Strategic action grids: a study on supply chain risk management in manufacturing industries in India

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Abstract

Purpose – The purpose of this paper is to provide strategic recommendations to supply chain managers of Indian manufacturing industries for a robust supply chain related to risk management by original equipment manufacturers (OEMs) and suppliers in manufacturing industries to ensure a robust supply chain risk management (SCRM).

Design/methodology/approach – Importance-performance analysis (IPA) is utilized to identify and provide strategic recommendations to manufacturing industries for improving their supply chain performance by attaching due importance to risk constructs and appropriately choosing mitigation strategies.

Findings – The investigation using the strategic action grids reveals that most of the means of risks are near the point of intersection of the grand means of the risk constructs and their impact on the supply chain, indicating that all the risks have the equal likelihood of occurrence. The mean importance of risk monitoring, risk avoidance (RA) and risk sharing surpass the mean performance for both OEMs and suppliers.

Research limitations/implications – The study is executed with following limitations: the study assumes that the manufacturing industries across different sectors perceive similar risk. The sectors considered are automotive, heavy engineering, general engineering and home appliances. The Southern States of India are considered because of the dominant presence of many industries, especially automotive industries. However, it should be noted that these States form the manufacturing hubs where the lead organizations are functioning along with their major suppliers.

Practical implications – By understanding the importance of SCRM dimensions and utilization of these dimensions, firms can mitigate the impact of risk on the supply chain. The detailed study of SCRM strategies highlights the importance attached to risk factors, mitigation strategies, and top management commitment. By the implementation of SCRM strategies, supply chain managers can improve the firm's performance.

Originality/value – The study involves empirically validated data on SCRM dimensions. The IPA is performed on the SCRM dimensions to investigate the importance attached to the factors of the dimensions and their performance.

Keywords Importance-performance analysis (IPA), Mitigation strategies, Indian manufacturing industries, Risk categorization, Strategic action grids, Supply chain risk management (SCRM)

Paper type Research paper

1. Introduction

India is an Asian manufacturing leader owing to the high availability of workforce, lower cost of manufacturing, better quality of products and availability of quality raw materials at affordable prices (Yu and Goh, 2014). The above factors have appealed multi-national companies in the global arena to invest in India. Advent of globalization, outsourcing, and

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ever increasing competitive environment have led to the emergence of risk issues in the supply chain. Hence, the organizations are forced to adopt innovative ways of doing business (Stefanovic *et al.*, 2009).

Manufacturing industries has been focusing on improving the performance of the supply chain by implementing strategies such as supply chain flexibility (Khan and Pillania, 2008), alignment of supply chain strategy with the business strategy (Dath *et al.* 2010), supply chain coordination (Kaur *et al.*, 2011; Ramanathan and Gunasekaran, 2014), demand forecasting (Gonçalves *et al.*, 2005; Jaipuria and Mahapatra, 2014), supplier selection (Huang and Keskar, 2007; Shemshadi *et al.*, 2011) and revenue sharing (Yang and Zhao, 2011; Zhang *et al.*, 2012). Chen and Wu (2013) argued that supply chain risk management (SCRM) has to be an integral part of supply chain management. Shenoi *et al.* (2016) have inferred that for a robust supply chain one needs to study risks present in the supply chain in entirety due multi-dimensional nature of the supply chain.

The supplier risk framework developed by Phusavat *et al.* (2015) to classify suppliers is based on the level of the risk perceived by them. A multi-level hierarchical framework developed for measuring and monitoring the resilient performance of the candidate industry (Sahu *et al.*, 2017). Hong *et al.* (2014) attempted to measure the perception of partnership and risk on performance and the importance of those perceptions to the supply chain. Existing studies on SCRM aim at establishing the relationship between the risk factors, mitigation strategies and performance. There are only a few articles on the study of importance attached to these factors. Hence, in this paper, an attempt is made to identify areas for improving the level of SCRM. By understanding the importance of SCRM strategies and implementing them, supply chain managers can improve the firm's performance. In this paper, we demonstrate the application of importance-performance analysis (IPA) to analyze the importance attached to the dimensions of SCRM and measure the benefits realized by manufacturers'.

The rest of the paper is structured as follows. Section 2 reviews literature on supply chain risk, risk assessment models and IPA. Section 3 describes methodology and data collection. Section 4 presents the data analysis and results. Section 5 discusses the results of the study, managerial implications, limitations and future scope.

2. Literature review

Modern day supply chains are vulnerable due to dynamic changes in economy, business and ecological environments more than ever before. First, catastrophes have been increasing in a large number, and its severity of impact on the firm and the supply chain is enormous during the recent past (Thun and Hoenig, 2011). Natural calamities such as droughts, floods, tsunamis have been occurring more frequently and have a significant impact on the economy. Second, supply chains, of late are highly complex than the yesteryears (Jüttner, 2005). A higher level of complexity is attributed to outsourcing, the relationship between the trading partners in the network, increased dependence on trading partners capabilities (Svensson, 2004; Thun and Hoenig, 2011), new technologies, shorter product life-cycles due to change in preference of the customer, regulatory requirements (Trkman *et al.*, 2010), competitive environment, etc. Third, to increase the efficiency of the supply chain, the supply chain managers strive to make their operations leaner and more efficient in an unstable environment (Wagner and Bode, 2006; Tang, 2006; Hult *et al.*, 2010). The supply chain network faces the risks related to demand, supply, finance, and risks related to production and operation (Wagner and Bode, 2008; Kaur *et al.*, 2011; Chen and Wu, 2013). An outcome of an efficient supply chain is the increase in performance. The efficiency of the supply chain may improve by initiatives such as product variety, reduced supplier base, and reduced assets through outsourcing of non-core activities.

