Imperative Need of Risk Analysis in Supply Chain Management

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Abstract:
Outsourcing. Just In Time. Lean Manufacturing. While some of the best business strategies in the world can help minimize cost and free you to focus on core competencies, these strategies may stretch your supply chain to its breaking point. In today’s uncertain and turbulent markets, supply chain vulnerability has become an issue of significance for many companies because supply chain disruption can reduce the company’s revenue, cut down the market share, inflate cost and may threaten the production and distribution of the company. As supply chains become more complex as a result of global sourcing and the continued trend to ‘leaning-down’, supply chain risk increases. The challenge to business today is to manage and mitigate that risk through creating more resilient supply chains.

With the increasing emphasis on supply chain vulnerabilities, effective mathematical tools for analyzing and understanding appropriate supply chain risk management are now attracting much attention. Hence, this paper attempts to fill this gap by offering various tools and methodologies for minimizing the different forms of risk resident in a supply chain and maximizing the usual profit objective of the firms.

Purpose:
In today’s volatile era with businesses and supply chains becoming increasingly global, the industrial environment is heavily affected by uncertainty, which can potentially turn into unexpected disruptions. Financial and political turmoil, socio-cultural changes, highly fragmented and demanding behavior of consumers, rapid development and changeover of products, have seriously modified the economic and industrial environment in which companies act, bringing out new issues related to assuring the continuity of the business against potential disruptive events.  
Moreover, one of the key factors contributing to disrupting supply chains is the focus on lean supply chains in academia and industry during the 90s. Zero-inventory and just-in-time movement of goods became the dominant model that increased the sensitivity of supply chains. Little issues quickly become big issues. Managing risk in the supply chain has never been as challenging as it is today. As more companies have outsourced production to overseas locations, supply chains have been extended, the number of nodes increased, and the complexity of the networks have moved exponentially. In the past, supply chain managers were mainly concerned with reducing cost, reducing purchase price variance, and managing inventory. Today, supply continuity is the single biggest business driver. Indeed, organizations now recognize that “preservation of shareholder value” is of paramount importance in supply chain management, and it has been assessed that disruptions can exert a tremendous impact on the company’s overall performance of supply chain operations.
Hence, this paper attempts to fill this gap by offering various tools and methodologies for minimizing the different forms of risk resident in a supply chain and maximizing the usual profit objective of the firms.

**Design/methodology/approach** – The research methodology applied here is secondary research. Relevant information was collected and analyzed for the purpose to be incorporated in the paper. Various tools like the Root cause analysis, Fish Bone analysis, etc. have been used to analyze the risk associated with Supply Chain Management.

**Findings** – By analyzing the information obtained from secondary data, it was found that a proactive approach in managing the Supply Chains is absolutely required in today’s ever changing world in order to mitigate the risks arising due to uncertainty. On the basis of relevant information provided in this paper it can be said that risk is involved at every level of the supply chain. Hence, it becomes the duty of every member associated with the supply chain of a particular product or service to analyze the risks factors at their level in the supply chain and have some contingent plans ready to mitigate any risk arising in the supply chain.

**Research limitations/implications** – The research limitation can be the lack of time due to which we were not able to conduct any primary research required to validate the findings on the basis of secondary data.

**Practical implications** – This research does has lots of practical implications by suggesting some basic tools which can be used by manufacturers, wholesalers, retailers, and all those involved in the supply chain to mitigate the impact of any uncertainty or risk. This can ensure the timely and adequate delivery of the products or services to the consumers.

**Originality/value** – This provides information about internal and external factors of risk management which manufacturing companies has to face during the process of supply chain management.

**Keywords:** Supply chain, Supply chain risk management, risk management, tools involved in risk management.

**Paper type:** Research Paper

**INTRODUCTION AND PURPOSE**

“Only those who risk going too far can possibly find out how far one can go.”
- T.S Eliot

In today’s volatile era with businesses and supply chains becoming increasingly global, the industrial environment is heavily affected by uncertainty, which can potentially turn into unexpected disruptions. Financial and political turmoil, socio-cultural changes, highly fragmented and demanding behavior of consumers, rapid development and changeover of products, have seriously modified the economic and industrial environment in which companies act, bringing out new issues related to assuring the continuity of the business against potential disruptive events.

