Chapter 2

Literature Review

2.1 Introduction

This chapter presents the theoretical basis of this study through examination of extant literature and also by obtaining a practitioner insight into the underlying issues of strategic sourcing risk management (SSRM). The literature survey covers various theoretical and practical dimensions of SSRM. The purpose of this chapter is thus to identify and present important tenets of the constructs employed in this research. This chapter first gives a brief on strategic sourcing (SS) and risk management (RM) separately and then puts into perspective two important facets of strategic sourcing, namely risk management in strategic sourcing and strategic sourcing as a tool for risk management in a supply chain network.

This chapter is organized into five sections: the second section, i.e. section 2.2, provides foundations of SS; the third section, i.e. section 2.3, provides foundations of RM; section 2.4 integrates the previous two sections and provides foundations of the SSRM. This section introduces SSRM frameworks and further sub-sections present extant literature review on important constructs of SSRM with respect to Indian automobile industry, overarching the theoretical foundations of SSRM constructs like risk sources and their identification, risk drivers, enablers, barriers in SSRM, tools and techniques for assessing risks and various strategies used by managers in the Indian Automobile Industry to mitigate risks. Final section, i.e. 2.5, identifies research gaps from critical review of available literature/ on SSRM so far in SSRM literature.

The literature survey has been carried out utilizing the following resources:

- Websites of the major Indian vehicle assemblers (VAs)/ OEMs and tier 1 and tier 1 auto component manufacturers. This was also a source for secondary data.
- Search of on-line publishers such as Emerald, Google Scholar, Science Direct, Springer Open, Taylor Francis etc. using keywords such as strategic sourcing, risk management, automotive industry, supply network etc.
- Published reports on automotive industry by trade associations, such as Confederation of Indian Industry (CII), Automotive Component Manufacturers

Association (ACMA) and Society of Indian Automotive Manufacturers (SIAM), as also reports prepared by large consulting firms.

- Articles posted on the web, e-news magazines and newspapers.
- Books on the global automotive industry and of some specific VAs such as Toyota, Ford etc.

2.2 Strategic Sourcing (SS)

For decades 'sourcing' has been just another word for procurement and considered as a peripheral corporate function. Globalization and rapid innovation has brought sourcing in center stage, where strategic sourcing is a core activity in supply chain network management for certain businesses. Strategic sourcing can be defined as 'satisfying business needs from markets via the proactive and planned analysis of supply markets and the selection of suppliers with the objective of delivering solutions to meet pre-determined and agreed business needs' (Beckmann and Akhavan, 2017). Strategic sourcing includes a wide range of activities namely creating an overall strategy for sourcing, evaluating and selecting suppliers, procuring materials/services and managing supplier relationships (Anderson and Katz, 1998). Strategic sourcing is increasingly seen to be a business capability of firms. Sourcing, if properly structured, can effectively combine the core competencies of a given firm with the skills and capabilities of its suppliers (Sartor et al., 2014). Sourcing decisions are vital for any organizations that want to leverage on its core competencies and outsource other activities in order to gain and retain competitiveness (Quarshite et al., 2015).

The importance of strategic sourcing has increased over time (Quinn and Hilmer, 1994), and has been projected to increase in the future (Benton and Shin, 2007). Further, strategic sourcing is prevalent in both manufacturing and service industries (Monczka et al., 2000; Monczka and Morgan, 2000; Christopher and Lee, 2009). Recently the subject of SS has been researched upon in relation methods to boost SS and supply network performance (Park & Kim, 2016), and the effect of material calamities on SS (Yin et al., 2017). There has been a widespread acknowledgement of the need of revising the traditional procurement function by manufacturing companies, to modern strategic sourcing because 40 to 85 percent of the cost of goods, and 30 to 50 percent of the revenues comprise sourcing cost. The savings of companies surmounting in strategic sourcing are between 10 to 20 times the operating cost of sourcing operations (Tachizawa and Wong, 2014).

According to Dave Nelson, former vice president of purchasing at Honda of America, "One of the reasons that Honda recognizes the importance of the purchasing function is that 80 percent of the cost of a car is purchased cost. So how goes purchasing, is how goes Honda". When an automobile producer sells a new car to a dealer for $ 18,000, it already has spent more than $ 10,800 (about 60 percent) to buy the steel, tyres, glass, paint, fabric, aluminum, copper, and electronic components necessary to build that car.

2.2.1 Pillars of Strategic Sourcing

Strategic sourcing has been receiving much attention in the supply chain operation research and production management literature. It is emerging as a practice that managers can use in many ways. Strategic sourcing term is used to capture linkages between sourcing strategy and organizational strategies. A strategic sourcing process considers suppliers and supply base integrated to an organizations competitive advantage. Strategic purchase is a procurement process that is mission critical. The Sourcing Strategy answers the fundamental question of how to buy. Procurement is quickly becoming recognized as a priority function that offers high-impact opportunities for improving the bottom line. Value analysis is emerging as an increasingly important approach to ensure that specifications exactly meet the business needs.

Although the discipline is still at an explorative stage, strategic sourcing can have a significant and positive impact on business performance. Hult et al. (2002), Kotabe and Murray (2004) and Su et al. (2009) all state that sourcing can influence the competitive advantage and business performance. However, strategic sourcing practice is in its infancy, a fact supported by mainly qualitative and explorative research studies.

In many organizations, sourcing personnel are not viewed as being "strategic", often because procurement is just another functional silo. People may not be positional to think about total owning costs, profitable growth, and the procurement pathways (Wiengartenet al., 2016). In addition, procurement may be positioned too low in the organization to have strategic clout and influence. Leaders in strategic sourcing carefully examine where to organizationally position their sourcing resources within the company. In practice, we see leading edge companies either integrate procurement into broader process-oriented organizations (e.g., product supply, sourcing) or place procurement on par with their functional counterparts such as manufacturing, marketing, and operations (Mohammed and Knapkova, 2016). The important questions which an organization should employ to align the purchasing function as part of its overall strategic architecture are given in Figure 2.1.

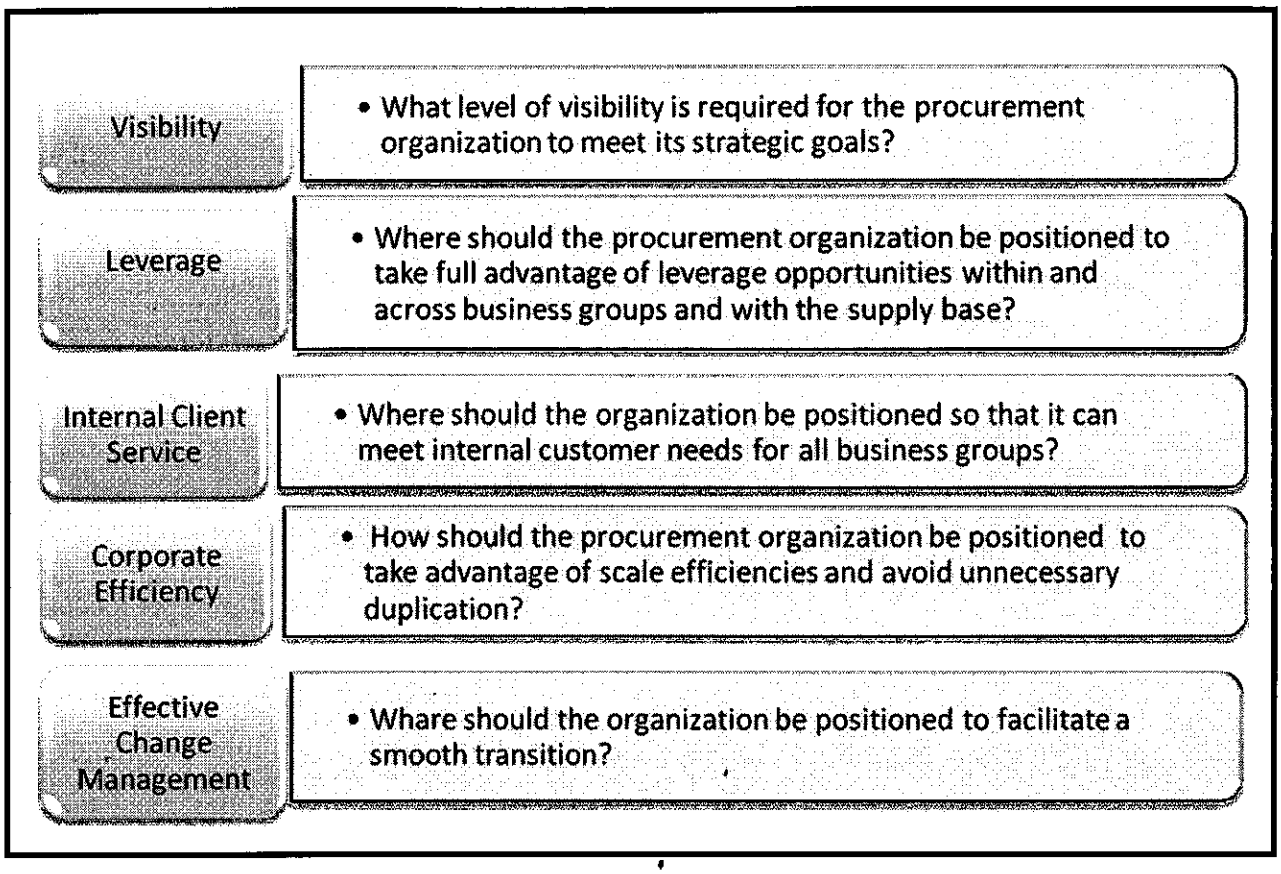

Figure 2.1: Organizational Alignment Questions

Source: Matthew et al. (2003)

Strategic procurement increasingly plays a key role in enabling the new innovative business designs of the likes of Dell, Wal-Mart and General Electric. General Electric has long relied heavily on its value-added suppliers to deliver industry leading products and services, and solutions in a variety of global markets and now seeks to create new value through procurement over the internet. Total cost of ownership (TCO) considers both supplier and buyer activities, and costs over a product or service's complete lifecycle in the context of the competitive forces at work in the relevant purchase category (Sharma, 2016). How supplier deals get structured, how risk gets shared, how technology trends are exploited, who owns the intellectual property - all of these represent strategic issues that go beyond the capabilities of the typical buyer and the technical user community (Vitasek, 2016). The definition and constructs of strategic sourcing are given at Table 2.1 and Table 2.2 respectively.

Table 2.1: Definitions of Strategic Sourcing

S. No.	Definitions	Authors
1	Strategic sourcing can be defined as satisfying business needs from markets via the proactive and planned analysis of supply markets and the selection of suppliers with the objective of delivering solutions to meet pre-determined and agreed business needs.	Okongwu et al., 2013
2	Strategic sourcing term is used to capture linkage between sourcing strategy and organizational strategy. A strategic sourcing process considers suppliers and supply base integral to and organization's competitive advantage. Strategic purchasing is one that is mission critical. Categorization of purchase into strategic and non strategic brackets is a first step in the strategic sourcing process.	Leire and Mont, 2012
3	Strategic sourcing is a logical complex commercial process involving the application of tools by skilled, competent and knowledgeable people; however, developing and implementing strategic sourcing is a functional process.	Quarshie et al., 2015
4	Strategic sourcing is an institutional procurement process that continuously improves and re-evaluates the purchasing activities of a company. In a production environment, it is often considered as one important component of supply network management.	Hoejmose and Adrien-Kirby, 2012
5	Strategic sourcing is the process of supplier management and supply network design used to achieve operational and performance objectives.	Kocabasoglu and Suresh, 2006

Table 2.2: Constructs of Strategic Sourcing

S. No.	Constructs	Authors
1	Sourcing decisions evaluate characteristics, factors, or criteria like, supplier quality consciousness, cost potential, reliability of delivery, innovativeness, and geographical location.	Mangan et al., 2016
2	Four dimensions of strategic sourcing centricity - learning orientation, performance orientation, planning orientation, and relational orientation are positively associated with profitability.	Giunipero, 2013

S. No.	Constructs	Authors
3	Traditionally, sourcing was restricted to identification of new or potential suppliers. This is, of course, still a fundamental aspect of strategic sourcing, but it has developed and expanded in recent years, considering strategic sourcing to be a pivotal activity for purchasing and supply management professionals, who draw a distinction between strategic, tactical and reactive sourcing.	Park and Kim, 2016
4	Sourcing strategy includes: two or more firms in a supply network entering into a long-term agreement; the development of trust and commitment to the relationship; the integration of sourcing activities involves sharing of the demand and sales data; the potential for a shift in the locus of control of the sourcing process.	Baker et al., 2016
5	Firms do not only want to save cost by sourcing parts and components from outside suppliers, but often also enter into such relationships to obtain access to new technologies or higher quality products, or to establish a foothold in new markets.	Nassimbeni, 2006 Sharma, 2016
6	Strategic sourcing, which is considered a key aspect of supply chain management, involves elements such as examination of purchasing budgets, the landscape of the supply market, negotiation which suppliers and periodic assessments of supply transactions	Vitasek, K., 2012

In light of the definition of SS by various authors, the core function of strategic sourcing could be summarized as under:

'SS is a process to be aligned with business strategy. Supply network is thus developmental and relationship oriented so that SS plays a vital role in an organization's competitive strategy. SS has thus become a dynamic process due to increased globalization and short product life cycle'.