Categorization of risks factors are based on their frequency of occurrence and their impact on the supply chain (Sodhi and Chopra, 2004; Oke and Gopalakrishnan, 2009). The risks such as coordination of supply and demand are of high likelihood and have low impact on the supply chain. Coordination of supply and demand is of high likelihood and low impact risks, while the vulnerability due to the disruption is categorized as a low likelihood and high impact risks.

2.1 Supply chain risk assessment models

Supply chain risk measurement is a herculean task due to its multitudinal nature and the non-availability of suitable metrics for evaluation (Wagner and Bode, 2006). Supply chain managers need to have better methods of measuring and managing supply chain vulnerability (Wagner and Neshat, 2010). Extant literature highlights the usage of various methods such as Analytic Hierarchy Process (AHP), multi-criteria decision making (MCDM) approach, structural equation modeling (SEM) to assess the supply chain risk.

Gaudenzi and Borghesi (2006) proposed AHP model to identify risk factors in the supply chain with the objective of improving customer value. The goal is to develop a model to assess risks in the supply chain and utilized AHP method in the definition of decision priorities.

Wu and Olson (2008) used three types of risk evaluation models within supply chains: chance-constrained programming, multi-objective programming and data envelopment analysis models. They compared and analyzed three simulation models. The results demonstrated that the proposed approach allows decision makers to perform, trade-off analysis between incurring costs, appropriate acceptable equality levels, and on-time delivery distributions. They have also suggested alternative tools for evaluating and improving the supplier selection decisions in an uncertain supply chain environment.

Wagner and Neshat (2010) used graph modeling to measure vulnerability drivers and their interdependencies. They developed supply chain vulnerability index that could be applied to real-world data.

Tuncel and Alpan (2010) discussed how a timed Petri-net framework model could be used to analyze a supply chain network facing various risks. The findings of the case study suggested that risk management decisions and appropriate mitigation strategies reduce overall system cost and improves its performance.

The model developed by Punniyamoorthy *et al.* (2011) for supplier selection includes multidimensional constructs both tangible and intangible criteria. They used SEM and fuzzy AHP for considering the fuzziness of human opinion also into account. The model proposed that the attributes such as management and organization, quality, technical capability, production facilities and capacities, financial position, delivery, service, relationship, safety and environmental concern and cost have priority in the supplier selection process. The model paves the way to mitigate the uncertainties in the strategic decision such as supplier selection.

The empirical study by Lavastre *et al.* (2012) suggests that effective SCRM can be realized only in collaboration and timely sharing of information among the trading partners.

Ghadge *et al.* (2013) followed systems approach for modeling supply chain risks which predicts the failure points and its impact on the supply chain network. A system-based risk modeling provides a holistic picture of risk behavioral performance that is difficult to realize through other research methodologies commonly preferred in the SCRM research. VIKOR (VlseKriterijumska Optimizacija I Kompromisno Resenje) method integrated with the fuzzy set theory to select potential supplier (proposed by Sahu *et al.*, 2016) is based on general strategy as well as resiliency strategy for supplier selection in the context of resilient supply Chain. Prakash *et al.* (2017) proposed a methodology to study the risks present in perishable food supply chain and to prioritize the risk mitigation strategies. Chand *et al.* (2017) utilized MCDM approaches to identify the supply chain that has minimum risks.

The research contributions till date are attributed to design methodologies to curtail risk and development risk index. In the recent years, researchers suggested the ranking of the attributes based on their importance. Hence, it necessitates IPA to understand the priorities and performance given by the manufacturing industries to dimensions of SCRM, namely, risk constructs, mitigation strategies, top management commitment (TMC), and their effect on supply chain performance and importance attached to each of them.

2.2 Importance-performance analysis (IPA)

Martilla and James (1977) proposed IPA, a technique to identify strengths and weakness based on the multi-attribute choice models. IPA is a tool to determine the strategy as "good work (keep it up)," "a scope for improvement (concentrate here)," "low priority" and "strategic overkill" (i.e. doing more than necessary).

IPA has been widely used to study customer satisfaction in service industries such as travel and tourism (Ramakrishnan and Usha 2016; Boley *et al.*, 2017), education (Wang *et al.*, 2016; McLeay *et al.*, 2017), hospital (Chen and Lin, 2013; Padma *et al.*, 2014; Raveendran *et al.*, 2017), supply chain practices (Ramanathan and Gunasekaran, 2014; Islam *et al.*, 2018). Azzopardi and Nash (2013) critically analyzed IPA and inferred that the analysis is most suited for identification and mitigation of validity concerns. Dwyer *et al.* (2014) utilized the IPA method for analyzing the destination competitiveness in the tourism industry. Dwyer *et al.* (2016) assessed the importance of different activities to improvise tourism development in Serbia. Ziegler *et al.* (2012) have studied the satisfactory level of tourists using IPA. Sever (2015) inferred that IPA is a useful tool for the identification of underlying deficiencies and setting priorities for the same. Padma *et al.* (2014) gained insights of hospital performance from the customers' perspective of service-quality by using IPA for patients and their attendants. Table I summarizes a comprehensive review of IPA in the recent literature.

