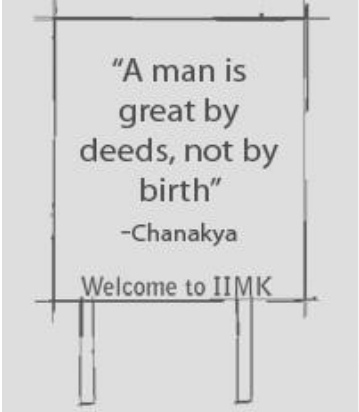

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A CONCEPTUAL FRAMEWORK FOR SUPPLY CHAIN RISK MANAGEMENT

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ABSTRACT

In an globalized business environment and highly competitive market, disruptions and glitches of supply chain can affect business survivability of an organization. Recently, supply chain risk management has emerged as an important priority area for supply chain managers and receiving attention in their decision making. Given the important the question of institutionalizing and developing a risk management system across the supply chain becomes relevant. In this paper, we have attempted to develop a conceptual framework for such a risk management system. The framework is being proposed based on the three argument of risk prevention, monitoring, and control of supply chain risks. Such a framework would benefit firms in terms of bringing an insight into the way a supply chain risk management system is to be viewed and institutionalized.

Keywords: supply chain, risk, risk monitoring, risk assessment.

INTRODUCTION

Supply chain practitioners and experts, over the years, had been too preoccupied with cost reduction and improving effectiveness; however, off late risks associated with a supply chain that have the potential of making the whole chain dysfunctional has caught their minds. In McKinsey global survey 2010[1] on managing global supply chains, executives around the globe recognizes supply chain risk management as one of the most important strategies. Managing risks has become a challenging task as the supply chain now has become very complex. The complexity arises from interconnectedness of activities along the supply chain and the environment. The increased level of uncertainty also added to this complexity. One can not achieve supply chain excellence without giving greater importance to risk management. Performance goals can not be reached if the supply chain faces frequent stoppages, delays and a risk to become dysfunctional. The need of the time is that excellence in supply chain practices needs a complete system of supply chain risk management in place. The whole concept of having a system in place for understanding, planning, organizing, controlling and monitoring of risks associated with the supply chain is Supply Chain Risk Management. However, in most cases this is better said than done. Although financial risk management is quite popular, supply chain risk management is still in its initial years of development. In this article we try to develop a supply chain risk management framework for the Indian industry.

RISKS AND UNCERTAINTY

'Risk', as defined in the dictionary, is the 'chance or possibility of suffering loss, injury, damage'. By definition, supply chain management is a concept that professes the chain - linking the suppliers through different stages of value addition and the customers - to act as one entity thereby delivering maximum customer value through coordination of the flow of material, information and money. Therefore, supply chain risks refer to the vulnerabilities to this flow. Baird and Thomas (1990) defined risk as "variation in the distribution of possible outcomes, their likelihoods and their subjective values". Therefore, risk is the uncertainty or variability associated with expected outcome. The variability in expected outcome may be due to occurrence of certain events whose occurrences are not certain. These risk events may occur during routine supply chain operations or through management decisions and actions. One should not confuse uncertainty with supply chain risk. Occurrence of an uncertain event or a management action may not necessarily lead to losses and thus truly causing a risk to the supply chain. For example, given uncertainty

[1] The challenge ahead for supply chains: McKinsey Global Survey Results, November 2010. Available at http://www.mckinsey.com/business-functions/operations/our-insights/the-challenges-ahead-for-supply-chains-mckinsey-global-survey-results (Retrieved on February 14, 2017).

in customer demand, supply chain inventory management may be designed not to serve a portion of the customer orders by defining a target service level. The question that arise here is "whether manager's organized efforts towards managing uncertainty (that is what managers do) in order to achieve defined supply chain performance targets can be referred as supply chain risk management?". The above makes definition and scopes of supply chain risks a bit confusing from a practitioner's point of view. For a practitioner the questions that reflect these confusions are:

1) Why do I need to worry about supply chain risks?
2) What can be classified as a supply chain risk?
3) Why supply chain risk management has suddenly become so important?
4) How are my regular operational practices different from supply chain risk management practices?
5) What additional mechanisms and practices have to be put in place to manage supply chain risks?
6) How supply chain risk management is different from risk management activities of the organization?
7) How the role of a risk manager is different that an operational manager?

