

**Impact of Quality Management and Process Integration on Supply Chain  
Performance in Indian Automotive Industry**

**Thesis**

**Submitted in partial fulfillment of the  
requirement for the award of the degree of  
Doctor of Philosophy**



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## CERTIFICATE

This is certified that **Mr. Gaurav Goyal, Regn. No. 950913013**, has completed his Ph.D. thesis titled **"Impact of Quality Management and Process Integration on Supply Chain Performance in Indian Automotive Industry"** under our supervision. This Ph.D. thesis is an authentic research carried out by him and it is being submitted to **Lalit Mohan Thapar School of Management, Thapar Institute of Engineering and Technology, Patiala**, for the award of a degree of **Doctor of Philosophy (Ph.D.)**. To the best of our knowledge, the research work presented in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.



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## DECLARATION

I hereby certify that the research work presented in this thesis entitled "**Impact of Quality Management and Process Integration on Supply Chain Performance in Indian Automotive Industry**" for award of degree of Doctor of Philosophy submitted to the Lalit Mohan Thapar School of Management of Thapar Institute of Engineering and Technology, Patiala, is an authentic record of my own work carried out under the supervision of Dr. Harsh Vardhan Samalia, Associate Professor at Rajiv Gandhi Indian Institute of Management, Shillong and Dr. Piyush Verma, Associate Professor at Lalit Mohan Thapar School of Management, Thapar Institute of Engineering and Technology, Patiala. Any material previously published or written by another author or person in the text is well acknowledged and referenced in my thesis.



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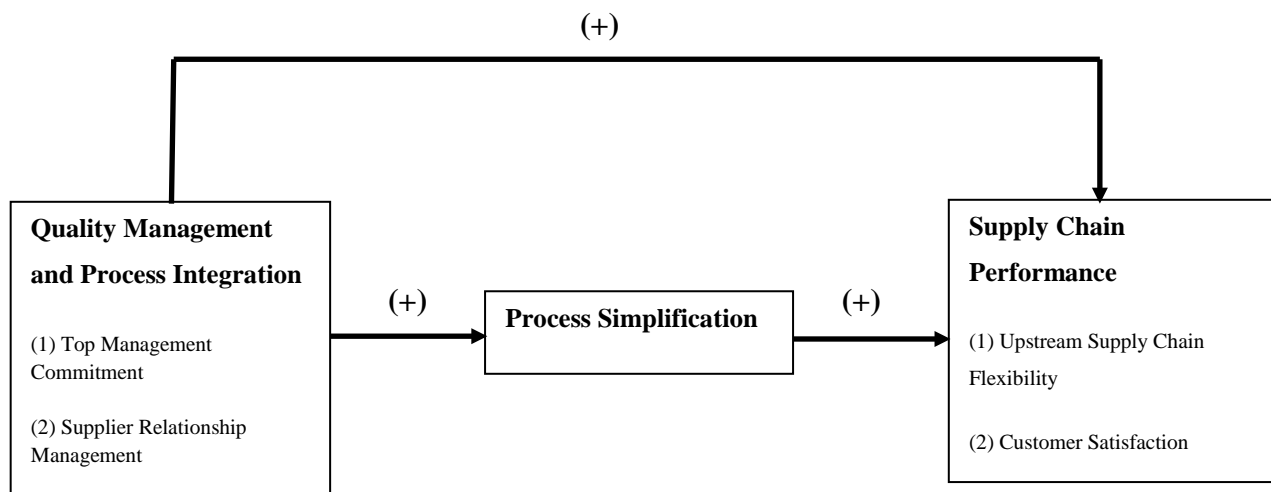
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## ABSTRACT

Focus of this thesis is to empirically validate the impact of quality management and process integration on supply chain performance with reference to Indian automotive industry. Extensive literature review and citation analysis helped in identification of top management commitment and supplier relationship management as vital quality management and process integration constructs that impact the supply chain performance (upstream supply chain flexibility and customer satisfaction) of automotive organizations. Moreover, research gap emphasizes that process simplification has a mediating impact on the relationship between quality management and process integration constructs, and supply chain performance. Research gap helped in formulation of the hypothesized relationships as well as the conceptual framework (presented below).



The conceptual framework highlights that simplified processes mediates the impact of quality management and process integration (top management commitment and supplier relationship management) on supply chain performance (upstream supply chain flexibility and customer satisfaction) issues of automotive organizations. Both researchers and corporate executives alike have focused on fact that integrated and then simplified upstream supply chain processes lead to removal of redundant manufacturing processes, reduction in complexity of the process and an increase in manufacturing responsiveness. Therefore, there is a requirement to blend quality management and process integration for improving the supply chain performance of organizations.

A research instrument was prepared based on the valuable feedback from industry and academia. This process helped to ensure comprehensiveness, clarity, face validity and readability of the scale. Snowball sampling methodology was used to collect data from automotive organizations on a five point Likert Scale (Strongly Disagree - Strongly Agree). PROWESS database was used to calculate the average financial standalones of the selected firms from 2012 to 2015. Results confirmed that substantial automotive market is captured to represent Indian automotive sector.

Correlation analysis resulted in statistically validating interrelationships between the study constructs. Confirmatory factor analysis was performed on the sample size of eighty as per HOELTER's criterion and the good of fit summary confirms the measurement model as good fit. At last, structural equation modeling is executed on the measurement model to confirm direct and indirect effects of measured and latent variables. Results confirmed the mediating impact of process simplification in all relationships except on the relationship between top management commitment and upstream supply chain flexibility. The mediating impact clearly highlights that Indian automotive units must have a strategic focus towards simplifying the upstream integrated quality processes to improve the upstream supply chain flexibility and customer satisfaction issues. The simplified upstream integrated quality processes may enable Indian automotive units to gain competitive advantage by capturing substantial market.

Managerial implications of this research gives strategic directions to top level managers of automotive organizational on how to improve the automotive supply chain performance. Whereas, theoretical contributions guides future researchers with new aspects in theory for improving the upstream supply chain flexibility and customer satisfaction issues.

Vital contribution of this thesis to literature is that a unique validated measurement model is proposed that caters the mediating impact of process simplification on the relationships between quality management and process integration constructs, and supply chain performance.

## ORGANIZATION OF THESIS

The chapters of the thesis are organized as follows:

Chapter I Introduction: Discussion on supply chain, supply chain management, quality management and process integration role in supply chain management, and importance of automotive industry in India is presented in this chapter.

Chapter II Literature Review: Vital quality management and process integration constructs are extracted from the literature. Citation analysis is performed to support the extracted constructs from the literature. Research gap helped proposing the conceptual framework of this thesis.

Chapter III Research Design and Methodology: Primary and secondary objectives of the study are discussed in detail. Hypotheses are developed among the constructs of interest and research framework is formulated. Collection of primary and secondary data is discussed in detail. This chapter ends with discussion on type of statistical techniques to be used for validating data

Chapter IV Analysis and Results: This chapter starts with elaborating the profile of respondents and organizations. The measurement scale's reliability and validity is computed to ensure that the scale is ready for analysis. At last, correlation, confirmatory factor analysis (CFA) and structural equation modeling (SEM) is carried out to validate hypothesized relationships and research framework.

Chapter V Discussion and Implications: This chapter concentrates on discussion of managerial implications and theoretical contributions of the thesis.

Chapter VI Conclusion and Future Scope: Strategic directions for automotive managers and future research directions for researchers are suggested in this chapter.

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## CHAPTER I - INTRODUCTION

Manufacturing organizations are working rigorously to survive in the competitive market. Customers are demanding higher quality product at lowest price, making it critical for manufacturing organizations to concentrate on improving quality as well as reducing internal cost of production. Quality in manufacturing is considered to be a measure of a state that is free from defects, deficiencies and significant variations. Leading firms are using various quality management practices for manufacturing defect free product. Few prominent quality management practices being used by industry covers total quality management (TQM), benchmarking, six-sigma, ISO quality series, quality circles and quality function deployment (QFD). These quality management practices not only help organizations to improve quality of the product but also help in reducing internal cost of production.

It has been noticed by researchers that quality has become as one of the important order qualifying criterion for many organizations and supply chain partners are under acute pressure to use quality management for improving quality of finished product (Bandyopadhyay & Sprague, 2003; Kuei *et al.*, 2005; Talib *et al.*, 2011). Small firms follow leading organizational policies and procedures for improving quality and this result in firstly qualifying and then winning the order. Overall, quality management practices result in producing finer quality product by lowering production costs and helping organizations in achieving superior competitive positioning in the market.

Manufacturing of a finished product requires support of many external organizations for production and assembly. Processes of these organizations must be integrated so that desired quality is achieved by chain of organizations at minimum cost. Prominent role of information technology in integrating the processes and in implementation of quality management is considered vital by researchers and industry practitioners (alike) (Beamon, 1998; Chen *et al.*, 2009; Becker, 2015).

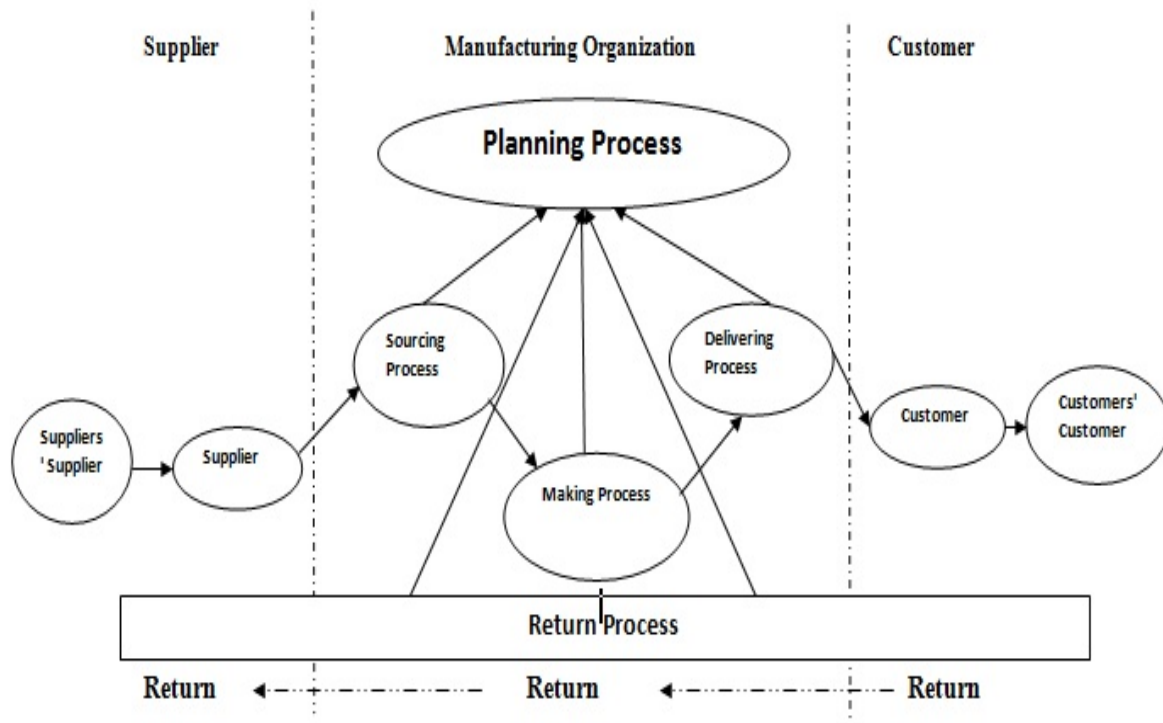
Technological advancements have lead to existing global grid driven by a crucial factor: information. Organizations can enhance communication by enhancing the use of information technology. Prominent manufacturing firms through use of informatics take leverage of various marketing platforms covering dedicated emails, websites and social networks. Small

businesses expand their market share through affordable advertising by leveraging the power of technology. Market forces have put forth global competition on chain of organizations to work towards improving quality and integration of inter-organizational processes. As businesses are virtually inter-linked therefore, it becomes imperative to concentrate on improving quality and integration among processes of the chain of organizations (supply chain) instead of the individual organization.

### ***1.1 Supply Chain***

Several independent firms are manufacturing materials and components and are passing them to various other agencies. In the current competitive environment, there is a need to link independent companies manufacturing and assembling raw material and sub-components of same product. Typically, supply chain comprises of raw material and component producers, product assemblers, wholesalers, retail merchants and transportation companies (La Londe & Masters, 1994). In the existing competitive market, it is impossible to imagine a successful organization without an efficient supply chain. Supply chain involves a system of organizations, workforce, process activities, information flow and resources involved in moving a product or service from upstream (suppliers) to downstream (retailers and distributors) and finally to the ultimate customer. In other words, we can define supply chain as a network of organizations that are involved, through upstream and downstream linkages, in different processes and activities to produce value in the form of products and services in the hands of ultimate consumer (Christopher, 1992). Supply chain involves linking these different firms for manufacturing the same product so that finished product can reach ultimate customer in a cost-effective manner.

From the viewpoint of producer of consumer product and services, supply chain processes can be classified as planning, sourcing, making, delivering, and returning (Chase *et al.*, 2014). The supply chain processes are presented in Figure 1.



**Figure 1: Supply chain processes (Source: Chase *et al.*, 2014)**

a) **Planning Process:** In this process, it is strategically required to manage existing supply chain by ensuring that available resources results in fulfillment of estimated demand. Major facet of this process is to develop a set of metrics for monitoring supply chain so that it is efficient to source, manufacture and deliver a high-quality product or service to ultimate customer. Developed metrics must be efficient to ensure a smooth return of material from customer to manufacturing organization and finally to suppliers.

b) **Sourcing Process:** This process involves selection of upstream supply chain partners (suppliers) for manufacturing and delivering the required goods and services. Relationships among the partners are scrutinized and improvised by clubbing of pricing, delivery and payment processes. Sequence of the processes involved covers receiving the shipment, verifying of the shipment, transferring of the verified shipment to manufacturing setup and at last approving supplier's payment.

c) **Making Process:** Required product is manufactured and its associated services are provided by this process. Steps required for manufacturing the desired product or service

include scheduling workforce processes, and coordination of material flow and other critical resources (equipment). For monitoring efficiency of these processes, a metrics is being used that measures speed, quality and worker productivity.

d) **Delivering Process:** Referred as logistics process and covers various processes like picking of carriers to move finished product from warehouse to customers, coordination and scheduling of movement of goods and information, developing and operating network of organization, running of information system for managing receipt of orders, and invoicing systems for collecting payments.

e) **Returning Process:** As product moves through chain of organizations, there is a chance of worn-outs, defects and excess order delivery. These problems can be taken care of by providing customers with after-sale support.

Supply chain is considered to be an integral part of any organization, as it directly impacts firm performance. Considering this fact, supply chain had been redefined as a network of agencies wherein numerous enterprises collaborate along the entire value chain to apply all modern concepts and technologies to make supply chains agile, responsive, flexible, robust, sustainable, cost-effective, and competitive. Hence, it becomes imperative for organizational survival to work harder in order to improve their supply chain in the cut-throat competition (Whipple & Frankel, 2000).

In today's competitive environment, supply chain has become the backbone of every business. Supply chain is used in almost every field of business; retail, manufacturing, textile, medical, construction industry, etc. In 2002, one of the leading retail store Wal-Mart achieved leadership status because of its efficient supply chain management practices (Chandran & Gupta, 2003). Nowadays, a lot of management awards; supply chain distinction awards, supply chain innovation awards and supply chain excellence awards are granted for having an efficient, competitive and better supply chain. Influential organizations from almost all sectors of business namely automobile, manufacturing, retail and textile are taking part in the management awards. Groups winning these awards are becoming benchmark for the other agencies in their respective businesses. Looking at this scenario, it becomes critical for every organization to emphasize on supply chain management.

## *1.2 Supply Chain Management*

Supply chain management (SCM) is mainly responsible for planning and controlling of material and information flow among supply chain partners. Therefore, it has become imperative for organizations to manage quality flow of materials and information by considering supply chain as a single entity (Ellram & Cooper, 1990). Organization(s) are encouraged to ensure that supply chain management takes a systems approach of viewing supply chain as a single entity, rather than a set of fragmented parts where each part perform its function (Ellram & Cooper, 1990).

Supply chain processes that every business needs to focus includes customer relationship management, supplier relationship management, customer service management, demand management, product development and commercialization, order fulfillment, manufacturing flow management and return's management (Lambert, 2004) and are presented in Figure 2. Figure 2 highlights that material flows to manufacturing organization through chain of suppliers by means of the purchasing department. Purchased material is then manufactured and assembled to a finished product in the manufacturing setup of the plant. Finished product after its quality check is moved to the retailers with the help of logistics. Through various distribution centers, it is then sold to the ultimate customer. It can be noticed from Figure 2 that information flow is managed throughout the supply chain. For a better understanding of these processes, they are being explained as below:

a) **Customer Relationship Management:** Firm's business mission makes it mandatory for the management to identify and target important customers or customer groups. This is specifically done to ensure that the goal to segment customers based on value to be delivered over a period of time is achieved. Cross-functional teams work along with key customers to improve processes for eliminating demand variability and non-value added activities. Performance reports of organizations are designed to measure value delivered to individuals or groups of customer along with the financial impact on customer.

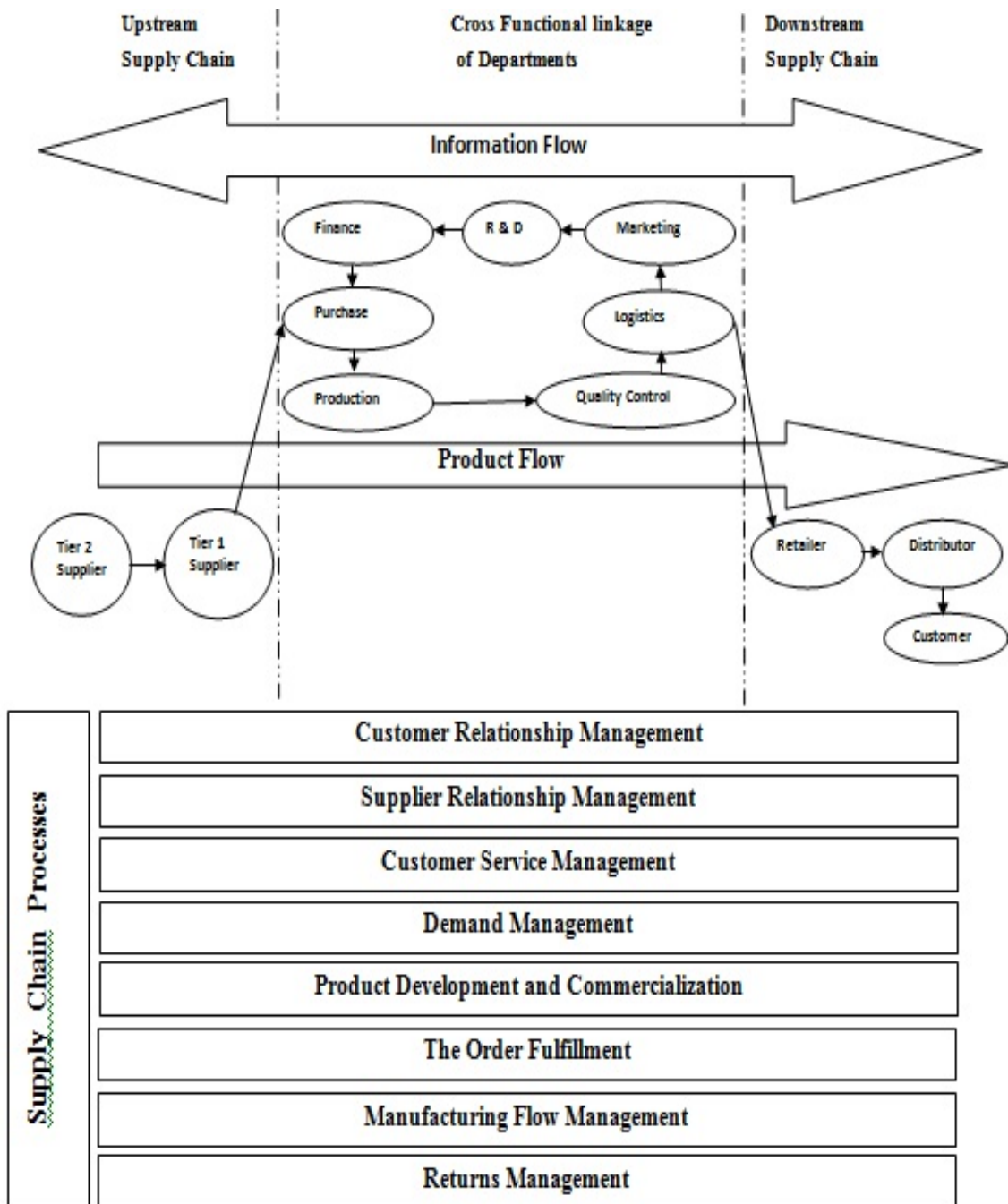


Figure 2: Processes involved in the supply chain management (Source: Lambert, 2004)

b) **Supplier Relationship Management:** Primary emphasis of this process is to concentrate on how a firm interacts with its suppliers. Organization must maintain a healthy relationship from the beginning (supplier) till the end of supply chain (customer). As per company's

strategy, firms maintain close relationships with few suppliers and manage arm-length relationship with the remaining. Product and Service Agreement (PSA) is negotiated with suppliers that define the length of relationship. By doing so, organizations will be in a position to integrate their supplier processes and improve quality of the product. Hence, enables suppliers to obtain long-term orders. The overall outcome is a win-win relationship between organizations and its suppliers.