The IPA is simple but powerful evaluation tool used by practitioners and academicians to find out which attributes that are doing well and attributes that has a scope for improvement. In other words, IPA is an evaluation tool used to prioritize the attributes for growth and guide strategic development (Slack, 1994; Seng Wong *et al.*, 2011).

The quadrants in "Foresee," "Vigilant," "Continuous monitoring," and "Impulsive" considered as equivalent to "Concentrate here," "Keep it up," "Strategic overkill," "Low priority," respectively for IPA studies on risk. The authors uphold that IPA provides more useful insights than quantitative analysis. Since meeting the customer demand have been recognized as an expectation and performance attribute function.

Table I.
A review of importance-performance analysis in recent literature

Author	Area	Purpose
Seng Wong *et al.* (2011)	E-Governance	Identification of focus areas
Chen and Lin (2013)	Hospital management	Evaluation of internal marketing strategies
Hong *et al.* (2014)	Supply chain risk	To understand the perception of partnership and risk on performance
Kotzab *et al.* (2015)	Supply chain	To determine the level of execution of inter-firm alliance supply chain
Lirn and Shang (2015)	Port risk management	Identification factors with low performance
Dwyer *et al.* (2016)	Tourism	Destination competitiveness
Chang *et al.* (2017)	Construction	To optimize their resource allocation for sustainable development
McLeay *et al.* (2017)	Education	Understanding student satisfaction
Islam *et al.* (2018)	Green supply chain	To identify critical green supply chain practices

3. Methodology

The present IPA study is based on the type of manufacturer, risks perceived, the mitigation strategies, and the TMC of the firm toward risk management (Shenoi *et al.*, 2016; Shenoi, 2017). The details on the dimensions of SCRM are provided in Section 3.1. The IPA study is performed on the basis of two different concepts to establish:

(1) relationship between SCRM constructs and their impact on the supply chain; and

(2) relationship between mitigation strategies and the effect on supply chain performance.

The instrument is designed using a five-point Likert scale ranging from "very low" to "very high" is used to measure the frequency of likelihood of occurrence of risk, and their impact on the supply chain. Also, the instrument captures the importance attached to these risks and the benefits realized by the firm. Each dimension's mean value plotted on a graph with performance on *x*-axis and importance on the *y*-axis. The point of intersection (POI) is the intersection of the grand means between the axes representing importance and performance. This point gives rise to four quadrants "keep it up," "concentrate here," "low priority" and "strategic overkill" (see Figure 1). The service gap is the difference between the importance and performance.

3.1 Data collection

The instrument developed is based on the review of the literature. A five-point Likert scale (with 1 indicating "very low" and 5 indicating "very high") has been adopted to study the frequency of likelihood of occurrence of risk and its severity of the impact on the supply chain (see Shenoi, 2017, for details on the questionnaire hyperlink provided).

The manufacturers are classified based on the product they produce, i.e., end product or subassembly. The population considered for the study is manufacturers in India which include original equipment manufacturer (OEM) and suppliers. The comparative study helps

Figure 1.
Strategic action grid in the IPA

in understanding the risk perceived by OEM and supplier. The respondents considered for our study include vice-presidents/senior personnel in the purchasing and materials management. About 120 respondents are contacted. About 40 respondents are from OEMs and about 80 respondents are suppliers to OEMs. Finally, 85 responses are received. The population considered for the study is the OEMs and suppliers with respect to manufacturers in India. OEMs are the final product manufacturers in various sectors, namely, the automotive (OEMs-7, suppler-12) (e.g. manufacturers of two and four-wheeler), the heavy engineering (OEMs-8, suppler-20) (e.g. manufactures of heavy machinery), pharmaceuticals (OEMs-7, suppler-8) (e.g. manufacturers of chemicals, fertilizer and drugs), and general engineering (OEMs-11, suppler-12). The supplier respondents were manufacturers of fasteners, brake linings, wheels, electrical components such as coils, motors, etc.

The risk constructs in SCRM with reference to Indian context (Shenoi *et al.*, 2016) considered for the study are as follows:

(1) Demand side risk (DSR) – demand volatility; demand forecasting; shorter life cycle of products; poor understanding of customer preferences and defects in products.

(2) Supply side risk (SSR) – financial stability; quality of products; and technological changes and design issues.

(3) Logistic risk (LR) – improper utilization of appropriate mode of transport; non-availability of special type of vehicles; and secured transport.

(4) Regulatory, legal and bureaucratic risk (RLB) – delay in approvals; new plans and policies encourage every stake holders.

(5) Infrastructure risk (IR) – improper maintenance (breakdown, preventive and corrective); disruptions in electricity, and IT failures.