Das et al. (2006) have stressed the growing importance of the purchasing function which is also because it "provides a critical link between manufacturing and supply base, both interpreting and communicating product plans and production needs to suppliers and concurrently providing a channel for manufacturing to stay cognizant of supplier technologies, capabilities and limitations". This indicates that supplier relationship strategy depends on both inter-organisation (manufacturer and suppliers) and intra-firm integration (purchasing and

manufacturing functions). This is exemplified in the 'Toyota Product System' wherein the purchasing function, as a first step, contributed in developing the Company's production philosophy and only then was it applied to the supply base (Das et al., 2006; Hines 1996). Thus, it is evident that 'strategic purchasing' has become a contributor to a firm's long-term goals.

2.2.2 Conceptual Perspective

Before delving further into various aspects of strategic sourcing, its determinants and antecedents, it is important to bring out the changes in the procurement function, including the strategy of global sourcing and outsourcing. The use of the concepts of purchasing, procurement, supply, and supply chain management will depend on the organization's stage of development and/ or sophistication, the industry in which they operate, and their competitive position (Zimmermann and Foerstl, 2014). The purchasing and supply management function has an entirely reactive role e.g., responding to requisitions or other unexpected requirements from the business (Beckmann and Akhavan, 2017). It is recommended to encourage purchasing and supply management professionals to move away from this type of sourcing (Blome and Schonherr, 2011). However, some organizations still operate entirely on the basis of unexpected demand, responding to individual needs, as and when they arise. Tactical sourcing is to some extent reactive as it covers those business requirements that cannot be planned in advance, but are provided within a framework of strategic sourcing (Chiang et al., 2012). All low-value requirements should have been aggregated into call off contracts for use by end users. Thus, requirements that are low value, yet high risk, are precisely those that require strategic sourcing plans (Kern et al., 2012).

Sourcing is used just as another name of procurement. Chaing et al. (2012) discussed the traditional purchasing role along with internal coordination as well as collaborative supply network activities such as information sharing with suppliers and supplier development. Many studies have investigated the implementation of strategic sourcing as a supply network practice intended to improve buyer–supplier relationships.

Strategic sourcing positively impacts firms strategic flexibility as well as their supply chain agility (Chiang et al., 2012). It has had a positive effect on sourcing performance in the US textile and apparel industry (Su et al., 2009). While strategic sourcing has been discussed as a helpful supply network management practice, many factors need to be considered for implementation. Companies may initially struggle due to lack of skill base or training to align

with the requirement of the corporate purchasing portfolio. The skill requirement within the organization is related directly with the complexity and risk of the purchase category within the context of the segmented buy. A number of major corporations/ companies have successfully exploited their strategic sourcing opportunities within a two to three year time frame, by using cross-functional teams approach coupled with selective up-gradation of skills.

Variants of sourcing for industry gaining importance with the globalisation and increasing complexity of the final product are 'offshoring' and 'outsourcing'. Outsourcing has emerged as a major mode of acquiring products/ services which are not core business of the firm. Early efforts at outsourcing were based on more of a transactional, arms-length relationship between VAs and suppliers with VAs selecting suppliers and switching orders based on issues of price, delivery and quality (Womack et al., 1990), resulting in a short-term business relationship at best. Such an approach has its own problems since suppliers may not be responsive to a particular VA's demand and quality requirements, or they may not have sufficient information to innovate or improve their products. Also, problems of coordinating the flow of material may lead to a wasteful inventory buildup (Womack et al., 1990).

However, outsourcing, as a strategy has to be judiciously resorted to, since it makes the manufacturer more vulnerable to increased dependence on supplier's technological and capacity levels and also due to supply chain complexities in dealing with and handling multiple suppliers of assemblies and components (Alaez-Aller and Garcia, 2010). 'Global sourcing' refers to "outsourcing and de-locations trends" practiced by manufactures in recent times in an effort to seek competitive advantage. Globalisation, information technology proliferation and varying customer requirements have further encouraged outsourcing by manufacturers, in turn, leading to Buyer Supplier Relationship (Handfield and Bechtel, 2002). The strategic decision a firm makes is either to manufacture 'in-house' (vertical integration) or procure from external suppliers and Toyota, originator of lean production were pioneers in outsourcing components and assemblies to suppliers and of ensuring the latter's integration into the complex process of vehicle production (Womack et al., 1990).

Outsourcing is a relatively recent phenomenon (Sislian and Satir, 2000) and the decision to 'make/ buy' (Carr and Pearson, 1999) is based on risk evaluation, costs incurred and competitive advantage achieved by adopting this strategy (Sislian and Satir, 2000). Outsourcing has since evolved from being based on cost and operational considerations to a larger strategic dimension and has proved to be a contributor to 'agility' of a manufacturing supply chain (Khan and Pillania, 2008). The major reasons, for outsourcing non-core activities by

manufacturers, are - competitiveness, short product life cycles, rapid technological changes, economic and policy considerations (Krause, 1999; Sharma et al., 2016). Other factors, which dictate the level of outsourcing by a firm, are the requirement of manufacturers to share information and maintain contact with suppliers, technological advantages and the level of their own and competitor's prevalent technology (Sislian and Satir, 2000). The growing importance of the purchasing function is also due to it providing a "critical link between manufacturing and supply base" (Das et al., 2006) and has changed considerably in recent times.

Initially, companies used to make some critical items within factory but over the last two decades there is increased reliance on supply markets. There seems to be a wide agreement on the factors that trigger sourcing decisions, with the primary factor being reduction in the purchase price of goods (Fawcett and Waller, 2011). Managerial concern has increased towards value and procurement aggressiveness in developing suppliers to meet specific supply objectives of quality, quantity, delivery, price, service, and the cost of supporting a process or commodity (Wei et al., 2018).

As part of strategic sourcing, cost management of the product/ service has been one of the major imperative/ consideration. Once the contract is signed, purchaser's job is not over but actually begins. One of the most important activity undertaken by strategic sourcing professionals is cost management, i.e. understanding the true underlying cost of what is purchased. This involves a process of unbundling the price paid and other components of price over the life cycle of a product or service, to deliver a target cost and a unit rate to determine if it is priced competitively in the market place. Cost management may involve different decision-support tools and database to create insights into the following:

- The gap between cost drivers and the assumed business case.
- Identifying the business case (e.g., is it a reasonable expense after we deliver it to the customer?).
- The total cost of offering a service, including all elements of receiving, use, and disposal over the life cycle of the offering.

Traditionally, companies have focussed on purchase price alone instead of taking a total cost view. Overemphasis on purchase price fails to consider several factors that can be the source of innovative, higher dollar, and more sustainable opportunities for suppliers and buyers alike. These factors include:

- Supplier economics and other logistics costs, such as transportation.
- Buyer's cost of acquiring and managing products and services.
- Quality, inventory, reliability, and other factors of a product or service over its lifecycle.
- The value of a product or service to internal and external customers.

A critical concept within the total system cost perspective is the notion of total cost of ownership. Total cost of ownership considers both supplier and buyer activities, and costs over a product or service's complete lifecycle in the context of the competitive forces at work in the relevant purchase category. From a lifecycle ownership standpoint, buying a higher quality item with a steeper price tag could be justified because the initial purchase cost would ultimately be offset by fewer manufacturing defects, lower inventory requirements, and lower administrative costs. Life cycle linkages with total system cost perspective are depicted in Figure 2.2.

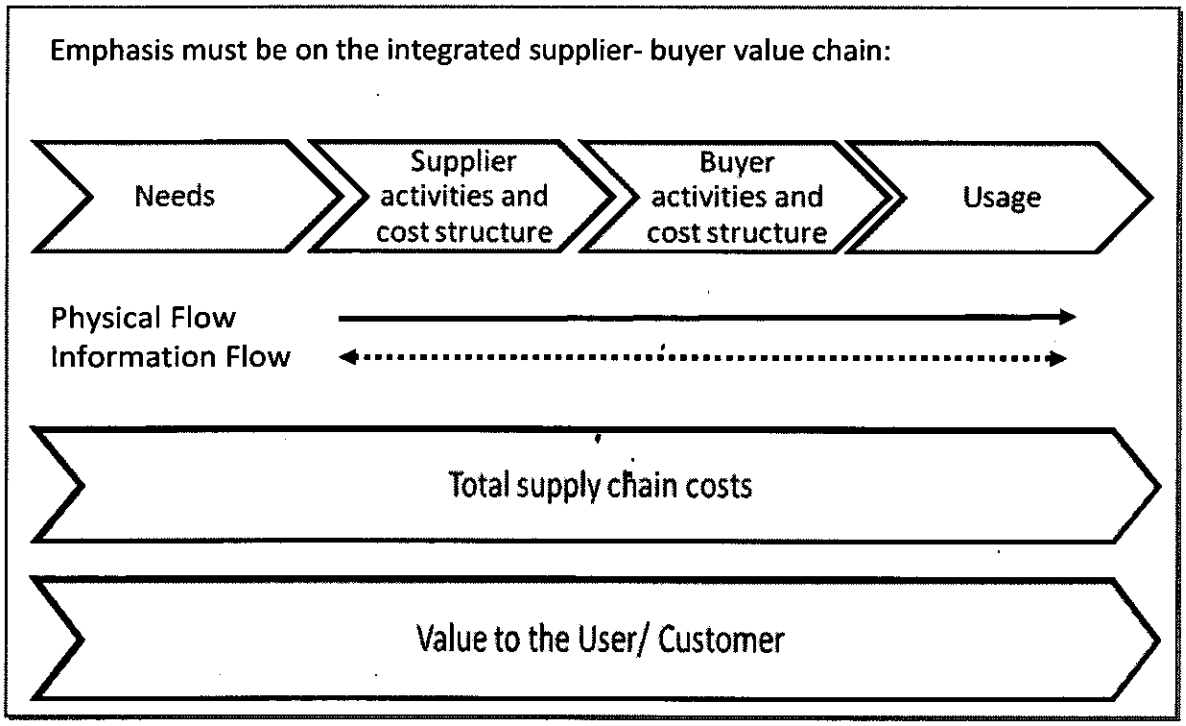

Figure 2.2: Total System Cost Perspective

Source: Matthew et al. (2003)

In some companies, value-added through procurement process is minimal. While users may be satisfied, prices paid are probably too high, contract terms and conditions may not be optimal, and little, if any, strategic value results from procurement.

The overall contribution of strategic sourcing is difficult to visualize, owing to the lack of quantified metrics as well as non identification of intangible advantages observed on adopting strategic sourcing risk management (SSRM) (Kim and Chai, 2017). The leveraging power of strategic sourcing in various industries is indicated in Figure 2.3 enumerating the cost reduction required in purchasing function vis-à-vis the manufacturing to have an impact of 20% rise in profitability.