c) **Customer Service Management:** This process represents firm's image in eyes of customer. Real time information pertaining promised shipping dates and product availability must be available to service providers so that they can satisfy customer's query. Information on product usage and its repair must be available to the service providers so that they can facilitate customers. Overall process deals with key point of contact for administering PSA.

d) **Demand Management:** This process aims to bridge the gap between customers' quantity requirements and supply chain production capabilities. Organizational management must ensure that they have the right process in place so that they proactively match supply with demand. By doing so, the management ensures that production plan is executed with minimal disruptions and results in increasing manufacturing flexibility as well as demand variability. In short firm's demand management process enables it to be more proactive to anticipated demand and more reactive to unanticipated demand. This will help organizations to improve their demand management system.

e) **Product Development and Commercialization:** The process provides structure to market the manufactured product by developing and launching it jointly with customers and suppliers. This process team must synchronize with customer relationship management team for identifying expressed and unexpressed customer needs. The process team requires selecting material and supplier in conjunction with supplier relationship management process. At last, process team must develop production technology for integrating and manufacturing best supply chain flow that is suitable for product/market combination.

f) **The Order Fulfillment:** Activities involved in this process intend to define customer requirements for designing a supply chain network and its related process. Developed system and process permit a firm to meet customer requests by minimizing total delivered cost. This

process is required to be implemented cross-functionally by maintaining coordination between vital suppliers and customers. Overall objective of this process is to develop a flawless process for product flow which starts from supplier and ends at various customer segments.

g) **Manufacturing Flow Management:** This process includes all essential activities for obtaining, implementing and managing manufacturing flexibility in supply chain system. Flexibility is the ability to change or react within a limited period of time, effort and cost (Upton, 1994). Whereas, manufacturing flexibility reveals the capacity to manufacture product variety promptly at minimal cost (Slack, 1987). The organizations can achieve the desired level of manufacturing flexibility by planning and executing beyond their organizational boundaries. Organizations must integrate their processes extensively with their supply chain partners to improve flexibility of supply chain system. By doing so, they will be in a position to improve quality of product.

h) **Returns Management:** The process manages supply chain activities associated with returns, reverse logistics, gatekeeping and avoidance within the firm, and across relevant members of supply chain. With effective implementation of this process, organizations will be in a position to manage the reverse product flow efficiently, identify opportunities to reduce unwanted returns and control reusable assets. Effective returns management enables firms with a chance to achieve sustainable competitive advantage.

To remain profitable in the competitive environment, organizations are required to manage their supply chain so that processes can give maximum output. Supply chain management can be seen in a way to improve competitive performance by combining the internal functions of a company and linking them with external operations of suppliers, customers and other chain members so that processes can give maximum output (Tutuncu & Kucukusta, 2008). Combining internal functions and external operations will make supply chain more productive and will help organizations to earn maximum profit by reducing their cost of production. With changing time, it has been recommended that supply chain management instead of combining must concentrate on integrating their supply chain processes. Supply chain management seeks to enhance competitive performance by tightly integrating internal functions within a company and effectively linking them with external operations of

suppliers, customers, and other channel members (Talib *et al.*, 2011). Integration of supply chain processes gives organizations an opportunity to manufacture a quality product.

Supply chain management was earlier used to be considered merely as an upstream and downstream linkage of organizations (Christopher, 1992). With changing time, supply chain management had guided a way to an approach where it creates value through collaboration and integration of various business processes in an organization and with its supply chain partners (Lee *et al.*, 2003). One of the primary concerns this approach has brought forward for experts in this domain is that of ensuring quality throughout supply chain network. Improving quality of product in supply chain is critical as it will make sure that customer is getting the desired quality finished product. Large number of studies done in different parts of the world covering Asia (Mehta, 2004; Kuei *et al.*, 2005; Lo *et al.*, 2007; Arauz *et al.*, 2009; Ou *et al.*, 2010), United States (Bandyopadhyay & Sprague, 2003) and Europe (Romano, 2002) depicts that management emphasis is now shifting from focusing on supply chain to understand supply chain's linkages with quality management practices followed by organizations (Talib *et al.*, 2011). As a result, the relationship between supply chain management and quality management has been acknowledged in literature by various researchers (Kuei *et al.*, 2008; Talib *et al.*, 2011).

Earlier supply chain managers were primarily responsible for placing orders and managing flow of orders and information with immediate suppliers. With changing market dynamics, supply chain managers have become incumbent to improve organizational processes covering improved customer service, enhanced continuity of supply, reduced exposure of firm to unanticipated risks, improved new product design process, reduced environmental waste, improved environmental performance, and contributed towards enhanced product and service quality (Melnik *et al.*, 2009). The improved organizational processes help managers in this area to get better quality of product and integrate their various supply chain processes.

### ***1.3 Quality Management***

Quality can be defined as meeting or exceeding customer expectations (Evans & Lindsay, 2002). Quality has a significant influence in the business world since 1980's. Leading organizations started with the concept of quality by applying theories of quality gurus,

Deming and Juran. These quality gurus changed organization's viewpoint of quality and made them realize the importance of quality. According to these "Gurus" quality can be seen as customer's desires in one form or other. Until and unless organization doesn't fulfill desire of the customer, it becomes hard for them to survive in competitive market. Thus, organizations have to manage their quality standards by providing appropriate training to their employees. Training of employees will help them to learn new concept and enable them to apply these concepts in their organizations for improving organizational processes.

Customer expectations vary with respect to time, therefore organizations are required to ensure that variations regarding quality are rectified from the beginning of the supply chain, supplier's quality improvement. For maintaining a healthy relationship between supplier and customer, firms are rating quality as one of the most important factors. In fact, organizations are not able to participate in global sourcing due to their supplier's not meeting quality requirements (Brockwell, 2011). The above discussion clearly highlights that there exists a positive association between supply chain management and quality management.

Importance of linking quality management to supply chain management is increasing and has also become essential for the survival of organizations. Organizations are trying to implement quality in their supply chain so that they can achieve better results as quality management practices are associated with supply chain performance improvements and cumulative capabilities (Flynn & Flynn, 2005). Continual quality management improvement leads to reduction of defects and process variations. This will lead to consistency in supply chain improvement due to decrease in process variations and improvement in on-time delivery. Therefore, supply chain management and quality management when taken together results in achieving higher customer satisfaction and lower defect rate which in turn can make organizations more profitable. Supply chain quality management is a concept that helps firms in achieving and meeting requirements of the customer by linking external and internal operations of the organization. Kuei *et al.*, (2008) defined supply chain quality management using three simple equations and each equation represents a letter that makes up SCQM.

SC = A product distribution network,

Q = Meeting market demand correctly, and achieving customer satisfaction rapidly

M = Enabling conditions and enhancing trust for supply chain quality.

Important quality management practices such as value stream mapping, value analysis, six sigma, Kaizen, performance measurement, quality function deployment and re-engineering have proven and will continue to show that they can achieve best results during production, delivery and support. There are several issues in supply chain management that organizations must concentrate and they include developing a common costing approach, sharing data related to cost and quality, developing mutually beneficial methods and developing logistics and inventory management systems. Improving quality of supply chain processes leads to cost reductions, improved resource utilization and improvised process efficiency (Beanion & Ware, 1998).

Leading organizations are integrating supply chain management and quality management for qualifying order. Supply chain quality management helps organizations to achieve success by satisfying the customer quality needs as well as by integrating internal and external operations of organizations. Researchers working in the field of supply chain improvement suggested that supply chain quality management has become necessary for firms survival (Kanji & Wong, 1998; Lee *et al.*, 2003; Wang *et al.*, 2004; Yang *et al.*, 2007). As customer's demand for a higher quality product, therefore it has become essential for firms to check qualities of product from beginning of the supply chain. It is being noticed by researchers that as soon as quality standards of product are improved from beginning of the process, final product is of higher quality and customer is highly satisfied (Talib *et al.*, 2011; Vlachos & Bourlakis, 2006; Rodriguez *et al.*, 2004; Wang *et al.*, 2004; Lee *et al.*, 2003). Emphasized has also been given for integrating processes of supply chain partners for improving quality of the product. The focus on improving quality of product and supply chain system involves organizational concentration on supply chain process integration.

#### ***1.4 Process Integration***

A process may be defined as a series of actions or steps taken in order to achieve a particular goal. All businesses need to focus on series of processes for manufacturing their product or

for creation of relevant service. A business process is referred to as a structured and measured set of activities with specified business outcomes for customers (Davenport & Beers, 1995). All organizations require these business processes to be managed for enhancing organizational profitability. Therefore, Zairi (1997) defined business process management as: "a structured approach to analyzing and continually improve fundamental activities such as manufacturing, marketing, communications and the other main elements of the company's operations". Organizations are following a process approach to focus on every process that meets customer's requirements through efficient management of operations. Product flows through a chain of organizations (supply chain) for its manufacturing, packaging and finally delivery. Hence, it becomes imperative to manage flow through the chain of organizations by concentrating on integrating processes of supply chain partners. Research of Hammer (2001) pointed out that the real "gold" can be found by integrating business processes across firms in the supply chain. Wadhwa *et al.* (2010) emphasizes that supply chain management aims at creating value in product through collaboration and integration of supply chain business processes.

It is paramount to differentiate between integrate and integration for a better understanding of the concepts. As per the Merriam-Webster Dictionary (2016), integrate means "to form, coordinate, or blend into a functioning or unified whole," and integration is "the act or process or an instance of integrating." Integration highlights on the fact that various organizations act as a single entity and take deliberate steps to achieve objectives through collaboration, commitment and coordination. The importance of integration in supply chain management has been extensively recognized and is explicitly indicated by various supply chain management definitions. Supply chain management can be defined as the integration of the major business processes from end users through original suppliers that provides products, services and information that add value for customers and other stakeholders (Copper *et al.*, 1997). Council of Supply Chain Management Professionals (CSCMP) defined supply chain integration as the integration of supply and demand management within and across companies. Wadhwa *et al.* (2010) suggests that supply chain management aims at creating value in the product through collaboration and integration of the SC business processes. Influence of supply chain process integration on competitive performance is highlighted in the study of Talib *et al.*, (2011). They defined supply chain management as an

approach to improve competitive performance by integrating the internal functions of an organization and linking these with the external operations of suppliers, customers and other members of the supply chain.

### ***1.5 Quality Management and Process Integration in Supply Chain Management***

Supply chain quality management is a concept that helps firm in achieving and meeting customer requirements by linking internal and external operations (Kuei *et al.*, 2005; Kuei *et al.*, 2008). Varied customer expectations have forced organizations to ensure that variations in quality requirements are rectified from beginning of the supply chain that is concentrating on supplier quality improvements. Moreover, researchers have recommended that organizations that concentrate largely on process-based performance must focus on upstream practices as compared to downstream practices of the supply chain (Guide & Wassenhove, 2001; Vachon & Klassen, 2008). Organizations are trying to implement quality in their upstream supply chain so that they can achieve better results (Flynn & Flynn, 2005). Continual quality improvement of upstream supply chain partners leads to a reduction of defects and process variations. This will lead to consistency in supply chain improvement due to a decrease in process variations and improvement in on-time delivery. Improving quality of supply chain processes leads to cost reductions, improved resource utilization and improvised process efficiency (Beanion & Ware, 1998). Researchers working in the field of supply chain improvement suggests that amalgamation of quality management and process integration has become necessary for firms survival (Kanji & Wong, 1998; Lee *et al.*, 2003; Wang *et al.*, 2004; Yang *et al.*, 2007). Thus, focus on improving quality of product in the supply chain system involves organizational concentration on process integration.

Premature research on integration focused mainly on make-or-buy decision using a Transaction Cost Analysis (TCA) framework for determining low cost alternatives (Coase, 1937; Williamson, 1975). Nowadays, integration has evolved into a wider concept than determination of lowest cost option. Integration concentrates on firm's objective to achieve operational and strategic efficiencies through collaboration between its internal functions and supply chain partners (Rodrigues *et al.*, 2004; Stank *et al.*, 2001). In addition to cost benefits,

other benefits for organization include access to better technology, process improvements, joint capabilities, improved competitive positioning and risk/reward sharing (Bowersox *et al.*, 2003).

Most of the supply chain integration concepts recognize clearly the existence of two flows throughout the chain, one being the information and other being the material(s) (Power, 2005; Prajogo & Olhager, 2012). Manufacturing organizations expect the supply of high-quality material so that they can manufacture the requisite finer quality product for achieving customer delight (Kearney, 2013). This makes it quite critical for organizations to concentrate on continual improvement in their relationship with suppliers for quality flow of material and information and thereby achieving improved upstream supply chain flexibility (Flynn *et al.*, 2010; Gallear *et al.*, 2015). One of the mechanisms by which manufacturing organizations management can achieve higher customer delight is by integrating and then simplifying their processes with their upstream supply chain partners. Process simplification (PS) means removing duplication in business processes (Chen *et al.*, 2009). Organizations by simplifying their supplier processes fulfill the production requirements that involve timely delivery of quality raw material, semi-finished parts and in-process parts to their manufacturing setup (Chan *et al.*, 2009; Chand *et al.*, 2015). Researchers and corporate executives (alike) have focused on fact that integrated and then simplified upstream supply chain processes lead to removal of redundant manufacturing processes, reduction in complexity of the process, lowering of operational cost as well as an increase in manufacturing responsiveness (Hoole, 2005; HP, 2010; Chen *et al.*, 2009; Peng *et al.*, 2016; Weingarten *et al.*, 2016). Therefore, there is a requirement to blend quality management and process integration for improving the supply chain performance of organizations.

### ***1.6 Automotive Sector in India***

Globally, every human being wants to commute faster and automobiles provide them with machinery that fulfills this requirement. Motor vehicle industry is more than a century old and represents a major portion of the global market with respect to manufacturing. This sector is facing a lot of problems on varying customer expectations and market dynamics. Customers want to have a superior quality product at minimal cost and market dynamics is making it difficult for automotive organizations to manufacture the desired product. To deal

with this problem, global automotive organizations are rigorously concentrating on improving integration between upstream supply chain processes and quality of product for their survival in the intense competitive environment.

In global market, Asian countries are representing a dominant position in the manufacturing of automobiles with India ranked third after China and Japan (IBEF, 2016). Automotive industry contribution to India's gross domestic product has increased from 2.77 percent in 1992-93 to 7.1 in 2016 (DHI, 2017). Indian automobiles production increased at a compound annual growth rate of 9.4 percent over the financial years 2006-2016 (SIAM, 2016). Two-wheeler segment leads the Indian automotive sector by capturing 81 percent of the market share. This is followed by the passenger vehicle segment which captures 13 percent of the market share. The remaining 6 percent of the market share is shared between commercial vehicles and three wheelers (SIAM, 2016).

Shoeb & Maqbool (2017) has highlighted on the fact that in the financial year 2014-15, automobile exports grow by 15 percent. Shoeb & Maqbool (2017) also suggests that global automobile exports grew by 1.91 percent as compared to financial year 2014-15. This signifies that Indian automobile's acceptance is increasing in the international market. The IBEF report of 2016 also suggested that passenger vehicle, commercial vehicle and two wheelers have registered a growth of 5.24 percent, 16.97 percent and 0.97 percent respectively in April-March 2016 over April-March 2015.

The Indian government has taken quite a few initiatives to ensure that automotive sector turns out to be world leader by 2020. As per the Indian Brand Equity Foundation (IBEF) report of 2016 Indian government is taking following initiatives for growth of automotive sector:

- Indian government aims to make automobile manufacturing the main driver of "Make in India" initiative, as it expects the passenger vehicles market to triple to nine point four million units by 2026, as highlighted in the auto mission plan 2016-26.
- In the union budget of 2015-16, government has announced plans to provide a credit of Rs 850,000 crore (US\$127.5 billion) to farmers, which is expected to boost sales in the tractors segment.

To ensure that government is successful in their initiatives, automotive organizations must improve quality and integration of the manufactured product to deal with upstream supply chain flexibility and customer satisfaction issues. As per various industry reports, automotive industry must try to integrate its quality processes by having an emphasized focus on simplifying its upstream supply chain processes (like vehicle development and manufacturing cycle) for attaining competitive advantage (EY, 2015; Gutmann, 2015; Threlfall, 2016). It has also been reported that an emphasized focus on achieving an excellent balance between product technology orientation and consumer-centric service driven ideology is essential for attaining sustainable advantageous competitive positioning (Becker, 2015). Automotive sector is vitally important to Indian economy and increased emphasis on its improvement will contribute to growth of the country as a whole (CSO & MSPI, 2015).

Above discussion clearly highlights the need to amalgamate quality management and process integration for improving supply chain performance of automotive sector. Therefore, next chapter of this thesis concentrates on reviewing the existing supply chain literature for identifying vital constructs of quality management and process simplification. Citation analysis will be performed on the selected studies to support identification of vital constructs. At last, research gap will help in formulation of the conceptual framework.

## CHAPTER II - LITERATURE REVIEW

In the initial years of supply chain, researchers and practitioners (alike) had mainly investigated processes of supply chain alone (Anderson & Gerbing, 1991; Barney, 1995). With changing market dynamics, organizations had started focusing on performance, design and analysis of the whole supply chain (Beamon, 1998 & 1999). From an organizational viewpoint, supply chain concept arose with frequent changes in manufacturing environment that includes rising costs of production, shrinking resources of manufacturing bases, shortening of product life cycles and globalization of market economies (Beamon, 1998 & 1999). All these factors had forced organizations to think towards integrating their supply chain processes as well as improving quality of the product so that they can survive in the cut-throat competitive environment.

Supply chain has been traditionally characterized by a forward flow of materials and a backward flow of information (Beamon, 1998). As a result, most of the supply chain concepts primarily focus on two types of flows in the supply chain system - 'material' and 'information' (Li *et al.*, 2005; Lo *et al.*, 2007; Wu *et al.*, 2011). Forward and backward flows highlighted on the fact that processes were required to be integrated for producing quality product as per customer requirements. Organizations must manage these flows by integrating supply chain processes and applying quality management in their supply chain system so that they could deliver quality manufactured product on time to the ultimate user.

Looking at the importance of quality management and process integration in supply chain management it will be interesting to explore their impact on supply chain performance measures. This research is targeted in this direction and to capture on these aspects, literature review chapter elaborates on the aspects covering supply chain, supply chain management, quality management, process integration, citation analysis, process simplification, supply chain performance measures, linking quality management and process integration, and research gap.

## ***2.1 Supply Chain***

Supply chain is considered to be a paramount technique by which the companies could survive in the competitive global environment. It has attracted many researchers' attention in the last couple of decades and has been considered as an emerging area of research (Christopher, 1992; Flynn & Flynn, 2005; Talib *et al.*, 2011; Becker, 2015; Chand *et al.*, 2015). Origin of supply chain could be traced from the work of Forrester (1958), who tried to understand the product delivery system as a whole. With changing market economics, organizational focus shifted from product delivery system to improving quality and integration among supply chain processes (Beamon, 1999; Christopher & Towill, 2001; Romano, 2002; Boon-iit & Wong, 2011). A supply chain could be defined as an integrated process wherein various business entities covering suppliers, manufacturers, retailers and distributors work together for acquiring raw material, converting these raw materials into specified final products and at last delivering these manufactured products to retailers (Beamon, 1998). But with emerging market dynamics, supply chain that earlier used to be considered merely as an upstream and downstream linkage of organizations (Christopher, 1992; Beamon, 1998) had given way to an approach where it creates value through collaboration and integration of various business processes among the chain of organizations (Lee *et al.*, 2003; Chand *et al.*, 2015).