(6) Stock/Data management risk (SDM) – improper utilization of standard product identification; maintenance of customer preferences; and sharing of information.

(7) Environmental risk (ER) – lack of planning to meet the climatic adversities such as floods, cyclones and Tsunamis, terrorist attacks on establishments; and civil unrest.

(8) Financial risk (FR) – untimely clearance of bills by customers; insufficiency in fund releases; over leveraging of funds in high risk investments; financial instability.

The risk in the modern supply chain is inevitable. But their impact on the supply chain can only be alleviated. The mitigation strategies adopted by the firm are as follows:

(1) Risk plan (RP) – methodologies to reduce the risk by implementing structured process.

(2) Risk monitoring (RM) – monitoring of control parameters, trading partner activities.

(3) Risk avoidance (RA) – by utilizing appropriate forecasting techniques, collaboration and late product identification.

(4) Risk sharing (RS) – reducing the impact of risk through flexible contracts, insurance, financial assistance by trading partners, etc.

4. Analysis, observations and findings

Shenoi (2017) performed IPA on responses of an empirical study on SCRM in Indian manufacturing industries to categorize the risk factors, mitigation strategies and TMC. The levels of risk faced by the different firms vary based on nature of its business. The attributes include the type of manufacturer, number of employees, turnover, the size, and export orientation of the firm (Padma *et al.*, 2008; Thun and Hoenig, 2011; Lavastre *et al.*, 2012).

Tables II and III presents the descriptive analysis on the frequency of likelihood of occurrence of risk constructs and their severity of impact on supply chains of OEMs and suppliers, respectively.

Table II shows that RLB, and DSR occur frequently and have a more significant impact on the supply chain for OEMs. ER occurs least frequently and has little impact on the supply chain. Hence, it is necessary to give importance to alleviate RLB and DSR risks. Also, the near mean value of FR and SSR signifies that OEMs need to attach importance to these risks also.

Table III evinces that SDM, DSR, SSR and RLB occur frequently and have a significant impact on the supply chain for suppliers. Also, IR, FR and LR are near to grand mean value of the frequency of likelihood of occurrence and have an average impact on the supply chain signifies that suppliers need to attach importance to these risks also.

Table IV signifies that OEMs attach the highest importance to RM to alleviate the risk perceived due to DSR and FR. Also, the due importance given to RA has reaped the benefits

	OEMs					
	Frequency of occurrence of risk			Impact on occurrence of risk		
RISK	Mean	SD	Range	Mean	SD	Range
DSR	2.19	0.62	2.75	2.43	0.74	3.00
SSR	2.00	0.59	1.75	2.30	0.84	2.75
LR	1.98	0.64	2.60	2.25	0.72	2.60
RLB	2.39	0.46	2.25	2.56	0.55	2.25
IR	2.00	0.55	2.00	2.16	0.69	2.67
SDM	2.03	0.59	2.33	2.31	0.76	2.67
ER	1.70	0.69	2.33	1.80	0.81	2.33
FR	1.98	0.67	2.33	1.96	0.75	2.33

Table II. Descriptive statistics of SCRM constructs-OEMs

	Suppliers					
	Frequency of occurrence of risk			Impact on occurrence of risk		
RISK	Mean	SD	Range	Mean	SD	Range
DSR	2.09	0.68	2.75	2.39	0.86	3.50
SSR	1.91	0.79	2.50	2.36	0.86	3.00
LR	1.59	0.63	2.60	2.00	0.98	2.80
RLB	2.07	0.69	2.25	2.37	0.84	3.75
IR	1.69	0.64	2.33	2.15	0.75	4.00
SDM	2.31	0.88	3.33	2.31	0.96	3.33
ER	1.25	0.49	2.33	1.84	0.86	4.00
FR	1.67	0.62	2.33	1.90	0.84	3.33

Table III. Descriptive statistics of SCRM constructs-suppliers

	OEMs					
	Importance of strategy			Performance		
Mitigation strategy	Mean	SD	Range	Mean	SD	Range
RP	3.05	0.61	2.50	3.19	0.76	3.00
RM	3.26	0.79	3.00	3.15	0.88	3.33
RA	3.11	0.89	4.00	3.00	0.54	2.33
RS	3.09	0.91	3.67	2.96	0.79	3.00

Table IV. Mitigation strategy of OEMs: importance vs performance

in the alleviation of risk factor SSR. It is evident from the mean of impact for the risk factors RLB, DSR, SDM and SSR (refer to Table IV), which suggest the due importance given to RM and RA have beneficial to the supply chain.

Similarly, the suppliers attach importance to RS (refer to Table V) to reduce the impact of risk due to SDM and DSR. The importance is extended to RA and RM so as to curtail the impact of risk factors (IR and FR). Table V suggests that the due importance given to these mitigation strategies (RS, RA and RM) have resulted in benefits to the supply chain.

Senior management plays a vital role in the conduct of business. The control flows from the top management to middle management and lower level management for day-to-day operations. The top management takes care of the organizational structure (OS), trading partner's alignment in the business, allocation of resources and regularly monitoring of performance (Dath *et al.*, 2010).