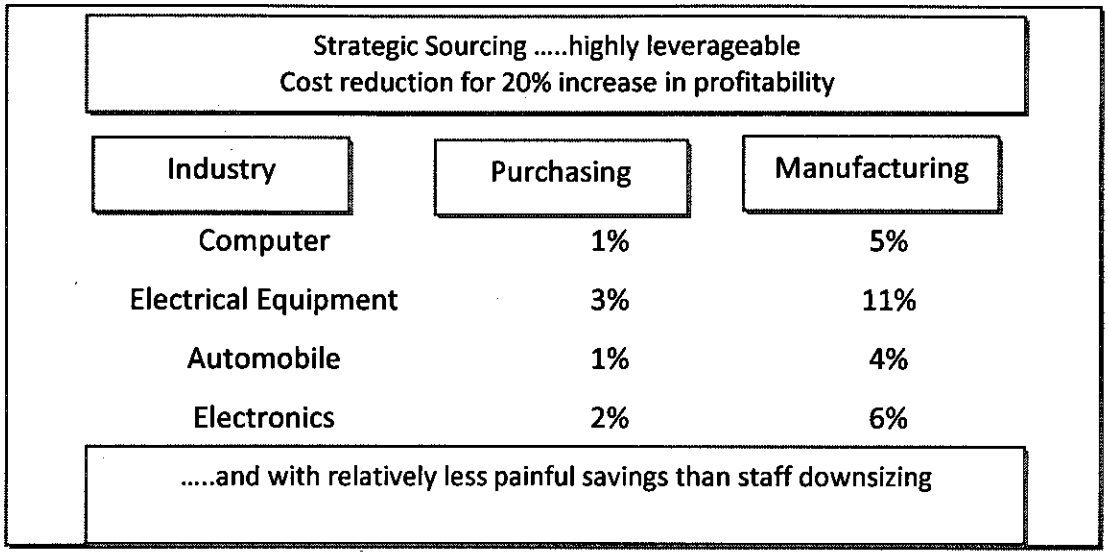

Figure 2.3: Leveraging Power of Strategic Sourcing

Source: Harrington and Lisa (1997)

Spekman et al. (1999), Chan et al. (2007) and Hartmann et al. (2008) point out the importance of the strategic alignment of sourcing and the corporate strategy. In many companies, the sourcing department seems to operate independently from corporate goals or with competitive objectives that differ from other departments (Moses and Ahlstrom, 2008; Weingerten et al., 2018). This weakness is a significant risk to the company, as operations across departments are misaligned and a strategic gap exists. However, there is limited research on the best practices for alignment and cooperation across departments, and the real impact of alignment on the business.

The sourcing model theory has evolved from 'make versus buy decision' to 'vested outsourcing'. Organizations consider procurement as a 'make versus buy' decision. 'Buying' has taken the definition of getting the best price over the competitors. This is majorly the essence of a transaction-based model (Vitasek, 2016). But this logic mostly works in less complex and simple transactions. Williamson (2008) suggests how organizations should consider sourcing as a continuum, instead of a make versus buy decision. The continuum keeps free market forces on one side, corporate hierarchies on the other and uses a hybrid approach for the middle ground.

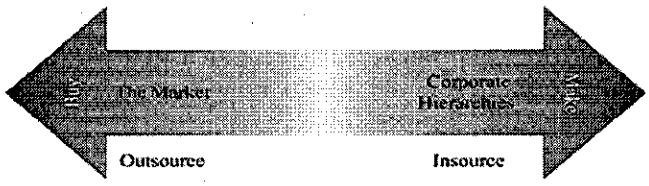

Fig.2.4: The Continuum of Outsourcing Solutions

Source: Williamson (2008)

The sourcing model has been refined into a 'Seven Sourcing Business Model' (Vitasek, 2016). A sourcing business model is a combination of an organization's Relationship Model and it's Economic Model. Seven sourcing business models, relationship model and economic model are enumerated in Table 2.3 (Keith et al., 2016) and Fig 2.5 depicts how the seven sourcing business models fall under the three categories of Williamson's Continuum (Vitasek, 2016).

Table 2.3 Sourcing Business Models (Source: Keith et al., 2016)

Relationship Models	Sourcing Business Models	Economic Models
Transactional Contact (Market)	Basic provider Model	Transaction-Based
	Approved Provider Model	
Relational Contract (Hybrid)	Preferred Provider Model	
	Performance Based/ Managed Services Model	Output-Based
	Vested Sourcing Business Model	Outcome-Based
Investment/ Vertical Integration (Hierarchy)	Shared Services Model	
	Equity Partnerships	

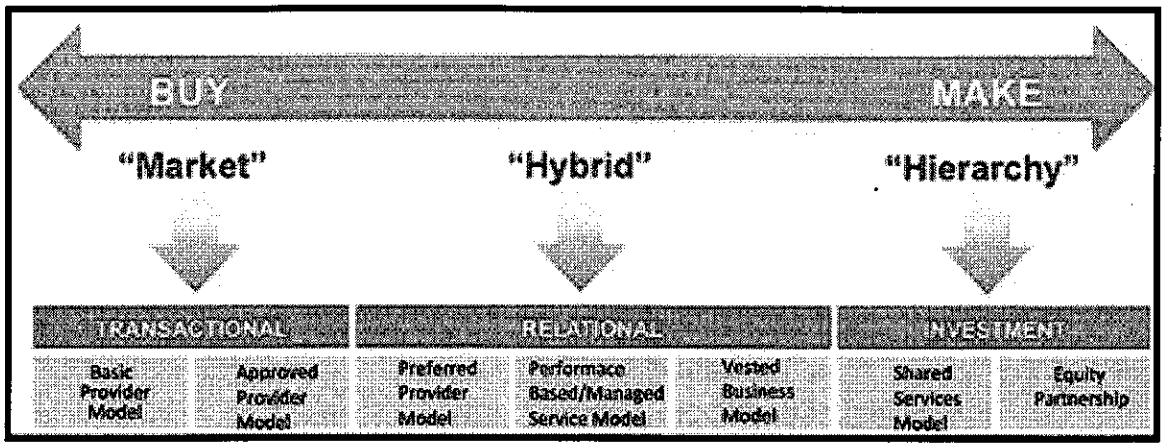

Fig.2.5: Business Models under the Williamson's Continuum

Source: Vitasek (2016)

2.2.3 Strategic Sourcing Process

The sequence of steps/ processes involved in implementation of the strategic sourcing is illustrated in the Figure 2.6 and description of each step in brief is listed below:

- **The Annual Plan**: The plan lays out the objectives to be achieved in the areas identified. The value of the same is to benchmarked vis-à-vis organizational priorities.
- **Development of Requirements**: This process will identify the old and new specifications formally evaluated with the suppliers. The forecasts are communicated and followed up with them for accuracy. Drop in required quantity, if any, will factor in the perspective demand pattern, stabilization and management of consumption.
- **Devise Sourcing Strategy**: While firming up the sourcing strategy, the decision makers have to understand the technology employed by the supply industry and therefore, its capabilities. Supplier and distributors economic viability and resilience, total costs and the necessary trade-offs across functional support for the sourcing strategy needs to be in place prior to the next phase, wherein the suppliers are evaluated.
- **Evaluate Suppliers**: An area of overlap in term of the possibility of it being a subset of devising sourcing strategy. The evaluation of suppliers on total cost of ownership, commitment to joint tech, productive enhancement and economic viability need to undertaken.
- **Develop Supplier Relationship**: Post identification of the supplier, as the final step of the SS, performance of a supplier is monitored and attention is paid to joint improvement aspects.

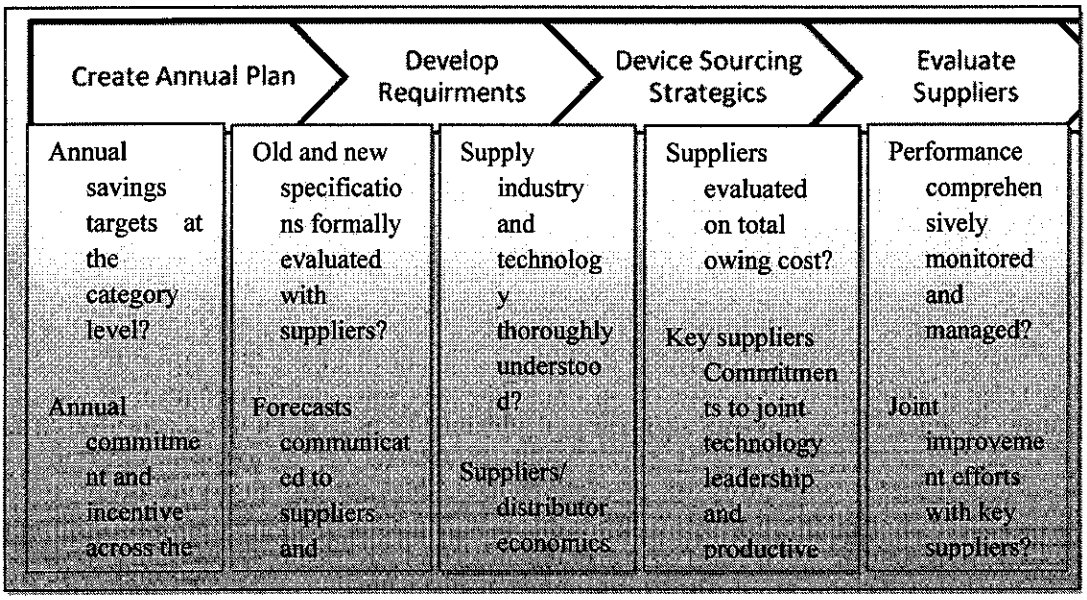

Figure 2.6: Process Assessment (Representative Questions)

Source: Matthew et al. (2003)

The first activity toward enhancing procurement economics is to develop a comprehensive and detailed understanding of how and where money is actually spent. Categorization of purchase into strategic and non-strategic brackets is the first step in the strategic sourcing process. Each company has a unique buy, or portfolio of purchased goods and services.

The sourcing strategy answers the fundamental question of how to buy. For some companies that have the capabilities to make or provide the service internally, the sourcing strategy questions are inter-twined with the make/ buy decision. A key aspect of selecting the most appropriate sourcing strategy is to identify the most appropriate strategy based on the various constructs which have major influence on product cost viability as well as ensuring a smooth and trouble free flow of operations. The strategies may cover establishing primary and secondary supplier arrangements, buying an equity stake in a supplier, forming long-term, sole-source partnership, contracting for supplier capacity, rather than specific products etc. (Leuschner, et al., 2012). In this way, consensus and support in strategy formulation for sourcing is established as an on-going process, and is particularly valuable in companies with highly compressed new product development cycles. New, innovative strategic variants are being implemented as fast as the supply and individual company situations change. Some of the questions to be addressed/ decisions to be made during sourcing strategy formulation are as under:

- Purchasing through open competitive bid vs selective bid evaluation (Friedman, 1956)
- Joining or buying consortium (Lysons and Farrington, 2006).
- Dealing directly with Original Equipment Manufacturers vs buying through a distributor.

Supply markets with restricted capacity may merit very different approaches compared to those characterized by excess capacity. For purchase categories characterized as high business impact and high degree of complexity, good decisions require the procurement professionals to have a thorough understanding of the supplier industry and technology trends. In some industries, such evaluations require engineering skills and/ or close relationships between procurement and engineering resources. With the globalization of the supply base, one high-tech company has established global commodity managers who provide technology and

supply situation updates to business heads and operations groups on a quarterly basis for such critical buys as memory and processor chips.

It has been observed in the case of Indian automobile industry that a symbiotic relationship and a closer vendor-customer understanding as part of sourcing strategies contributes towards reduction in the total cost of ownership (TCO). Towards this end, companies are now viewing suppliers as extension of themselves. The TCO concept in strategic sourcing leads companies to view their supplier relationships as assets, not simply sources of low-cost materials ready to be pitted against each other in a relentless drive for unit-price reductions. Indeed, companies are increasingly viewing suppliers as extensions of themselves, rather than simply as vendors to be kept at arm's length. To these companies, the supplier-customer relationship is not just about buying specific products or services, but rather about acquiring the technical, managerial, or executional (e.g., logistics, cost economies) expertise. To gain lasting competitive advantage through a sourcing arrangement, the relationship between buyer and seller must go beyond the traditional boundaries. To serve as assets, supplier relationship must be acquired, maintained, enhanced, or, in some cases, divested. Spurred on by progressive management philosophies or, in some cases, by concerns of legal liabilities, companies have become increasingly interested in overall business practices of their suppliers, for example, Starbucks Coffee, Levi-Strauss and Reebok International. Figure 2.6 depicts an outline of SS process along with relevant aspects to be addressed at respective stages.

2.2.4 Tools/ Techniques of Strategic Sourcing

Transaction cost theory has been the basis of analyzing sourcing/ purchase (Moser et al., 2011). As per this theory, close relationships tend to lower transaction costs which in turn need appropriate governance structures in order to ensure efficiency of the transaction process. However, this theory focuses on cost aspects only, neglecting issues/ risks arising during SS (Moser et al., 2011). However, the practice based on this theory gave rise to opportunism and dominance with obvious negative reactions specifically in times of economic and demand uncertainty (Hoyt and Huq, 2000; Handfield and Nichols, 1999). Despite the importance of the awareness of advantages and disadvantages about sourcing, many companies seem to only have a vague understanding about the risks and benefits of outsourcing and only have a general idea that it will reduce cost, gain access to other companies' competence and allow them to focus on their core competencies (Smith et al., 1998). This study considers the determinants of SS, asset

specificity, information sharing and risks in examining the SS and these constructs are grounded in transaction cost theory (Williamson, 2008).

Anderson and Katz (1998) provided a Procurement Maturity Model (PMM) that describes pathways to companies for cost reduction and revenue enhancement through strategic sourcing. The model can be easily manipulated by a user to select a current practice and compare the current practice against the corresponding best practice. The model then performs a gap analysis; identifying and prioritizing measures that the user can undertake to implement best practices and improve organizational procurement performance.