In the beginning of twentieth century, researchers had noticed that organizations were not considering on integrating product design and logistics networks. Therefore, organizations were facing issued related to cost reduction, appropriate energy usage and waste management among chain of organizations. The study of Krikke *et al.*, (2003) developed a quantitative supply chain model to support decision-making on aspects covering structure of product design; modularity, reparability and recyclability; and logistics design. The developed structural model was applied to a closed-loop supply chain design problem pertaining to refrigerators. The study concluded that supply chain network structure had an impact on costs, whereas product design impacted energy and waste. Another vital contribution of the combined model of supply chain network structure and product design results is that it reduces cost, energy usage and waste.

In another study on improvements in product design, Schaller (2008) proposed a mathematical model to integrate design of cellular manufacturing system with design of a production network of supply chain system. Heuristic procedures were used to generate solutions for varied test problems successfully. This mathematical model was useful to reduce cost of production in a cellular manufacturing system and hence helped organizations in improving their profit margins. Further, study of Noori & Georgescu (2008) proposed a framework to enable applications of supply chain structure design early in the new product introduction process. This study used three links covering architecture link, technology link and focus link to connect gaps between product design, process design and supply chain design. Authors used a case study approach in the Northern American auto industry and proposed integrative strategies to deal with situations resulting from varied combinations of new product patterns and supply chain types. These strategies would enable organizational supply chain to deal with varied customer specifications at a very early stage of supply chain.

Supply chain design strategies for specific type of perishable products covering melons and sweet corns was proposed by Blackburn & Scudder (2009). Based on products marginal value of time (MVT) concept, authors developed a mathematical model to deal with an issue of minimizing lost value in supply chain. Further, study of Bottani & Montanari (2010) was grounded in proposing a discrete-event simulation model for supply chain strategy improvements of fast moving customer goods. Simulation model aimed at quantitatively assessing varied supply chain combinations to improve total supply chain costs and bullwhip effect. Results of the simulation model provided useful insights to optimize supply chain designs of fast moving customer goods.

Wadhwa *et al.*, (2009) attempted to investigate the impact of impulsive demand distribution on inventory-based performance of some inventory control policies. The proposed model aimed to examine the role of varied customer demand and its impact on inventory-based performance of organizations under given inventory control policies. Results of the study suggested that independent decision-making by each node of supply chain leads to bullwhip effect. Study also suggested that inventory policy which was best suited for one supply chain node might not be efficient for the entire supply chain. While, inventory policy that performs poorly for one node could be most suitable for the entire supply chain. Accordingly, study

developed a joint management policy that was beneficial for all organizations that were linked in the supply chain structure.

Qi *et al.*, (2009) focused on to test supply chain strategy model that hypothesize lean, agile and lean/agile approaches with respect to Chinese manufacturing firms. The emphasis of supply chain strategy model was on product characteristics and firm performance (financial and operational). Cluster analysis suggested that most of the Chinese companies were adopting different lean, agile, and lean/agile supply chain strategies. Authors also noticed that some Chinese firms were still following a traditional strategy that didn't follow principles of lean and agile strategy. Hence, firms following traditional strategies perform worse than firms following the lean, agile and lean/agile strategies in terms of operational performance and financial performance. In another study on Chinese manufacturing firms, Qi *et al.*, (2011) extended their work and investigated the moderating effect of environmental uncertainty on the relationships among competitive strategy, supply chain strategy and business performance. Analysis results validated the moderating effect of external environment on the relationships among competitive strategy, supply chain strategy and business performance. Study suggested that firms focusing on differentiation strategy emphasized on agile supply chain strategy. Whereas, organizations with cost advantage were inclined more towards implementation of both lean and agile supply chain strategies. Dong-Hua & Zailani (2011) investigated the moderating effect of organizational culture on the relationship between supply chain relationships and design quality in Chinese automotive organizations. Results of the analysis revealed that automotive organizational culture had influenced buyer-supplier relationship and design quality. This result had suggested Chinese automotive organizations to have an emphasized focus on improving their organizational culture for enhancing their competitive positioning.

Acar *et al.*, (2010) through optimization and simulation methodologies validated a decision support framework to investigate relative impact of demand, supply and lead time uncertainties on cost and customer service performance. Results indicated that demand uncertainty had possess a greatest negative impact on supply chain performance. Authors also indicated the relative importance of variation of supply and lead time uncertainties with respect to supply chain performance measures.

Ivanov (2010) defined supply chain as a network of organization wherein a number of various enterprises (suppliers, manufacturers, distributors, and retailers) collaborate (cooperate and coordinate) along the entire value chain and apply all modern concepts and technologies to make supply chains agile, responsive, flexible, robust, sustainable, cost-effective, and competitive. This will help organizations to increase customer satisfaction and decrease costs which results in increasing supply chain profitability and stability. Thus, managers must focus on continual quality improvement and process integration throughout their supply chain system so that they could achieve competitive positioning (Boon-iit & Wong, 2011).

Researchers had tried to develop different supply chain models showing relationship between various parameters for managing an effective supply chain. Kanji & Wong (1999) proposed a supply chain model to achieve business excellence in organizations. Whereas, Sinha and Kohnke (2009) proposed a 3A-framework; affordability, access and awareness; to show improvements in design of health care supply chain. Further, Ivanov (2010) proposes a conceptual framework that emphasized on interlinking supply chain strategy, design, planning and operations on adaptation principles. This was specifically done so that efficiency, consistency, implacability and sustainability of decisions on how to design, plan and run supply chains could be improved. Takahashi *et al.*, (2011) proposed a two-echelon dual-channel supply chain mathematical model along with a new inventory control policy. This model had the ability to reduce number of setups without increasing much inventories at warehouses. Takahashi *et al*, (2011) also emphasized that the proposed policy could reduce total cost under all conditions, especially under conditions where the unit setup costs of production and delivery were significant and customers arrive through both channels.

The above discussed models were developed to help organizations improve their supply chain management practices so that organizations could improve product quality and integration among their supply chain processes to reduce internal cost of production. The discussion clearly indicates that organizations must focus on supply chain management for improving quality of the product as well as integration among chain of firms.

## ***2.2 Supply Chain Management***

Many researchers had tried to define supply chain management for better understanding of the concept. According to Ellram (1991), supply chain management was considered to be an integrative approach for planning and controlling of materials flow from suppliers to end-users. Thus, supply chain management helped organizations to cooperatively manage and control their distribution channel relationships for maximizing efficient use of resources. According to Giunipero & Brand (1996), supply chain management had evolved into three typologies: flow of goods approach (Jones & Riley, 1985; Scott & Westbrook, 1991), flow of goods and information approach (Towill *et al.*, 1992; Cooper & Ellram, 1993) and integrative value added approach (Cavinato, 1991; Langley & Holcomb, 1992). These different typologies signify that supply chain management adopted an integrative system approach to manage the operational activities and relationships among chain of organizations. In fact, Lambert *et al.*, (1998) defined supply chain management as integration of key business processes, from end user through original suppliers that provides products, services and information to add value for customers and other stakeholders.

Taken together, above-discussed definitions emphasized that top management must be committed for providing a high quality product and service to customers. Research models of these studies lack to address issues covering leadership influence on supply chain relationship, managing processes other than logistics and quality, ways to develop close relationships, and cost requirements of customers. To cover these aspects, Kanji & Wong (1999) came with the Kanji's business excellence model. The Kanji's business model empirically validated relationship among leadership, cooperative relationship, customer focus, management by fact, continuous improvement and business excellence. In other words, the excellence model emphasized that top management must be committed to cultivate a supportive culture with suppliers for ensuring a long-term relationship and quality performance. This would ensure that firm was committed to meet needs of its suppliers by having an open-minded discussion with suppliers. Hence, firms would be in a position to assess their performance. Any deficiency in their supplier performance would be rectified by improving their supply chain processes so that firms continuously meet customer needs.

Kanji (2001) extended the research of Kanji & Wong (1999) and had discussed forces of excellence in the Kanji's business excellence model. This research had discussed Kanji's business excellence model as an index and provided route to business excellence through total quality management framework. Further, Wong (2001) based on theory of co-operation and competition proposed that leadership had a major role to play in supply chain partnership. The study also proposed that leadership affects interaction and goal orientation among supply chain managers, supply chain partners and the resulting outcome. Wong (2003) used supply chain business excellence model to indicate how organizations get best support from their suppliers to outperform their competitors. It could also be noticed from the study of Kanji (2003) that Vedanta Model of business is incorporated into Kanji's business excellence model. This helped leadership to develop organizational value (Karma) to improve core concepts of commitment (Bhakti) and embed business knowledge (Janana) resulting in achieving best business results for organizations.

Croom *et al.*, (2000) contributed to a critical theory debate through presentation and use of a framework that categorizes supply chain management literature. Authors used PROCITE database from which literature had been classified according to two criteria: content and methodology-oriented criterion. Authors had suggested that supply chain management literature lacks contribution of theoretical work in comparison to empirically based studies. Consequently, the authors recommend that future studies must target to enhance supply chain management literature by contributing more theoretical work in the field.

Majumder & Srinivasan (2008) developed a mathematical model by considering network supply chain with price dependent demand. The developed mathematical model analyzed effect of large scale problems involving long sequences of contracts. Authors found that contact leadership and position of the leader affect performance of entire supply chain. Further, Hsu *et al.*, (2009) on the basis of evolutionary economics and work of Penrose (1959) proposed that resource based view of the firm complements traditional industrial organizational theory (Olavarrieta & Ellinger, 1997; Sinkovics & Roath, 2004). Organizational management could recognize competitive value of their resources and capabilities by looking at their combined effect on strategies pursued by firms (Barney, 1991). As resources and capabilities in a supply chain system covers inter-firm activities,

therefore Hsu *et al.*, (2009) proposed that operational capabilities; new product design and development, just-in-time and total quality management; impacts supply chain management practices that further impact firm performance. Conceptual framework proposed by Hsu *et al.*, (2009) depicted the mediating role of supply chain management practices on the relationship between operational capability and firm performance. But, the conceptual framework fails to address the external customer-firm-supplier integration impact on firm's financial and non financial performance. This gap in the literature was being addressed by Ou *et al.*, (2010).

Ou *et al.*, (2010) enriched literature by investigating a structural model that depicts the mediating role of internal supply chain management on the relationship between external customer-firm-supplier integration and firm performance. Results validated that external customer-firm-supplier relation management positively impacted firm internal contextual factors which in turn had positive effects on firm performance. The study also predicted that successful implementation of supply chain management not only directly improved operational performance but also indirectly enhanced customer satisfaction, and financial performance. As a result, organizational management must be committed to improve their relationships with upstream supply chain partners to satisfy customer's needs.

McMullan (1996) suggested that important supply chain practices covers of technology, cost competitiveness and inventory management. But with changing market dynamics, Tan (2002) suggested that supply chain management practices were influenced supply and materials management, information technology and sharing, and operations and customer service. Supply chain management practices were aimed with a goal to integrate organizational upstream and downstream activities (Tan *et al.*, 1998; Narasimhan & Kim, 2001). Upstream activities of supply chain management covers involvement of supplier in strategic and operational decision-making and encouraging information sharing with upstream supply chain partners. Whereas, downstream activities involved developing and maintaining customer contacts through solving customer problems based on customer feedback (Tan, 2002). For integrating upstream and downstream activities involved in a supply chain system, it had become paramount for organizations to cover on aspects covering locating closer to the market, helping supply chain partners (suppliers and vendors) in

developing just in time capabilities, creating a well-suited information platform and building organizational teams for ensuring quality and operational efficiency (Tan *et al.*, 1998; Ramdas & Spekman, 2000; Narasimhan & Kim, 2001; Tan, 2002)

Mondragon and Lyons (2008) investigated role of geographical proximity of suppliers to vehicle assembly plant. Results of the study highlighted on the facts that geographical proximity of the supplier helped considerable reduction in overall pipeline inventory between vehicle assembly plant and second tier component supplier. Findings suggested that for improving supply chain performance, geographic proximity of suppliers could be used to implement multi-tier synchronized sequencing of components.

Li *et al.*, (2005) defined supply chain management as strategic coordination of business processes within an organization and across businesses with an objective of improving performance of individual organizations and entire supply chain. This study had proposed and validated a model that considered strategic supplier partnership, customer relationship, information sharing, information quality, internal lean practices and postponement as dimensions of supply chain management practices to improve performance outcomes; delivery performance and time to market; of supply chain management practices. Strategic supplier partnership emphasized on long-term relationship between organization and its supplier by designing to leverage strategic and operational capabilities of individual organizations. Ultimate result of strategic partnership would result in achievement of significant ongoing benefits (Gunasekaran *et al.*, 2001; Gunasekaran *et al.*, 2004).

Role of supplier involvement (Olhager, 2002; Ragatz *et al.*, 2002), supplier relationship (Cox *et al.*, 2002; Randall *et al.*, 2003; Yang & Pan, 2004) and supplier quality assurance (Romano, 2002) was found to be critical for new product design and development, total quality management capabilities and just-in-time. Organizations by working on these supplier parameters would be in a position to improve their operations capability as well as supply chain management practices which further resulted in improving the market positioning and firm performance (Chang *et al.*, 2003; Kim & Ha, 2003; Vickery *et al.*, 2003).

To respond to market uncertainties, organizations were required to enhance their supply chain competence. Chow *et al.*, (2008) defined supply chain management as a hierarchical and strategic approach for planning supply and demand, for sourcing raw materials and components, for making products and parts, for tracking inventory and order fulfillment, and for delivering product to the end user. This definition highlights on the fact that supply chain management from a strategic approach is now being considered as a hierarchical and strategic approach.

Zhao *et al.*, (2007) reviewed literature of Chinese organizations related to supply chain management, quality management and logistics management. This research enriched the existing Chinese manufacturing literature by developing a conceptual typology of important supply chain management and quality management issues. Authors developed twenty seven propositions that will help future researchers to enrich China-based research. The study recommended that there was major dissimilarity in quality of selected published articles, in terms of measures and methods.

Sahay *et al.*, (2007) conducted an analysis for assessing current state of supply chain management practices followed by Indian manufacturing organizations. This was specifically done to identify areas that need to be addressed for increasing competitiveness of Indian manufacturing organizations. Results of the study revealed that most Indian organizations had aligned their supply chain objectives with their business objectives but still lack in aligning their processes with management focus. Accordingly, Indian organizations must form a supply chain strategy to align their processes for quality improvement with respect to management focus.

Improving quality of product in supply chain is critical as it would ensure that customer gets desired finished product. Researchers had emphasized that management emphasis was now shifting from focusing only on supply chain to understand supply chain's linkages with quality management as well as process integration (Mehta, 2004; Kuei *et al.*, 2005; Lo *et al.*, 2007; Arauz *et al.*, 2009; Chen *et al.*, 2009; Ou *et al.*, 2010; Talib *et al.*, 2011). Accordingly, it becomes imperative to investigate literature relevant to quality management and supply chain process integration.

### ***2.3 Quality Management***

Combining supply chain management and quality management ensures that organizations had a satisfied customer and could survive in the global competitive environment (Kuei *et al.*, 2005). Worldwide organizations are under tremendous pressure to cater aesthetic demands of customers in a cost effective manner. Researchers with respect to changing market dynamics had suggested use of various quality management practices. Kanji & Wong (1998) implemented quality management in the Hong Kong construction industry. Authors observed that due to complicated nature of construction industry there were abundant problems in assuring quality performance. Accordingly, they recommended that managing supply chain as a whole and adopting a total quality system and procedure couldn't yield best results until and unless quality culture was not created in construction industry. Wong & Fung (1999) performed another study on construction projects and found that supply chain management issues related to total quality were delineate. Authors examined strategy, structure and task for managing supplier/subcontractor relationships. Results of the case study revealed that supply chain relationship should promote collaborative behavior from suppliers/subcontractors in meeting quality objectives.

Sharma & Gadenne (2002) examined different industry groups to investigate similarities and differences in total quality management practices. The authors based on industry category explored relationship between total quality management practices and business performance. Analysis suggested existence of some common factors covering value chain integration, efficiency and employee involvement that differed between industries. Further, Lai (2003) investigated the impact of market orientation on quality management implementation and business performance. Study suggested that top management commitment and supplier relationship management were vital quality management implementation constructs.

Flynn & Flynn (2005) examined the prospective that quality management offered for improving supply chain performance. This research examined four themes and they covered pursuit of supply chain and quality goals simultaneously, leading to development of cumulative capabilities, relationship between quality management practices and supply chain performance measures, and relationship between a specific set of quality management

practices known as co-makership and supply chain performance measures. The study possessed a strong relationship for these four themes and suggested that top management commitment and supplier relationship management were among the most important quality management constructs for improving supply chain performance. Further, Nair (2006) performed meta-analysis to cover two objectives covering formalized performance implications of adopting quality management practices and examined empirical research in quality management to determine which quality management practices were positively related to improved performance. Results supported hypothesized relationships and suggested that supplier relationship management and top management commitment were considered to be vital quality management practices for improving organizational performance.

The above discussion clearly highlights that researchers had considered supplier relationship management and top management commitment as vital constructs of quality management for improving organizational supply chain performance. Therefore, there is a requirement to review literature with respect to the role of supplier relationship management and top management commitment in quality management.

### *2.3.1 Role of Supplier Relationship Management*

Manufacturing organizations were dependent on their suppliers for supply of quality raw material to manufacture and achieve competitive market positioning. It could be noticed for the study of Soderquist & Motwani (1999) that automotive suppliers had confronted challenges and adopted quality management related concepts of lean production in its operations to achieve positive market outcomes. Scannell *et al.*, (2000) focused on automotive first tier suppliers and tried to explore extend of association of supply chain management quality practices with their upstream source. The study investigated how supply chain management quality practices both individually and collectively relate to improve competitive performance; flexibility, innovation, quality and cost. The study concluded that supplier development, supplier partnering and just in time purchasing were very much correlated with their upstream source. The authors also recommend that supply chain management practices (both individually and collectively) were related to improve

competitive performance. Hence, automotive organizations must focus on improving their supplier quality management for achieving enhanced customer satisfaction.

Sun (2000) suggested that in Shanghai focus of manufacturing organizations was on internal quality control which involves supplier relationship management. Hence, organizations must focus on developing good relationships with their suppliers. Wong (2000) proposed a conceptual framework that highlighted integration between supplier satisfaction and customer satisfaction. The study revealed that supplier satisfaction was impacted by cooperative culture, commitment to supplier satisfaction and constructive controversy. At last, it was being recommended that supplier satisfaction helps in increasing customer satisfaction. Further, Lai *et al.*, (2005) used transaction cost analysis to explore the link between relationship stability and supplier commitment to quality. Study results suggested that the link was stronger when suppliers' perception of a certainty of supply with buyer firm was greater. Authors also suggested that asset specificity and transaction frequency had no impact on link. Hence, organizational management must be committed for maintaining healthy supplier relationship for supply of materials.

Samson & Terziovski (1999) examined role of supplier relationship management in improving total quality management practices and operational performance of manufacturing organizations. Analysis results highlighted that supplier relationship management impacts both total quality management as well as operational performance of manufacturing organizations. Further, Ho *et al.*, (2001) investigated the impact of total quality management practices on quality management. Results suggested that supplier relationship management was considered to be an important total quality management practice that impacts quality management of manufacturing firms.

Kaynak (2003) through a comprehensive literature review had examined direct and indirect impact of total quality management practices at various performance levels. Study recommended that supplier quality management was among most important quality management practice that impacted firm performance. In another literature review study by Talib *et al.*, (2011) vital total quality management constructs were identified. Study revealed that supplier relationship management impacts firm performance. As a result, organizations must consider improving supplier quality for enhancing their firm performance.

Further, Wu & Weng (2010) explored major factors considered by manufacturers in supplier selection. Eight supplier selection factors were identified covering price response capability, quality management capability, technological capability, delivery capability, flexible capability, management capability, commercial image and financial capability. Causal model of these identified factors was constructed and validated to help manufacturing organizations in supplier selection. In another study on selection of supplier, Xie *et al.*, (2011) used a mathematical model to investigate quality investment and price decision of a make-to-order (MTO) supply chain with respect to supplier. The authors focused on the fact that supply chain was subject to financial risk due to volatility of orders from buyers. Model results showed that both supply chain strategy and risk-averse behavior had significant impact on quality investment and pricing. Centralized decision-making was considered to be an effective way for achieving high quality of products.

Bandyopadhyay & Sprague (2003) highlighted the role of total quality management approach for achieving quality management in manufacturing industry. The study discussed that quality was no doubt an order winning criterion but it had also become an order qualifying criterion. Results of the study conveyed that some good firms like OM, FORD, Chrysler, IBM and Motorola had implemented total quality management and gained a competitive edge in the market place. In another study by Bandyopadhyay (2005) a model framework was developed for facilitating process of developing an industry specific quality standard. The author commented that although ISO-9000 series of quality standard provided a basis for prevention based total quality management approach to quality assurance but it failed to address the specific requirements of any specific company or its industry.