Table VI presents the descriptive analysis of TMC of OEMs. The analysis suggests that the top management emphasized on the establishment of long-term collaboration (LTC) and relationship, OS, risk identification and mitigation strategies (RIM), and appropriate, measurement and control mechanisms (MMC). The importance in the implementation of these strategies reflected in the implementation of the mitigation strategies also, which is an evidence of the alignment of supply chain strategy with the business strategy.

Table VII presents the descriptive analysis of supplier's TMC. The inference drawn from the Table VII, it can be inferred that the top management's emphasis is on trading partner alignment (TPA). The strategies such as OS, LTC, adequacy of resources (AR), and measurement, monitoring and control (MMC) appear in the decreasing order of the means. The alignment of goals, participating in cross-functional teams, etc., is necessary for the sustained performance of the suppliers. Hence, it is essential to attach importance to TPA, OS and LTC.

Table V.
Mitigation strategy of suppliers: importance vs performance

	Suppliers					
	Importance of strategy			Performance		
Mitigation strategy	Mean	SD	Range	Mean	SD	Range
RP	3.64	0.64	3.00	3.69	0.93	3.50
RM	3.72	0.80	3.00	3.67	0.93	3.67
RA	3.71	0.85	3.67	3.50	0.88	3.67
RS	4.01	0.78	3.00	3.65	0.83	3.00

Table VI.
TMC of OEMs: importance vs performance

	OEMs					
	Importance			Performance		
TMC	Mean	SD	Range	Mean	SD	Range
Organizational structure (OS)	3.84	0.61	2.00	4.00	0.82	3.00
Alignment of trading partners strategies (TPA)	3.51	0.93	3.00	3.51	0.87	3.00
Availability of adequate resources (AR)	3.75	0.75	3.00	3.84	0.71	3.00
Appropriate measurement, monitoring and control mechanisms (MMC)	3.81	0.80	3.00	3.63	0.85	3.00
Training of employees (TE)	3.42	1.14	4.00	3.57	1.19	4.00
Good communication and dialogue process (GCD)	3.36	0.99	5.00	3.63	0.85	3.00
Benchmarking and continual improvement (BCI)	3.60	0.93	3.00	3.60	0.93	3.00
Risk identification and mitigation strategies (RIM)	3.84	0.93	4.00	4.00	1.03	4.00
Long-term collaboration and relationship (LTC)	3.87	0.85	3.00	4.06	0.74	3.00

Source: Shenoi *et al.* (2016)

TMC	Suppliers Importance Mean	SD	Range	Performance Mean	SD	Range
Organizational structure (OS)	4.02	0.90	3.00	4.04	0.97	4.00
Alignment of trading partners strategies (TPA)	4.17	0.90	3.00	4.12	0.88	3.00
Availability of adequate resources (AR)	3.92	0.88	3.00	3.94	0.87	4.00
Appropriate measurement, monitoring and control mechanisms (MMC)	3.90	0.87	4.00	3.88	0.92	4.00
Training of employees (TE)	3.77	0.96	4.00	3.65	0.95	4.00
Good communication and dialogue process (GCD)	3.83	0.81	3.00	3.88	0.81	3.00
Benchmarking and continual improvement (BCI)	3.94	0.96	3.00	3.98	0.94	3.00
Risk identification and mitigation strategies (RIM)	3.52	0.96	3.00	3.75	0.86	3.00
Long-term collaboration and relationship (LTC)	3.98	0.78	3.00	3.90	0.80	3.00

Table VII. TMC of suppliers: importance vs performance

4.1 IPA on occurrence of risk constructs: OEM vs supplier

The risk constructs such as RLB, DSR and SDM lie in the region of "Vigilant" (see Figure 2(a)) indicating that they occur frequently and have an enormous impact on the firm and the supply chain for OEMs. Other risks such as IR, LR and SSR lie near the intersection of the grand means suggesting the equal probability of frequently occurring risk. Figure 2(a) suggests that risk construct ER is a least frequently occurring risk, and does not majorly affect the supply chain and the firm. In the case of a supplier, SDM, DSR, RLB and SSR (refer Figure 2(b)) are the risk constructs lie in the region of "Vigilant" indicating the high frequency of occurrence, and impact the firm and supply chain. Other risk constructs such as FR, LR, and ER lie in the region of "Impulsive," while the risk IR lies very close to the region of "Continuous monitoring."

4.2 IPA on alertness of risk constructs: OEM vs supplier

Table VIII shows that OEMs attach the highest importance to SSR and DSR. As finished goods manufacturers, they procure the sub-assemblies from suppliers and supply the