Ellram (1993, 2000) classified cost activities into pre-transaction, transaction, and post-transaction phases, whereby the estimate of future costs and an entire range of administrative overhead costs would not be overlooked.

Furthermore, one of the common methods employed in strategic sourcing and decision making is the Total Cost of Ownership (TCO) approach proposed by many authors (Spekman et al., 1999; Emiliani, 2004; Wouters et al., 2005). It considers the buyer's entire value chain and mainly evaluates the supplier performance by taking into account all the costs caused by a supplier (Degraeve, et al., 2000). As opposed to an initial-price perspective that mainly accepts short term approach, TCO allows for a long-term perspective selecting different buying situations (Ferrin and Plank, 2002; Kim and Chai, 2017). TCO is more exhaustive methodology covering all visible and hidden costs in sourcing decisions (Sharma et al., 2015).

TCO is a structured methodology for determining the true cost of acquisition of a product, considering all the costs related to purchasing and using the product, also including cost elements such as: quality, transportation, maintenance, and administration (Degraeve et al., 2000; Ellram, 1995). However, Wouters et al. (2005) claim this approach is seldom applied in practice. Some authors argue to emphasize upon the uniqueness of a company, the characteristics or adapting strategies on the product level (Cho and Kang, 2001). This situation is also supported by different trends in sourcing by means of comparing, for instance, the automotive and retail industries (Edgell et al., 2008; Ganesan et al., 2009).

After detailed literature review the eight salient cost factors and sub factors considered by a manufacturing company in TCO model for sourcing decisions have been identified (Sharma, 2016). These TCO cost factors are 'Product Design' cost (tooling and prototyping costs, testing and evaluation costs, process planning and design documentation), 'Maintenance and Downtime' cost (Planned and unplanned downtime costs, out-of-service costs, maintenance costs), 'Operation' cost (assembly and manufacturing costs, labour costs, long-term operations

costs), 'Quality related' cost (cost of quality that includes durability, replacement, field failure, rework, scrap, customer returns and rejection costs), 'Logistics' costs (transport costs including freight, packaging, handling, warehousing tariffs, duties and import fees, outbound costs), 'Inventory' cost (safety stock cost, out of stock costs), 'Administrative' cost (administration of post-purchase agreements, supplier selection and evaluation, partnering and team costs) and 'Transaction' cost (procurement and ordering costs, transactional activity costs). In effect all cost drivers need to be captured and considered as tools while employing techniques to achieve effective and efficient strategic sourcing.

2.2.5 Antecedents and Practices of Strategic Sourcing: Indian Automobile Industry

The automobile industry is predominantly dependent on raw materials, components and external interfaces which calls for intensive operational planning and execution at all levels of management, especially the sourcing and supply management. India has emerged as one of the cheapest sourcing destinations in the automotive map edging out arch rivals like China, Mexico and Eastern Europe due to availability of a large pool of skilled workers, low production costs, faster design and development process and also due to India's emerging market status (Tang and Musa, 2011). The foreign companies outsource most functions regionally retaining control on product development and strategic procurement (Auto SCM India, 2006: ACMA, 2015). Manufacturing firms have increasingly formed strategic alliances with their global suppliers, even when highly specific assets are involved (Janet Y. Murray, 2001) and strategic sourcing warrants due import during considered decision making in the Indian automobile industry context.

Global sourcing network management has emerged as an important topic in academia and industry. Gereffi and Lee (2012) divided the key characteristics of the global supply network into three aspects: the consolidation of the global supply network with new geography value creation, especially in emerging economies, like China, India etc., the significant roles of global retailers and private standards in the supply chain network, and how economic changes affect the market and regionalization of the supply network. Global sourcing is critical for establishing good relationships, promoting collaborations, and improving responsiveness (Presley et al., 2016). Supplier location is one of the most important factor in evaluating suppliers' capability and performance in the supply network (Sarkar and Mohapatra, 2006; Chan and Kumar, 2007).

In designing global sourcing strategies managers need to solve design problems such as internal manufacturing location as well as external supplier location (Meixell and Gargeya, 2005). Holweg et al. (2011) emphasized that firms attempting to conduct global sourcing for the first time should consider the differences between domestic and global suppliers in terms of lead times, product complexity, demand uncertainty, total cost, and customer service level. In global supply network context, supply and purchasing executives and managers establish different strategies from managing domestic supply sources. The characteristics of global sourcing generate differences among the impacts on the relationship among information sharing, supplier innovativeness, strategic sourcing, and supply network agility (Caniato et al., 2013; Fan et al., 2017).

2.3 Risk Management

The first research on risk management (RM) is attributed to Bernoulli in 1738, who measured risk with geometric mean and diversified risk across independent events. First application of RM was in insurance and purpose was to reduce the firm's cost in insurance coverage (Cummins, 1976). R Min companies became an important subject in the 1950s. At the same time high insurance costs, originating from commercial insurances was a burning issue and the big companies in American industry searched for new solutions. In the 1990's evolution of economic financial context of firms pushed RM towards managing financial and business risks of firm to optimize performance of the firms (Doherty, 2000; Lam, 2004). The job of a risk manager has changed significantly over the years as new areas of risk have emerged, for example issues related to the environment and information technology.

RM means taking deliberate actions to shift the odds in your favour - increasing the odds of good outcomes and reducing the odds of bad outcomes (Kutsch and Hall, 2010). The progressive change led to most modern definitions of RM. In early 2000 scholars talked about integrated RM, it is also known as enterprise risk management (ERM). De Loach (2000) defined ERM as a structured and disciplined approach which aligns strategy, processes, people, technology, knowledge to evaluate opportunities and threats faced by firms. ERM is a process, affected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives (COSO, 2004).

Risk management seeks to address all three dimensions of the risk construct (the likelihood of occurrence of a particular event or outcome, the consequences of the particular event or outcome occurring and the causal pathway leading to the event) by analyzing the sources and seeking to understand the forces that may drive a particular sequence of events and how these might be managed to improve the chances of positive outcomes in terms of performance and, by corollary, avoid negative consequences.

Recent trends such as market globalization, reduced product life-cycle, reduced supply base, necessity to be lean, excessive use of outsourcing and off-shoring have all contributed to increased risks (Manuj and Mentzer, 2008; Craighead et al., 2007). The event study conducted by Hendricks and Singhal (2005) indicated that supply disruptions affected performance negatively by 8 percent. Therefore, it is vitally important to minimize rate of disruptions and improve recovery time from disruptions. Supply risk management and alignment with the supplier increase complexity. If companies spend 50% of their revenue, they are highly exposed and depend on their supply base. Amit and Schoemaker (1993) note that managers face considerable uncertainty and ambiguity that stems from ever-changing proprietary technologies and other factors. A failure may affect a company in several ways, such as financial, market-share, shareholder value, customer, competitors, reputation, legal or brand perspectives (Baker et al., 2016).

Therefore, risk management is essential in sourcing decisions, especially if entering long-term contracts (Kraljic, 1983; Harland et al., 2003). While the appropriate consideration influences strategic risks, leads to a competitive advantage and affects business performance (Anderson and Katz, 1998; Clarke and Varma, 1999; Harland et al., 2003; Hallikas et al., 2004; Blackhurst, 2005), the consideration and evaluation of risks should be mandatory in sourcing. However, many companies lack the real implementation and preparation provided by contingency plans (Zsidisin et al., 2000; Chopra and Sodhi, 2004; Luo et al., 2009; Meena et al., 2011; Golini and Kalschmidt, 2015).

After the assessment of risks, strategies including transferring risk, taking on the risk, eliminating risk, reducing risk and subdividing risk (Anggara and Affriada, 2011) must be undertaken to manage them. There are two ways of reducing the risks associated with input and output market uncertainties, namely, reducing the frequency of occurrence of risky events (proactive strategies) and reducing the negative consequences of risky events after their occurrence (reactive strategies) (Blome and Schonherr, 2011; Pandey and Sharma, 2017). Those strategies that are aimed toward reducing the probability of disruptions and are

implemented prior to the occurrence of the risky events are called proactive strategies (Aven and Aven, 2011). The proactive strategies discussed in the literature are avoidance, investment in developmental activities, control strategy and integration. Strategies that create capability to alleviate the effects of a disruption after its occurrence and are built on the principle of Supply Chain recovery to include flexibility, redundant resources and risk pooling/ demand management strategies are reactive strategies (Sharma and Bhat, 2014). In contrast to crisis management which is reactive in nature, RM process is proactive (Beckmann and Akhavan, 2017). An analysis of the impact of various mitigation strategies on various risks indicates that each risk mitigation strategy has limitations and there is a need to identify specific strategies for specific risks (Chopra and Sodhi, 2004).

Most papers propose a conceptual methodology for managing risks. For example, Cucchiella and Gastaldi (2006) developed a framework for the risk management to minimize firm risks. Some popular tools such as failure mode and effect analysis (FMEA) and analytical hierarchy process (AHP) have been used for this purpose (Dong and Cooper, 2016; Mital et al., 2017). Wu et al, (2006); Gaudenzi and Borghesi (2006) for example applied the AHP model, Sinha et al, (2004) applied the FMEA approach, and Cucchiella and Gastaldi (2007) applied the real option model. Some authors have also developed mathematical models to analyse risk behaviour in supply networks (for example Nagurney et al., 2005; Dong and Cooper, 2016).

It seems that companies are unprepared for such risks, or need to trade-off between the cost and rewards of risk management if a risk never occurs (Zsidisin et al., 2000; Chopra and Sodhi, 2004). The evaluation or consideration of risks in sourcing was proposed by Kraljic (1983); however, a research gap exists in providing sufficient evidence regarding how risk management is considered in strategic sourcing and the Kraljic purchase portfolio model has been described in Section 2.4.1. Therefore, further research is required to validate and establish appropriate supply risk management tools.

2.3.1 Definition of Risk

Several definitions for risk exist (Risk: Analysis, perception and management, 1992; Hamilton, 1996; Kaplan, 1997; Deloach, 2000). All definitions share some common characteristics, that are all well covered by Kaplan (1997), with three questions: "What can happen?", "How likely it is?", and "What are the consequences of it?".
Kaplan (1997) answers the above questions by a "Triplet".

Triplet can be described using the following equation
$<S_i , L_i , X_i>$ where i = 1, 2, ...n

- S_i is scenario identification and description;
- L_i is the probability of that scenario; and
- X_i is the consequence or evaluation measure of that scenario, i.e. the measure of damage.

At an academic level, there is a growing body of research on risks from different perspectives e.g., finance, economics, project management, strategy and international business. The Table 2.4 gives various definitions of risk from perspectives of different disciplines.

Table 2.4: Definitions of Risk from Different Discipline Perspective

S. No.	Risk Definition	Author Name
1	'Variance of returns'	Markowitz, 1952
2	'Risk is essentially the process of choosing between prospects that have different outcomes, each with differing probability'	Kahneman and Tversky, 1979
3	'Risk is the likelihood of the occurrence of an uncertain event or set of circumstances that would have an adverse effect on the achievement of a project's activities'	Simon et al., 1997
4	Risk is the probability that an event will occur and it is most often used to express the probability that a particular outcome following a particular exposure.	Brian, 2001
5	Risk is an influence affecting strategy caused by an incentive or condition that inhibits transformation to quality excellence.	Peidro and Mula et. al., 2010
6	Risk is an uncertain event or condition that, if it occurs, has an effect on at least one objective.	Carbone et al., 2012
7	Risk is expected prices won't yo-yo out of control over your contract period or that your current strategy will be able to deal with yo-yo pricing.	Heckmann et al., 2015
8	'Risk associated with failure to satisfactorily implement a business process re-engineering project'	Mangan et al., 2016
9	'Within the SSRM context, it is purely the downside that accurately reflects the business reality'	Kim and Chai, 2017
10	The probability of something happening multiplied by the resulting cost of benefit, if it does. This concept of 'Risk Factor' is used to compare levels of risk.	Pandey and Sharma, 2017

These and several other definitions provided by risk management authors are consistent with the literature, that suggests following two components of risk:

- Potential losses (if the risk is realized, what losses will result and what is the significance of the consequences of the losses (Harland et al., 2003; Manuj and Mentzer, 2008; Mitchell, 1995);
- Likelihood of losses (the probability of the occurrence of an event that leads to realization of the loss).