One of the important quality tools includes ISO 9000 certification. The study of Rao *et al.*, (1997) investigated effect of ISO 9000 certification on quality management in four countries (US, India, China and Mexico). Results recommend that ISO 9000 registered companies exhibit higher levels of quality leadership, information and analysis, strategic quality planning, human resource development, quality assurance, supplier relationships, customer orientation, and quality results. Further, research of Quazi *et al.*, (2002) used Rao *et al.*, (1997) study and investigated impact of the relationship between ISO 9000 certification and quality management on Singapore firms. Results of the study revealed that ISO 9000

certification didn't affect quality management of Singapore firms. This is due to the fact that Singapore firms were more process driven than customer driven. Therefore, organizations had to focus more on process management as compared to improving quality.

Empirical study of Romano (2002) examined whether diffused adoption or knowledge/confidence in ISO 9000 quality system requirements (i.e. 'sensitivity' to certification) of diverse supply chain members could really influence quality management practices/procedures and operational performance of individual firms in supply chain. Study highlighted that those firms with most advanced internal quality systems tend to buy extensively from certified suppliers. Lee *et al.*, (2003) constructed a high quality supplier selection mathematical model to deal with supplier selection problems, ISO 9001 certification. Study highlighted on the fact that in selecting suppliers, quality management factors were considered first followed by price and delivery. The study concluded that selecting proper number of suppliers improves quality of goods ordered.

Further, Tan & Sia (2001) investigated role of ISO 9000 certification in Malaysian manufacturing industry. Results emphasized that after gaining ISO 9000 certification product quality as well as process quality improved. This study also highlights on the fact that the major reasons for seeking registration of ISO 9000 certification in developing countries, like Malaysia, was due to management-driven practice as compared to customer-driven in developed countries. With changing market dynamics, Lambert & Ouedraogo (2008) also investigated impact of ISO 9001 management system on some dimensions of organizational learning and their latter affects on process performance in French manufacturing companies. Results of this study suggested that ISO 9001 system could be a useful tool for organizational learning and knowledge management.

The case study approach of Dasgupta (2003) used a six-sigma approach to suggest organizations on strength and weaknesses in their supply chain. In another study on six-sigma methodology application guidelines were developed for assessment, improvement and control of quality in supply chain management (Wang *et al.*, 2004). Results suggested that improvement in quality of all supply chain processes reduces cost and improves level of customer service. Author recommended that organizations must develop a system for improvement in quality of supply chain processes. Carmignani (2009) aimed to develop a

standard for implementing a process management system in whole supply chain. The study was divided into two parts quality management and supply chain management. Quality management concentrated on selection of reference model to develop the standard. Whereas, supply chain focused on section of drivers and main processes that standard had to manage. Developed standard resulted in modified interpretation of ISO 9001:2000 norms that improved ISO 9001 standard to general requirements for a whole process approach. Another benefit of developed standard is that it extended and applied ISO 9001 concepts addressing quality aspects within a single organization to whole supply chain.

Li *et al.*, (2011) adopted quality standards; ISO 9000 series; to help organizations develop and maintain supply chain processes that meet performance criterion of Supply Chain Operations Reference (SCOR) model. Data analysis helped in extending five decision areas (Plan, Source, Make, Deliver, and Return) of SCOR model by integrating quality assurance measures in supply chain processes. Results recommend that 'Plan' and 'Source' decisions were more important to customer-facing supply chain performance (reliability, response, and flexibility). Whereas, 'Make' decisions positively affect internal-facing performance metrics (cost and asset). Management judgment on effects of implementing ISO 16949 on supply chain performance of automobile units and their related firms was examined by Liu (2009). Multiple regression analysis was used to examine management judgment. Results clearly indicated that implementation of ISO 16949 was judged to have improved quality performance of supply chain.

Zu & Kayank (2012) gave an agency theory perspective on supply chain quality management. The authors aimed to examine two approaches buying; outcome based and behavior based; firms could utilize to manage supplier quality. Study also investigated ways in which factors inherent in supply chain relationships affect use of these approaches in quality management. A conceptual framework was proposed that relates underlying factors of a supply chain relationship to use of quality management approaches. Results proposed that management rather than relying on one generic supply chain quality management approach for all suppliers firms need to choose different management mechanisms for different suppliers. These mechanisms covered aspects related to salient attributes of individual suppliers and their relationships with buyers. The study also considered five types

of agency-based factors; information asymmetry, goal conflict, risk aversion of suppliers, length of relationship and task characteristics.

Tseng (2014) investigated mediating role of supplier relationship management in the relationship between knowledge management capabilities and corporate performance. Results indicated a positive influence of knowledge management capabilities on corporate performance, whereas supplier relationship management had a partial mediating impact on the relationship between knowledge management capabilities and corporate performance. These results amply highlights that there are other constructs that impact the relationship and might include top management commitment. Further, Al-Abdallah *et al.*, (2014) performed a cross country study and investigated the impact of supplier relationship management on competitive performance of the manufacturing firms. Study suggested that supplier relationship management's two major practices covering supplier partnership/development and supplier lead time reduction had a significant and positive effect on competitive performance of manufacturing organizations.

Pérez-Aróstegui *et al.*, (2015) recommended that supplier relationship management impacts the relationship between information technology and quality management practices. As a result, organizations must have an emphasized focus on integrating the quality processes to improve their competitive positioning. Moreover, Luthra *et al.*, (2014) and Luthra *et al.*, (2016) investigated the critical success factors for improvement of social, environmental and economic performance of Indian automotive organizations and found that supplier relationship management plays a significant role in the boosting the organizational performance.

### *2.3.2 Role of Top Management Commitment*

Another major quality management practice covered total quality management and it aimed at continuously improving quality of products and processes for achieving customer satisfaction. Joseph *et al.*, (1999) developed an instrument for measuring total quality management implementation in Indian business units. Results suggested that managers of Indian business units should give more emphasis on total quality management training to its supply chain partners so that current quality management practice could be improved and

sustained. Another contribution of the study emphasizes that organizational commitment had higher factor score, among all critical factors, and it was advised that Indian organizational management should emphasize more on it.

Performance of manufacturing organizations is highly impacted by commitment of top management. Samson & Terziovski (1999) examined relationship between total quality management practices and operational performance. Authors investigated individual and combined impact of total quality management practices and operational performance on firm performance. It was being noticed that operational performance of manufacturing organizations was highly impacted by top management commitment. Further, Kaynak (2003) through a comprehensive literature review had examined direct and indirect of total quality management practices on various performance levels. Study suggested that commitment from the top management was one of the most important quality management practice that impacted firm performance. Thus, organizational management must be committed for improving the quality of product as well as organizational operational performance.

Further, Sun (2000) and Arauz *et al.*, (2009) developed and validated their research frameworks emphasizing that product development was positively affected by commitment from the top management in handling supplier relationship and customer relationship. Moreover, Prajogo & Sohal (2003) examined relationship between total quality management and innovation performance and compared the nature of this relationship against quality performance. Results of the study suggested that total quality management was positively and significantly related to both product quality and product innovation with magnitude of the relationship more on product quality. Consequently, organizational management must be committed to improve organizational product quality.

Lau *et al.*, (2004) used Malcolm Baldrige National quality Award (MBNQA) criteria to search current state of quality management implementation and practices in China. Firms were compared with respect to three different stages of a quality system covering focus on inspection, statistical quality control and total quality management. Results highlighted on the fact that firms practicing total quality management had superior performance. Accordingly, quality managers and professionals should take a leading role in promoting contemporary, strategic management concepts and practices. Lo *et al.*, (2007) conducted an

empirical study in Pearl River Delta (PRD) of China to scrutinize the impact of supply quality management. This study suggested that quality-conscious companies continuously improved their operations in order to meet perpetually increasing needs of their customers. Therefore, organizational management must initially adopt quality conscious practices such as a customer focus, continuous improvement and total involvement while planning to implement supply quality management practices.

Rahman (2008) investigated status of quality management practices between manufacturing and logistics companies in Australia and found that manufacturing companies attain more extensive quality practices than logistics firms. Reasons that logistics firms were unable to cater quality management practices were due to changing corporate culture and training of employees. Similarly, manufacturing companies were focusing on establishment of employee ownership of quality process and a precise focus on changing corporate culture. Therefore, manufacturing organizational management must be committed to improve their quality management to gain competitive advantage. On the other hand, Foster & Ogden (2008) depicted how operations and supply chain managers approach quality management. Results suggested that those who identified themselves as supply chain managers utilized and emphasized quality tools and values to a greater extent than those who identified themselves as operations managers. Kahnali & Taghavi (2010) investigated relationship among quality management practices as well as their direct and indirect effect on firm performance. The study strongly recommended that top management must focus to improve quality of delivered products from suppliers so that they achieve customer satisfaction. The above discussion highlights the role of management commitment in terms of assuring quality.

Zakuan *et al.*, (2010) proposed a conceptual model for implementing quality management practices to improve organizational performance in Malaysian and Thailand automotive industry. Quality management practices covered quality leadership, customer focus and satisfaction, quality information and analysis, human resource development, strategic planning management, supplier quality management, quality results, and quality assurance. Whereas, organizational performance covered satisfaction level, employee satisfaction and customer satisfaction, and business results; productivity, number of successful new product, cost performance and profitability. The proposed conceptual framework is still required to be

validated in the Malaysian and Thailand automotive industry. Whereas, Vanichchinchai & Igel (2011) investigated the mediating role of supply chain management on the relationship between total quality management practices and firm's supply performance in Thailand automotive industry. Results suggested that total quality management practices not only had a significant direct positive effect but also had a significant indirect effect on supply chain management practices and firm's supply performance. Therefore, management must be committed to improve these aspects for better performance.

Kim *et al.*, (2012) investigated which type of quality management practice was directly or indirectly related to five different types of innovation. Results indicated that a set of quality management practices through process management had a positive relationship with all types of innovation. Hence, organizational management capability to manage processes might play a critical role in indentifying routines, establishing a learning base, and supporting innovative activities.

Luthra *et al.*, (2014) identified critical success factors in the Indian automotive organizations and suggested that management commitment was a must for managing quality processes to improve environmental, social and economic performance. Further, Luthra *et al.*, (2015) developed and validated an interpretive structural model depicting that Indian manufacturing organizational management must concentrate on social responsible green supply chain management practices. Recently, Luthra *et al.* (2016) investigated the critical success factors in the Indian automotive industry and found that internal management and competitiveness played a crucial role towards achievement of expected performance outcomes.

Discussed studies highlights on the fact that top management commitment and supplier relationship management must be considered vital quality management constructs that impact organizational performance. The above discussion was unable to discuss whether process integration literature also considers these constructs as vital. Thus, it becomes imperative to investigate the literature of process integration.

#### ***2.4 Process Integration***

Role of information technology was booming business world and there was a requirement to link processes of supply chain management with the help of information technology for

enhancing organizational supply chain performance. Process of supply chain integration should progress from assimilation of internal logistics processes to external integration with suppliers and customers (Chen *et al.*, 2009). Such internal and external integration could be accomplished by continuous automation and standardization of each internal logistics function and by efficient information sharing and strategic linkage with suppliers and customers. This notion implies that information system utilization played an important role in each stage of supply chain process integration (Bowersox, 1989; Hewitt, 1994). Process integration emphasizes unity of entire supply chain processes by focusing strategically on optimization of interactions between different nodes of supply chain for the entire concerned process rather than picking individual processes and optimizing them separately (Barratt, 2004).

Kim (2006) examined causal linkage among supply chain management practices, competition capability, level of supply chain integration and firm performance. LISREL analysis was performed on collected data and results suggested that in small firms efficient supply chain integration played a more critical role for sustainable performance improvement. Whereas, in case of large firms performance improvement was being impacted by close relationship between level of supply chain management practices and competition capability. At last, study recommended usage of systemic supply chain integration in early stages of organization processes. But it had been recommended that once it was being implemented organizational focus must be on supply chain management practices and competition capability.

Lee *et al.*, (2010) focused on to investigate relationship between supply chain structure and supply chain activities. This study categorized supply chain on three distinctive networks; supply network, conversion network and distribution network; and also investigated five dimensions of supply chain management activities; organizational capacity, revitalization support, collaboration, appraisal and responsibility and information system. Authors concluded that companies in distribution network were most powerful users of supply chain management. It is also noticed that statistically there was no difference in application of supply chain management activities between companies in supply network and those in conversion network.

Katunzi (2011) aimed to identify obstacles of process integration along supply chains in manufacturing organizations. The article was focused to suggest issues faced by manufacturing organization covering determination of dominant factors in engagement of supply chain management activities, barriers faced upon implementation, strategies or bridges applied to overcome these barriers and benefits available for successful organizations. Authors concluded that barriers faced by manufacturing organizations in implementing process integration includes silo mentality, lack of supply chain visibility, lack of knowledge, lack of trust and at last activities resulting in causing bullwhip effect.

Childerhouse & Towill (2011) aimed to verify the link between supply chain integration and competitive performance. Authors performed eight year international field study of fifty products and their associated supply chains. Extensive statistical analysis found breadth of supply chain integration significantly correlates with increased performance. Results verified that most of the tested products supply chains were not integrated. At last, it was noticed that most supply chains seems to follow a popular route when seeking to enable seamless operations. Thus, organizations looking for enhanced performance in the competitive environment must integrate their supply chains.

Most of the supply chain integration concepts had recognized clearly the existence of two flows throughout the chain, one being the information and other being the material(s) (Power, 2005; Prajogo & Olhager, 2012). Manufacturing organizational management expect the supply of high-quality material so that they could manufacture the requisite finer quality product for achieving customer delight (Kearney, 2013). This makes it quite critical for organizations to concentrate on continual improvement in their relationship with the suppliers for the quality flow of both material and information and thereby achieving improved upstream supply chain flexibility (Flynn et al., 2010; Gallear et al., 2015). One of the mechanisms by which manufacturing organizations management could achieve higher customer delight was by integrating and then simplifying their processes with that of their upstream supply chain partners. The organizations by simplifying their supplier processes fulfill the production requirements that involved timely delivery of quality raw material, semi-finished parts and in-process parts to their manufacturing setup (Chan *et al.*, 2009; Chand *et al.*, 2015). Both researchers and corporate executives alike had focused on that

integrated and then simplified upstream supply chain processes lead to the removal of redundant manufacturing processes, reduction in complexity of the processes, lowering of operational cost as well as an increase in the manufacturing responsiveness (Hoole, 2005; Chen et al., 2009; Peng et al., 2016; HP, 2010; Weingarten et al., 2016).

For manufacturing the product as per customer's requirements, organizations were dependent on their suppliers for supply of quality raw material (Romano, 2002; Arauz *et al.*, 2009; Majumdar & Manohar, 2016). Researchers had suggested that manufacturing organizations must possess flexible supply of materials from their upstream supply chain partners to deal with varied customer requirements (Chan *et al.*, 2009; Soh *et al.*, 2016). Moreover, researchers had suggested that supply chain's process integration scope was dependent on the supply chain management effort for enhancement in upstream supply chain flexibility (Jayaram *et al.*, 2010; Combe *et al.*, 2012). Thus, manufacturing organization(s) management must concentrate on integrating and then simplifying their supplier processes for improving their product flexibility (as per the requirements of the manufacturing organizations) (Romano, 2002; Prajogo *et al.*, 2012).

The above discussion makes it quiet evident that top management commitment and supplier relationship management were considered to be vital process integration constructs.

#### *2.4.1 Role of Top Management Commitment*

Kim & Narasimhan (2002) investigated the impact of set of advisable information systems utilization strategies; independent operation stage, functional integration, internal integration stage and external integration stage; on supply chain integration initiatives; information systems for value creation, information systems for infrastructural support and information systems for logistics operation; for improving organizational supply chain performance; cost reduction and differentiation. Authors validated the proposed model depicting relationships among constructs using structural equation modeling. Results revealed that information systems for value creation, information systems for infrastructural support and information systems for logistics operations impact the supply chain performance of organizations. The discussed results recommended that organizational management must have an emphasized

focus on improving their supply chain utilization strategies so that they could improve organizational supply chain performance.

Product technology transfer was considered to be one of the most important supply chain utilization strategies. Tatikonda & Stock (2003) tried to address concern of product technology transfer by integrating it into a new product system. Conceptual framework was built on organizational theory perspective and highlighted on the fact that maximum product technology transfer effectiveness could be achieved when organizations match type of technology transfer with type of relationship with upstream supply chain partner. The article emphasized that type of relationship with the supplier impacts integration of processes linked with new technology. Therefore, firm's management must have an emphasized focus on their relationship with upstream supply chain partners before proceeding for product technology transfer. Further, Petersen *et al.*, (2005) investigated three pressing issues related to supplier integration into new product design. First issues catered to what managerial practices affects effectiveness of new product development team when suppliers were to be involved. Second issues involved investigation on whether managerial practices differ depending on when supplier was to be involved and what level of responsibility was to be given to supplier. Lastly, study investigated whether supplier involvement in new product development could produce significant improvements in financial returns and/or product design performance. Analysis results significantly validated all pressing issues and suggested that organizational management must maintain a good relationship with supplier's as they could affect new product design which further impacts financial performance of organization.

Rodriguez *et al.*, (2008) investigated another pressing issue on new product development that covered the moderating impact of climate between departments on the relationship between top management commitment and new product development. The study considered developing new product to be multidisciplinary process which required commitment from organizational management to improve climate between integrated departmental processes to achieve new product development. Further, research of Hafeez *et al.*, (2010) argued that management must consider operational and behavioral perspectives while adopting e-technology. The study proposes a generic framework for evaluating business performance of e-supply chain companies and tested it on Malaysian SME's. Structural equation modeling

was used to test impact of supply chain strategy, E-business adaption and interaction of these constructs on overall business performance. Result of the study suggested that management of Malaysian SMEs were having a technology orientated focus however, they need to develop efficient logistics networks to cater for a geographically dispersed population.

Lee *et al.*, (2010) focused to investigate evaluation of antecedents; relationship characteristics, organizational characteristics and information/technology characteristics; on performance consequences of buyer-supplier relationship through supply chain activities; information sharing and collaboration. Results of the study suggested that trust, interdependency and rate of technological change were major antecedents that impacted level of operational and strategic information sharing and collaboration. Further, it had also been reported that higher the degree of strategic information sharing and collaboration greater was the level of effectiveness. However, the study concluded that there was no significant relationship between length of relationship and information sharing as well as collaboration.

Supply chain robustness was considered to be essential parameter for achieving supply chain collaboration. Cao & Zhang (2011) empirically documented association among information technology, supply chain robustness and supply chain performance. Results showed that there was a positive impact of information technology on supply chain robustness and supply chain performance. Accordingly, organizational management must have an emphasized focus on improving their information technology and supply chain robustness for enhancing their organizational supply chain performance. Further, Ramanathan *et al.*, (2011) proposed a conceptual framework and a standard set of metrics so that they could evaluate performance of supply chain collaboration. Authors used a dual case study approach to validate their proposed conceptual framework. Discussion on case studies enabled organizational management in understanding the usage of performance metrics in initial and advanced stages of supply chain collaboration.

Datta & Christopher (2011) investigated the effectiveness of information sharing and coordination mechanisms in reducing uncertainty on the make-to-stock supply chain of manufacturing organizations. Result of the study suggested that a centralized information structure without widespread distribution of information and coordination was not effective in managing uncertainty of supply chain networks even with increased frequency of

information flow. Consequently, organizational management must be committed to manage their information systems for reducing uncertainty in the make-to-stock supply chain and maintaining good relationships with their suppliers.

Deshpande (2012) addressed that literature had not comprehensively answered key questions such as what were the linkages between different dimensions of supply chain management; long term relationship, concurrent engineering and strategic purchasing; supply chain performance; inventory cost, delivery flexibility and customer responsive time; and organizational performance; financial and market performance, and customer satisfaction. Authors addressed these issues by proposing a conceptual framework among these constructs. Conceptual model was still required to be validated by applying available statistical tools.

Sukati *et al.*, (2013) evaluated business performance through supply chain implementation in Malaysian manufacturing industry. Research findings indicated significant correlation between supply chain management implementation; internal-firm relationship, firm-supplier relationship and firm-customer relationship; and business performance; strategic performance and operational performance; for manufacturing industry. The study highlighted that strategic coordination required inter-firm integration of supply chain partners.

