Since 1990s, companies have been forced to improve efficiency in many aspects in this competitive business world. Also, at the same time, the uncertainties have increased that made them to consume more resources to accomplish for demand, supply, as well as internal uncertainties for their better sustainability in the competitive environment.

Nowadays, business trend have shown interest in outsourcing, reduction of the supplier base, long term relationships with suppliers, reduced inventory, and short lead times. Due to these business activities, the vulnerability to risks increases in the supply chain and delineate the function of business units. Hence, the supplier selection becomes a decision of strategic level. To make appropriate selection of supplier, it is an important task to mitigate the risks by planning for the various uncertainties. The dependency on supplier has become the main consequence of the selection. This increasing dependency on suppliers is more prone to uncertain events, thus, the supply chain risk management has become necessary part of the supplier selection.

Many articles have been published on supply chain risk management in last two decades. This chapter reviews literature from different authors which addresses risk from supplier's perspective. It also emphasizes on various strategies and models to mitigate the risks.

2. Importance of Managing Supply Chain Risks

Supply Chain Management includes a wide range of very significant and inherent risks and opportunities that can affect the entire chain. Supply Chain is prone to many vulnerabilities. Broadly, the various types of risks are:

1. **Material flow risk:** Many examples abound of how natural disasters, labour strikes, fires and terrorism have halted the flow of material. Demand fluctuations and supply disruptions are two kinds of primary uncertainties in supply chain material flow which include issues as single sourcing risk, sourcing flexibility risk, supplier selection/outsourcing, supply product monitoring/quality and supply capacity.
2. **Financial risk** takes into account foreign exchange, currency risk, and tariffs and taxes as well as product price, markups, and rebates. It also involves the inability to settle payments and improper investment. The common risks are exchange rate risk, price and cost risk, financial strength of supply chain partners and financial handling/practice.
3. **Integrity issues:** Supply Chain integrity has become an important requirement for brand owners across the industries. It is essential to keep your supply chain from being compromised or interrupted and to ensure its integrity. Supply

chain integrity protects the brand, minimizes costs due to loss or damage, and enables you to provide a quality product to the end consumer. These issues go beyond fraud alone to include risks associated with regulatory compliance, conflicts of interest, brand, and reputation.

4. **Operational Risk:** These are the risk associated with the execution of a company's business functions. It includes risks of tangible and intangible assets. They address not only cost, efficiency, and contracting issues but also business disruption risk and misalignment of supply chains.
5. **Information risk:** Supply Chain is one of the most collaborative environment in an organization, thus, it inherently poses greater risks to the confidentiality, integrity and availability of corporate information. They should consider the accuracy, timeliness, and relevance of data shared among parties, information system security and disruption, intellectual property and information outsourcing risk.
6. **New technology risks** will emerge as smart phones, tablets, social media, cloud computing, and new types of technology continue to develop.

There are different literature review that indicates no clear definition of supply chain risk. Tab. 1 comprises of various definitions selected from different literature.

References	**Heading**	**Definition**
A. Foroughi et al. 2006	Perspectives on Global Supply Chain Supply-Side Risk Management	A supply chain risk is an uncertainty or unpredictable event affecting one or more of the parties within the supply chain or its business setting, which can negatively influence the achievement of business objectives.
J. Chen et al. 2013	Supply chain operational risk mitigation: a collaborative approach	Supply chain risk is the potential deviation from the expected value of a certain supply chain performance measure
C. S. Tang 2006	Perspectives in supply chain risk management	Supply chain Risk is defined as "operational" risks and "disruption" risks.
C. Colicchia et al. 2012	SCRM: a new methodology for a systematic literature review	Supply chain risk is the variation in the distribution of possible supply chain outcomes, their likelihoods, and their subjective values.
O. Tang et al. 2011	Identifying risk issues and research advancements in supply chain risk management	Supply chain risk is refer to (i) events with small probability but may occur abruptly and (ii) these events bring substantial negative consequences to the system.
U. Juttner 2003	Supply chain risk management: outlining an agenda for future	Supply chain risk is any risks for the information, material and product flows from original supplier to the delivery of

	research	the final product for the end user.
A. Badea et al. 2014	Assessing risk factors in collaborative supply chain with the analytic hierarchy process (AHP)	Supply chain risk refers to the risks which affect the movement of efficient process of information, materials and products among different parts of the supply chain in an organization or in a global supply chain.