2.3.2 Risk Assessment: Identification and Evaluation

According to Rao et al. (2009), one or more of the four sources namely, environmental factors, industry factors, problem-specific factors and decision-maker related factors are responsible for the occurrence of business risks, out of which the relevant risk sources are environment characteristics, automobile industry characteristics, sourcing methodology and strategy and decision-making variables. There are potentially an infinite number of factors exposing the business to undesirable consequences in terms of performance and risk (Carbone et al., 2012; Garvey et al., 2015). Risk drivers determined by various researchers include globalisation, product variants, outsourcing, global sourcing, reduction of the supplier base/ and supplier concentration, focus on efficiency, partnerships and other close relationships, centralised distribution and production, supplier dependence and customer dependence (Gimenez and Sierra, 2012).

Researchers suggest that an approach to managing risks needs to follow a formal and structured approach to identifying, quantifying, and reducing risk (Frosdick, 1997; Khan and Burnes, 2007). Common risk identification methods include Delphi method, checklists, module decomposition method, force field analysis, constraint analysis, SWOT analysis, diagramming techniques like root-cause analysis, process flow charts, influence diagrams and scenario analysis (Niu and Tian, 2007; Jahangiri et al., 2017). Dani and Ranganthan (2008) presented a conceptual model for indentifying and assessing risks. Authors suggested use of scenario planning in proactive management of supply chain risks. Moreover, there can be no general types of risks, but these must be defined from within the context, and each sourcing agency has its own and unique set of risks.

2.3.3 Risk Management Framework

The RM process identifies the risks and their negative consequences and represents it in economic terms, which enables the managers to select appropriate risk response (Zsidisin, 2001). A generic Risk Management model is shown with its various components in Fig. 2.7.

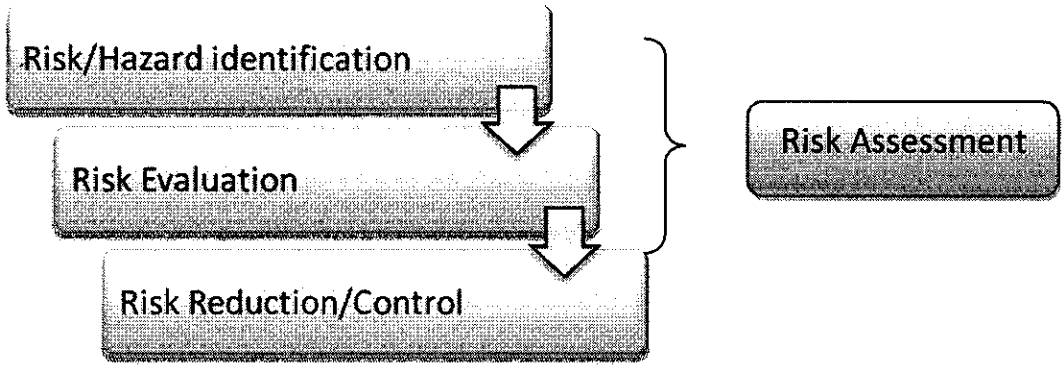

Fig. 2.7: A Proposed Generic Risk Management Model

Tang (2006) argues that with the kind of business disruptions that have taken place in recent times (e.g. terrorist attacks, hurricanes, earthquakes, floods and SARS) business continuity and sourcing risk management will become as important as cost reduction. Some of the disruptions resulted from man-made disasters, like the fire accident at the electronics plant in Albuquerque, New Mexico, which caused $400 million in lost sales at Ericsson (Norman and Johnson, 2004); Longshoreman strikes at US ports in 2002, which caused an estimated $11 to $22 billion in lost sales; and terrorist actions like 9/11 that crippled transportation networks across the USA. In July 2007, Toyota Motor Corporation halted production in all Japanese factories due to an earthquake that severely damaged Riken Corporation, their major parts supplier for piston and seal rings. Moreover, the damage to Riken affected other automotive manufacturers, prompting suspended production at facilities for Mitsubishi Motor Corporation, Suzuki Motor Corporation and Honda Motor Corporation; all of these companies depend on Riken for engine parts (Hayashi et al., 2007). Very recent Japan's tsunami and earthquake in Feb. 2011 and floods in Chennai severely affected many large companies (Sharma et al., 2016). Some large companies that were victims of this natural disaster are Sony, Toyota Motors, Nissan Motors, Honda Motors, Hyundai Motors, Ford Motors, Panasonic, Fuji Heavy Industries, Asahi Kasei Corp. etc. Moreover, much more research has been published in recent years following disasters such as the 2001 terrorist attack on the World Trade Center, the 2004 tsunami in the Indian Ocean and the 2015 floods in Southern India.

Informed decisions can only be made for known risks only, not for unrecognized risks, hence there is need for greater understanding of consequential risk linkage at following four levels(Peck, 2005):

- Process/ product level.
- Infrastructure/ assets level.
- Organization/ inter-organization level.
- Environmental level.

Juttner et al., (2003) suggested that there are four inter-related constructs to supply network risk management:

- Risk sources.
- Risk drivers.
- Risk management strategies.
- Outcomes of supply risk.

Norrman and Lindroth (2004) suggested a three dimensional framework to analyze different SSRM issues. The dimensions are:

- Unit of analysis, describing the levels which are affected by this issue (more local to the company or affecting the whole supply network).
- Type of risk or uncertainty, describing if the issue is operational or strategic
- Risk and business continuity management process, which shows the stage within the risk management process.

On similar lines McCormarck and Trkman (2009) provide a model for supplier risk assessment. In their proposed model, supplier connected risk (supplier related risks), characteristics of supplier market, and sourcing structure generate risks to the whole supply network.

Risks in a sourcing network are difficult to assess for three primary reasons: risks are difficult to identify because of the mutual interactions, they can arise in every echelon of the supply network, and there are fewer well-defined tools and techniques for RM, so that they are generally managed in an ad hoc fashion (Shi, 2004). SSRM needs awareness of both events that may cause disturbances at every significant link along the supply network and their negative consequences (Finch 2004). Shi, (2004) suggested a system approach to manage risks in supply network that consists the following steps:

- Risk identification.
- Risk categorization based on their nature and collective impact.
- Risk management programme.

2.4 Risk Management (RM) from Strategic Sourcing (SS) Perspective

The concepts of risk and risk management have been studied in detail in a number of areas such as Economics (e.g. Kahneman and Tversky, 1979; Finance (e.g. Smith et al., 1998), Strategic management (e.g. Simons, 1999) and International Management (e.g. Miller, 1992). Outsourcing of complete or partial activities creates great opportunities but also created new types of risks to organizations. For understanding strategic sourcing risk management (SSRM), it is imperative to analyze each construct of SSRM. SSRM is management of risks that implies both strategic and operational horizon for both long term and short term.

Sourcing of products from across the globe is increasing with economic development. Global sourcing has opened many avenues of cost reduction for companies and companies are sourcing from low cost countries. However, these decisions can also have unintended consequences, exposing organizations to considerable risk (Engardio, 2001; Christopher and Peck, 2004; Soni and Kodali, 2013). In practice, a growing number of companies are suffering an increased exposure to global sourcing risks. In pursuit of cost reduction, companies are using total landed cost model and total cost of ownership (TCO) models to evaluate global sourcing decisions. Companies face many risks from different dimensions in sourcing decisions and SSRM has increasingly attracted attention of academicians and practitioners. Supply disruptions can result in a variety of problems such as long lead-times, stock-outs, inability to meet customer demand, and increases in costs (Svensson, 2000; Chopra and Sodhi, 2004; Manuj and Mentzer, 2008). Ultimately, these problems have an adverse effect on the financial performance of the firm (Hendricks and Singhal, 2005). One of the challenges confronting managers and decision makers is that supply network cost structures have become very dynamic. Labour costs, fuel costs, and currency exchange rates for low-cost countries all fluctuate significantly, causing profitable sourcing strategies to turn unprofitable much more quickly than they have in the past. Leading companies today have integrated workflows across engineering, procurement, and supply network organizations to incorporate total-landed-cost analysis into engineering and procurement decisions (Vitasek, 2016).

Nowadays the competition is not among single firms, but on the contrary, among supply networks (Caputo et al., 2005; Sadler and Gough, 2005). In this context SSRM provides a way to deal with risks in the whole supply network holistically by sharing risk information on real time basis (Rice and Caniato, 2013). Supply chain disruptions are "unforeseen events that may occur in the supply network which might affect the normal or expected flow of materials and components". To understand SSRM, two parameters, sources of disturbance and category of

disturbance, can be used (Svensson, 2000). SSRM is "the identification and management of risks for the supply network, through a coordinated approach amongst supply network members, to reduce vulnerability as a whole". (Christopher, 2000). A risk management system is basically an action plan that specifies which risks can be addressed, and how to address them. Risk awareness, its management framework and SS risk management practices have been developed and studied by Sharma (2016) in detail.

However, research on risk in the supply network context has only started to develop in recent years (e.g. Harland et al., 2003; Christopher and Peck, 2004; Zsidisin et al., 2004, Manuj and Mentzer, 2008). Risk sourcing is a critical issue since companies, which are unable to manage it are likely to suffer in terms of performance (Mitchell, 1995). Poorly managed risks can lead to inaccurate forecasting, lower product quality, decrease in turnover and share price, loss of reputation, poor relationships with the other members of the supply network and conflict amongst the organization's stakeholders (Cousins et al., 2008; Hoffmann, 2011).

One of the main factors impacting a supply network's stability and consistency are the raw materials which the companies acquire in order to develop their product. Holweg et al. (2011) developed a supply volatility index to prove how the current practices may no longer fit the environment that most of the companies operate in nowadays. Post 2009, the companies are not only susceptible to temporary shocks, but there is much volatility in the market that will lead to higher variance in vital business factors: from energy cost, to raw materials, and currency exchange rates. They suggested that a new system must be explored to revamp the supply network foundations as the current foundations of the supply networks were built on the basis of the low price of a single commodity such as oil, or low labour cost.

2.4.1 Tools/ Techniques for Strategic Sourcing Risk Management

For the purpose of risk assessment, different analysis methods have been developed with varying design and purpose for diverse risk situations. For every type of analysis method, there are specific definitions, structures, calculation models and ways of expressing the final result.

The portfolio analysis answers key questions of how to shape the present and future business portfolio (of product or services) in order to reduce the risk of functioning in a changing environment, and increase the effects of the implemented strategy (Bamberger, 1981). It involves identification and evaluation of all products or service groups offered by company

on the market (so called product mix) and preparing specific strategies for every group according to its relative market share and actual or projected sales growth rate. Boston consultancy group (BCG) growth-share matrix is one of the most popular strategic portfolio method (Morgan and Rego, 2009).

Kraljic (1983) has developed a 'Portfolio Purchasing Model' which is quite popular and used in the companies worldwide. It helps purchasers maximize supply security and reduce costs by making most of their purchasing power, thereby moving the procurement from a transactional activity to a strategic activity, i.e. 'purchasing must become supply management'. It involves segmentation of sourcing products as per the two dimensional 'Product Purchase Classification' matrix, i.e supply risk vs profit impact. Four quadrants of the Kraljic matrix, as shown in the Fig 2.8, are:

- Non-critical items (purchasing approaches include using standardized products, optimizing order volume and inventory levels).
- Bottleneck items (approaches include over ordering, when the item is available and looking for ways to control vendors).
- Leverage items (approaches include using your full purchasing power, substituting products or suppliers, and placing high-volume orders).
- Strategic items (options include developing long-term supply relationships, analyzing and managing risks regularly, planning for contingencies, and considering making the item in-house rather than buying it, if appropriate).

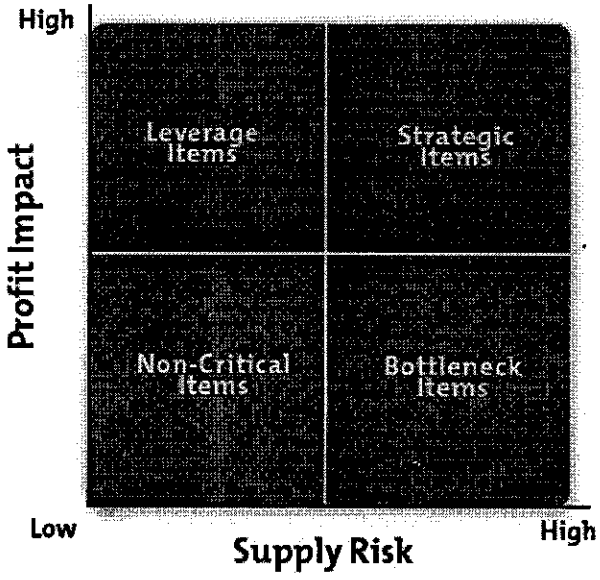

Figure 2.8: Product Purchasing Classification Matrix

Source: Kraljic (1983)

Zsidisin et al. (2004) examined tools and techniques used by purchasing departments within organizations to assess supply risk. The analyses can be classified according to the degree to which they are quantifiable. The risk assessment methods can roughly be categorized as quantitative, semi-quantitative or qualitative.