Moreover, one of the key factors contributing to disrupting supply chains is the focus on lean supply chains in academia and industry during the 90s. Zero-inventory and just-in-time
movement of goods became the dominant model that increased the sensitivity of supply chains. Little issues quickly become big issues. In addition, supply chains have become more global, increasing the order to delivery cycle times by a factor of four or five. This acts to amplify the potential of a disruption and the impact. Outsourcing has also become the dominant model, increasing the forces driving disruptions such as other customers competing for volume and attention, information flow issues, mistrust, win-lose negotiations, financial stress, misalignment of interests and goals. These have increased the likelihood of a disruption exponentially. According to a 2006 study by Accenture Consulting, three out of four top supply chain executives at major U.S. enterprises say they have had a disruption in the past five years from which it took at least a week – and sometimes several months – to recover.

As a common term to designate the likelihood of occurrence of such events we use the word risk: although the concept of risk is multi-dimensional and not univocally defined, it is generally established the fact that it is linked to uncertainties associated with events.

Managing risk in the supply chain has never been as challenging as it is today. As more companies have outsourced production to overseas locations, supply chains have been extended, the number of nodes increased, and the complexity of the networks have moved exponentially. In the past, supply chain managers were mainly concerned with reducing cost, reducing purchase price variance, and managing inventory. Today, supply continuity is the single biggest business driver. Indeed, organizations now recognize that “preservation of shareholder value” is of paramount importance in supply chain management, and it has been assessed that disruptions can exert a tremendous impact on the company’s overall performance of supply chain operations, if there are not suitable mechanisms or tools able to prevent or smooth their negative effects, as many real cases have showed in the past few years (Sheffi, 2005).

During the last decade, several events (i.e. earthquake in Kobe in 1995, terrorist attack to WTC in 2001, SARS in 2002-2003) have significantly disrupted supply chains and produced major losses for the companies involved (Tang, 2006). Companies such as Ericsson, Hershey, Apple, Walmart, and a host of other major companies who rely on timely delivery of products and services to meet customer needs have incurred major losses due to supply chain disruptions. Publicly traded firms experiencing supply chain disruptions, for example, have reported negative stock market reactions to announcements of such disruptive events, with the magnitude of the decline in market capitalization being as large as 10% (Knight & Pretty 1996; Hendricks & Singhal 2005). As a matter of fact, Ericsson reported a $400 million loss because it did not receive chip deliveries from the Philips plant in a timely manner (Latour, 2001). Although the true costs of any supply chain disruption can be difficult to quantify precisely, at least one firm surveyed by Rice and Caniato (2003) estimated that the daily cost impact of a disruption in its supply network to be in the neighborhood of $50-$100 million.

Due to the new relevance that the concept of risk has assumed, risk management concepts and approaches have been studied and formalized in the past and have been around for several years, but have generally been focused in the financial, project management or safety areas. Such concepts and approaches are generally not immediately suitable for use in the supply chain management arena, since they should be fitted to a completely different context than those they have been thought to. But, before the definition of risk managing model and methods, one of the key question it is worth to consider is: what is the benefit of Supply Chain Risk Management (SCRM)?
According to a recent research report from Aberdeen (Figure 1), it leads to not only cost avoidance by reducing the probability and impact of disruptions it leads to performance improvements.

![SCRM Benefits](image)

Source: *Aberdeen Group*, September 2005

Once the importance of managing risk has been assessed, the further step is to define suitable models to analyze, assess, manage and communicate risk within a company as well as in a complex, geographically dispersed supply chain composed by several, legally independent entities.

With these issues in mind, this paper analyses various tools and methodologies for Supply Chain Risk Management (SCRM). The purpose of this paper is to provide an overview on the fundamental concepts of supply chain risk management, and it details the process and statistical tools which can be used by the industries in order to have adequate Supply Chain Management for an effective wealth maximization.