Tab. 1. Definitions of Supply Chain Risk

Similar to supply chain risk definitions, various definition has been put forth to define supply chain risk management. Hence, supply chain risk management is defined as, "the management of supply chain risk through coordination or collaboration among the supply chain partners so as to ensure profitability and continuity" (Tang, 2006). Also, supply chain risk management is defined as, "the identification of potential sources of risk and implementation of appropriate strategies through a coordinated approach among supply chain members, to reduce supply chain vulnerability" (Christopher et al., 2003). The main aim of the supply chain risk management is to protect the organization from the adverse effects and improve its performance.

3. Historical background

The SCRM literature deals with issues with qualitative and quantitative approaches. Several earlier attempts, have also been made by researchers to review the dimensions of risks and their impact on supply chain functioning. Few others have also reviewed the literature dealing with quantitative models having strategies to manage the risks at the operational and strategic level by addressing the risk issues of such functional aspects of the supply chain as demand management, supply management and product management. The literature also addresses the main blockage to effective supply chain collaboration.

3.1 Various Types of Models for Managing Risks

A. Foroughi et al. (2006) focussed on risks to the inbound/supplier side part of the supply chain, in which parts or services move from the supplier to the manufacturer or retailer. The reasons for increasing vulnerability in supply chain are:

i. The number of companies worldwide using global supply chains is growing.
ii. Increased competition has led many firms to adopt JIT's lean inventory practices, which demand frequent and small lot sizes, the maintenance of little or no inventory, and close relationships with only one or very few suppliers.
iii. Companies with supply chains must deal with factors related to increased competition. These competition-related factors make forecasting demand and adjustment to unexpected product life cycle and customer preferences a huge challenge.

iv. Many companies depend on supply partners located half way around the world, experience a loss of control over many sections of their supply chains. A lack of visibility into faraway suppliers' operations can make it impossible to predict when disruptions may potentially occur and to take the necessary steps to recover from disruptions.
v. Relationships among members of a company's supply chain are often complex, a factor that increases and makes it difficult to identify vulnerabilities.
vi. Finally, surprisingly few companies are actually planning for risks. Advanced planning systems do not traditionally deal with the unexpected, and many companies lack a strategic approach to risk management. Mismatches between demand and supply occur because many companies' plans are too aggregated and based on inaccurate inventory and capacity information.

A. Foroughi et al. (2006) describes major threats to supply chains and discusses the way Supply Chain Risk Management is used to identify threats, assess them, and determine what actions should be taken to manage them. They explained that the outcome of risk assessments can guide firms to handle risks, through forecasting, appropriate use of single or multiple suppliers, risk sharing, information sharing and collaboration with suppliers, flexible supplier relationships, and security prevention measures.

C. S. Tang (2006) reviewed various quantitative models for managing supply chains and related them with actual practices. He addressed the concern of SCRM along two aspects:

1. Supply Chain Risk – operational risk or disruption risk.
2. Mitigation Approach – supply management, demand management, product management, or information management.

Operational risks are referred to inherent uncertainties such as uncertain demand, supply or cost. And disruption risks are referred to the major disruption caused by natural and man-made disasters such as earthquake, floods, terrorist attacks, etc.or economic crises.

Mitigation approach intended to improve supply chain performance via collaboration or coordination as follows. First, to ensure efficient supply of materials, a firm can coordinate or collaborate with upstream partners in supply chain. Second, to influence demand in a beneficial manner, a firm can coordinate or collaborate with downstream partners. Third, to make supply meet demand easily, a firm can modify the product or process design. Fourth, if firms allow accessing various types of private information available to individual supply chain partners by improving their coordinated or collaborative effort.