Let us try to understand supply chain risk afresh. A supply chain is designed to achieve a certain level of performance. Managers across the supply chain exist to ensure that supply chain meets the designed performance level by minimizing the adverse effects of uncertainties arising within and the external environment. A glitch in the supply chain, which again is caused due to uncertainties, may result in non-achievement of the designed performance level. These glitches may cause both short-term as well as long-term losses in the form of sales and market share, poor customer service resulting in lower customer satisfaction and loyalty etc. (Hendricks and Singhal, 2005). Whereas regular supply chain practices handles an anticipated amount of uncertainty, the second type of uncertainties that leads to supply chain glitches are unanticipated one. Sodhi and Lee (2007) also have referred to 'unanticipated changes' within the scope of supply chain risks. Chopra and Sodhi (2004) broadly categorized risks in terms of their effects seen in a supply chain into: (1) delays, (2) disruptions, (3) forecast accuracies, (4) system breakdowns, (5) intellectual property breaches, (6) procurement failures, (7) inventory problems and (8) capacity related issues. What characterizes the above risks is that all of the above categories of effects are not designed in a supply chain but are outcomes that are unanticipated. Therefore, we assume the scopes of supply chain risks management to refer to only those uncertainties that lead to 'unanticipated adverse impacts that was not designed for'.

INSTITUTIONALIZING SUPPLY CHAIN RISK MANAGEMENT SYSTEM

The above sections highlight why supply chain risk management is important and what it means when we talk of supply chain risks. Now, the important issue that emerges here is how to institutionalize a system meant for managing risks along the supply chain. Institutionalizing supply chain risk management may not mean having a new system in place, separate from the existing management process, with managers associated with it having separate roles and responsibilities. Rather, a supply chain risk management system has to be built on the existing management process and within the same management hierarchy. The difference comes in the form of more awareness and understanding about supply chain risks and managers taking proactive roles in identification, assessment, planning and control of such risks. Supply chain risk management is also about making the supply chain resilient and flexible to handle more unanticipated risk situations. The present work attempts to understand the existing risk management practices and propose a framework on how these practices can be further strengthened to develop a more effective supply chain risk management system. The present work focuses on the following issues:

1) The processes related to identification of sources of risks, assessment and monitoring of risk events, risk mitigation approaches, and contingency planning
2) The nature exchange of risk information and processes that supports such exchanges
3) The decision making process for identification of sources of risks, assessment and monitoring of risk events, risk mitigation approaches, and contingency planning
4) Risk learning environment

DECISION MAKING FOR RISK MANAGEMENT

This section attempts to answer the following questions: 1) what decisions manager are required to take for risk management?, 2) whether the quality of decision making helps in minimizing the adverse consequences of a risky situation?, 3) what facilitates better risk decisions?, 4) who should take risk decisions?, and 5) whether such decision making process can be supported with a systematic organizational process? Supply chain managers have to take decisions for a variety of risky situations. Such decisions are related to the following risk management activities of a manager: 1) selecting a risk reducing/mitigating measures and taking action, 2) defining and assigning risk management roles and responsibilities, 3) design and implementation of risk management policy, 4) preparation of a contingency plan, 5) managing alliances with business partners, 6) leading supply chain reengineering and change for

to make a resilient supply chain, and 7) adding risk management capability in terms of physical infrastructure, manpower, technology etc. Typical risk decisions may be as follows:

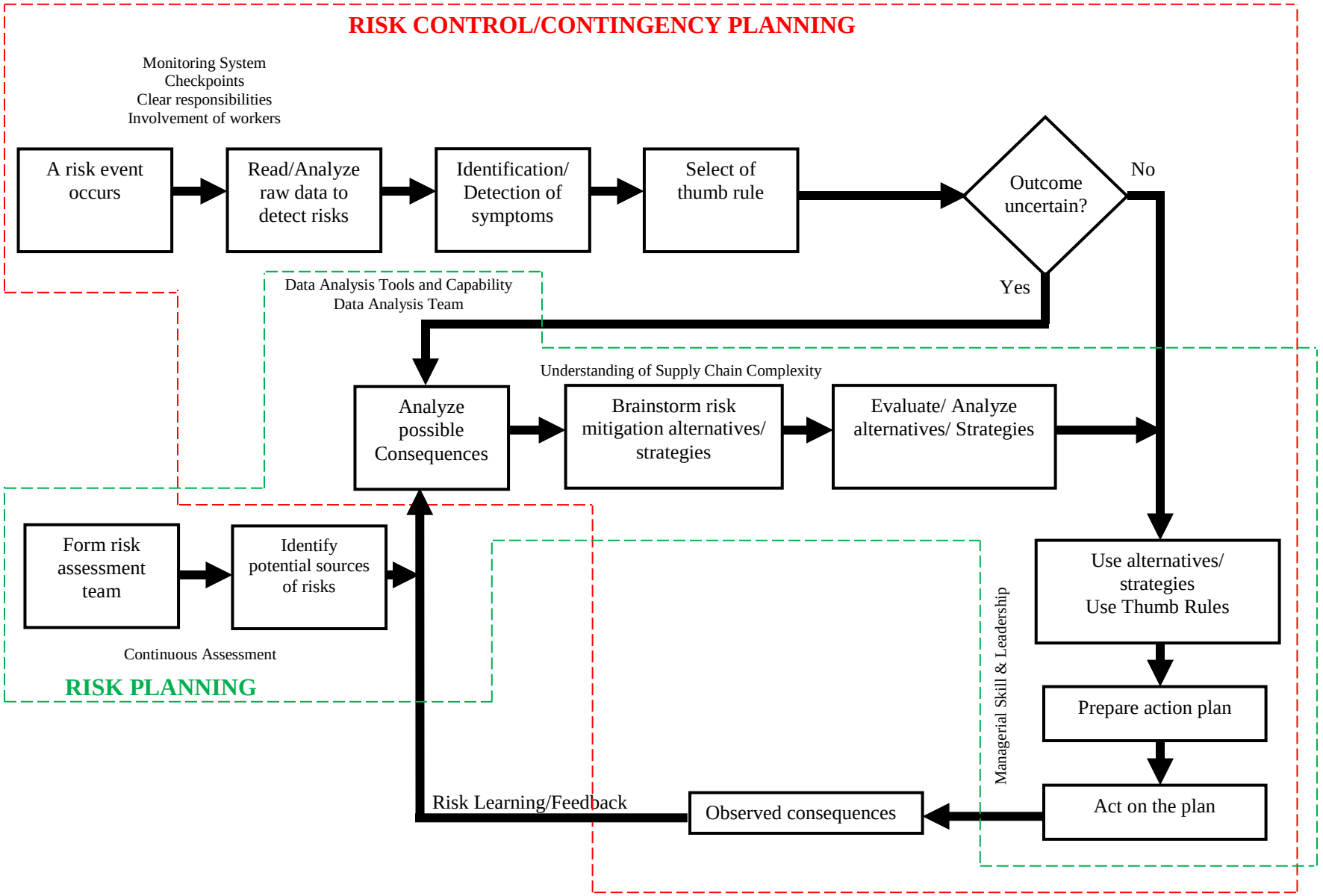
1) Putting checkpoints for risk monitoring
2) Assigning clear roles and responsibilities for risk assessment and analysis, monitoring, measurement, contingency actions
3) Deciding on adding risk management capability through acquisition of newer technologies, skilled manpower, risk assessment and analysis tools, safety-related equipments, mechanisms for risk-related information exchange etc.
4) Deciding on a reward mechanism for risk minimizing efforts of employees
5) Deciding on bringing in a supply chain restructuring for making a resilient supply chain. Decisions here may be how flexible the supply chain will be, how partners can be made more proactive through incentives and negotiations
6) Decision related to how partners will be involved to coordinate risk management efforts
7) Decision on what information are to be shared with partners for better decision making
8) Contingency planning

As can be seen above that the manager's risk related decisions may be strategic, tactical and operational in nature. As a general rule it can be argued that strategic and tactical decisions are called when a supply chain is assessed for its vulnerabilities and risk prevention and controlling plan has to be established. Operational decisions are called when the above plan is operationalized or the supply chain faces a risky situation starting from identification of risks, risk communication, selection of mitigations strategy, assigning tasks, releasing resources and control. Among the above the first two decisions triggers the others and a manager's skills are tested when they take the latter decisions as their effectiveness will decide the losses incurred. The occurrence of a risk event can be detected either through monitoring of raw data or through analysis of raw data. Therefore, a data capturing and data processing capabilities are important for early detection of risks. When a risky situation arises most often there may be lesser time to evaluate and analyses alternative action plans and therefore, selection of risk mitigation strategy in such cases are guided by predetermined thumb rules as it facilitates speedy decisions and actions. The thumb rules are predetermined through an overall assessment of the vulnerabilities facing the supply chain and planning actions – strategic and tactical decisions. The thumb rules here refer to recommended actions at the operational level when the supply chain faces a risky situation. In situations requiring quicker decisions, real-time information exchange capability facilitates timely decisions and enhances decision effectiveness. A good risk management information system will also increase the effectiveness of decisions and actions taken towards risk management. The qualities of such decisions are guided by the understanding of the decision maker of the risk situation and ability to identify alternative strategies, an

information system capable of providing real-time risk-related data and their processing. Therefore a supply chain-wide information system with the following capabilities will enhance the quality of decisions and actions towards risk management: 1) capturing of risk data as and when a risk event has occurred and relaying it, 2) storage and fast retrieval of historical risk data, 3) analytical capability for faster analysis of risk data and its communication, 4) storage and faster retrieval of past analysis of risk data, 5) information on availability of resources to be utilized for risk management, and 5) communications between people involved in the risk management process.