Lin (2014) developed a research model to investigate electronic supply chain management system determinants and found top management commitment as one of the key determinants. Results suggested that organizations with certain perceived benefits, perceived costs, competitive pressure and top management commitment were most likely to adopt electronic supply chain management. Thus, for integrating processes and for improving competitive positioning organizational management must emphasize on electronic supply chain management. Further, Ralston *et al.*, (2015) tried to understand the relationship among firm's strategy, supply chain integration efforts and firm performance. The analysis results clearly indicated that firm's strategy impacts internal and external integration and it further impacts organizational operational and financial performance. Hence, top management must be committed to concentrate on forming right strategies for their organizations so that they could balance the gap between customer expectations and supplier production ability for improving their competitive positioning. Lee *et al.*, (2016) investigated the role of knowledge

sharing in influencing the software process improvement. The study concluded that software process improvement knowledge mediates the impact of top management support on software process improvement success. The result suggests that organizational management must work on improving the knowledge sharing among their supply chain processes to improve their software process improvement.

#### *2.4.2 Role of Supplier Relationship Management*

Tatikonda & Stock (2003) tried to address the concern of product technology transfer by integrating it into a new product system. The article integrated literature on new product development, technology management and supply chain management to present a conceptual framework. Conceptual framework was built on the organizational theory perspective and discovered the determinants of product technology transfer. Framework highlighted on the fact that maximum product technology transfer effectiveness could be achieved when organizations match type of technology transfer with type of relationship with upstream supply chain partners. The article emphasized that type of relationship with supplier impacts integration of processes linked with new technology. Therefore, firm(s) management must have an emphasized focus on their relationship with upstream supply chain partners before proceeding for product technology transfer. Barratt (2004) emphasized that process integration had concentrated on the entire supply chain processes by strategically optimizing interactions among different nodes of the supply chain. Results suggested that supplier relationship management had a positive impact on strategic optimization of customer processes.

Srinivasan & Brush (2006) examined consequence of enforceability and adaptability with respect to governing vertical alliances and supplier's performance ramification. Authors argued that factors that proved to be valuable for suppliers covered adaptive and collaborative orientation fostered by (OEM's), credible commitment from supplier for exchange of information sharing, presence of certain non verifiable safeguards and incentives inherent in target pricing. Analysis results indicated that information sharing together with original equipment manufacturer(s) dependence and target pricing enhances supplier performance. Thus, under certain conditions suppliers could venture into close relationships

with buyers for mutual benefit related to process integration. Dedrick *et al.*, (2008) showed how numbers of suppliers were being chosen (supplier management) by use of information technology. Results of the study reported positive relationship between number of suppliers and electronic procurement for custom goods was negatively moderated by deeper buyer–supplier system integration.

Park *et al.*, (2010) suggested a framework for an integrative supplier relationship management system by analyzing comprehensive approaches to overall supplier relationship management functions. Result proposed that framework could play a major role in enhancing the efficiency and effectiveness of supplier relationship management by adopting an integrative concept because functions of supplier relationship management were highly interrelated. In another study on supply chain integration, Gimenez *et al.*, (2012) investigated moderating effect of supply complexity in relationship between supply chain integration and performance. Research was focused to validate that supply chain integration was only effective in buyer-supplier relationships if characterized by high supply complexity. Authors validated that supply chain integration increases organizational performance if supply complexity was high, while very limited or no influence in observed in case of low supply complexity. Further, study suggested that in case of high supply complexity environments use of structured communications for achieving supply chain integration had a negative effect on cost performance. Organizational management must be committed to ensure that in high supply complexity environment they must maintain good supply chain integration with their suppliers to improve organizational performance.

Khan *et al.*, (2012) discussed how role of human factor could improve coordination in supply chain. Authors integrated two coordination mechanism found in literature into a model for a two-level supply chain in which incoming quality level of raw material provided to a vendor by a set of suppliers was not perfect. Model addressed supply chain coordination by specifically investigating role of different human factors on total cost of supply chain. Khan *et al.*, (2012) highlighted role of integrating process integration and quality management for improving organizational cost advantage.

Perols *et al.*, (2013) emphasized on the relationship between of supplier integration and time-to-market. Analysis results validated that supplier product integration slow down time-to-

market whereas supplier process integration speeds up time-to-market. Results also suggested a positive relationship between supplier integration and adoption of external technology which either accelerates or decelerates time-to-market depending on the level of internal exploration activities. These results recommend that organizations must concentrate on supplier process integration and external technology for accelerating their product to the market.

Hashemi *et al.*, (2015) considered economic and environmental criteria for selecting supplier in the integrated supply chain of automotive organizations. The authors used analytic network process and grey relation analysis to validate their proposed supplier selection matrices. The study would help automotive organizations to select supplier on criteria covering environmental and economic rather than emphasizing on cost, quality and delivery. The study of Hashemi *et al.*, (2015) was not able to cover the role of risk in the environment. Weingarten *et al.*, (2016) explored the role of risk and risk management practices in the accomplishment of supply chain integration. Result suggested that supplier integration was considered to be effective even in case of high risk environment. Therefore, organizations through supply chain risk management practices must harmonize and strengthen the performance impact of supplier integration.

The above discussed literature clearly made it evident that top management commitment and supplier relationship management are considered to be vital process integration constructs. Now it becomes critical to perform the citation analysis to make it evident that top management commitment and supplier relationship management are vital quality management and process integration constructs.

## ***2.5 Citation Analysis***

In order to arrive at the constructs having critical impact, citation analysis has been performed. Researchers by using journal citation scores have validated the importance of studies as well as constructs (Li & Tsui, 2002; Yang & Meho, 2006; Cukier *et al.*, 2009). This thesis has concentrated on performing citation analysis using the citation scores of studies indexed in three major databases namely - ProQuest, Scopus and Google Scholar. Researchers had used these databases individually in the literature for showing the

importance of studies (Li & Tsui, 2002; Yang & Meho, 2006; Cukier *et al.*, 2009). Thus, this thesis has used all the three databases at the same time to investigate the gap in literature.

Citation scores of studies are taken from all the three databases - ProQuest, Scopus and Google Scholar at the same time on 13 May, 2014. It is specifically done to ensure that there is no alteration in the citation scores. Moreover, the period considered for selection of studies is from 1999 to 2011. The reason for choosing this period is due to the fact that studies after 2011 will yield less citation scores. The reason for not considering the other studies is either due to less citations than the selection criterion or due to the fact that they aren't cited in one of the above mentioned databases chosen for analysis.

Research studies yielding higher citations in manufacturing domain are being considered for analysis. Criterion of minimal ten citations per database has been used for the selection of studies under the citation analysis (Li & Tsui, 2002). This is specifically done to ensure that the study is considered vital by researchers using all the three databases - ProQuest, Scopus and Google Scholar.

After constructing a panel of such studies, a frequency analysis of constructs that is carried out in order to reflect their relative importance. Frequency of occurrence of the constructs is determined in the selected journals and Table 1 clearly depicts that supplier relationship management (SRM) and top management commitment (TMC) are considered to be vital quality management and process integration constructs in manufacturing.

**Table 1: Important manufacturing constructs**

<b>Constructs {Study} [ProQuest, Scopus, Google Scholar]</b>	<b>SRM</b>	<b>TMC</b>
{Samson & Terziovski, 1999} [248, 623, 1,314]	✓	✓
{Sun, 2000} [13, 42, 71]	✓	✓
{Ho <i>et al.</i> , 2001} [43, 82, 151]	✓	-
{Tan & Sia, 2001} [30, 70, 117]	✓	-
{Kaynak, 2003} [247, 537, 1,229]	✓	✓
{Lai, 2003} [23, 43, 94]	✓	✓
{Prajogo & Sohal, 2003} [70, 168, 361]	-	✓
{Lau <i>et al.</i> , 2004} [31, 53, 90]	-	✓
{Flynn & Flynn, 2005} [38, 100, 179]	✓	✓
{Gosain <i>et al.</i> , 2004-05} [76, 217, 341]	-	✓
{Lai <i>et al.</i> , 2005} [47, 58, 105]	✓	✓
{Li <i>et al.</i> , 2005} [133, 270, 616]	-	✓
{Nair, 2006} [95, 191, 356]	✓	✓
{Hsu <i>et al.</i> , 2009} [23, 41, 92]	✓	✓
{Melnyk <i>et al.</i> , 2009} [18, 37, 95]	-	✓
{Ou <i>et al.</i> , 2010} [30, 43, 117]	-	✓
{Zakuan <i>et al.</i> , 2010} [20, 38, 75]	✓	✓
{Datta & Christopher, 2011} [13, 46, 86]	✓	✓
{Talib <i>et al.</i> , 2011} [47, 36, 75]	✓	✓
<b><i>Frequency of occurrence of Constructs</i></b>	<b>13</b>	<b>17</b>

*Note:* {}[, ., ] denotes {the study} and number of citations indexed in [Proquest, Scopus, Google Scholar] respectively as on 13<sup>th</sup> May, 2014.

(✓) indicates the constructs considered in the respective study.

## **2.6 Process Simplification**

Fawcett *et al.*, (2007) concentrated on understanding how information technology (information sharing - connectivity and willingness) was used for enhancing supply chain performance (operational performance and competitive performance). Data was collected through a large-scale survey and semi-structured interviews. Regression analysis was used to

validate relationship between constructs of the study. Results of the study revealed that most organizations were emphasizing on connectivity but overlooking willingness to improve on performance. Hence, organizational management must have an emphasized focus on willingness along with connectivity to improve the supply chain performance.

The study of Chen *et al.*, (2009) proposed a structural model that concentrated on the fact that internal and external process integration requires process simplification as one of the key constructs to improve firm performance. Authors also focused on the fact that simplified processes reduce redundant and complex processes. Redundant and complex processes could be achieved by ensuring compatibility among business processes, evaluating whether there were unnecessary activities within various processes across firms, ensuring reduction in performing identical jobs by employees in various departments and ensuring that employees aim to redesign work routines and processes to make them simpler (Chen *et al.*, 2009; Chen *et al.*, 2009).

Martin & Patterson (2009) focused on the need to integrate external processes with business partners (supply chain partners) by investigating use of common measurement metrics. This metrics determined which ones were most useful for measuring performance using supply chain management practices. The authors found that firms that were engaged in supply chain management integration had cycle time and inventory as most significant measuring outcomes. Therefore, organizations dealing with problems related to inventory management must integrate with their supply chain partners to improve on their supply chain performance. One of the ways by which they could improve the supply chain performance is by integrating and then simplifying their upstream supply chain processes.

Cigolini *et al.*, (2011) proposed a meta-model, which automatically allowed building of simulation model for supply chain. The proposed meta-model dramatically reduced time required to test a specific configuration of supply chain and/or a specific management policy by simplifying supply chain into six different scenarios, where demand is deterministic. Hence, this paper highlighted the role of simplification in determining appropriate supply chain scenario.

Wu *et al.*, (2014) proposes a novel research model that covers four key social exchange issues; trust, commitment, reciprocity and power; to be considered as antecedents of information sharing and collaboration for improving supply chain performance. Results validated that all social exchange issues had an impact on information sharing and collaboration. Whereas, authors suggested a partial mediation impact of information sharing and collaboration on supply chain performance. The partial mediation impact highlighted that there are other factors like process simplification that could impact the supply chain performance of the organizations. This thesis will validate the mediating role of process simplification in the relationship between quality management and process integration, and supply chain performance.

### ***2.7 Supply Chain Performance Measures***

Organizations are striving in the competitive environment to improve their organizational supply chain performance. Researchers have articulated on the fact that one of the ways through which organizations competes on competitive performance has shifted from manufacturing to supply chain management (Christopher, 1992; Christopher & Towill 2001; Chan *et al.*, 2009; Jayaram *et al.*, 2010). Thus, it had become imperative for organizations to focus on improving their supply chain performance measures.

Beamon (1999) presented an overview and evaluation of performance measures used in supply chain models. The study proposed a framework for selection of performance measurement systems for manufacturing supply chains that covered three types of performance measures resources, output and flexibility as necessary components of any supply chain performance measurement system. From an organizational viewpoint, supply chain concept arose with frequent changes in manufacturing environment that includes rising costs of production, shrinking resources of manufacturing bases, shortening of product life cycles and globalization of market economies (Beamon, 1998 & 1999). All these factors had forced organizations to think towards integrating their supply chain processes as well as improving quality of the product so that they can survive in cut-throat competitive environment. Further, Gosain *et al.*, (2004-5) based on coordination theory explored how organizations by forging supply chain linkages enable offering and partnering flexibility to

deal with ubiquitous changes. Results of the study revealed that modular design of interconnected processes as well as structured data connectivity were related with higher supply chain flexibility. Another result of the study highlighted that coordination related knowledge was essential for supply chain flexibility implementation. At last, organizations must share broad range of information with their supply chain partners for achieving enhanced supply chain flexibility which would result in further achieving superior customer satisfaction.

In an another study on flexibility, Swink *et al.*, (2005) proposed and validated a conceptual framework that suggested that strategy integration and manufacturing capabilities acts as intermediaries by which manufacturing practices affects market-based performance. Analysis results suggested that strategy integration played a critical role in enhancing of manufacturing cost efficiency and new product flexibility. Moreover, the moderating role of strategy integration was noticed among manufacturing capabilities constructs and process quality management practices on certain manufacturing capabilities. Whereas, mediating role of manufacturing cost effectiveness and new product flexibility capabilities was observed between strategy integration and market-based performance. This highlighting that flexibility and customer satisfaction are considered vital constructs of supply chain performance.

Yang *et al.*, (2007) investigated relationship between supplier collaboration and manufacturing flexibility. Results suggested that not all supplier collaborative activities contributed equally to development of different types of manufacturing flexibility. The study also suggested that for improving quality of product it was required to focus on those supplier collaborative activities that impact manufacturing flexibility. With changing market dynamics and focus on supplier flexibility issues in manufacturing system, Chan *et al.*, (2009) offered a simulation study on increase in suppliers' flexibility level in relation to information system automation level of the supply chain. Organizational management with respect to suppliers' flexibility level would be in a position to identify physical characteristics of the alternative suppliers and hence improve their overall delivery lead-time of their supply chain system. The improve delivery lead-time would help in improving the customer satisfaction. The discussion highlighting that flexibility and customer satisfaction must be considered as an important supply chain flexibility performance measure.

Mellat-Parast & Spillan (2014) utilized two theoretical views, resource-based view and transaction cost economic theory, to explore effectiveness of logistics and supply chain integration on manufacturing firm's competitiveness. The authors suggested that logistics and supply chain strategy acted as a driver of logistics and supply chain integration for achieving firm competitiveness. Results of the study indicated that main driver of logistics and supply chain integration, and logistics decision was logistics/supply chain strategy. The logistics/supply chain strategy considered flexibility and customer satisfaction as vital constructs. Whereas, logistics/supply chain process integration was considered as the most significant predictor of manufacturing firm's competitive positioning. Shah & Sharma (2014) had tried to explore the relationship among the constructs of logistics flexibility and customer satisfaction. Result of the study had suggested that for increasing organizational supply chain performance, customer responsiveness and flexibility were the keys to respond to market volatility and uncertainty.

Lin & Tseng (2016) had adapted a hierarchical structure and linguistic preference for identifying competitive priorities under sustainable supply chain management. Result of the study suggested that innovation is a top priority for all sustainable supply chain management aspects. The study suggested that flexibility and customer satisfaction impacts the innovation initiatives of organizations focusing to improve their supply chain performance.

Discussed studies had investigated individual impact of quality management and process integration on supply chain performance measures but lack to consider their combined impact on supply chain performance measures (upstream supply chain flexibility and customer satisfaction). Therefore, this thesis has directed its research direction towards identification of the mediating impact of process simplification on the relationship between quality management and process integration constructs (top management commitment and supplier relationship management), and supply chain performance measures (upstream supply chain flexibility and customer satisfaction).

## ***2.8 Linking Quality Management and Process Integration***

The above discussion had clearly suggested that quality management and process integration had been considered as an individual approaches for improving the supply chain performance

of organizations. Literature has yet to discuss quality management and process integration as a collective approach for improving the supply chain performance. Thereby, there is a requirement to have an emphasized focus on linking quality management and process integration as a collective approach for improving the supply chain performance of manufacturing organizations.

Kuei *et al.*, (2005) verified an association between quality management and supply chain competence. They considered supplier partnership in terms of quality and integration as a major construct representing quality management. Results highlighted that some firms with quality management initiative and supply chain competence tend to perform better in terms of customer service and product quality. Discussed results highlighted on the role of process integration in quality management. The study limits to highlight the role of supplier collaboration in improvising manufacturing flexibility.

Yang *et al.*, (2007) investigated relationship between supplier collaboration and manufacturing flexibility in motherboard industry. Most importantly, Yang *et al.*, (2007) found that not all supplier collaborative activities contributed equally to development of different types of manufacturing flexibility. The study also suggested that for improving quality of product it was required to focus on those supplier collaborative activities that impact manufacturing flexibility. These activities could involve integrated supply chain processes and thus highlighting the requirement for considering quality management and process integration as a single approach.

Sanchez-Rodriguez & Hemsworth (2004) examined and validated the impact of quality management in purchasing and its effect on purchasing operational performance and internal customer satisfaction. The study suggested that quality management was considered to be a vital input for improving purchasing operational performance and internal customer satisfaction. Further, Hemsworth *et al.*, (2008) investigated effect of quality management in purchasing on related information systems practices and their combined effect on purchasing performance. Results of the study suggested that quality management in purchasing impacts information sharing practices and there exists a combined impact of quality management practices in purchasing and information sharing practices on purchasing performance. Thus,

this study highlighted the importance of considering quality management and process integration for improving purchasing performance.

Researchers had also investigated role of quality management in wood industry. Espinoza *et al.*, (2010) through a case study approach reported first in-depth investigation of quality measurement from a supply chain perspective. Results of the study revealed improvements with respect to supplier quality management. It was being suggested by authors that poor quality impacts customer satisfaction and hurts profitability. Espinoza *et al.*, (2010) extended the study and developed a five-step method to develop performance measures. This approach facilitated collaboration between supply chain partners and provided information that allowed a more efficient focus on improvement projects. It was being concluded that companies that wanted to integrate their suppliers and customers could benefit from information presented in this research. Discussed researches highlighted the need for using quality management and process integration for improving organizational performance.

Further, literature review study by Chan & Chan (2010) emphasized on to relate coordination among supply chain members regarding supply chain dynamics. Out of varied list of papers, more than hundred papers were selected for review. Results concluded that even though simulation was useful in many facets of supply chain studies still analytical approaches were widely accepted tool, especially for well-defined problems. Most of the proposed methodologies didn't consider flexibility in coordination methodologies. Even most of the studies had not taken quality management and process integration as a collective approach to deal with flexibility problems. Hence, this gap in literature will be presented by this thesis. In another literature review study by Akyuz & Erkan (2010) a critical supply chain performance measurement review was provided. This review study covered articles coming from major journals and was aimed at revealing basic research methodologies/approaches and improvements in performance management. The study covered a broad base of articles lying at the intersection of supply chain, information technology, performance measurement and business process management. Authors after screening list of journals mainly focused on how to improve supply chain performance in new era. The article concluded by stating that there was further requirement to study topics covering framework development, empirical cross-industry research and adoption of performance measurement systems for improvement

of supply chain performance. Thus, this thesis recommended the requirement of a new framework to cover the gap in existing literature.

Das (2011) introduced a new approach by integrating quality management systems with strategic level global supply chain planning model. This new approach enabled organizations to deal with problems related to product recall risks that arise from quality and safety-related product failure. Complex operations of global supply chain in a multi-product, multiple plants and multilayered supplier situation were considered to develop a quality management system based supplier affiliation and plant approval process. Then authors effectively integrated the developed quality management system based supplier affiliation and plant approval process in a mixed integer programming based strategic global decision model. The study used assumed mathematical example to explain entire model functioning in global environment. Moreover, this study lacked to cover validity of the proposed model with respect to real data from the organizations. Overall, study used a combined approach of quality management and process integration to improve global supply chain issues. But this paper also lacks to cover how quality management and process integration by simplified processes improves upstream supply chain flexibility.

Talib *et al.*, (2011) highlighted similarities and potential benefits between quality management and supply chain management. Study suggested that quality management and supply chain management had common goals covering strengthening organizational competitiveness and customer satisfaction. Approach of quality management emphasized internal participation where as supply chain management emphasized external participation. The study proposed that there were number of benefits associated with integration of quality management and supply chain management covering ability to improve customer responsiveness, supply chain communications, continuous improvement and innovation, and commitment of top management towards continuous change. The study results highlight on the requirement for linking quality management and process integration for improving supply chain performance.

Wu *et al.*, (2014) proposes a novel research model that covered four key social exchange issues; trust, commitment, reciprocity and power; to be considered as antecedents of information sharing and collaboration for improving supply chain performance. Analysis

results validated that all social exchange issues had an impact on information sharing and collaboration. Whereas, authors suggested a partial mediation impact of information sharing and collaboration on supply chain performance. The partial mediation impact emphasizes that there are other constructs that impact the supply chain performance. Authors suggested that as their research was targeted at combination of various industries therefore, future research could target a particular industry. As a result, this thesis fill these gaps in the literature by investigating the mediating impact of process simplification on the relationship between quality management and process integration, and supply chain performance of automotive organizations.