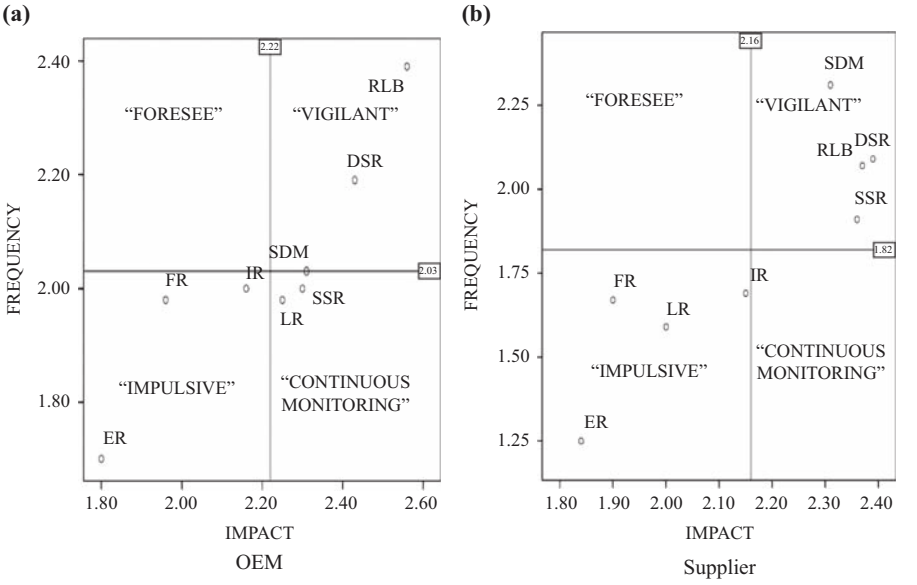

Figure 2. Frequency of occurrence of risk vs impact on supply chain

finished products to market on demand. We observe that OEMs perform well on SDM, IR and LR.

Table VIII shows that suppliers attach the highest importance to RLB, LR and DSR. As they supply sub-assemblies to OEMs, they ensure regulatory norms, logistics, and demand for the timely availability of the goods to the customers. On par with OEMs, suppliers perform well on SDM, IR and LR. The difference service-gap is large for RLB in both the cases of OEMs and suppliers. For the risk constructs, DSR, SSR and RLB the mean importance surpasses mean performance as observed in the service-gap for OEMs. The suppliers fall short marginally when compared with OEM. This finding reinforces that OEMs and suppliers have varied needs and perceptions. Analyzing the service gaps is imperative for understanding the consumer preferences and accordingly devising better strategies to meet them.

The risk constructs ER and RLB lie in the region "Keep it up" (see Figure 3(a)) indicating that the OEMs benefited by their alertness toward these risk constructs. While the risk constructs DSR and FR are very close to the region of "Keep it up" indicates that firms have

	Importance (I)			Performance (P)			Service gap (I–P)		
Risk constructs	OEM	Supplier	t	OEM	Supplier	t	OEM	Supplier	t
DSR	3.09	2.92	1.45	2.85	2.96	−1.15	0.24	−0.04	0.84
SSR	3.18	2.90	1.45	2.91	3.00	−0.63	0.27	−0.10	0.55
LR	2.82	2.96	−0.64	2.97	2.98	−0.05	−0.15	−0.02	−0.77
RLB	2.97	2.96	0.04	2.58	2.38	0.74	0.39	0.58	5.29*
IR	2.58	2.67	−0.54	2.97	3.08	−0.51	−0.39	−0.41	−7.48*
SDM	2.85	2.58	1.13	3.00	3.06	−0.27	−0.15	−0.48	−4.08*
ER	2.52	2.40	0.51	2.85	2.71	0.53	−0.33	−0.31	−4.12*
FR	2.61	2.44	0.63	2.85	2.96	−0.58	−0.24	−0.52	−4.71*

Note: *Significant at 0.001 level

Table VIII.
Comparing service gap of OEM and suppliers

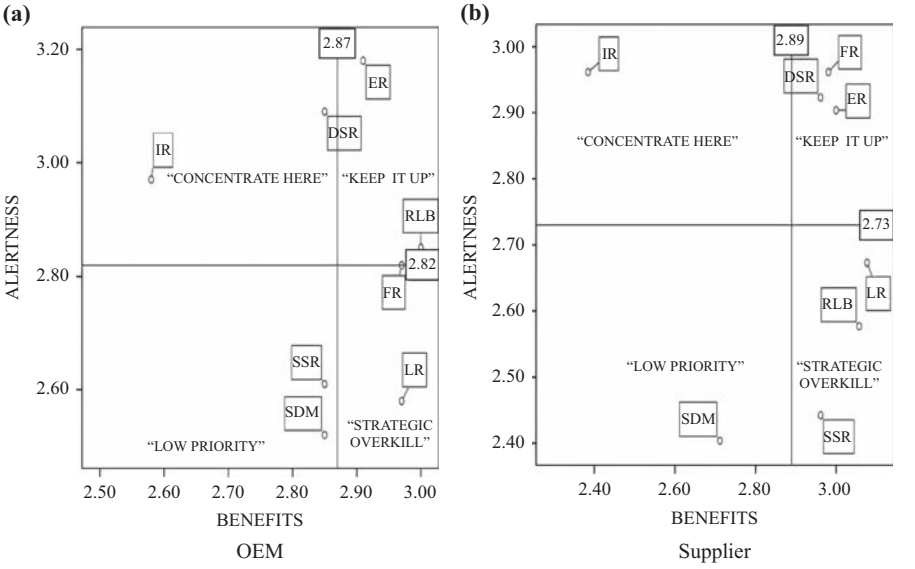

Figure 3.
Risk alertness vs benefits on supply chain

benefited due to risk alertness. The risk factor IR placed in the region "Concentrate here" supporting its impulsive behavior.