The Decision Tree Analysis, first used by Waters (2011) was a pioneer quantitative tool to evaluate risk factors. However, this tool neither provides any real industry risk assessment, nor has it been proven to be accurate and was originally designed to evaluate between different options with respect to risk and not to evaluate the risk factor itself.

The scenario analysis and stress testing method by Finke and Nägele (2009) evaluates the effects that changes in some risk factors have on a firm's operating activities. While their focus is primarily on high risk incidences such as disastrous events including natural calamities and man-made disasters, they do not include any way to evaluate the frequency, but use severity as a "risk indicator" (Marshall, 2001). Although, it is one-dimensional in nature, the advantage of scenario analysis and stress testing over and above the similar advantages of other methods, is the fact that it considers the scenarios which are likely to happen or which are highly improbable. The prime drawback of this method is the lack of incorporation of quantifiable data. Simulation based supply network risk assessment model to assess the disruptions caused by failures in some supply nodes and their impact on the key performance measures of interest to enable companies to undertake risk assessment and identify most critical scenarios have been developed by Seck, et al. (2015).

The 'Fuzzy Logic' framework allows not only zeroes and ones as values, but any real number between zero and one, as opposed to the Boolean Logic. Many mathematical models based on Fuzzy Logic have been structured to test risk-based scenarios in supply network design, supplier selection, capacity forecasting, ideal warehouse premises problems and others (Lee and Wolfe, 2003; Wang and Shu, 2005; Mitra et al., 2009; Peidro et al., 2010; Wu et al., 2010).

Sinha et al. (2004) investigated supplier risk in the aerospace industry and developed an integrated definition for function modeling (IDEF0) based risk management method. IDEF0 is a structured modeling method for developing functional or activity models of systems or enterprises (Mayer et al., 1998). Once the model was developed, they employed Failure Mode and Effect Analysis (FMEA) to analyze and prioritize potential failures.

The artificial neural networks (ANNs) method which amalgamates computer science and biological science, has been used to design expert systems for vendor management systems, sales and raw materials demand projections based on various factors, particularly for solutions to problems like shrinking the bullwhip effect in the major supply chains (Aburto and Weber

2007; Gumus, Guneri et al., 2009; Ko Tiwari et al., 2009; Luo Wu et al., 2009). ANN can be used with other assessment tools to evaluate and mitigate risks. Research by Raut et al. (2017) presents an integrated Data Envelopment Analysis (DEA) and ANN methodology for the evaluation and selection of 3PL providers.

Monte-Carlo approach has also been used to conduct research regarding the investigation of risk scenarios. Klibi and Martel (2011) have suggested a novel method using three-phase hazard modeling approach for the assessment of supply networks, wherein they categorized the supply risks in terms of threats, sources susceptible to high risk and the amount of exposure; the assessment of networks in terms of damage and time to recovery. They also estimated future risk events using Monte-Carlo simulations and ways to mitigate those risks.

Some of the groundbreaking work on the subject of identification of company operational and financial difficulties, using financial ratios was taken up by Edward I. Altman in the 1970s. In his research papers, he studied business failure patterns of different companies and attempted to quantify the variables which can indicate corporate distress. He developed two models to quantify business and credit risk using a Z-Score model and a proprietary ZETA model (Altman, 2013). Both models proved to be highly accurate while predicting the bankruptcies of companies. They concluded that financial ratio analysis is an excellent tool to detect corporate failures in both short and long run.

Gaudenzi and Borghesi (2006) provided an analytical hierarchy process (AHP) method to evaluate supply risks, in order to meet the supply network objectives. Wu et al. (2010) developed an analytic hierarchy process (AHP) based supplier risk assessment tool to determine the relative weights of individual risk factors. Using these weights and the probability of each risk factor occurring for a supplier, an overall risk index was computed. Methods for assessing risk are also contained in the growing literature, which are used for supplier assessment and selection (Talluri et al., 2006). FMEA can be implemented as a risk management framework for identification and assessment of supply network risks (Anggara and Affriada, 2011).

The Bayesian network modeling approach is a more recent model incorporating both quantitative data and subjective expert opinions (Pai et al., 2003). Lockamy and McCormack (2012) explored a new method using Bayesian networks for determining a supplier's overall risk probability, and the probable impact a supplier may face on the cash flows of the company. They concluded that the supplier risk profiles can be used to identify and single out risk events which have the largest potential influence on a company's cash flows. Sharma and Saurabh (2015) evaluated supply chain risks using Bayesian belief network modeling. The drawbacks of

their model are the presentation of risk variables in binary form and not including many significant risk factors in supply chain.

The Bayesian network modeling has been adopted by Sharma and Routroy (2014) to conclude that information risks in a supply chain, namely, information security, information leakages and reluctance toward information sharing have significant influence on a company's revenue.

While this brief literature review covers most of the extant topics with regard to sourcing/ supply risk management, it also highlights that there is potential for research to model supply risks using financial ratios and standard proxy variables from firms' financial statements (Lixandru, 2016). The link between the raw material market indices, various liquidity ratios and quantitative analysis of business and credit risk may be used to arrive at reasonable solutions for a company's supply chain risk. For non-quantifiable subjective factors, a solution could be found by using a Bayesian network model. An Orders-of-Magnitude AHP (OM-AHP) based ex-ante supply network risk assessment model, created by Dong and Cooper (2016), allows for comparison of the tangible and intangible elements that influence supply risks. However, a guiding structure of how to pivot using OM-AHP did not exist. Analytic hierarchy process (AHP), a risk assessing tool which fulfils the task of assessing and managing the supply chain risks helps managers in identifying the risk indicators, evaluating the impact of undesired events and the varied cause and effect relationships along the chain, thereby prioritizing the objectives of the strategic sourcing and identifying the best supplier from various alternatives. Mital et al. (2017) assessed sourcing risk across various product categories using cognitive maps and AHP methodology. A leap in analyzing supply networks has already been taken by Lockamy and McCormack (2012) using Bayesian network modeling. There still exists scope of integrating the above reviewed methods into the whole industry perspective. Some of the recent studies developed Bayesian Belief Network model, but all of these lack in terms of comprehensiveness in one industry specific supply chain risk factor. In this research, relevant aspects of various methods summarized above have been combined in an effort to provide an empirical model to evaluate industry specific risk which include financial, economic, supply chain and natural calamities risks.

Methods for assessing risk are also contained in the growing literature, which are used for supplier assessment and selection (Talluri et al., 2006). FMEA can be implemented as a risk management framework for identification and assessment of supply chain risk (Anggara and

Affriada, 2011). Therefore, the outcomes of the risk assessment activities need to provide a classification of all identified risks and put them into a prioritized order. Graphical illustration can help to map risks in an appropriate way and show where, when, and with what likelihood and impact risks might occur (Yates and Stone, 1992; Steeleand Court, 1996; Harland et al., 2003; Hallikas et al., 2004; Norrman and Johnson, 2004; Manuj and Mentzer, 2008b; Zsidisin, and Ritchie, 2008; Schmitt and Snyder, 2012). Over the years well suited tools and techniques have been developed. These include failure mode effect analysis (FMEA), risk benefit analysis (RBA), risk breakdown structure (Cagliano et al. 2012) and risk simulation.

Some frequently used qualitative and quantitative tools/ techniques of SSRM in the literature are summarised hereafter:

- **Checklists**: The checklists include the questions concerning risks, vulnerabilities and damage exposure, and constitute a control tool that evaluates against an established security level (Tuncel and Alpan, 2010).
- **Hazard Operations**: It is used to identify the reasons why the quality and production goals set for a process plant may not be reached (Hamilton, 1996).
- **The What-if Method**: It involves making a detailed description of the course of events in connection with a certain risk event, called scenarios (Carbone et al., 2012).
- **Variance Analysis**: It can be undertaken for every operation, process and flow, to analyze where a variance from the normal can occur and what the consequences may be (Tuncel and Alpan, 2010).
- **Risk Matrix**: It incorporates product of probability and consequence. It is very difficult to get quantitative data, and so it could be a subjective judgment of experts (Nilsson, 2003).
- **Risk Mapping**: People involved in different risk areas estimate risks in respective risk area by using defined criteria (Hillson et al., 1997; Fan et al., 2017).
- **Delphi-Technique**: The expert panel anonymously answers a number of assessment questions. The assessment is repeated. The different experts can now adjust their assessments. The procedure is repeated until consensus is reached (Alverbro et al., 2010)
- **Fault Tree Analysis (FTA)**: Looks at what causes and contributing factors there were or could have been for a certain hazardous event (Alverbro et al., 2010).
- **The Jonson Analysis**: The probability and consequence are analyzed and then graded on a specific scale (Hamilton, 1996; Carbone et al., 2012).

- **Simulation Methods**: Techniques such as Monte Carlo, Petri Nets are used to calculate probability of event and impact of risky events (Tuncel and Alpan, 2010; Seck et al., 2015).
- **Decision Trees**: Risk is analyzed objectively and subjectively with measures such as perception of experts (Alverbro et al., 2010).

2.4.2 Risk Sources in Strategic Sourcing Risk Management: Indian Automobile Industry

SSRM starts with risk sources identification and categorizing them based on their effects on supply network profitability. RM literature classifies risks as: hazard risks (pure risks), financial risks, operational risks and strategic risks. Fig. 2.9 gives example of each risk category:

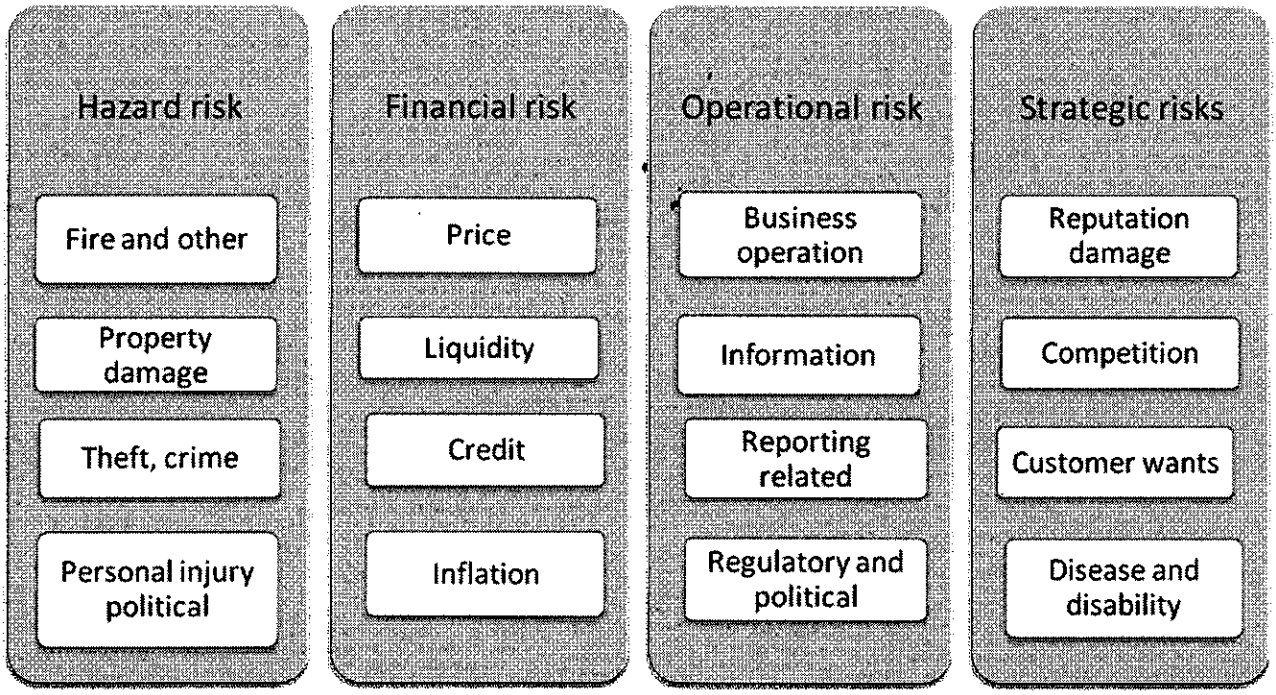

Fig. 2.9: Classifications of Risks

Source: Casualty Actuarial Society, 2003

In literature, various ways of categorizing sources of risk coexist (Goldberg et al., 1999; Miller, 1992). Christopher and Peck (2004); Manuj and Mentzer (2008) suggested three categories of supply risk sources, i.e. environmental risk sources, network related risk sources and organization risk sources. An environmental risk source comprises any uncertainties arising from supply network environment interactions. Network related risks could be in the form of

delays of materials from suppliers, large forecast errors, system breakdowns, capacity issues, inventory problems, and disruptions. Another classification provided by Tang (2006) categorized supply risks into operations and disruptions risks. The operations risks are associated with uncertainties inherent in a supply network, which include demand, supply, and cost uncertainties while disruption risks are those caused by major natural and man-made disasters such as flood, earthquake, tsunami, and major economic crisis.