C. S. Tang (2006) highlighted the gap between theory and practice to develop new models for mitigating supply chain disruptions.

M. Goh et al. (2007) presented a stochastic model of the multistage global supply chain network problem, incorporating a set of related risks, viz. supply, demand, exchange and disruption. They used Moreau-Yosida regularization to design

an algorithm for treating the multistage global supply chain network problem under scenario of variety of risks with the objective of profit maximization and risk minimization.

F. You et al. (2009) considered risk management approach for a global multi-product chemical supply chain under demand and freight rate uncertainty. A multi-period planning model was proposed for a two-stage stochastic linear-programming approach that takes the production and inventory levels, transportation modes, times of shipments, and customer services levels into consideration. They described a simulation framework that relies on a rolling approach which suggested that atleast 5% savings in the total real cost can be achieved as compared with the deterministic case. They also introduced an algorithm based on the multi-cut L-shaped method to solve the resulting large scale industrial size problems.

3.2 Supplier Selection Issues by various Authors

Y. Huang and G. Q. Huang (2012) proposed an integrated approach for most suitable supplier selection, pricing and inventory decisions in a multi-level supply chain. To evaluate the marginal benefaction of the supply chain members, a numerical study and sensitive analysis of cooperative game theory was conducted. They concluded the following:

i. The rise of one retail market scale increases the retail price and demand for the product in that market, without affecting other retail markets.
ii. An increased market scale increases the importance of this market and the suppliers who only provide components for the product in this market range.
iii. The change of the setup cost has relatively very little impact on the pricing decisions and marginal benefaction of the supply chain members.

A. N. Sadigh et al. (2013) proposed a new mathematical model for production decision, assembly scheme determination, distribution center location, and logistics distribution planning integrated with supplier selection. The objective function considered was:

i. Minimization of total cost including order cost, purchasing cost, distribution centers locating cost, and transportation cost.
ii. Minimization of maximum transportation time of purchased products to customers.
iii. Maximization of part qualities.

In order to solve the multi-objective problem, weighting method was used. Also, modified genetic algorithm was proposed to get Pareto optimal solution sets. After the computational experiments, it was observed that high-quality solutions as well as better computational times were obtained.

M. Srinivasan et al. (2011) examined the relationship between buyer-supplier partnership quality, and supply chain performance, in the presence of supply and demand side risks, and environmental uncertainty. They developed a specific hypothesis based on theoretical tenets of resource-based view, relational capital theory, and transaction cost economics using data analysis process. The results

demonstrated that positive relationship between partnership quality and supply chain performance, which is strengthened in the presence of high demand and supply-side risks, but weakened in the presence of high environmental uncertainty.

3.3 Research literature by different authors

O. Khan et al. (2007) reviewed the general literature on risk, and especially in terms of qualitative versus quantitative approaches. Also, there is a need for the empirical test of the proposed models of supply chain risk. Though there are number of risk management system have been put forward, most of the approaches tend to follow the generic process which consists of three critical stages:

1. Risk Identification which determines all risk factors that are likely to occur
2. Risk Analysis is to understand the likelihood and extent of the most significant risks.
3. Risk Evaluation is to decide the most appropriate management response for each risk/combination of risks and the most appropriate party to manage each of the identified risks.

Also, as there is a wide range of techniques available to each of the three stages of the risk management process, they can be separated under three groups:

1. Qualitative Techniques: They seek to identify, describe, analyze and understand risks.
2. Quantitative Techniques: They seek to model risk in order to quantify its effect.
3. Control Techniques: They minimize risk exposure by responding to identified risk.

P. Singhal et al. (2011) focussed on the following issues as:

- Spectrum of supply chain risks with their significance;
- Contribution of various research methodologies to managing the supply chain risks;
- Issues primarily related to description and implementation of SCRM.

The multi-layered top town taxonomy was employed to classify and codify the literature and gaps were put forward. They studied the pool of SCRM literature that focused on coordination, decision-making and sector-wise SCRM implementation issues and relevant propositions were derived. P. Singhal et al. (2011) concluded that it is not enough to concentrate on mitigation strategies but also to understand and influence the entire supply chain, more importantly, the nature and flow progression across the various interfaces.

