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Analysis on supply chain risks in Indian apparel retail chains and proposal of risk prioritization model using Interpretive structural modeling

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ABSTRACT

Indian apparel retail industry is on a complete transformation journey and trying to evolve as an organized industry. It is very common to find the disruption factors in every business and the ways to mitigate and manage them is of current research interest. The paper discusses the selective risks associated with the apparel retail supply chains in India by structural analysis of the controllable risks that are identified. The work also reveals the use of Interpretative Structural Modeling (ISM) to establish the interdependencies between these risks spread across various supply chain functions of retail industry. The relationships are established based on expert opinions using Delphi technique followed by ISM modeling technique and Fuzzy MICMAC analysis. It also classifies the risk factors based on their driving and dependence power. ISM is proved to be a useful tool to help understand the impact of risks at stages of retail supply chain. Globalization, labor issues and security and safety of resources turns out to be the strong drivers of other supply chain uncertainties. The domino effect of these risks leads to financial crises for the organization.

The paper also proposes a new model for the Risk Priority Number (RPN) calculation using ISM and Fuzzy MICMAC methodology for the applications in retail and various other domain risk studies. The sample size of experts is small and to remove the biasness of opinion, the model can be further validated using Structural Equation Modeling (SEM) in the future. The outcome would help practicing managers to analyze and to take actions for managing the factors by improving the bottom line of the organization by proper utilization of resources.

1. Introduction

In the last two decades, supply chains of businesses have been experiencing rapid globalization and emerging technological changes especially in the manufacturing and retail business. Today, supply chains across industries are being stretched the way it was never done before. The most trusted brands do only the assembling of components which are outsourced for manufacturing. Similarly, major apparel retailers do their business as well. They do product development and outsource rest of their operations. This has made supply chains more complex, fragile and prone to many disruptions. It is an established fact that recent commercial chains are dynamic networks of interconnected firms and industries (Hakansson and Snehorta, 2006). And, the search for better markets and cheaper sources of raw materials have made the supply chains more and more complex and retailers need to sustain their business (Sahin and Robinson, 2002; Wu and Olson, 2008; Ganesan et al., 2009). Many disruptions and risk factors have threatened production and retail distribution systems. They directed a decline in the market share, cost escalation and dissatisfaction amongst customers. In the last decade, supply chain risks are studied diligently and are categorized into inherent or *high frequent risks and disruption or infrequent risks* (Kleindorfer and Saad, 2005; Oke and Gopalakrishnan, 2009). These disruptions could also be due to political, labor, market uncertainty, material, financial and information risk impacting supply chain performance (Shapira, 1995; Prater et al., 2001; Christopher and Lee, 2004; Quinn, 2006; Tang, 2006a, 2006b; Poirier et al., 2007; Tang and Nurmaya Musa, 2011). How does one protect the business

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from disruption? The answer lies in the integration of supply chain risk management as a core component in the operations of the business. This intuited the studies on supply chain risks and mitigating strategies, which are increasingly becoming popular (Wei and Choi, 2010), eventually lead to the studies from the domain specific risk mitigating strategies as well.

India, being a growing destination for the retail business, the risk is to be analyzed from supply chain perspective, though the sector is highly fragmented. Boston Consulting Group reports that the organized retail industry will achieve $260 billion business by 2020 (BCG Report, 2011). In the last decade, Indian retail market has shown the considerable growth in the Apparel business and so as food business. With many foreign apparel players eyeing to enter India through FDI, it has become a research destination. To support that, though there are reports existing in this domain, the focus on retail supply chain still attracts several problems to be explored in the supply chain and its risk domain.

This paper will explore and analyze selective disruption factors in the domain of study. The study also proposes a methodology to prioritize risks by analyzing the interdependencies between them. This contextual relationship is established through a technique called *Interpretive* Structural Modeling (ISM) and followed by a *Matriced' Impacts Cruoses Multiplication Applique a un Classement* (MICMAC) analysis for segregation of study variables. Thus, our proposed model is based on a notion that each risk is associated with multiple ones in a way that either it drives them or is dependent on them. To design the mitigation strategies, the first step is to identify and analyze the risk in terms of its frequency of occurrence, severity in terms of cost and what other disruptions it could lead to. The focus is to propose a methodology based on MICMAC analysis to analyze and prioritize the supply chain risks so that appropriate strategies can be designed to improve the business efficiency. For prioritizing the risks, there is a new formula proposed based on the structural model, which is the unique contribution of the model.