**BACKGROUND**

Risk is a concept that has applications in everything we do. It has several components, not the least of which is the lack of knowledge about the events that may impact us and our ability to manage them. In order to understand risk we first need to define and decompose it, specifically as it pertains to the supply chain. Under these statements, a common sense definition of risk – acknowledged by the International Organization for Standardization (ISO, 2002) – mainly deals with two of its essential components: *losses* (along with related amounts) and *uncertainty* of their occurrence. Another similar definition given by Culp (2001) states that risk can be defined as any source of randomness that may have an adverse impact on a person or a corporation. In the
financial industry, operational risk is defined as the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events (New Basel Capital Accord, 2006).

According to Wagner and Bode (2006) it is possible to distinguish four interrelated terms: 

**Supply chain risk:** it is defined as the negative deviation from the expected value of a certain performance measure, resulting in negative consequences for the focal firm. Hence, risk is equated with the detriment of a supply chain disruption. The authors explicitly adopt the notion of risk as purely negative as the one that corresponds best to supply chain business reality. As a consequence, they do not consider either ‘‘happy disasters’’ nor the situation where managers intentionally ‘‘gamble’’ on risk.

**Supply chain disruption:** a supply chain disruption is an unintended, untoward situation, which leads to supply chain risk. For the affected firms, it is an exceptional and anomalous situation in comparison to every-day business. Supply chain disruptions can materialize from various areas internal and external to a supply chain. Consequently, their nature can be highly divergent.

**Supply chain risk source:** attempting to circumscribe supply chain disruptions (i.e. the demarcation of supply chain risks from other business risk), many scholars have proposed classifications in the form of typologies and/or taxonomies of risks. The derived classes of supply chain disruptions are often labeled supply chain risk sources.

**Supply chain vulnerability:** while a supply chain disruption is the situation that leads to the occurrence of risk, it is not the sole determinant of the final result. It seems consequential that also the susceptibility of the supply chain to the harm of this situation is of significant relevance. This leads to the concept of supply chain vulnerability. In other way, Christopher and Peck (2004) define supply chain vulnerability as “an exposure to serious disturbance”, while Barnes and Oloruntoba (2005) describe vulnerability as “a susceptibility or predisposition to loss because of existing organizational or functional practices or conditions”.

**Categorizing Risk**

Supply chain risks can be categorized in many different ways and from different perspectives, e.g. from a corporate governance or financial risk agenda, or even in terms of a multi-level complex system [14]. However, based upon a framework originally proposed by Mason-Jones & Towill [15], we suggest that at its simplest there are three categories of risk which can be further sub-divided to produce a total of five categories:-

- Internal to the firm
- Process
- Control
- External to the firm but internal to the supply chain network
- Demand
- Supply
- External to the network
- Environmental
Processes are the sequences of value-adding and managerial activities undertaken by the firm. The execution of these processes is likely to be immediately dependent on internally owned or managed assets and on a functioning infrastructure. Therefore, internally owned or managed assets and the reliability of supporting transport, communication and infrastructure should be carefully considered. Process risk relates to disruptions to these processes.

Controls are the assumptions, rules, systems and procedures that govern how an organization exerts control over the processes. In terms of the supply chain they may be order quantities, batch sizes, safety stock policies etc. plus the policies and procedures that govern asset and transportation management. Control risk is therefore the risks arising from the application or misapplication of these rules.

The next two categories are external to the focal firm, but remain internal to the inter-organizational networks through which materials, products and information flow. Ideally the focal firm should have an awareness of potential or actual disturbances to the anticipated flow of product and information from within and between every node or link in the supply chain networks through which its own value-streams flow. In practical terms this may not be possible, but the focal firm should at least strive to familiarize itself with those risks that are known or likely to affect adjacent organizations. It is unlikely that the focal firm will ever have intimate knowledge of all potential risks, though appropriate monitoring should increase the likelihood and provide early warning of actual events.

Demand risk relates to potential or actual disturbances to the flow of product, information, and in this instance cash emanating from within the network, between the focal firm and the market. In particular, it relates to the processes, controls, asset and infrastructure dependencies of the organizations downstream and adjacent to the focal firm.

Supply risk is the upstream equivalent of the above, it relates to potential or actual disturbances to the flow of product or information emanating from within the network, upstream of the focal firm.