Azizi *et al.*, (2016) validated the impact of knowledge management practices on quality management and competitive advantage. This study considered top management commitment and supplier relationship management as vital quality management constructs and highlighted on the requirement of taking quality management and process integration for achieving competitive advantage. But the study wasn't able to consider the role of simplified processes in improving the organizational supply chain performance. This thesis has tried to verify the mediating impact of process simplification on the relationship between constructs of quality management and process simplification, measures of supply chain performance. Description and supporting references of constructs are presented in Table 2.

**Table 2: Research constructs description and supporting references**

<b>Constructs</b>	<b>Description</b>	<b>Supporting References</b>
Supplier Relationship Management (SRM)	Supplier selection based on cost, quality and integration; Supplier development; length of the relationship.	Rao <i>et al.</i> , (1997); Samson & Terziovski (1999); Soderquist & Motwani (1999); Scannell <i>et al.</i> , (2000); Sun (2000); Wong (2000); Ho <i>et al.</i> , (2001); Tan & Sia (2001); Quazi <i>et al.</i> , (2002); Romano (2002); Bandyopadhyay & Sprague (2003); Dasgupta (2003); Kayank (2003); Lai (2003); Lee <i>et al.</i> , (2003); Tatikonda & Stock (2003); Barratt (2004); Wang <i>et al.</i> , (2004); Bandyopadhyay (2005); Flynn & Flynn (2005); Kuei <i>et al.</i> , (2005); Lai <i>et al.</i> , (2005); Nair (2006); Srinivasan & Brush (2006); Yang <i>et al.</i> , (2007); Dedrick <i>et al.</i> , (2008); Lambert & Ouedraogo (2008); Carmignani (2009); Hsu <i>et al.</i> , (2009); Lin (2009); Jayaram <i>et al.</i> , (2010); Park <i>et al.</i> , (2010); Wu & Wong (2010); Zakuan <i>et al.</i> , (2010); Datta & Christopher (2011); Li <i>et al.</i> , (2011); Talib <i>et al.</i> , (2011); Das (2011); Qi <i>et al.</i> , (2011); Xie <i>et al.</i> , (2011); Vanichchinchai & Igel (2011); Gimenez <i>et al.</i> , (2012); Khan <i>et al.</i> , (2012); Whitten <i>et al.</i> , (2012); Zu & Kayank (2012); Perols <i>et al.</i> , (2013); Al-Abdallah <i>et al.</i> , (2014); Luthra <i>et al.</i> , (2014); Tseng (2014); Wu <i>et al.</i> , (2014); Hashemi <i>et al.</i> , (2015); Pérez-Aróstegui <i>et al.</i> , (2015); Azizi <i>et al.</i> , (2016); Lin & Tseng (2016); Luthra <i>et al.</i> , (2016); Weingarten <i>et al.</i> , (2016); Dubey <i>et al.</i> , (2017)
Top Management Commitment (TMC)	Commitment to motivate employees for producing quality product using integrated processes.	Kanji & Wong (1998); Joseph <i>et al.</i> , (1999); Samson & Terziovski (1999); Kim and Narasimhan (2002); Kayank (2003); Lai (2003); Prajogo & Sohal (2003); Tatikonda & Stock (2003); Lau <i>et al.</i> , (2004); Flynn & Flynn (2005); Gosain <i>et al.</i> , (2004-5); Lai <i>et al.</i> , (2005); Li <i>et al.</i> , (2005); Petersen <i>et al.</i> , (2005); Nair (2006); Lo <i>et al.</i> , (2007); Foster & Ogden (2008); Rahman (2008); Rodriguez <i>et al.</i> , (2008); Arauz <i>et al.</i> , (2009); Hsu <i>et al.</i> , (2009); Melnyk <i>et al.</i> , (2009); Hafeez <i>et al.</i> , (2010); Kahnali & Taghavi (2010); Lee <i>et al.</i> , (2010); Ou <i>et al.</i> , (2010); Zakuan <i>et al.</i> , (2010); Cao & Zhang (2011); Das (2011); Datta and Christopher (2011); Ramanathan <i>et al.</i> , (2011); Talib <i>et al.</i> , (2011); Vanichchinchai & Igel (2011); Zang & Wong (2011); Deshpande (2012); Kim <i>et al.</i> , (2012); Khan <i>et al.</i> , (2012); Sukati <i>et al.</i> , (2013); Lin (2014); Luthra <i>et al.</i> , (2014); Wu <i>et al.</i> , (2014); Luthra <i>et al.</i> , (2015); Ralston <i>et al.</i> , (2015); Azizi <i>et al.</i> , (2016); Lee <i>et al.</i> , (2016); Lin & Tseng (2016); Luthra <i>et al.</i> , (2016); Dubey <i>et al.</i> , (2017)
Process Simplification (PS)	Simplifying processes to reduce redundant and complex processes.	Bowersox <i>et al.</i> , (2003); Rodrigues <i>et al.</i> , (2004); Hoole (2005); Chen <i>et al.</i> , (2006); Fawcett <i>et al.</i> , (2007); Chen <i>et al.</i> , (2009); Chen <i>et al.</i> , (2009); Martin & Patterson (2009); Cigolini <i>et al.</i> , (2011); Marley <i>et al.</i> , (2014); Wu <i>et al.</i> , (2014); Jeon <i>et al.</i> , (2015); Prawira <i>et al.</i> , (2017)
Upstream Supply Chain Flexibility (USCF)	The responsiveness of the upstream supply chain system to deal with variations in demand.	Beamon (1999); Gosain <i>et al.</i> , (2004-5); Swink (2005); Yang <i>et al.</i> , (2007); Chan <i>et al.</i> , (2009); Vanichchinchai & Igel (2011); Whitten <i>et al.</i> , (2012); Mellat-Parast & Spillan (2014); Wiengarten <i>et al.</i> , (2016)
Customer Satisfaction (CS)	Satisfaction with respect to finished product performance; strengthen long-term relationship with the customer	Romano (2002); Flynn & Flynn (2005); Chan <i>et al.</i> , (2009); Ou <i>et al.</i> , (2010); Talib <i>et al.</i> , (2011); Vanichchinchai & Igel (2011); Ellinger <i>et al.</i> , (2012); Yu <i>et al.</i> , (2013); Mellat-Parast & Spillan (2014); Shah & Sharma (2014); Lin & Tseng (2016); Dubey <i>et al.</i> , (2017)

## ***2.9 Research Gap***

The term transaction cost was first used by Coase (1937) to develop a theoretical framework for predicting when certain economic tasks were to be performed by firms and when they would be performed on markets. With changing market dynamics, Oliver E. Williamson (1981) came with theory of transaction cost economics (TCE). This theory emphasized on the fact that organizations must produce in bulk to gain economics of scale that would help firms in achieving better financial positioning. However, market trend had changed with respect to manufacturing of a product involving chain of firms and each firm having different production systems. Hence, firm's capability must concentrate on attaining competitive advantage instead of economics of scale.

Resource based view emphasized on firm's ability to attain competitive advantage by managing their resources in such a way, exploiting transaction specific investments, that it created a competitive barrier (Penrose, 1959; Wernerfelt, 1984). A firm might reach a sustainable competitive advantage by managing its heterogeneous set of resources and these resources couldn't be easily bought, transferred or copied which resulted in adding value to firm product (Barney, 1991; Barney, 1995). Further, organizational management must be committed to manage these heterogeneous set of resources. However, resource based view lacks to discuss role of leadership with respect to internal and external environment for managing heterogeneous set of resources and hence improving competitive positioning of organization.

A contingency theory is considered to be an organizational theory claiming there is no best way to organize a corporation, to lead a company or to make decisions. Instead, optimal course of action was contingent (dependent) upon internal and external situation (Fiedler, 1964). Thus, contingency theory of leadership emphasized that leader must be accepted and respected by its followers and also leader must have a great deal of authority and power. But, Scott (1981) in his book described contingency theory by stating that best way to organize depends on the nature of the environment to which the organizations must relate.

In this competitive environment, top management must simplify their processes to manage good relationship with their suppliers for managing firm's integrated processes. Highlighting

that top management commitment and supplier relationship management were important aspects that organizations must focus in order to improve their quality of product as well as integration among chain of organizations. This will enable organizations to gain competitive advantage. Researchers had treated top management commitment and supplier relationship management as vital constructs for both quality management and process integration.

With the rising global pressure for quick production and delivery of automobiles, automotive organizations were responding by focusing on flexibility as an added dimension of their supply chain system. Flexibility might be defined as the ability to change or react within a limited period of time, effort and cost (Upton, 1994). Specifically in the supply chain context, Slack (1987) explained flexibility as the ability of the manufacturing system to respond to changes in product and volume. Thereby, having flexibility in the supply chain represents a potential source for improving organizational efficiency (Vickery *et al.*, 1999; Hoole, 2005; Weingarten *et al.*, 2015). Automotive organizations involved many external supply chain partners and it had been noticed that flexibility initiatives carried out by a chain of plants outperforms the flexibility initiatives of a single plant (Jordan & Graves, 1995). Therefore, it becomes quite critical to improve the flexibility initiatives of automotive organizations and its partners taken together as a single entity comprising the supply chain. The supply chain must have the capability to fill items in the product portfolio of the manufacturing plant from their respective suppliers in a timely and cost-effective manner, also referred to here as upstream supply chain flexibility. Researchers had recommended that automotive organizations that concentrated largely on process-based performance must focus more on upstream practices as compared to downstream practices of the supply chain (Guide & Wassenhove 2001; Vachon & Klassen, 2008). Researchers had also argued that customers change their buying decision(s) due to late delivery of automobile caused by problems with upstream supply chain flexibility (Scannell *et al.*, 2000). Hence, it becomes more pertinent to focus on upstream supply chain flexibility with respect to automotive organizations especially.

Upstream supply chain flexibility must have the capability to deal with various issues pertaining to manufacturing like the production of automobiles with varied specifications, delivery of variable size items on a frequent basis from suppliers and adjustment of

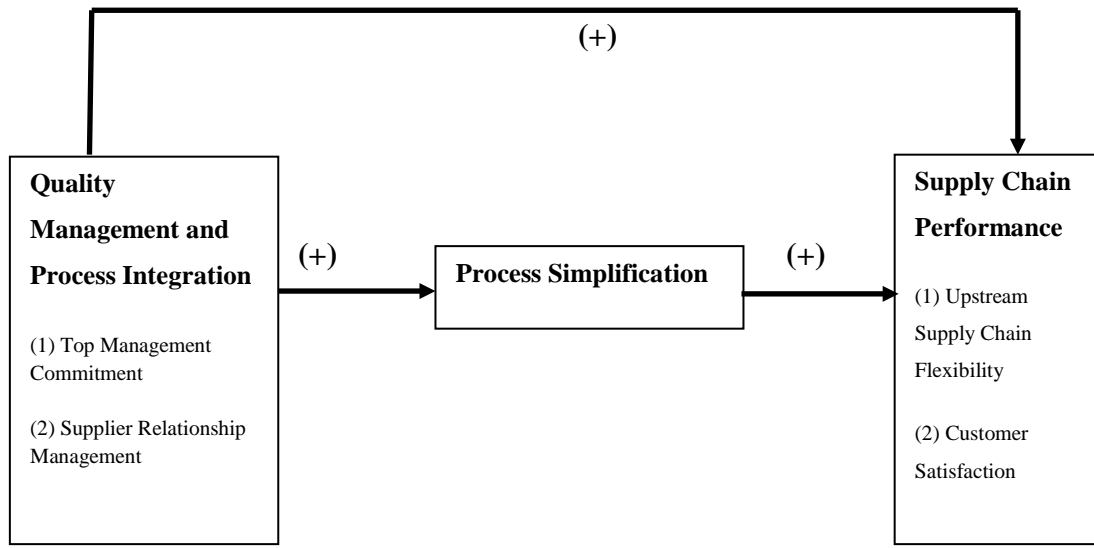
production capacity with respect to varying customers' demand. Thus, automotive organizations required integration of their diverse complex quality processes with that of their upstream supply chain partners to improve on the upstream supply chain flexibility issues. Process integration emphasized the unity of the entire supply chain processes by having a strategic focus on the optimization of the interactions between different nodes of the supply chain from the beginning of the concerned process rather than picking the processes and optimizing them separately (Barratt, 2004).

The researchers had stressed that top management commitment and supplier relationship were among the most important quality management and process integration constructs that impacts the organization(s) manufacturing performance (Gosain *et al.*, 2004-5; Chan *et al.*, 2009; Lee *et al.*, 2010). The customers always ask for a high quality manufactured product and manufacturing organizations were continuously striving to integrate themselves with their upstream supply chain partners in order to come out with a superior made quality product that fulfills the customer expectations. But the problem was that the end user expectations vary hugely with respect to time and therefore, it becomes the responsibility of the top management to ensure that the upstream supply chain system was flexible enough to deal with these significant variations in demand. One of the ways by which organizations may deal with these changes in demand is by simplifying their large number of upstream supply chain processes. Process simplification in general lexicon meant removing duplication in business processes (Chen *et al.*, 2009). Therefore, the organizations concentrating on simplification of integrated supplier quality processes would be in a position to improve the upstream supply chain flexibility.

It had to be emphasized here that most of the supply chain integration concepts have clearly recognized the existence of two flows throughout the chain, one being the information and other being the material(s) (Power, 2005; Prajogo & Olhager, 2012). The manufacturing organizations on the basis of information flow among their upstream supply chain partners were expecting the supply of high-quality material so that they can manufacture the requisite finer quality product for achieving customer delight (Kearney, 2013). This will make it quite critical for organizations to concentrate on continual improvement in their relationship with the suppliers for the quality flow of both material and information, resulting in improved

upstream supply chain flexibility (Flynn *et al.*, 2010; Gallear *et al.*, 2015). Manufacturing organizations management can achieve higher customer delight by integrating and then simplifying their quality processes with that of their upstream supply chain partners. The organizations by simplifying their supplier processes fulfill the production requirements that involve timely delivery of quality raw material, semi-finished parts and in-process parts to their manufacturing setup (Chan *et al.*, 2009; Chand *et al.*, 2015). Both researchers and corporate executives alike have focused on the fact that integrated and then simplified upstream supply chain processes lead to the removal of redundant manufacturing processes, reduction in complexity of the processes, lowering of operational cost as well as an increase in the manufacturing responsiveness (Hoole, 2005; Chen *et al.*, 2009; Peng *et al.*, 2016; Weingarten *et al.*, 2016). All these said benefits thereby might result in achieving the higher upstream supply chain flexibility.

The above discussion amply highlights the need to investigate the mediating role of process simplification in the relationship between constructs of quality management and process integration, and measures of supply chain performance. The presented study aims to explore the mediating role of process simplification on the relationship between two primary quality management and process integration constructs (top management commitment and supplier relationship) and supply chain performance measures (upstream supply chain flexibility and customer satisfaction) with respect to the Indian automotive sector. The conceptual framework is presented in Figure 3. The reason for choosing the automotive industry is two-fold. Firstly, as per various industry reports automotive industry must try to integrate its processes by having an emphasized focus to simplify its upstream supply chain processes (like vehicle development and manufacturing cycle) for attaining competitive advantage (Gutmann, 2015; Threlfall, 2016). Secondly, automotive sector is of vital importance to the Indian economy and an increased emphasis for its improvement will contribute to the growth of the country as a whole (CSO and MSPI, 2015).



**Figure 3: Conceptual Framework**

The proposed conceptual framework is now required to be validated in the Indian automotive sector. For doing so, there is a requirement to formulate the research design and select appropriate methodology. The following chapter of the thesis will cover research design and methodology. Main emphasis of the next chapter will be to elaborate on primary and secondary objectives, relationships among the constructs, collection of primary and secondary data and selection of statistical techniques to be used for validation of data.

## **CHAPTER III - RESEARCH DESIGN AND METHODOLOGY**

Focus of this chapter is to elaborate on the objectives, hypothesis development, data and statistical techniques to be used. Primary and secondary objectives of the study are discussed in the detail. Relationship among the constructs are formulated and presented in the form of hypothesis. Type of data and how it is being collected is discussed in detail. Lastly, the statistical techniques used highlights on which technique to be used for validation of collected data.

### ***3.1 Objectives***

The primary objective of the research is to study the impact of quality management and process integration on supply chain performance in Indian automotive industry. Based on the above discussed primary objective, sub-objectives of the study are further stated as:

- a) To identify the factors affecting Quality Management and Process Integration in supply chain.
- b) To develop a conceptual framework of Quality Management and Process Integration for improving the supply chain performance of automotive organizations.
- c) To empirically validate the developed conceptual framework.

First sub-objective has been achieved through an extensive literature review chapter which resulted in identification of top management commitment and supplier relationship management as vital constructs of quality management and process integration. The literature review also suggested that upstream supply chain flexibility and customer satisfaction are measures of supply chain performance. It has been proposed that process simplification possesses a mediating impact on the relationship between quality management and process integration constructs and supply chain performance measures.

### ***3.2 Hypotheses Development***

Customers are always demanding for a high quality manufactured product and organizations strive continuously to integrate themselves with their upstream supply chain partners in order

to come out with a superior made quality product (Chen *et al.*, 2009; Azizi *et al.*, 2016). But the problem is that the end user expectations vary hugely with respect to time. Thus, it becomes the responsibility of top management to ensure that supply chain system is flexible enough to deal with these significant variations in demand. One of the most important way by which organizations deal with these changes in demand is by simplifying their large number of supply chain processes. Process simplification in general lexicon means removing duplication in business processes (Chen *et al.*, 2009).

For eliminating duplication of processes in manufacturing, it is very critical to identify and remove redundant elements within organizational and inter-organizational upstream processes so that these processes become more effective and efficient (Forhlich & Westbrook, 2001; Chen *et al.*, 2006). It becomes imperative for organizations to stick to standard operational policies and procedures for designing effective and efficient routines (Bowersox *et al.*, 1999). Standard operational policies and procedures further call for attention of organizational management of upstream supply chain partners towards inter-functional and inter-organizational unification and process standardization (Bowersox *et al.*, 2003). By doing so, organizational management can simplify their processes by reducing complexity to improve upstream supply chain flexibility and achieve customer satisfaction. Various researchers had made an attempt to improve supply chain flexibility of automotive organizations. Scannel *et al.*, (2000) considered flexibility issues of upstream supply chain as a primary measure for improving the competitive positioning. Sanchez & Perez (2005) treated flexibility of supply chain partners as a primary input to explore relationship between dimensions of supply chain flexibility and firm performance. Thun & Hoeing (2011) analyzed supply chain flexibility as a vital input to reduce supply chain risk. Lastly, Thome *et al.*, (2014) explored main effects of the flexible supply chain capabilities to improve firm performance. However, all these studies lack in exploring the mediating impact of process simplification on the relationship between quality management and process integration constructs (top management commitment and customer satisfaction), and supply chain performance measures (upstream supply chain flexibility and customer satisfaction).

Thus, it becomes imperative to simplify upstream supply chain processes for achieving customer satisfaction. The above discussion helped in formulating the following hypothesized relationships:

H<sub>1a</sub>: Top Management Commitment positively affects upstream supply chain flexibility.

H<sub>1b</sub>: Top Management Commitment positively affects customer satisfaction.

H<sub>1c</sub>: Top Management Commitment positively affects process simplification.

H<sub>1d</sub>: Process simplification positively affects upstream supply chain flexibility with respect to top management commitment.

H<sub>1e</sub>: Process simplification positively affects customer satisfaction with respect to top management commitment.

Manufacturing system consists of product and volume flexibility (Slack, 1987). With respect to supply chain, product flexibility concentrates on supply chain system's ability to manufacture new products or make modifications to the existing ones (Ramdas, 2003). For making the product as per the requirement of the customers, organizations are dependent on their suppliers for the supply of quality raw material (Romano, 2002; Arauz et al., 2009; Majumdar & Manohar, 2016). The customer satisfaction is very much dependent on fulfillment of customer requirement(s) and they vary with respect to time, so it becomes vital for the manufacturing organizations to have the flexible supply of material from their suppliers (Chan *et al.*, 2009; Soh *et al.*, 2016). It has been examined that supply chain's process integration scope is dependent on the supply chain management efforts for the enhancement in upstream supply chain flexibility (Jayaram *et al.*, 2010; Combe *et al.*, 2012). As a result, the manufacturing organization(s) management must concentrate on integrating and then simplifying their supplier processes for improving their product flexibility (as per the requirements of the manufacturing organizations) (Romano, 2002; Prajogo *et al.*, 2012).