The responsibility of taking risk-related decisions moves up the hierarchy as the scope of the risk event that has occurred or investigated expands. The scope of a risk event here represents the extent to which supply chain members are affected. For example, a risk event may have both the origin and consequences observed only within one function, more than one functions, occurrence and consequences felt in different functions, within one supply chain partner, more than one SC partner, occurrence and consequences felt in different partner. However, if the risk is studied, investigated and evaluated systematically in advance, actions can be designed in the form of thumb rules and the responsibility may be delegated to lower level managers. Further, the manager exercises some degree of analysis and judgment in case either the outcome of the recommended actions has some degree of uncertainty or the context/situation is different from the context/situation analyzed in advance. The responsibility will also move vertically up when the potential consequences of the risk event is high. As the outcome uncertainty of risk-related decisions higher lengthier will be the decision making activities mostly in the form of reevaluation and communications. As the outcome uncertainty increases the decision making responsibility also shifts up the organization hierarchy to senior managers.

The strategic and tactical decisions are taken to facilitate planning of risks. These decisions are actually not triggered by the occurrence of a risk event but by its anticipation. Thus, the effectiveness of these plans is not tested until when a risk event has actually taken place. Nevertheless they are very effective for risk prevention and facilitate risk control and contingency actions through advanced planning. Risk planning starts with the identification of potential sources of supply chain risks followed by assessment of consequences, brainstorming alternative risk mitigation strategies and mapping strategies with risk contexts. The complete risk management process including the strategic and tactical planning and the operational handling of a risky situation is described in the following figure.


RISK CONTROL/CONTINGENCY PLANNING
Monitoring System
Checkpoints
Clear responsibilities
Involvement of workers
A risk event occurs
Read/Analyze raw data to detect risks
Identification/ Detection of symptoms
Select of thumb rule
Outcome uncertain?
No
Yes
Data Analysis Tools and Capability
Data Analysis Team
Understanding of Supply Chain Complexity
Analyze possible Consequences
Brainstorm risk mitigation alternatives/ strategies
Evaluate/ Analyze alternatives/ Strategies
Form risk assessment team
Identify potential sources of risks
Continuous Assessment
RISK PLANNING
Use alternatives/ strategies
Use Thumb Rules
Prepare action plan
Act on the plan
Managerial Skill & Leadership
Observed consequences
Risk Learning/Feedback

MAPPING MITIGATION STRATEGIES WITH RISK CONTEXTS

Decision making for managing risks is tricky as in most cases the decision maker face a situation where the outcome of the decision alternatives are hard to predict (Aven at al., 2007). Risk mitigation strategies can be preventive, corrective or reactive. The preventive strategies are more speculative in nature and taken based on an assessment of the risk. Hence, an appropriate and effective risk assessment capability becomes very important for such taking right decision for such speculative situations. The time lag between the occurrence of a risk event and realization of its consequences plays an important role in deciding what risk mitigation strategies to be adopted. We also classify risks based on the time between the occurrences of a risk events and realization of its consequences into: (1) risks with positive time between occurrence and realization of effects, and (b) risks with occurrence and consequences are realized simultaneously and suddenly (earthquake, cyclone, fire etc). In the first case, the occurrence of the events may go unnoticed, however, gives many early indications of leading to realization of risks. A consequence of this is to risk management is that, if a continuous risk monitoring system is in place to detect such early warnings, the adverse consequences of such risks may be averted by taking corrective actions. In the latter case, the supply chain has very little or no time to take any corrective steps once a risk event occurs. A best logical strategy in such case will be to adopt a reactive strategy. A reactive strategy is to a contingency plan that minimizes damages when a risk event occurs.