M. Christopher et al. (2011) proposed that a multidisciplinary approach is required when dealing with global sourcing risks. Global sourcing trends are making supply chains longer and more fragmented and this is exposing firms to greater costs and risks. It presents a classification of risks covering four categories: supply risk, process and control risks, environmental and sustainability risks, and demand risks.

To mitigate global sourcing risks, following generic risk management strategies were formulated:

i. Network re-engineering.
ii. Collaboration between global sourcing parties.
iii. Agility.
iv. Creating a global sourcing risk management culture.

P. Macurova et al. (2013) examined risk generated by suppliers during the period of economic fluctuations and their relations to the positions of companies in the supply chain. The numerous sources of risks coming from the supplier's side are related to the ability of supplier, his responsibility, economic status and location.

Risks coming from the suppliers may manifest themselves as a breach of the agreed delivery time, quantity or quality, incorrect documentation accompanying the delivery, incorrect packaging, etc. Also supplier side failure is a supplier bankruptcy or its withdrawal from the market. Insufficient communication about problems of a supplier brings another risk, which makes it difficult to respond quickly to the situation, because the customer is unable to take attenuating measures in advance.

They conducted research in two stages by means of a questionnaire analysis and follow-up of multiple case studies. The result showed certain signals of increasing dependence on the suppliers, deepening imbalances in the supply chains and decreasing opportunities of reducing the presence of risks. The surveys have also detected tendencies leading to structural measures strengthening resilience of the supply chain.

O. Tang et al. (2011) investigated the research development in supply chain risk management (SCRM). The review had classified the potential risk associated with different flows, namely material, cash and information flows. The various potential methods were proposed in developing quantitative models for risk management such as Robust planning, Revenue management, Agency theory, Option theory, System dynamics and Reverse logistics.

3.4 Review on Supply Chain Collaboration

A. Badea et al. (2014) analyzed supply chain crisis as the main blockage to effective supply chain collaboration. They mentioned the two collaboration concepts (vertical and horizontal) in supply chain that can be influenced in practice by potential risk factors.

Vertical collaboration is described as being the relationship between buyer and supplier. This occurs when two or more organizations such as the manufacturer, the distributor, the carrier, and the retailer share their responsibilities, resources and performance information to serve similar end customers.

Horizontal collaboration is the relationship between competitors and other supply chains actors. Horizontal integration is one of the supply chain collaboration strategies and it is used when two or more unrelated or competing organizations cooperate to share their private information or resources.

Five alternatives for a good collaboration were proposed: Information sharing collaboration, decision synchronization collaboration, incentive alignment collaboration, resource and skill sharing collaboration, knowledge Management collaboration. They combined the research methodology with the application of the analytic hierarchy process (AHP).

J. Chen et al. (2013) examined three types of risks, namely supply risk, demand risk and process risk in relation to three types of collaboration, namely supplier collaboration, customer collaboration and internal collaboration, as a mechanism to mitigate those risks. They defined that the supply risk and demand risk arise from external operations, while process risks from internal operations. Also, process risk increases from the unexpected changes in the supply or orders changes from customer. The survey was carried out and resulted that supply chain risk can be better mitigated and managed through supply chain collaboration.

4. Conclusion

From the literature review, it can be seen that generalizability and validation of the models proposed and strategies formulated is still required. Moreover, only few parameters are taken into account as demand, time and cost but in certain conditions. More real conditions and parameters are needed to be taken into consideration and to be worked upon as demand, time in uncertain conditions. Last but not the least, the ways to reduce the dependence on significant and special suppliers are required and the barriers and secondary risk associated with them are needed to be found out. Some researchers have paid attention but there is a need to analyze the effectiveness of risk assessment methodologies. The future research might consider efforts in validation of various risk models and development of new algorithms to consider more certain situations such as demand, cost and lead time.

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