For enhancing product flexibility, suppliers are required to manufacture as per product design and be flexible enough to cope up with any manufacturing changes in product design (Prajogo *et al.*, 2012; Yu *et al.*, 2013). One of the ways to manage changes in product design is by asking suppliers to invest significantly in their tooling and equipment for increasing their flexibility so that they meet manufacturing expectations (Arauz *et al.*, 2009). Accordingly, commitment from the manufacturing organizational top management is

required towards providing proper flow of information to their suppliers for improving their upstream supply chain flexibility and hence obtaining competitive advantage (Chen *et al.*, 2009; Soh *et al.*, 2016). The flow of information might ensure that duplication in processes is significantly reduced and processes are highly integrated and simplified. This might result in achieving improvised upstream supply chain flexibility and customer satisfaction. Therefore, we hypothesize the following relationships:

H<sub>2a</sub>: Supplier relationship management positively affects upstream supply chain flexibility.

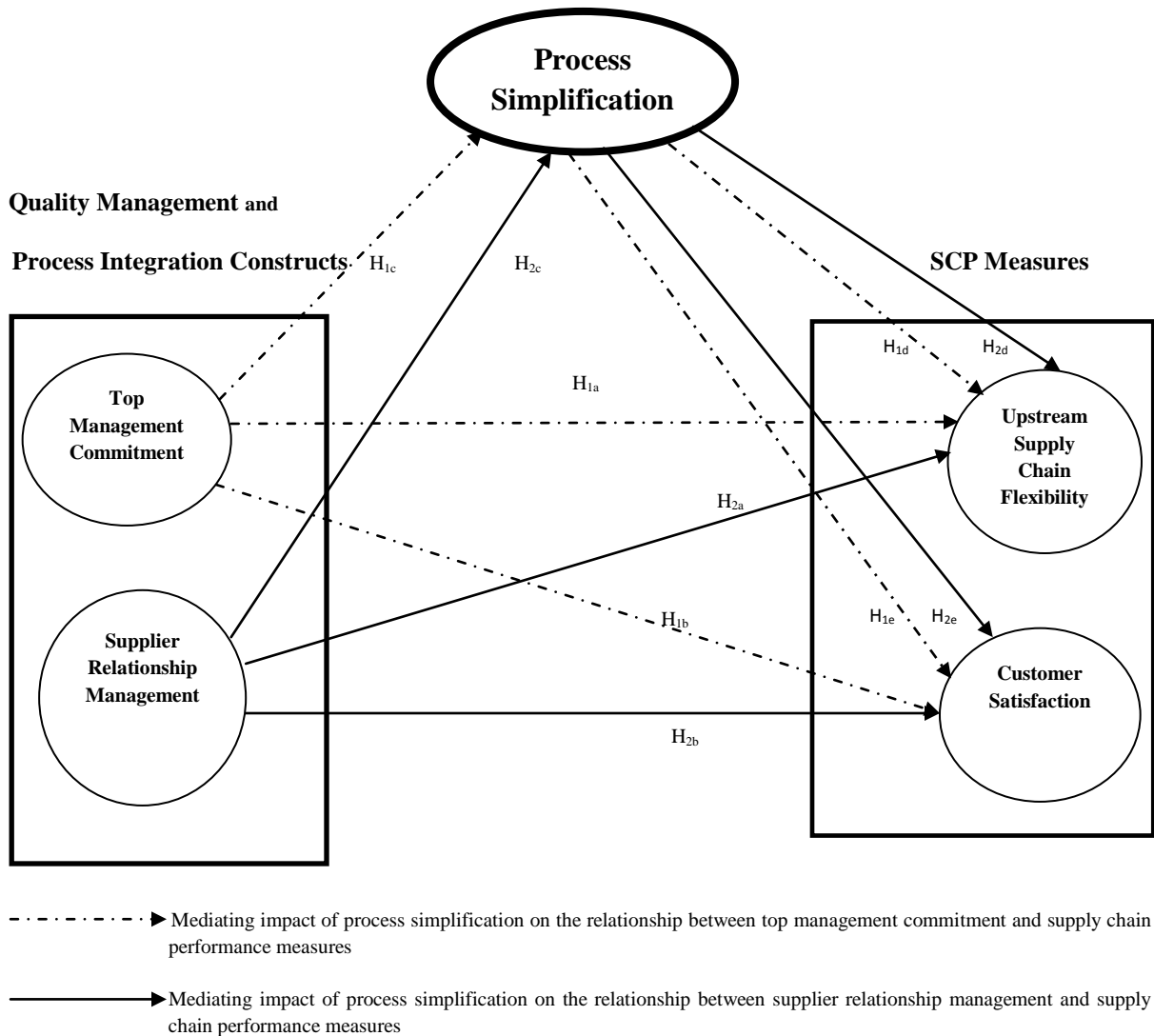
H<sub>2b</sub>: Supplier relationship management positively affects customer satisfaction.

H<sub>2c</sub>: Supplier relationship management positively affects process simplification.

H<sub>2d</sub>: Process simplification positively affects upstream supply chain flexibility with respect to supplier relationship management.

H<sub>2e</sub>: Process simplification positively affects customer satisfaction with respect to supplier relationship management.

Based on the above discussion research framework is formulated and presented in Figure 4 which satisfies the second sub-objective. It is clearly evident from Figure 4 that process simplification mediates relationship between quality management and process integration constructs and supply chain performance measures.



**Figure 4: Research framework**

### 3.3 Instrument Design

An instrument is required to be prepared for statistically validating the hypothesized relationships. Thus, an initial draft of the questionnaire items was prepared based on the extant literature in supply chain domain (Yong & Wilkinson, 2003; Fynes *et al.*, 2005; Lo *et al.*, 2007; Yang, 2008; Arauz *et al.*, 2009; Chen *et al.*, 2009; Jayaram *et al.*, 2010; Lee *et al.*, 2010; Qi *et al.*, 2011; Vanichchinchai & Igel, 2011; Whitten *et al.*, 2012). Ten automotive management executives were contacted for in-depth interviews to ensure that the constructs of interest and their relationships were consistent with industry practices. These meetings resulted in identification of relevant items for the constructs. After obtaining this valuable feedback, a draft was prepared and sent for feedback to select academicians with relevant

experience in the field. This ensured that instrument was in alignment with industry as well as academia. The process helped to ensure comprehensiveness, clarity, face validity and readability of the scales of the survey instrument. Based on the valuable feedback, questionnaire was further revised and finalized. Questionnaire items along with supporting references are presented in Table 3. The final questionnaire with demographic details and items is presented in Appendix I.

**Table 3: Research questionnaire with supporting references**

<b>Construct</b>	<b>Item No</b>	<b>Items</b>	<b>Supporting Reference</b>
<b>Supplier Relationship Management</b>	<b>SRM 1</b>	Shares quality improvement benefits and risks.	Vanichchinchai & Igel (2011)
	<b>SRM 2</b>	Periodically provides quality performance feedback to suppliers.	Yang (2008)
	<b>SRM 3</b>	Communicates clearly the product specifications and quality requirements to supply chain partners.	Yang (2008)
	<b>SRM 4</b>	Selects the supplier(s) based on their product flexibility performance (i.e. responsiveness to change processes according to the product design).	Qi <i>et al.</i> , (2011)
	<b>SRM 5</b>	Works with its supply chain partner's in teams to improve upon the overall supply chain flexibility.	Vanichchinchai & Igel (2011)
	<b>SRM 6</b>	Supply chain partners have made significant investments in their tooling and equipment for the improvement of organization's final product.	Fynes <i>et al.</i> , (2005)
	<b>SRM 7</b>	Committed to develop a long-term relationship with suppliers by improving their processes in long run.	Whitten <i>et al.</i> , (2012); Gimenez <i>et al.</i> , (2012)
	<b>SRM 8</b>	Creates supply chain management improvement teams that include members from its supply chain partner organizations for improvising its supply chain activities.	Jayaram <i>et al.</i> , (2010)
<b>Top Management Commitment</b>	<b>TMC 1</b>	Employees are responsible for inspection of their work quality.	Vanichchinchai & Igel (2011)
	<b>TMC 2</b>	Focuses at continuously improving supply quality of the product by making it as one of its organizational goal	Lo <i>et al.</i> , (2007).
	<b>TMC 3</b>	Places executives at the business facilities of its supply chain partners to facilitate collaboration.	Vanichchinchai & Igel (2011)
	<b>TMC 4</b>	In case of a mishap in supply chain, senior managers are committed to find out reason for the same.	Lee <i>et al.</i> , (2010)
	<b>TMC 5</b>	Top management encourages active participation of employees in the integrated production activities to assure quality.	Arauz <i>et al.</i> , (2009)
	<b>TMC 6</b>	Employees and suppliers understand that outcome of their work affects the work of their colleagues.	Yong & Wilkinson (2003)
	<b>TMC 7</b>	Employees are committed to protect the company's business related information as if it's their own.	Yong & Wilkinson (2003)
	<b>TMC 8</b>	Senior managers ensure that employees have access to the right tools, equipment and materials to get the job done.	Yong & Wilkinson (2003)

**Table 3: Research Questionnaire with Supporting References (cont...)**

<b>Construct</b>	<b>Item No</b>	<b>Items</b>	<b>Supporting Reference</b>
<b>Process Simplification</b>	<b>PS 1</b>	Ensures compatibility among all relevant business processes.	Chen <i>et al.</i> , (2009)
	<b>PS 2</b>	Puts effort in simplifying product design in order to reduce process complexity without sacrificing product functionality.	Chen <i>et al.</i> , (2009)
	<b>PS 3</b>	Common standards are used to link processes smoothly with its supply chain partners.	Chen <i>et al.</i> , (2009)
	<b>PS 4</b>	Regularly evaluates whether there are redundant activities within various processes across firms.	Chen <i>et al.</i> , (2009)
	<b>PS 5</b>	Ensures reduction in performing identical jobs by employees in various departments.	Chen <i>et al.</i> , (2009)
	<b>PS 6</b>	Employees aim to redesign work routines and processes for making them simpler.	Chen <i>et al.</i> , (2009)
<b>Upstream Supply Chain Flexibility</b>	<b>USCF 1</b>	Has the ability to produce products with varied specifications (viz features, options, sizes, colors and special specifications).	Vanichchinchai & Igel (2011)
	<b>USCF 2</b>	The supply chain has the ability to deliver shipments of variable sizes on a frequent basis to upstream supply chain partners.	Vanichchinchai & Igel (2011)
	<b>USCF 3</b>	Has the ability to rapidly adjust production capacity in response to changes in customer demand.	Vanichchinchai & Igel (2011)
	<b>USCF 4</b>	Supply chain processes has the ability to minimize safety stock throughout the supply chain.	Vanichchinchai & Igel (2011)
	<b>USCF 5</b>	The organization has a good overall delivery performance system.	Vanichchinchai & Igel (2011)
<b>Customer Satisfaction</b>	<b>CS 1</b>	Supply chain has the ability to deliver desired quality and quantity(s) to final customers	Vanichchinchai & Igel (2011)
	<b>CS 2</b>	Has a system to collect complaints on product quality aspects.	Vanichchinchai & Igel (2011)
	<b>CS 3</b>	Emphasizes on integrating business processes with its supply chain partners to create value for customers.	Vanichchinchai & Igel (2011)
	<b>CS 4</b>	Cooperates extensively with customers with respect to selection of quality processes for improvement in product design.	Vanichchinchai & Igel (2011)
	<b>CS 5</b>	Lays down roles, tasks, and responsibilities clearly to supply chain partners in order to create value for customers.	Vanichchinchai & Igel (2011)
	<b>CS 6</b>	Supply chain has the ability to respond quickly for solving problems of final customers.	Vanichchinchai & Igel (2011)
	<b>CS 7</b>	Collects and evaluates both formal and informal complaints through integrated processes for the satisfaction of its customers to strengthen long term relationships.	Vanichchinchai & Igel (2011)

### 3.4 Data

Primary and secondary data for the study is collected from the Indian automotive organizations. For collecting primary data, a research instrument was prepared and sent to three-hundred automotive organizations. Data was collected using snowball sampling technique. Reason for choosing snowball sampling was that respondents had given references of other respondents in automotive industry. Respondents includes top management executives of Indian automotive organizations covering chief executive officer's (CEO's), chief operational officer's (COO's), president's, vice-president's, supply chain manager's and quality manager's from the said organizations. Table 4 presents the respondent's profile and proportion of respondent designation. It is clearly evident from Table 4 that supply chain managers and quality managers represent the majority of responses. Reason for less response of CEO's, COO's, presidents and vice presidents is due to the fact that they have forwarded the research instrument to supply chain and quality managers of their respective organizations.

**Table 4: Proportion of respondent designation**

<b>Designation (Automotive Organization)</b>	<b>Number of Respondents</b>	<b>Respondent's Percentage</b>
Chief Executive Officer (CEO)	13	12.98%
Chief Operations Officer (COO)	5	04.55%
President	12	11.03%
Vice President	9	08.44%
Supply Chain Manager	31	29.87%
Quality Manager	35	33.13%

This study considers that the respondent is replying on behalf of the organization. Hence, the organization is considered the unit of analysis. Automotive organizations cover raw material supplier, component supplier and manufacturer. Table 5 presents descriptive statistics highlighting the position of the company in the upstream supply chain. It is clearly evident from Table 5 that manufacturers represents majority of the responses.

**Table 5: Descriptive statistics of the automotive organizations**

<b>Position of the company in the supply chain</b>	<b>Number of Automotive Organizations</b>	<b>Percentage of Automotive Organizations</b>
Raw Material Supplier	14	13.33
Component Supplier	25	23.81
Manufacturer	66	62.86

Finalized questionnaire captures organizational responses on a five-point Likert scale (1- Strongly Disagree, 5- Strongly Agree). Research instrument was distributed to the top management executives of three hundred automotive organizations across India via email, personal visits and through postal mails. Research team was able to collect one hundred thirty eight organizational responses of the top management executives of automotive organizations. After careful examination of these one hundred thirty eight responses, one hundred and five responses were found to be valid for further analysis. The reason for not selecting the other thirty three responses was due to wrong and incomplete response provided by the targeted respondents. Overall, response rate of the study is 35.00 percent which is acceptable in comparison with earlier studies (Hsu *et al.*, 2009; Wu *et al.*, 2014; Azizi *et al.*, 2016).

The secondary data in terms of average annual financial standalones of automotive groups for the period of 2012 to 2015 was taken from the PROWESS database in October, 2015. The reason for choosing period of 2012 to 2015 was due to the fact that data collection started in the year 2015 and the research team considered taking previous few years of financial data for ensuring the automotive market capture. PROWESS database is a well established database where researchers have extracted organizational financial data to support their hypothesis (Prasad & Ravinder, 2012; Elango & Pattnaik, 2013; Chittoor *et al.*, 2015). This thesis has considered automotive organizations listed in the PROWESS database that comprises of main automobile groups and ancillary units. The average annual financial standalones for automotive groups and ancillary units are presented in Table 6.

**Table 6: Average financial standalones of automotive organizations and ancillary units**

<b>Type of Organization</b>	<b>Total Average Financial Standalones (Rs. Millions)*</b>	<b>Average Financial Standalones (Rs. Millions)*</b>	<b>Percent Average Financial Standalones</b>
Automobile Organizations	74,65,064.3	48,78,307.5	65.35
Ancillary Units	37,01,642.2	19,74,045.5	53.33
Overall	111,66,706.5	68,52,353	61.36

\*Average financial standalones retrieved from PROWESS in October, 2015.

It is clearly evident from Table 6 that average financial standalones of automobile organizations are found to represent 65.35 percent of the market, whereas ancillary units represent 53.33 percent of the market share. Taken together, automotive organizations

financial standalones represents more than 60 percent of market share and is considered as representative of automotive market by the research team. Statistical techniques are now required to be selected and performed on the collected primary and secondary data to validate the hypothesized relationships.

### ***3.5 Statistical Techniques Used***

To satisfy the third sub-objective, research framework is required to be validated using available statistical tools. Validity and reliability of collected data is required to be checked before proceeding for statistical validation of the hypothesized relationships. Content validity of the research instrument is checked by taking feedback from the industry and academia. The data is then collected from automotive organizations. Reliability of the collected data is verified by performing reliability analysis in SPSS 21.0.

Reliability and validity of the research instrument motivated the research team to select available statistical tools for validation of the hypothesized relationships. Research instrument depicting the hypothesized relationships is statistically validated by ensuring predictive order of measured variables (Path Analysis) and measurement of latent factors (Factor Analysis). Thus, it is required to perform Confirmatory Factor Analysis (CFA) first for ensuring the model fit and then perform Structural Equation Modeling (SEM). Reason for not using Interpretive Structural Modeling (ISM) and Analytical Hierarchical Process (AHP) is due to the fact that the model is already built and ranking of the constructs is not required.

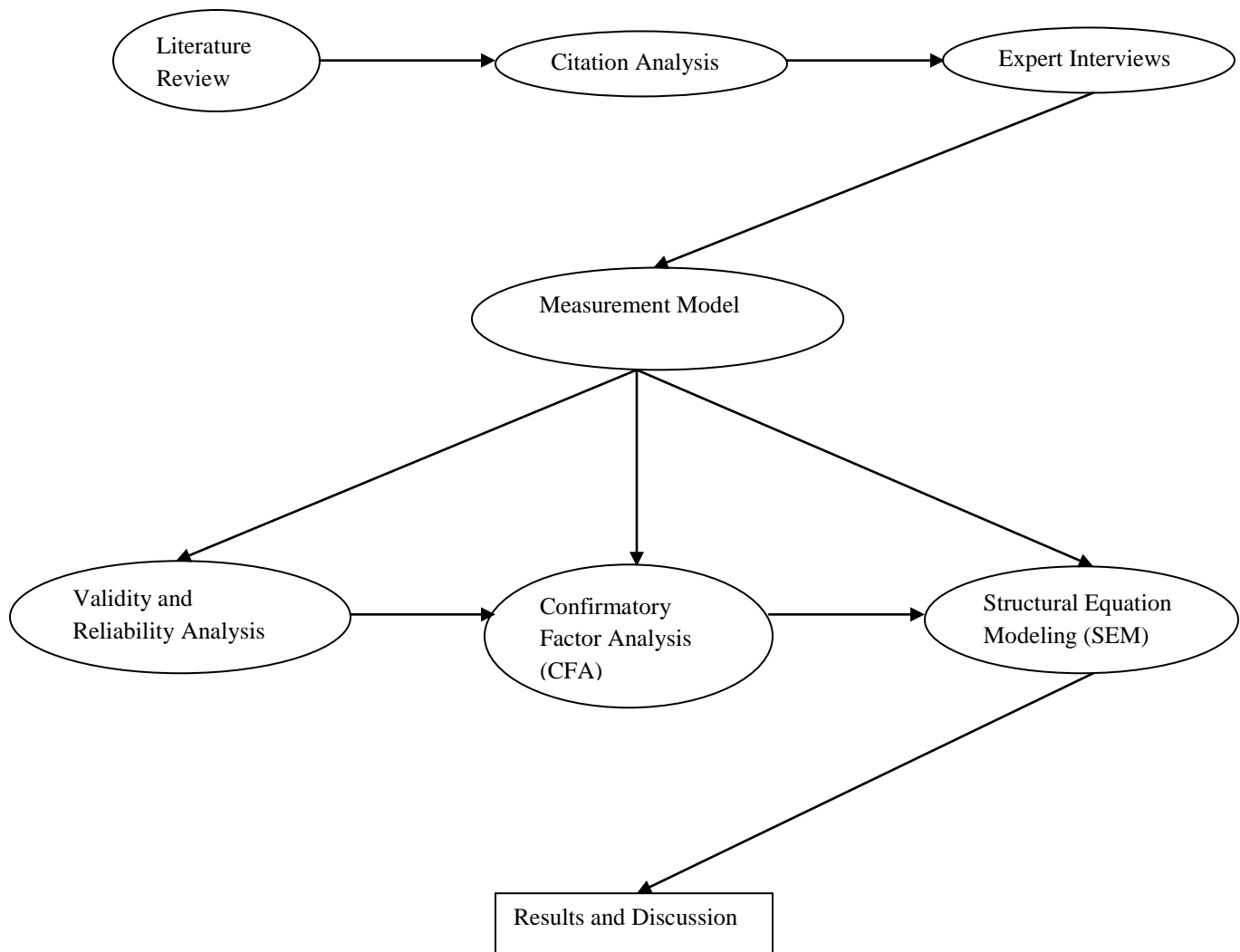
Confirmatory factor analysis is used to signify whether measures of the constructs are consistent with researcher's understanding of the nature of that construct that is data fits hypothesized measurement model (Hair *et al.*, 2010). Model fit measures are then obtained to assess how well the proposed model has captured covariance between items. Confirmatory factor analysis is limited in a form that it can only provide measurement model fit but will not be in a position to give relationships among latent variables. Moreover, confirmatory factor analysis models direct effects of factors on measured variables that is unable to deal with indirect effects (Nachtigall *et al.*, 2003; Hair *et al.*, 2010; Saldanha *et al.*, 2013). To measure the indirect affects, structural equation modeling is performed on fitted measurement model provided by confirmatory factor analysis.