RISK PREVENTION

The genesis of a supply chain risk management system is in the acceptance of the fact that risks exists in the supply chain. Prevention of such risks is possible if we can identify the sources, measure the likely consequences, and assess the likelihood of occurrences (Tummala and Schoenherr, 2011). Andersen (2008) pointed that various types of risks are dealt by different specialists in the organization. If we have to assess adverse effects for each uncertain events risk assessment will itself become a mammoth task. Such a strategy will also require the assessors to have good domain knowledge of all areas which may get affected by an uncertain event. For a supply chain what is important is not the occurrence of an uncertain event but the adverse effects it has due to such occurrences. A supply chain is exposed to a large number of risk sources but with varying degrees of consequences being observed by the supply chain as a whole and the individual supply chain members. Further, information and knowledge on many of risks sources, their behavior and consequences are not easily understood and available (Ritchie and Brindley, 2007). In such a case, in order to develop a risk management system, it will be prudent to first identify the most vulnerable points/areas in the supply chain and then assess major risk sources that may affect these

vulnerable points/areas. The location information can be put into good use if the risk management team emphasizes on the question on how during the normal operation of the supply chain risks can be tracked. An early detection of triggers would also facilitate development of an early warning system to be very useful for control purposes. Thus, as an outcome of the risk identification exercise is the sources of the risks, their triggers and their location. Needless to say that these checkpoints may extend beyond the organizational boundary to include locations across the supply chain.

Risk assessment can also be viewed as a process of quantification of risk. The vulnerabilities are assessed by identifying key variables that influences directly or indirectly the supply chain performance. Assessment risk has a simple formula as given below.

$$\text{Risk} = \text{Likelihood of occurrence} \times \text{Consequences}$$

Management of supply chain risks is possible only if risks are assessed using the above formula. However, assessments of consequences and well as the frequency are a tedious and time-consuming job and may require the expertise and knowledge of people having good exposure of risk environment. While for frequently occurring risks a simple frequency distribution would suffice, for many other risk events, occurring less frequently or rarely, expert's estimation can be the beginning. There are plenty of reported evidences on the use of a variety of tools used for assessing risks. For example, Neiger et al. (2009) proposed a novel value-focused process engineering approach for risk identification in supply chains. Tuncel and Alpan (2010) used Failure Mode, Effects, and Criticality Analysis (FMECA) for assessing forces of supply chain disruption for a medium-sized company in Turkey. Wagner and Neshat (2010) collected data from 760 firms to apply graph theory to quantify supply chain vulnerabilities. Schoenherr et al. (2008) used Analytic Hierarchy Process (AHP) to select offshore supplier location for a US manufacturing firm.

RISK CONTROL/ CONTINGENCY PLANNING

The question of risk control and contingency planning arise in two situations: (1) when early symptoms of the likely occurrence of a risk event is detected, and (2) when a risk event has occurred but the full consequence of the risk event is yet to be realized. The above perspectives brings in two different approaches to risk management. Whereas in the first case the focus of risk management is on preventing the occurrence of the risk event itself, the later the focus of the later is on minimizing damages. In the case of the former a good risk monitoring system is desirable. However, in the latter case, damages can be minimized by minimizing damage to supply chain operations and infrastructure. Characteristic of a good

monitoring system is to identify checkpoints where early symptoms are likely to be visible which can facilitate corrective actions. To succeed, worker's involvement and training is of paramount importance. A systematic operating procedures and assigning clear responsibilities would go a long way to make the monitoring system effective. A prerequisite to implementation of such monitoring system would be to develop standards for the parameters to be monitored and escalation levels for deviations. There are also situations the parameters to be monitored may be a composite one. In such cases multi-criteria scoring mechanisms may also be used (Blackhurst et al. 2008).

Once a risk event occurs the only option left is to put effort to minimize damages. Such an effort is referred here as contingency planning which is more reactive in nature. Often, in such situations, the decision maker is left with very little time to plan but to act. An earlier and detailed risk assessment and analysis becomes very handy in such situation such an exercise would have resulted in thumb rules which can be immediately applied without wasting valuable time in analyzing the effectiveness of such actions. The amount of damage not only depends on the firefighting mechanisms but also on the flexibility or agility of the supply chain. Contingency planning becomes a challenge for risk events that have low probability of occurrences, however, has very high consequences. Flexibility and agility becomes very useful in such situations. Some flexible strategies that are incorporated in the supply chain design itself is the use of backup or responsive options. Leadership and superior managerial skill becomes very useful during periods of crisis. A great way of improvising the risk management system is to learn from past occurrences of risk event and its management.

CONCLUSION

This paper discusses the importance of risk management in supply chain and tries to build a conceptual framework for developing a supply chain risk management system. The framework is built over the concept of risk prevention, risk monitoring, and contingency planning. It also emphasizes that a detailed and early identification of risks and their assessments forms the backbone of any risk management system. Comprehensive assessment and evaluation of risks guides the people in action in the form of thumb rules and risk management process. A major contribution of this paper is to bring an insight into the way a supply chain risk management system is to be viewed and institutionalized.

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