In the case of suppliers, the risk constructs FR, DSR, and ER fall in the region "Keep it up" (refer to Figure 3(b)), indicating that the suppliers benefited by their alertness toward these risk constructs. Risk constructs LR, RLB and SSR lies in the region of "Strategic overkill," pointing to the role played by small investments in curtailing these risks thus benefiting the organization.

4.3 IPA on mitigation strategies: OEM vs supplier

The strategy which alleviates the impact of risk on the supply chain on the occurrence of risk is called mitigation strategies. Table IX suggests that the mean importance of RM and RP surpasses the grand mean performance for both OEMs and suppliers. Strategy RM lies in the region of "Keep it up" (see Figure 4(a)) for OEMs. The strategy RS lies in the region of "Concentrate here" suggests that the due importance given to the strategy did not help to reap the benefits. While the strategy RP having low importance, which lies in the region of "Strategic overkill," has benefited the organization.

In the case of suppliers, the strategy of RS lies in the region of "Keep it up" (see Figure 4 (b)). While the strategies RM and RP lie in the region of "Strategic overkill," suggesting the benefits obtained despite low importance.

	Importance (*I*)			Performance (*P*)			Service gap (*I*–*P*)		
Mitigation strategies	OEM	Supplier	*t*	OEM	Supplier	*t*	OEM	Supplier	*t*
RP	3.05	3.64	1.29	3.19	3.69	0.7	−0.14	−0.05	−1.11
RM	3.26	3.72	−0.12	3.15	3.67	1.21	0.11	0.05	1.66
RA	3.11	3.71	0.34	3.00	3.50	0.73	0.11	0.21	0.54
RS	3.09	4.01	0.36	2.96	3.65	0.68	0.13	0.36	0.48

Table IX. Comparing service gap of OEM and suppliers

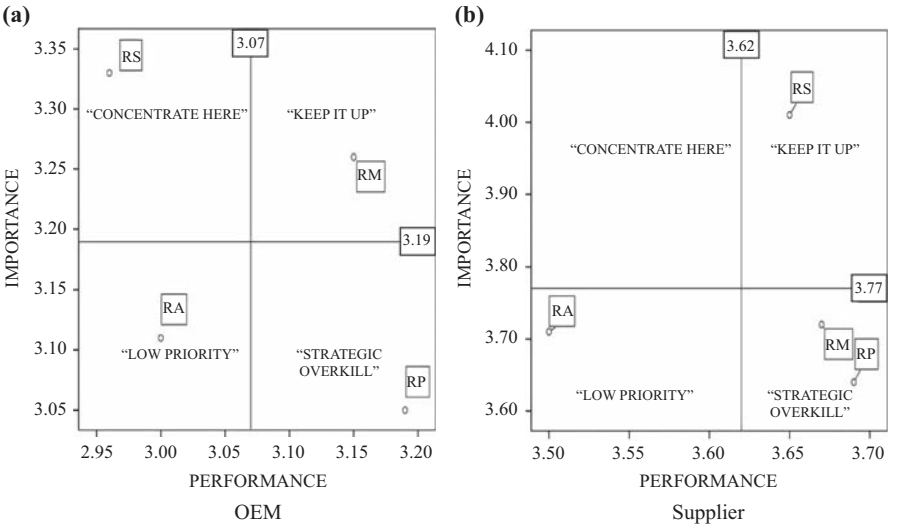

Figure 4. Mitigation strategies importance vs performance on supply chain

4.4 IPA on TMC: OEM vs supplier

The top management has a significant role in the decision-making process that leads to the better implementation of policies and strategies which reflects in the better performance of the organization.

OEMs have realized the benefits by implementing the strategies such as OS, AR and LTC (see Table X). These strategies lie in the region of "Keep it up" (see Figure 5(a)) for OEMs. While the strategy, MMC mechanisms, has not reaped the benefits despite the due importance given to them. The strategies, TPA, training of employees (TE), and Good Communication and Dialog process (GCD), lie in the "Low priority" region.

The strategies (TPA, OS, AR and benchmarking and continual improvement (BCI)) lie in the region of "Keep it up" (see Figure 5(b)) for suppliers evincing the benefits realized. While the strategies such as LTC, MMC mechanisms, and GCD process lie very close to the region of "Keep it up." The rest of the strategies TE and RIM strategies lie in the "Low priority" region.

Table X.
TMC of OEMs and suppliers: importance vs performance

	Importance (*I*)			Performance (*P*)			Service gap (*I*–*P*)		
Top management commitment	OEM	Supplier	*t*	OEM	Supplier	*t*	OEM	Supplier	*t*
OS	3.84	4.02	0.06	4.00	4.04	0.10	−0.16	−0.02	0.08
TPA	3.51	4.17	0.17	3.51	4.12	0.30	0.00	0.05	0.23
AR	3.75	3.92	−0.02	3.84	3.94	0.22	−0.09	−0.02	0.31
MMC	3.81	3.90	0.13	3.63	3.88	0.19	0.18	0.02	0.14
TE	3.42	3.77	0.93	3.57	3.65	0.43	−0.15	0.12	−1.15
GCD	3.36	3.83	−0.27	3.63	3.88	0.35	−0.27	−0.05	0.90
BCI	3.60	3.94	0.20	3.60	3.98	0.32	0.00	−0.04	0.22
RIM	3.84	3.52	−0.12	4.00	3.75	−0.16	−0.16	−0.23	−0.68
LTC	3.87	3.98	0.05	4.06	3.90	−0.26	−0.19	0.08	−0.58