The fifth and final category relates to disruptions that are external to the network of organizations through which the value-streams/product supply chains flow.

Environment - These events may of course directly impact upon the focal firm or on those upstream or downstream, or indeed on the marketplace itself. They may affect a particular value stream (e.g. product contamination) or any node or link through which the supply chain passes (e.g. as the result of an accident, direct action, extreme weather or natural disasters). They may be the result of sociopolitical, economic or technological events many miles or organizations removed from the focal firm’s own supply chains, but may have carry-over effects through linkages to other industry networks. The type or timing of these events may be predictable (e.g. those arising from regulatory changes), but many will not be, though the impact of these types of events may still be assessed. However our research revealed instances where organizations had every opportunity to identify forthcoming disruptions, but either failed to do so. The industrial action affecting the US West Coast ports in 2002 was one such example. Well ahead of the actual events the likelihood of disruptions was discussed in the press and on television news
channels. The same channels later reported the massive disruptions to supply chains experienced by those who did not heed the warnings.

A further issue which adds to supply chain risk is that upstream and downstream ‘visibility’ is often very poor. In other words there is frequently only a limited exchange of information between adjacent entities in a network. For example a supplier to an original equipment manufacturer (OEM) may have no information on the rate of sale that the manufacturer is achieving, only receiving sporadic orders with the expectation that delivery can be made within an ever-shorter timescale.

The reality is that most organizations are ‘forecast-driven’ rather than ‘demand driven’ and are forced to take decisions in isolation of each other. Whilst this lack of shared information is a source of considerable additional cost to the supply chain as a whole, it is also a significant source of vulnerability.

There is often a significant ‘disconnect’ in organizations between the determination of business strategy and the recognition of the impact of those strategic decisions upon supply chain vulnerability. For example many companies have moved from domestic to global sourcing in search of lower unit costs. However, that definition of cost is too limited – it does not always take account of the increased risk to the supply chain through extended/lead-times, reliance on partners who themselves may be vulnerable to external events or the potential loss of control.

The need for formalized procedures for supply chain risk management within and between organizations emerges very strongly from this research. The findings of the empirical study revealed that practitioners frequently struggle to come to terms with the scope and variety of potential risks. Consequently, many were unable to readily identify appropriate tools and techniques which might be employed to manage the panoply of potential risks. Furthermore whilst some form of business continuity planning exists within most large businesses, business continuity management has been slow to take into account the risks that emanate from the wider supply/demand network. It is our contention that many of the threats to business continuity lie outside the focal firm, hence the need for a much broader perspective when it comes to contingency or continuity planning.

**The Importance of Supply Chain Management:**

- It helps in dealing with uncertain environments – matching supply and demand
  - Boeing announced a $2.6 billion write-off in 1997 due to “raw materials shortages, internal and supplier parts shortages and productivity inefficiencies”
  - U.S Surgical Corporation announced a $22 million loss in 1993 due to “larger than anticipated inventories on the shelves of hospitals”
  - IBM sold out its supply of its new Aptiva PC in 1994 costing it millions in potential revenue
  - Hewlett-Packard and Dell found it difficult to obtain important components for its PC’s from Taiwanese suppliers in 1999 due to a massive earthquake
- U.S. firms spent $898 billion (10% of GDP) on supply-chain related activities in 1998
- Shorter product life cycles of high-technology products generates higher revenues
  - Less opportunity to accumulate historical data on customer demand
- Wide choice of competing products makes it difficult to predict demand
- The growth of technologies such as the Internet enable greater collaboration between supply chain trading partners
  - If you don’t do it, your competitor will
  - Major buyers such as Wal-Mart demand a level of “supply chain maturity” of its suppliers
- Availability of SCM technologies on the market
  - Firms have access to multiple products (e.g., SAP, Baan, Oracle, JD Edwards) with which to integrate internal processes