The paper has been structured as follows: It starts with the introduction about the supply chain risk management, followed by the literature review on supply chain risk and Indian retail industry. Then, the discussions on establishing the variables, ISM model formulation and MICMAC analysis. It ends with the discussions on the new risk assessment framework, managerial implications and future scope.

2. Literature review

The literature review has been done through systematic literature review methodology proposed by Tranfield et al. (2003). The review process has followed the planning for the review, conducting the review exercise and reporting/dissemination protocol in a systematic way. The review includes papers from various journals like *Business Process Management, International Journal of Physical Distribution and Logistics Management, Journal of Operations Management, Supply Chain Management: An International Journal, The International Journal of Logistics Management, Journal of Manufacturing Technology Management, International Journal of Operations and Production Management and etc.* It also includes articles and Reports *from* Harvard Business Review and reports on Supply chain risk management published by various prominent consulting companies like Deloitte, PwC, Accenture, Technopak, etc. The second part covers the review on identifying the risks variables and understanding the risk mitigating strategies from 2000 to 2014.

Supply chain risk is defined as "any risk to material, product and information flow from original supplier to the delivery of the final product" (Christopher et al., 2003). There is a growing importance to risks domain from supply chain perspective (Harland et al., 2003; Zsidisin and Ellram, 2003; Zsidisin et al., 2004; Khan et al., 2008; Wu and Olson, 2008; 2010; Wagner and Bode, 2008; Tang and Tomlin, 2008; Rao and Schoenherr, 2008; Rao and Goldsby, 2009; Colicchia and Strozzi, 2012; Sodhi et al., 2012; Bandaly et al., 2013; Marley et al., 2014). Rao et al. (2006) gives the complete typology of various risks in supply chain system. Further, it is being identified as a function of uncertainty level and the impact of an event (Sinha et al., 2004). However, it is the common belief that management within SC gathered more focus and momentum only after the 9/11 attacks in USA (Ghadge et al., 2012). This risk can be an internal element to the supply chain or due to external factors (Goh et al., 2007). They can also be classified as operations and disruptions risk (Tang, 2006a). The former are associated with uncertainties inherent in a SC which include demand, supply, and cost uncertainties. Disruption risks, on the other hand, are those caused by major natural and man-made disasters such as flood, earthquake, tsunami, and major economic crisis. Supply chains are vulnerable to disruptions due to a number of variables. These disruptions or risks can also have significant impact on profit margins of the businesses and such failure occurs due to one element which has an impact on both upstream and downstream operations (Chopra and Meindl, 2001). It is not only the profitability, but also the reputation of firm at stake. With the customers' expectations becoming more, and managing lead times of products is becoming very challenging, unless due attention is given to risk assessment exercise, the probability of supply chain failure is high (Khan et al., 2008, 2012). Not only has this, but the cost of break cascaded across the businesses also and it may impact the other end showing the ripple effect (Ritchie and Brindley, 2007a, 2007b; Braunscheidel and Suresh, 2009; Neiger et al., 2009; Yang and Yang, 2010). On the other side, Cousins et al. (2004) elucidate the consequences of failure to manage risks effectively. Several papers discuss on risk identification and assessment methodologies (Chopra and Sodhi, 2004; Lavastre et al., 2012). Various models for supply chain risk management have been proposed in the recent years (Olson and Wu, 2008, 2011; Pfohl et al., 2011; Giannakis and Louis, 2011; Xia and Chen, 2011; Manuj and Sahin, 2011; Cagliano et al., 2012; Kern et al., 2012; Rossi and Pero, 2012; Zegordi and Davarzani, 2012; Klibi and Martel, 2012; Chiu and Choi, 2013; Li and Womer, 2012). Table A2 gives summary of various modeling studies conducted in supply chain management field so far. Some of these models help businesses to identify their risks and give a direction for continuity plan by evolving the mitigating strategies as well (Juttner, 2005).

The means of managing the risks is very unique to individual business. To support that, Juttner et al. (2002, 2003) suggest investigating risk management in different supply chains and developing strategies based on their environments. Risk assessment

Table 1
Variables (risks) for ISM.

Risk no.	Risk
R1	*Globalization*
R2	*Raw material and product quality standards*
R3	*Scarcity of resources*
R4	*Supplier uncertainty*
R5	*Lack of co-ordination/alignment*
R6	*Behavioral aspect of employees*
R7	*Infrastructure risks*
R8	*Delay in schedule/lead time*
R9	*Demand uncertainty*
R10	*Customer dissatisfaction*
R11	*Financial risk*
R12	*Security and safety*