Each company would have different set of risks (Cheng and Cheu, 2018). In aggregate terms, there is a common pattern in the types of risk a company faces. Different authors have classified risks in different ways. It provides various supply network risk classifications as discussed in RM literature. Lockamy and McCormack (2012) categorized the supply risks into operational risks, network risks and external risks and analyzed the impact of these risks on firm's revenue using Bayesian network. Supply risks can be expressed in a different topological manner. Pfohl et al. (2011) used interpretive structural modeling for providing a structural relationship among supply chain risks. The sourcing risks can be classified under various categories and few important ones are listed below:

- Macroeconomic, policy, competitive, resource risk (Goshal, 1987).
- Customers/ demand, suppliers and technology (Chen and Pulraj, 2004; Lin and Li, 2006; Tupa et al., 2017).
- Internal to supply chain, external to supply chain (Wu and Chidamaram, 2006).
- Application level, organizational level, and Inter-organizational level (Finch, 2004).
- Operations and disruptions risks (Tang, 2006; Seck et al., 2015).
- Strategic, tactical and operational risks (Zsidisin and Ritchie, 2008; Sharma, 2016).
- Supply, process, demand, intellectual property risks, behavioural risks and political/ social risks (Tang and Tomlin, 2008).
- Environmental, industry, organizational, problem specific and decision maker specific risks (Shashank Rao, 2009; Weingarten et al., 2018).

Risk in a global supply network has been defined as "the distribution of performance outcomes of interest expressed in terms of losses, probability, speed of event, speed of losses, the time for detection of the events, and frequency" (Manuj and Mentzer, 2008). The sourcing of products from across the global marketplace is an increasing trend associated with economic development (Mangan et al., 2016). This trend is the result of many independent decisions taken by firms around the world looking for new sources of competitive advantage. However,

these decisions can also have unintended consequences, exposing organizations to considerable risk (McGillivray, 2000; Engardio, 2001; Christopher and Lee, 2009).

Global sourcing risks caused by these factors can be classified into different categories. Based on the supply chain risk categorization proposed by Christopher and Peck (2004), we propose that global sourcing risk can be classified as follows: supply risk, process and control risk, environmental risk, demand risk, and logistics risks (see Table 2.4). Manson-Jones and Towill (2005) classified global sourcing risks into demand, supply, control, process and environmental risks. Sharma and Bhat (2014) provided the supply risk topology that classifies supply chain risk sources into demand risk, supply risk, process/control risk, environmental risk, logistical and catastrophic risks. Similarly, McCormack and Trkman (2009) provided a conceptual model for identifying and predicting supply risk based on supplier's attributes. There is a need to develop comprehensive decision making models for supply risks management which integrates the processes with triggering points (Xia and Chen, 2011). Table 2.5 presents the important risk factors, identified from the literature, affecting global sourcing decisions.

Table 2.5: List of Risk Factors Affecting Global Sourcing

S. No.	Risk Factor	Risk Sub Factors
1	Demand Risks	Volatile demand; Forecast inaccuracy; Credit uncertainty
2	Supply Risk	Financial problems with suppliers; Quality problem; Supply delays; Supplier market capacity shortages
3	Process Risk	Production halt (machine break down) Production halt (labour strike)
4	Control Risk	Mechanism to control operations and behaviour in firms
5	Relationship Risk	Opportunistic behavior because of asymmetric information; Leakage of core competences to other competitors
6	Environmental Risk	Legal; Political; Economic; Social risks
7	Natural Risks	Terrorist attacks, Floods, Earthquakes, Fire, Tsunamis and Wars

The risk factors affecting the sourcing in the automobile industry were validated through experts opinion. Nine risk factors have been identified and these are tabulated at Table 2.6 along with their detailed description.

Table 2.6: Risk Factors with Detailed Description

S. No.	Risk Factor	Description	References
1	Demand Volatility	Lower economic growth, combined with rising volatility in crude oil prices and high interest rates have created a strong demand for the Indian vehicle market which has added to the uncertainty in the buying decision for people in India. The increases in excise duty on vehicles have also contributed to the lower levels of automobile demand in the Indian market.	Nagurney et al., 2005; PwC, 2013; Sharma, 2016
2	Inadequate R & D Expenditure	In the last five years, the automotive companies have shown growth leading to R&D investment of almost of 6-7 per cent. BMR Advisors (2015) reports that the Indian automotive industry is set to contribute 13 percent to the GDP compared to the present contribution which is less than 10 percent.	BMR Advisors, 2015
3	Credit Risk	All of the companies in the automotive sector need credit lines from major banks and lenders to invest in their on-going operations, R&D expenditures and other future needs. Credit rating agencies use complex, quantitative econometric models and focus on financial analysis, and the ability of the companies to settle their debts – both short and long term.	Kleindorfer and Saad, 2005
4	Exchange Rate Fluctuation Risk	The trend of export and import has been increasing in the industry and thus importance of exchange rate risk has been increasing. Foreign activities are a source of exchange rate risk (Copeland, 2005). Players in the automotive industry, despite having greater ability to remain currency neutral due to their worldwide operations and better capital management, cannot completely eliminate the foreign exchange risk.	Copeland, 2005

S. No.	Risk Factor	Description	References
5	Raw Material Price Fluctuation	Raw materials contribute about 47% to the cost of a vehicle. On average, an automobile is mainly made of steel (47%), iron (8%), plastic (8%), aluminum (7%), and glass (3%) (Kallstrom, 2015). Approximately one fourth of an automobile manufacturer's operational costs depend on steel and aluminum. So, any fluctuation in global steel or aluminum prices has a direct impact on profitability. As a result of increase in raw material prices – mainly metal and energy prices – the volatility in the sector has been on a rise in past few years, though the overall volatility is still considered medium.	Wagner and Bode, 2008
6	Supply Chain Disruption	The top two historic supply chain goals have now been downgraded by companies, from reducing operating costs and inventory levels, to concerns of how to improve customer service and speed of product delivery to markets.	Zsidisin et al., 2004
7	Regulatory Risk	The industry is subject to regulations and legislations related to environmental concerns. Import, export tariff, sales and excise duty also affect the prices of the vehicles, affecting the firm and industry as a whole (Oetzel, Bettis, & Zenner, 2000). Bharat stage emission standards (BSES) are emission standards instituted by the Government of India to manage the yield of air contaminations from vehicle including engine.	Oetzel et al., 2000; Bogoslaw, 2007; Das and Nayak, 2017
8	Economic Instability	The auto sector has a strong positive correlation with macro-economic factors. Per capita income, employment levels, size of middle class, interest rates are the major economic parameters that affect this industry. GDP growth and GNI per capita, Index of Industrial Production (IIP) is the main factors which indicate the amount of disposable income that is with the citizens of the country.	Miller, 1991; Pandey and Sharma, 2017

S. No.	Risk Factor	Description	References
9	Country Risk	Country risk is defined as the risk of investing or lending in a country, where some of the changes in the business environment that may unfavorably affect operating profits or the value of assets in the country. Country risk mainly applies to the companies operating within the risky country. The OECD publishes country ratings based on the following factors: economic risk, transfer and convertibility risk, and cases of unforeseeable circumstances (e.g. war, revolution, civil disturbance, floods, and earthquakes).	Baker et al., 2016

2.4.3 Risk Drivers

Companies do not have understanding of potential risks in outsourcing/off shoring decisions which makes it important for them to minimize rate of disruptions and improve recovery time from disruptions. Supply risk management and alignment with the supplier increase complexity. If companies spend 50% of their revenue, they are highly exposed and depend on their supply base. The managers face considerable uncertainty that stems from ever-changing proprietary technologies and other factors. A failure may affect a company in several ways, such as financial, market-share, shareholder value, customer, competitors, reputation, legal or brand perspectives. Pandey and Sharma (2017) analysed various risks which may disrupt the automotive supply network. Risk management through strategic sourcing seeks to address all three dimensions of the risk construct. No company wants disruptions in their supply network operations. The companies' utmost priority is business continuity and customer satisfaction (Wei et al., 2018).

Risk drivers are the competitive factors, which are necessary for the firm to be competitive in market. These drivers simultaneously increase the risk exposure of the firm. Juttner (2003) has suggested following five primary reasons that have risk implications (also called risk drivers) for supply networks in recent years:

- A stronger focus on efficiency rather than on effectiveness;
- Supply network globalization;
- Focused factories and centralized distribution;

- Increased outsourcing; and
- Supply base reduction.

2.4.4 Strategic Sourcing Risk Management (SSRM) Enablers

An enabler or positive force proves critical for an organization/ company to respond to a crisis situation. The potential enablers of strategic sourcing risk management (SSRM) implementation are grouped into four categories, namely supplier risk assessment enablers, data sharing in supply network enablers, partnership with supplier enablers, and supply flexibility enablers (Ho, 2001; Yin et al., 2017).

A foreboding about a catastrophe can help a company with valuable preparation time to align its capabilities to minimize disruption effects, or even dodge the disruption completely. Timely identification of potential catastrophes necessitates foresight on the working environment, i.e., suppliers, markets, inventories, competitors, laws, and transportation (Talluri et al., 2006) as well as constant monitoring of the geographical environment. In the year 2000, a fire destroyed the Mexican plant of Philips, a cell phone chip manufacturer, on which both Nokia and Ericsson relied for the supply of cell phone chips. Nokia had anticipated the potential disruption, and promptly contacted Philips to use its alternate facilities to meet Nokia's demand. Just by keeping their supplier processes under control, Nokia increased its market share by 4%. On the other side, Ericsson was late which costed it $1.8 million in terms of lost revenue, as all available capacity of Philips was taken by Nokia (Norrman and Johnson, 2004). The second issue is that of predictive analysis (Jahangiri, Eivazi and Mofazali, 2017). Understanding the supply risk has become a priority and tools are needed to predict the supply network risks (Ruiz-Torres, Mahmoodi, and Zeng, 2013). There is a need for intelligent search agents and dynamic risk indices at every node of the supply network (Menczer, 2003).

The role of data sharing in supply networks is very crucial, as it enables other companies to get a clear picture of disruptions that occurred in one part of the supply chain to help them respond effectively by taking appropriate actions like re-routing, changing production plans, re-deploying production resources or adjusting capacities. Effective data sharing requires event driven data of supply chain operations and tight integration of information systems across suppliers, manufacturers, logistics service providers and customers. Cisco's e-hub, a private exchange, meets these two requirements as it connects multiple tiers of suppliers and immediately provides all players a complete picture of supply disruptions and shortages (Lee and Wolfe, 2003). Information asymmetry originates in supply networks when

one member has greater access to information sources compared to other players (Lee and Whang, 2000). The member who has more access to information can enjoy undue advantage, reducing profits and increasing supply vulnerability. Presence of information asymmetry does not resolve the conflicting decision criterion in terms of decisions related to inventory, transportation, lead time, capacity, and quality (Simichi et al., 2006). Managers can use the criteria of information visibility (both in upstream and in downstream), the speed and frequency of sharing of information between supply chain members to rate information asymmetry (Fan et al., 2017). In disruption discovery, visibility across the supply network has become the new battle ground for sourcing competitiveness (Blakhurst, 2005). Visibility is real time data/ information sharing with every node in the supply network. Even though data sharing and visibility are often used interchangeably, in this context, data sharing is an activity and visibility is the outcome of that activity (Swaminathan and Tayur, 2003; Lee et al., 2013).

Moorman et al. (1992) define commitment to a relationship as an enduring desire to maintain a valued relationship. In a review of relationship commitment in industrial relationships, Morgan and Hunt (1994) inferred that commitment was the key component to successful relationships. The presence of communication in inter-organizational relationships has been found to be linked with commitment (Morgan and Hunt, 1994). The other important antecedent for supply risk management is aligning the resources and interests of all supply network partners to minimize the supply disruptions and enhance the supply network performance (Baker et al., 2016). Numerous studies indicate that successful buyer-supplier relationships are associated with high levels of information sharing (Kim and Chai, 2017). According to Mentzer et al. (2001), a primary component of supply management is sharing risk as well as reward among members of the supply network.