<table>
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<th>Category of Risk</th>
<th>Drivers of Risk</th>
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| Disruptions      | • Natural disaster  
|                  | • Labor dispute  
|                  | • Supplier bankruptcy  
|                  | • War & terrorism  
|                  | • Dependency on a single source of supply as well as the capacity & responsiveness of alternative suppliers |
| Delays           | • High capacity utilization at supply source  
|                  | • Inflexibility of supply source  
|                  | • Poor quality or yield at supply source  
|                  | • Excessive handling due to border crossings or to change in transportation modes |
| Systems          | • Information infrastructure breakdown  
|                  | • System integration or extensive systems networking  
|                  | • E-commerce |
| Forecast         | to sales promos, incentives, lack of supply chain visibility & exaggeration of demand in times of product shortage |
| Intellectual property | • Vertical integration of supply chain  
|                  | • Global outsourcing and markets |
| Procurement      | • Exchange rate risk  
|                  | • Percentage of a key component or raw material procured from a single source  
|                  | • Industry wide capacity utilization  
|                  | • Long-term vs, short-term contracts |
| Receivables      | • Number of customers  
|                  | • Financial strength of customers |
Hence, we can realize the importance of risk management in Supply chain management. Above mentioned are the types of risks involved in the supply chain management and their drivers.

**TOOLS AND TECHNIQUES USED TO MITIGATE SUPPLY CHAIN RISK**

The first and the foremost technique to mitigate risk should be to analyze the type of the risk and its impact on the organization’s product and services. Risks can be broadly categorized as Internal risk and External risk. Internal risks are the risks that arise from within the organization. It may be due to some shortcomings or some faults in their operations and processes which can lead to a defect in the product/services offered by the organization. Whereas, the External risks are caused due to the external factors which are not in the control of the organization and are not involved with the organizational functioning, but do impact a lot on the organization’s functioning.
From the company’s point of view, the top management of an organization should analyze the risk associated with the product or services being offered in order to mitigate any unforeseen error which may arise due to uncertainties during the supply. If we take an illustration of the failures arising in supply chain management as shown in the figure above, the delays occurring in the supply of a product or services may be due to bad weather and inadequate road maintenance which can be considered as risk drivers as these are the causes due to which the risk arises and the effect or impact of this risk driver is in the form of delay. This delay in supply chain can be avoided by taking a Mitigative action which is, modification of the vehicle used to carry the goods due to inadequate roads. This will ensure the proper functioning of the supply chain by making the goods available at right time, at place and in right condition.

The following can be the layout to risk management strategy for its execution can be done by performing risk assessment which involves:

- Development of risk management plan
- Assemble risk management team
- Execute risk generation process
- Rationalize risk list
- Rank risk and prioritize
- Write risk response plans
- Establish risk review process
- Periodically review risk

This can be shown in form of the figure given below:
Many a time the supplier is also in a risk due to the lack of information which may arise due to various sources. These sources have been given in brief below:

- Ineffective management
- No sharing of information
- No alternative suppliers
- Inability to influence suppliers
- Inability to meet required volumes
- Lack quality process in operations
- Financial instability or financial failure
- Incorrectly interpreting requirements
- Political instability/ war affecting suppliers’ operations
- Suppliers exiting market on short notice
- Product quality problems
- Labour / Management problems
- New or unproven product / process technology utilised
- Long physical distances between buyer and suppliers
- Variability / transportation disruptions with inbound supply channels
- Currency rate & material price fluctuations
- Natural disasters or “acts of God” affecting suppliers’

The suppliers and the manufacturers can also do the root cause analysis which is a statistical tool mostly used in Total Quality Management. An illustration of this tool can be shown below as:
Ishikawa’s Fishbone diagram or the cause and effect diagram can also be used to analyze the cause of a problem and its effect on the supply chain. Fishbone diagram is based on the fact that the problems arise due to Man, Machine, Materials and Process. It can help the producers and supplier analyze what is the actual cause of failure in the supply chain.
CONCLUSION:

With the help of the information provided above, it can be said that analyzing risk in supply chain management can help in building an efficient supply chain and avoiding the failures and delays in supply chain management. In today’s competitive world, the powerful organizations are those which follow a proactive approach in assessing the loopholes in their supply chain. The organizations always have an alternative course of action for managing their supply chains by taking contingent actions. These contingent actions help the organization in taking Mitigative actions to mitigate the risks arising in the supply chain. Various tools and techniques sited above can be used to mitigate the risks involved in supply chain management.
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