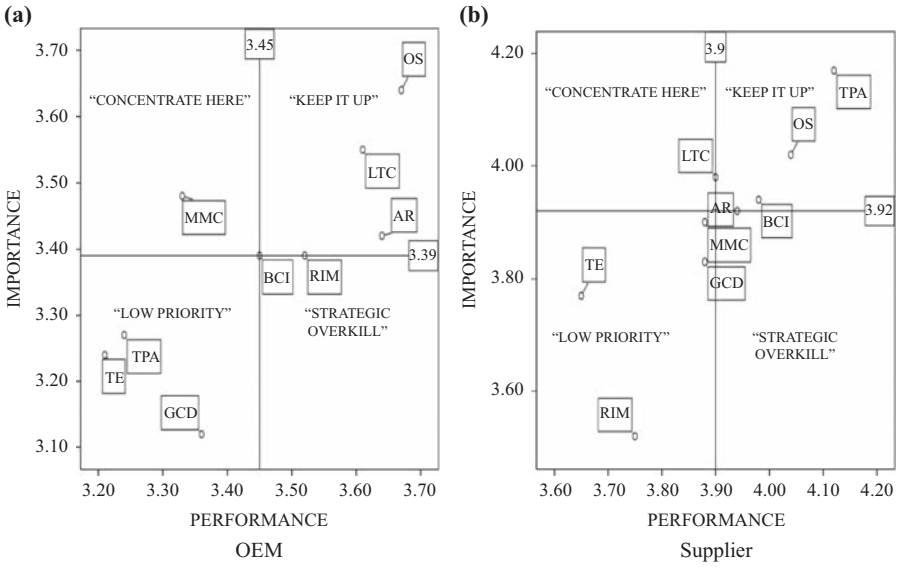

Figure 5.
TMC importance vs benefits on supply chain

5. Conclusion

This study is performed to understand the risks, mitigation strategies, and the TMC of OEMs and suppliers in reducing the risk. The finding indicated that most of the risks, as noted by their means, are near the POI of the grand means of the risk constructs and their impact on the supply chain, indicating that all the risks have the equal likelihood of occurrence. The OEMs have benefited by following RM mitigation strategy, while suppliers have benefited by RS as they lie in the region of "Keep it up." The strategies adopted by the Top Management such as OS, LTC, AR and BCI have benefited the organizations as they are placed in the "Keep it up" region.

5.1 Contributions to theory and research implications

Our findings observe that most of the means of risks are lying in the region of "Vigilant" which suggests the risks are equally probable. The mitigation strategies followed by the firm lie below the grand mean of performance which suggests that the proper and timely implementation of strategies is necessary for the better performance. The RP lies in the region of "Strategic overkill" for both OEMs and suppliers indicating that the administrators should ensure importance with adequate resources for better performance. Similarly, the strategy RA is placed in "Concentrate here" region for both OEMs and suppliers. The TMC prominently lies in the region of "Keep it up" region which ensures the total involvement of top management in curtailing risk and implementation of mitigation strategies. The study demonstrates how IPA tool is utilized to prioritize the strategies to realize the benefits.

5.2 Implications for practitioners

There is no single risk factor in which the firm's performance improves in the presence of risk. To identify the occurrence of risk, one needs to have an appropriate MMC mechanisms for monitoring the supply chain. After the identification of risk, it is necessary to identify appropriate mitigation strategies. Also, BCI of our activities such as skill management, tools for identification of risk and mitigation strategies are necessary for sustained performance. The detailed study of SCRM strategies lays emphasis on the importance attached to risk factors, mitigation strategies, and TMC. By the implementation of SCRM strategies, supply chain managers can improve the firm's performance.

5.3 Suggestions and recommendations for policy makers

The risk managers of OEMs and suppliers need to be appropriately trained to face the risk. A proper training and well-documented knowledge need to be in reach to all the managers of the firm. By studying the dimensions each sector, a standard risk index is defined. The risk index enables the comparison of the firm's quality levels to that of their competitors. Risk managers are to be rewarded, as they drive toward performance even in the turbulent environment.

5.4 Limitations and scope for future research

The study is executed with following limitations:

(1) The study assumes that the manufacturing industries across different sectors perceive similar risk. The sectors considered are automotive, heavy engineering, general engineering, and home appliances.

(2) The Southern States of India are considered because of the dominant presence of many industries, especially automotive industries. However, it should be noted that these states form the manufacturing hubs where the lead organizations are functioning along with their major suppliers.

Further study can explore the specific type of industry along with other variables such as green environment, quality certification, network structure, type of supply chain, etc. The IPA study can be extended to identify the importance-performance gap between the focal firms to that of the competitors. The researchers may utilize Fuzzy IPA by replacing the conventional IPA due to the nature of fuzziness in the human perception.

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