Helferich and Cook (2002) provide a detailed guideline for a disaster management process. In the situation of a risk arising, it must restrained by developing a contingency plan for implementation. A contingency plan is an alternative plan that will be used if possible foreseen risk events becomes a reality, answering all other questions of what, when, where and how much actions take place. These plans serve as a user's manual in case of disruption (Golini R. and Kalchschmidt M., 2015). The recovery stage needs to be characterized with the adoption of tasks like assessment of undamaged resources and identification of the human resources and physical infrastructure needed. Cooperation with law enforcement and government efforts is essential as in certain disasters, assistance from the state or centre can be crucial in recovery. Supply flexibility and contingency planning have proven to have a favorable impact on a firm's

ability to respond to unforeseen disruptions in a manner that minimizes overall risk exposure (Fawcett et al., 1996 and Yin et al., 2017).

2.4.5 Strategic Sourcing Risk Management Barriers

Barriers or resisting forces for SSRM implementation can be classified into four categories, namely, Cost focus, Ad-hoc or poor planning, Data security/ privy breaches and Hard visualisation of SSRM benefits (Ho, 2015).

Lack of pre-assigned roles and responsibilities result in creation of chaos. Deployment of the resources of the firm, across the supply network, with disaster, recovery planning and proper alignment helps in enhancing driving capabilities with matched organisational processes (Day, 1994). Physical, technological, informational resources must be collected, cleared, moved, opened and governed. A web of immense confusion is created by inter-connected features which are of great assistance such as intranet and extranets, electronic data interchange, video conferencing, global positioning system, and even private radio (Richey, 2010; Kim and Chai, 2017).

However, instead of improvement in the overall performance and the whole supply network performance metrics, cost focus leads to conflicts among other parameters. Performance metrics are the most crucial aspect and hence form the basis of integrated work management systems. Lack of appropriate performance metrics is one of the biggest barriers for supply network alignment (Fawcett and Magnan, 2001).

Ad-hoc or poor planning imposes a lot of impedance in strategic sourcing for it is a complex matrix of numerous inter-dependent operations juxtaposed into each other (Golini and Kalchschmidt, 2015). Risk and reward sharing are vital for collaboration among the source partners and inadequate information sharing or even data security breaches may result in behaviours that lead to a breakdown in the collaboration efforts. Information systems and technologies have the potential to coordinate and integrate the activities across the supply process along with the associated risks of the data breaches, un-intentional or otherwise (Tupa et al., 2017). Internet enables companies to get real time data, which improves the performance of the entire supply operations, and it has been proven that the internet can have significant impact on the management of the strategic sourcing risks and improvement in the competitiveness of firms. With the advent of web-technologies, source risk management will focus on helping decision makers in better managing source partner relationships, efficiently

integrate internal processes and collaborate in real time with trading partners. The level of collaborative risk management depends also on partner's technological capability (Kwan, 1999). **Inadequate** information technology infrastructure implementation and data security has become the major concern for supply process managers (Arena et al., 2017).

Both the SSRM enablers and barrier factors are dynamic and together affect the company's competitive advantage. This research bridges this research gap by developing a force field analysis of these factors in the Indian automobile industry context to evolve an effective SS model.

2.4.6 Risk Mitigation

However, there is still a limited understanding about how supply risks should be assessed, when making global sourcing decisions and how they are mitigated once global sourcing is in place. Risk affects the true cost of business. Manager's use landed cost models or true cost of ownership models for assessing global sourcing decisions, but they do underestimate risks aspect in analyzing these decisions. Sourcing literature is lacking on models that combine cost and risk factors in a dynamic fashion. Both factors are dynamic and together affect the sourcing decisions. This research bridges this research gap by developing a model, that will combine the costs and risks (that is also known as soft cost or hidden costs) and will represent the true cost of business in long term.

Researchers have reported empirical and conceptual studies on SSRM but still companies have limited understanding how supply network risks affect the global sourcing decisions (Attren and Attren, 2018). Despite the increased importance, the cost models at hand for evaluating global sourcing decisions for specific parts or part families still do not provide managers with a tool for the holistic cost and risk assessment of operational sourcing decisions in a global context. In this research study, we provide a logical extension of TCO models and factored risk dimension into sourcing decisions. Methodology for quantification of all cost and risk factors in sourcing decisions had been provided. These factors can be monitored over time so that manager can make informed decisions about right suppliers and assess suppliers on these dimensions.

The recent review by Snyder et al. (2012) includes a thorough survey of routine sourcing research. One major theme is that cost trumps reliability when selecting suppliers (Rehmaan et al., 2018). Specifically, several works considering a single firm that must procure from unreliable suppliers show that an order may be placed with a particular supplier only if orders are also placed from all suppliers that are cheaper than supplier. Moreover, the majority of works find diversification to be an important component of an effective strategy for mitigating supply risk. Aside from selecting suppliers, many works focus on the problem of allocating orders among a set of selected suppliers. Kostamis et al. (2009) show that when ordering from one reliable supplier and one unreliable supplier, the total order quantity decision and the allocation of the order to the two suppliers may be addressed independently. Several works in the Operations Research literature consider the role of in-house production in the optimal sourcing strategy for a manufacturing firm. Many of these works focus on setting prices and determining contracts with external supplier when the capacity for in-house production is insufficient to satisfy all demand or demand is uncertain. The literature mentions that a manufacturing firm uses in-house production to satisfy demand requirements up to a threshold defined by relevant cost parameters with any arising demand fluctuations being satisfied using contingent sources of supply. Finally, the manufacturer may reduce their disruption risk by sourcing from the higher cost, but perfectly reliable, supplier (Wagner, 2011).

Location is a key feature that sourcing managers must consider when establishing strategic sourcing strategies. More importantly, managing global supply network makes the managers consider various factors such as exchange rate, different culture and economic environments and so on (Vining and Goberman, 2017). Thus, decision making regarding facility location is an important factor, as it is a risk mitigating factor regarding supply disruption in global supply network management (Mangan et al., 2016; Singh et al., 2018).

Researchers had developed decision models for supplier selection problem (Smytka and Clemens, 1993; Lowson, 2003; Liu and Hai, 2005). As cost is the major motivation for sourcing, so total cost models have been developed. In off shoring decision, managers calculate landed cost and analyze different alternatives based on laded costs. Landed cost models for vendor selection have been evaluated by (Degraeve et al., 2000). Young et al. (2009) commented that landed cost modules are not adequate to capture all cost in off shoring and illustrated important criteria like price, quality, flexibility, delivery reliability etc. Carr and Ittner (1992) investigated total cost of ownership and attempted to develop conceptual models

that embraced all relevant costs beginning with the identification of demand and ending with the ultimate disposition of a spent asset. Optimization cost models are used to find optimal cost solution (Black et al., 2017). For example linear programming algorithms may be used to find results such as total supply cost, how much components should be purchased from given suppliers by establishing appropriate objective function. Scenario based TCO models have been developed by Hammami et al. (2014). Similarly nonlinear programs may be used to determine supplier selection strategy to serve global manufacturing sites where lead time, distance, and purchase quantity all drives in determining total costs (Bertimas and Freund, 2008). Cost optimization models may be used for model development for multiple supplier locations and multiple manufacturing sites with given constraints. In this research, main purpose is to consider risks and costs to make strategic sourcing decisions based on relevant criteria.

There are a few models that capture all types of costs in sourcing decisions. Holweg et al. (2011) provided an analytical model for global sourcing decision that captures only static and dynamic factors. Some of the papers (Araz and Ozkarahan, 2007; Bevilacqua, et al., 2006; Cheng and Cheu, 2018) highlighted risk factors in sourcing decisions and have provided mitigation plans for risks involved in sourcing. Companies struggle to find a true cost of sourcing decision. Robust supply chain risk mitigation strategies in pioneering companies that have been in literature are presented and important ones are listed hereafter:

- **Postponement**: It entails delay product differentiation using product or process design concept like standardization, modularization, commonality and operational reversal. This strategy has been pioneered by HP, Benetton and Asian Paints (Feitzinger and Lee, 1997; Aviv and Federgruen, 1999).
- **Strategic Stock**: The strategy ensures that instead of carrying safety stock some inventories are stored at strategic locations, which are shared amongst multiple partners. It has been adopted and developed by Toyota and Sears (Kevin, 2006).
- **Flexible Supply Base**: It involves using more suppliers and moving production volumes among the chosen suppliers. Developed by HP (Billington and Jhonson, 2002).
- **Make and Buy**: This is one of the most common strategy adopted, wherein the outsourcing of some of the production is resorted to. Zara has been the pioneer of the same (Ghemawat, 2003).

- **Flexible Transportation**: Adopting the transport facility using multimodal transportation, multi carrier and multiple routes. It has been developed by Seven Eleven Japan (Lee, 2004).
- **Revenue Management via Dynamic Pricing and Promotion**: The selling price is dynamically adjusted to meet uncertain demand with limited capacity. It has been adopted and developed by American Airline (Talluri and Ryzin, 2014).
- **Assortment Planning**: It can be used in set of products on display, manipulating customer choice and it has been pioneered by Supermarket (Chong et al., 2001).
- **Economic Incentives**: Align incentives for risk sharing (Narayanan and Raman, 2004).
- **Real Options**: It can be employed where multiple suppliers and plants are to be considered. Automobile industry has been the pioneer of the same (Shah and Sinha, 2013).

SSRM strategies may be broadly grouped in two major categories: Proactive Strategies and Coping Strategies. Proactive strategies are decisions and activities that are aimed towards reducing the probability of disruptions. Proactive strategies are implemented prior to occurrence of the risky events in supply chain. These include avoidance, security and supplier development, control strategy and supply network integration. Coping strategies provide a capability to supply chains to mitigate the effects of a disruption. These strategies are built on principle of recovery in supply chain, which provide options that can allow a company to offset the losses in a part of a supply chain by gains from available alternatives (options).These include flexibility (external flexibility and internal flexibility), redundant resources, risk pooling strategies (including demand management strategies). A robust decision framework for supplier identification has been developed for strategic sourcing decisions by combining cost factors and risks factors as part of this research to act as a SS risk mitigation strategy in the Indian automobile context.

2.5 Research Gaps in Strategic Sourcing Risk Management (SSRM)

The knowledge gaps arise from the limited use of quantitative or mixed-method research approaches. Despite the recognition of many theories as relevant, the research is limited to the application of theory in a business environment. Besides Procurement Maturity

Models, Holweg et al. (2011) provided an analytical model for global sourcing decision that captures only static and dynamic factors. Kraljic (1983) provided a 'Portfolio Purchasing Model' with an aim of assessing risk and monitoring profits. Because of there being a limited number of models that capture all types of costs in sourcing decisions, companies struggle to obtain the value of the true cost of sourcing decisions (Mital et al., 2017). Thus, a decision framework needs to be developed for bridging the gap between strategic sourcing decisions and risks factors.

Although there has been remarkable academic progress in the field of risk management, empirical research within this field is still in its early stages. There is a need for empirical research that analyses the main risks (Thun and Hoenig, 2011; Lavastre, Gunasekaran, and Spalanzani, 2012; Vining and Goberman, 2017). Risk management shall be a vital facet of strategic sourcing in any industry, especially the manufacturing industries. Consequently, industry specific research assumes importance. Ericsson risk management model (Norrman and Johnson, 2004), developed after a fire at its sub-supplier is one of the most discussed cases in the risk management literature. Risk management has also touched the automotive, telecommunication, semiconductors, machinery and machine tools, metal industry, and other sectors in few studies of the developed nations, though very limited literature exists on the subject with respect to developing nations, including India.

The automotive industry has been a motivating arena for research in risk management (Grötsch, Blome and Schleper, 2013; Sharma, 2016); however, the few empirical findings reveal that risk management practices within this industry are still in their infancy (Blos et al., 2009; Thun and Hoenig, 2011; Pandey and Sharma, 2017). Strategic sourcing risk management from the Indian prospective is lacking in the automobile sector, since the scope straddles almost the complete industrial space from textile to steel to petro-chemical. An effort towards addressing the gap is required; though the available literature is scarce on the topic.

The identification of risks and sources thereof can be viewed as the trigger for risk management (Kern et al., 2012; Seck et al., 2015). Attempts to develop a risk profile to include risk sources and risk drivers for this industry, that could serve as a guide for practitioners of strategic sourcing, to start the risk management process are needed. Lack of availability of data for undertaking risk management in the automotive industry today, in spite of awareness, is identified as a considerable gap (Sharma, 2016). This gap can be addressed through employment of secondary sources and suitable techniques. Hence, the aim of this research is to

bring to light the areas which still remain unresolved, develop measures which improve the success factors for risk assessment and management in strategic sourcing of automobile industry and bridge the gap between risk management frameworks and evolved procurement models (Lorentz et al., 2013). The existing knowledge gaps brought out by literature review provide the fundamental basis, guidance and rationality for this research project.