Structural equation modeling ensures predictive order of measured variables along with measurement of latent factors. This measurement of latent factors will include the direct as well as the indirect effect measures. Moreover, structural equation modeling is a combination of path analysis, factor analysis as well as regression analysis (Nachtigall *et al.*, 2003; Hair *et al.*, 2010; Saldanha *et al.*, 2013) which is required for validation of the research framework.

Above discussion amply highlights the objectives of the study and the techniques to be used for validation of collected data from automotive organizations. To fulfill the discussed objectives, the subsequent chapter of the study will give attention on analyzing data and elaborating on validation of hypothesized relationships. For analyzing data validity and reliability analysis, correlation analysis, confirmatory factor analysis and structural equation modeling will be used. Validity and reliability analysis will focus on formulation of the research questionnaire, sampling techniques to be used, respondent's profile, organization's demographics, response rate for the study, and reliability analysis. Further, correlation analysis will signify correlation among the constructs of study. Whereas, confirmatory factor analysis will reflect on model fit. Lastly, structural equation modeling concentrates to validate the mediating impact of process simplification. Result of these analyses will be used to validate the hypothesized relationships.

## CHAPTER IV - ANALYSIS AND RESULTS

The research flow diagram depicting formation and validation of the measurement model is presented in Figure 5. It is clearly evident from Figure 5 that literature review, citation analysis and expert interviews helped in formation of the measurement model. Validity and reliability of measurement model is computed to ensure that instrument is valid and reliable. After confirming validity and reliability of the scale, confirmatory factor analysis is performed to confirm model fit. Model fit parameters ensured that model is a good fit. Result of the structural equation modeling validated the proposed hypothesis as well as the structural model. These results supported the mediating impact of process simplification on the relationship between quality management and process integration constructs; top management commitment and supplier relationship management; and measures of supply chain performance; customer satisfaction and upstream supply chain flexibility. Analysis results enriched literature in the form of a validated measurement and structural model that other researchers can use in other sectors. Managerial implications suggested by the study will help automotive organizational management in strategy formulation. The limitations and future scope of the study are presented for future researchers in the underlying area.



**Figure 5: Research flow diagram**

#### ***4.1 Reliability and Validity Analysis***

Finalized questionnaire was used for collecting data from automotive organizations. Data is collected on a five point Likert scale (1-Strongly Disagree, 5- Strongly Agree) from one hundred and five automotive organizations. The collected data is required to be reliable before proceeding for further analysis. Consequently, construct's Cronbach's alpha (Cronbach, 1951) is computed using SPSS version 21. Reliability analysis is performed on three sets of data covering pilot testing data set of 50 organizations, confirmatory factor analysis data set of eight organizations and structural equation modeling data set of hundred

and five organizations. Result of reliability analysis is presented in Table 7. It is clearly evident from Table 7 that value of Cronbach's alpha for each construct is found to be more than 0.7, which is acceptable as per the literature (Cronbach, 1951; Nunnally, 1971; Churchill, 1979; Arauz *et al.*, 2009; Hsu *et al.*, 2009; Gallear *et al.*, 2015; Soh *et al.*, 2016). Hence it can be concluded that the data set is reliable and can be tested for statistical validation of the hypothesized relationships. Before proceeding for the final testing it is also required to confirm the correlations among the constructs of the study. The significant correlations among the study constructs will help in ensuring that relationships among the constructs. Hence correlation analysis is required to be performed for confirming that constructs are significantly correlated.

**Table 7: Reliability analysis**

<b>Constructs of the study</b>	<b>Pilot Testing Dataset (50) Cronbach <math>\alpha</math></b>	<b>Confirmatory Factor Analysis (CFA) Dataset (80) Cronbach <math>\alpha</math></b>	<b>Structural Equation Modeling (SEM) Dataset (105) Cronbach <math>\alpha</math></b>
Top Management Commitment (TMC)	0.812	0.900	0.877
Supplier Relationship Management (SRM)	0.856	0.872	0.858
Process Simplification (PS)	0.885	0.875	0.890
Customer Satisfaction (CS)	0.842	0.861	0.842
Upstream Supply Chain Flexibility (USCF)	0.864	0.878	0.873

#### **4.2 Correlation Analysis**

The correlation coefficient measures linear association between the constructs of the study. It is a must that all the constructs of the study are significantly correlated for performing confirmatory factor analysis (Hair *et al.*, 2010). Correlation analysis is performed on the data using SPSS 21.0. Results depicting interrelationships between study constructs are represented in Table 8. Pearson correlation coefficient of top management commitment is significantly correlated with upstream supply chain flexibility (0.657,  $p < 0.01$ ) as well as customer satisfaction (0.648,  $p < 0.01$ ). It is also noticed from Table 8 that supplier relationship management's Pearson correlation coefficient is significantly correlated with both upstream supply chain flexibility (0.579,  $p < 0.01$ ) and customer satisfaction (0.556,  $p < 0.01$ ). Pearson correlation coefficient of process simplification is also found to be significantly correlated with upstream supply chain flexibility (0.530,  $p < 0.01$ ) and customer

satisfaction (0.613,  $p < 0.01$ ). Results depict that independent variables are significantly correlated with dependent variables at  $p < 0.01$ . It is also evident that top management commitment (0.559,  $p < 0.01$ ) and supplier relationship management (0.609,  $p < 0.01$ ) are significantly correlated to process simplification.

The above discussed results clearly signify that constructs are significantly correlated with each other. After confirming the correlation among the constructs confirmatory factor analysis is required to be performed to validate the model fit.

**Table 8: Mean, standard deviation and correlations**

	Mean	Standard Deviation (SD)	Upstream Supply Chain Flexibility	Customer Satisfaction	Top Management Commitment	Supplier Relationship Management	Process Simplification
Upstream Supply Chain Flexibility	4.1698	0.74283	1				
Customer Satisfaction	4.1971	0.61659	0.614**	1			
Top Management Commitment	4.3488	0.60070	0.657**	0.648**	1		
Supplier Relationship Management	4.0783	0.61921	0.579**	0.556**	0.567**	1	
Process Simplification	3.8857	0.74073	0.530**	0.613**	0.559**	0.609**	1

\*\* Pearson correlation is significant ( $p < 0.01$ ).

### 4.3 Confirmatory Factor Analysis

The confirmatory factor analysis was developed by Jöreskog (1969) to replace older methods of analyzing construct validity by analyzing whether the model is consistent with the researchers theory. Confirmatory factor analysis is used to significantly validate whether measures of the constructs are consistent with researcher's understanding of the nature of that construct. Specifically concentrating on whether data fits the hypothesized measurement model (Hair *et al.*, 2010). In other words, we can say that confirmatory factor analysis deals with the measurement model that includes relationship between observed measures and latent variables. Confirmatory factor models are commonly represented by path diagram. In a path diagram observed measures are presented by squares whereas latent variables are presented by circles. In other words, we can say that constructs are latent variables presented in a form

of circles and construct items are observed measures presented in a form of squares in path diagram.

Confirmatory factor analysis is used for various purposes covering psychometric evaluation, construct validation and scale development. For developing the scale, confirmatory factor analysis examines latent structure of test instrument by verifying number of underlying dimensions of the instrument and pattern of item-factor relationship. The model fit measures are then obtained to assess how well the proposed model has captured covariance between the items. The most common model fit measures include ratio of Chi-square and degree of freedom (CMIN/DF), Root Mean Residual (RMR), Goodness Fit Index (GFI), Adjusted Goodness Fit Index (AGFI), Tucker Lewis Index (TLI), Comparative Fit Index (CFI), Normed Fit Index (NFI), Root Mean Standard Error of Approximation (RMSEA) and HOELTER's Criterion.

The ratio of Chi-square and degree of freedom is commonly known as relative chi-square or normed chi-square. In AMOS Chi-square value is represented as CMIN. Hair *et al.*, (2010) suggested that the ratio must be close to one and must not be more than five for the measurement model to be acceptable. Researchers have argued that the ratio must not be more than three (Qi *et al.*, 2011; Zhu *et al.*, 2013). Thus, there is no exact higher limit for the ratio but it must be as close to one for acceptance of the measurement model.

Root mean residual (RMR) represents the difference between corresponding elements of observed and predicted covariance matrix. It must be as close to zero as possible for the measurement model to be considered as acceptable (Hair *et al.*, 2010). Researchers have suggested that ideally it must be less than 0.05 (Jackson *et al.*, 2009; Hair *et al.*, 2010; Saldanha *et al.*, 2013) and the upper confidence level must not exceed 0.8 (Hu & Bentler, 1998).

The measure of fit between the hypothesized model and the observed covariance matrix is suggested by goodness of fit index (GFI) (Jöreskog, 1969). Goodness of fit index is often reported as it is the first fit index proposed (Jöreskog, 1969). It explains the variance that can be explained by the measurement model. It ranges between zero to one and must be as close to one as possible (Jöreskog, 1969; Hair *et al.*, 2010). Researchers have suggested that the

value of goodness of fit index of 0.9 and above is generally considered as acceptable for the measurement model to be considered as a good fit (Jackson *et al.*, 2009; Hair *et al.*, 2010; Saldanha *et al.*, 2013). However, various researchers have also accepted the goodness of fit index value ranging from 0.8 to 0.9 due to low sample size (Lai *et al.*, 2002; Vickery *et al.*, 2003; Chiou *et al.*, 2011; Zhu *et al.*, 2013).

Adjusted goodness of fit index (AGFI) corrects the goodness of fit index as it gets affected by number of indicators of each latent variable (Jöreskog, 1969; Hair *et al.*, 2010). The value of adjusted goodness of fit index ranges from zero to one. Researchers have suggested that the adjusted goodness of fit index value of 0.8 and above is considered acceptable for the measurement model to be considered as a good fit (Jackson *et al.*, 2009; Hair *et al.*, 2010; Saldanha *et al.*, 2013). While various researchers have also accepted the adjusted goodness of fit index value ranging from 0.7 to 0.8 due to low sample size (Lai *et al.*, 2002; Vickery *et al.*, 2003; Chiou *et al.*, 2011; Zhu *et al.*, 2013).

Comparative fit index (CFI) compares the measurement model with the null model. Comparative fit index is also known as Bentler comparative fit index (Bentler, 1990). Specifically, comparative fit index compares the fit between measurement/target model and independence/null model. The fit refers to the difference between observed and predictive covariance matrices represented by chi-square index. Hence, it can be concluded that comparative fit index represents the ratio between discrepancy of the measurement/target model and independence/null model (Bentler, 1990). The comparative fit index value ranges from zero to one. Researchers have suggested that comparative fit index value must be close to one for considering the model fit (Lai *et al.*, 2002; Vickery *et al.*, 2003; Hair *et al.*, 2010; Chiou *et al.*, 2011; Zhu *et al.*, 2013). Moreover, researchers have emphasized that value of comparative fit index must be above 0.9 for considering the measurement model to good fit (Bentler, 1990; Lai *et al.*, 2002; Vickery *et al.*, 2003; Hair *et al.*, 2010; Chiou *et al.*, 2011; Zhu *et al.*, 2013).

Normed fit index (NFI) is commonly known as Bentler-Bonett fit index (Bentler and Bonett, 1980). Bentler and Bonett (1980) suggest that normed fit index varies from zero to one. The normed fit index is the ratio of the difference between chi-square of independence/null model and measurement/target model, and chi-square of independence/null model. Researchers

have suggested that the value of normed fit index must be above 0.9 for considering the measurement/target model as a good fit. The normed fit index value of 0.9 indicates that the model of interest improves the fit by ninety percent relative to the independence/null model. However, it is being suggested that for small sample size the fit is often underestimated.

The problem with Bentler-Bonett fit index is that there is no penalty for adding parameters. Tucker Lewis Index (TLI) covers this problem and ensures that there is a penalty of adding parameters (Tucker & Lewis, 1973). For computing the Tucker Lewis Index, Tucker and Lewis (1973) proposed the following steps:

- Divide chi-square of target model and null model by their corresponding degree of freedom values. This will generate relative chi-squares for each model.
- Calculate the difference between these relative chi-squares.
- Finally, divide the difference by the relative chi square for the null model minus 1.

Tucker Lewis index depends on the average size of the correlation in the data and if the average correlation between variables is not high than the value of Tucker Lewis index will also be low.

Root mean standard error of approximation (RMSEA) represents the relationship between chi-square, degree of freedom and sample size (Hair *et al.*, 2010). It is the most popular measure of model fit which is represented in almost every study of confirmatory factor analysis and structural equation modeling (Lai *et al.*, 2002; Vickery *et al.*, 2003; Hair *et al.*, 2010; Chiou *et al.*, 2011; Zhu *et al.*, 2013; Esfahbodi *et al.*, 2016). Researchers have suggested that root mean standard error of approximation ranges from 0 to 0.1 (MacCallum *et al.*, 1996). MacCallum *et al.*, (1996) have suggested that the root mean standard error of approximation values of 0.01, 0.05, and 0.08 signify excellent, good and mediocre fit. However, researchers have suggested the cutoff for poor fitting model as 0.10 (Qi *et al.*, 2009; Hair *et al.*, 2010; Chiou *et al.*, 2011; Qi *et al.*, 2011; Zhu *et al.*, 2013). For the measurement model considered as fit, the values of root mean standard error of approximation ranges from 0 to 0.10. The reasons for considering root mean standard error of approximation values more than 0.05 are lower sample size, degree of freedom and chi-square values (Jackson *et al.*, 2009; Hair *et al.*, 2010). As a result, studies with lower sample

size are expected to have root mean standard error of approximation value of more than 0.05 but less than 0.10.

Hoelter (1983) proposed a simple index (critical N) and tentative acceptance criterion, which, by focusing on sample size, provides an improved method for assessing goodness-of-fit. In other words the Hoelter index states the sample size at which the chi-square will be significant ( $\alpha = 0.05$ ). Indicating how small one's sample size will be for performing the confirmatory factor analysis.

Researchers in the supply chain domain have applied confirmatory factor analysis on a small data set of less than hundred and fifty (Lai *et al.*, 2002; Vickery *et al.*, 2003; Qi *et al.*, 2009; Chiou *et al.*, 2011; Qi *et al.*, 2011; Zhu *et al.*, 2013; Esfahbodi *et al.*, 2016). This thesis in alignment with these studies has used a data set of hundred and five organizational responses for validating the measurement model. This thesis has also ensured that substantial market of automotive sector is being covered by the collected data.

The research framework's model fit is tested using confirmatory factor analysis (CFA) in AMOS 21.0. The study considered a sample size of eighty for performing CFA on the basis of HOELTER's criterion (Hoelter, 1983). Instrument items are allocated as observed variables while the constructs of the study are named as unobserved variables. The initial confirmatory model is presented in Figure 6. The values of the initial parameters of model fit are presented in Table 9.

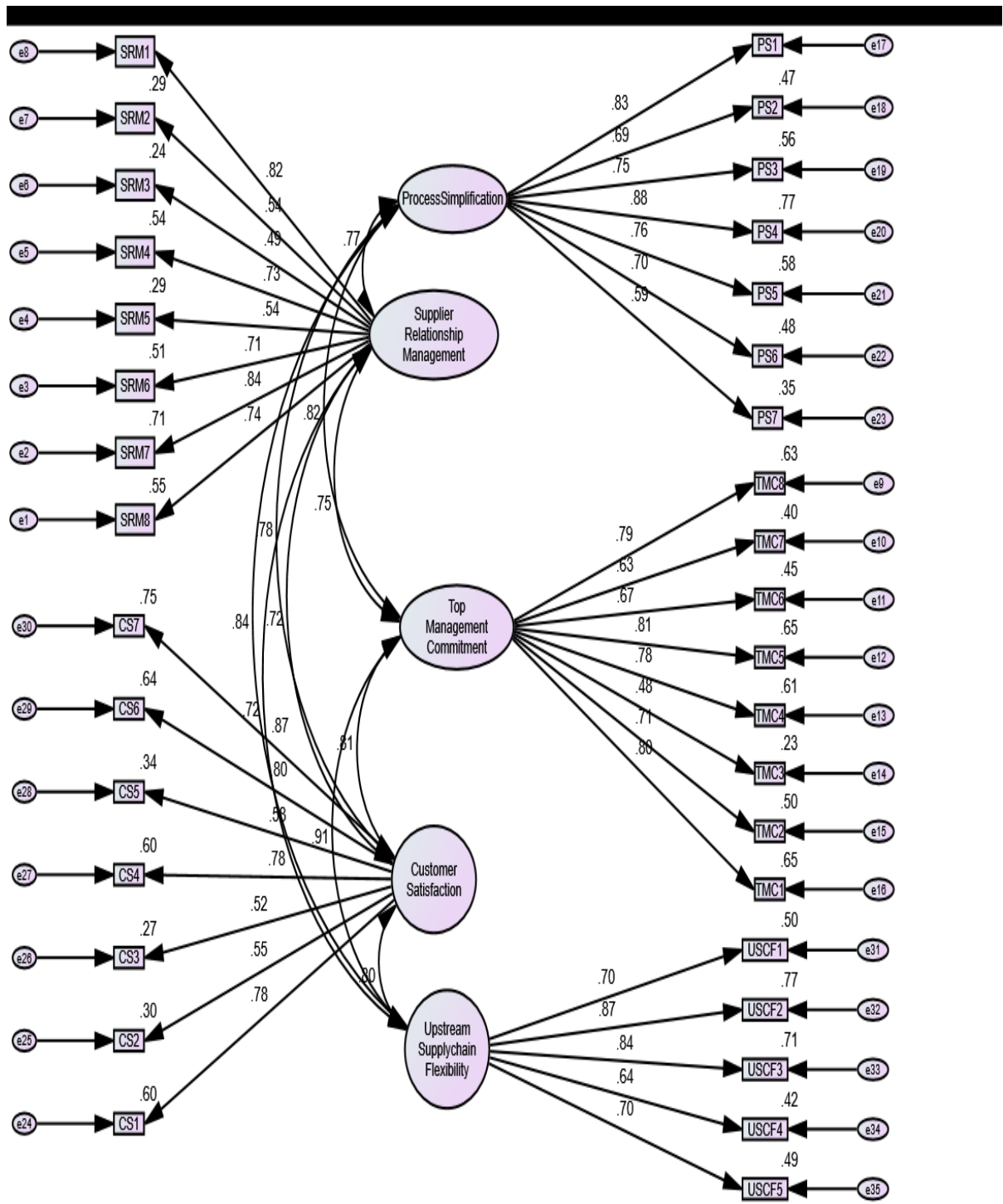


Figure 6: Initial confirmatory factor analysis model

**Table 9: Initial confirmatory factor analysis results**

Sr No	Parameters	Analysis Results	Acceptable Range
1	CMIN/DF	2.195	1-3
2	Root Mean Residual (RMR)	<b>0.071</b>	<0.05
3	Goodness Fit Index (GFI)	<b>0.565</b>	>0.90
4	Adjusted Goodness Fit Index (AGFI)	<b>0.502</b>	>0.80
5	Tucker Lewis Index (TLI)	<b>0.674</b>	>0.90
6	Comparative Fit Index (CFI)	<b>0.698</b>	>0.90
7	Normed Fit Index (NFI)	<b>0.565</b>	>0.90
8	Root Mean Standard Error of Approximation (RMSEA)	<b>0.123</b>	<0.05
9	HOELTER's Criterion (0.05)	80	40

It can be noticed from Table 9 that the values of Root Mean Residual (RMR) (0.071), Goodness Fit Index (GFI) (0.565), Adjusted Goodness Fit Index (AGFI) (0.502), Tucker Lewis Index (TLI) (0.674), Comparative Fit Index (CFI) (0.698), Normed Fit Index (NFI) (0.565), Root Mean Standard Error of Approximation (RMSEA) (0.123) represent a poor fit. Whereas chi-square and degree of freedom (CMIN/DF) (2.195) and HOELTER's Criterion (80, acceptable 40, 0.05) represent a good fit. Results presented in Table 8 represent a poor model fit. Hence, few items are required to be dropped for ensuring the measurement model fit. As per Figure 6, low item loadings of < 0.7 are required to be dropped for ensuring model fit (Jackson *et al.*, 2009; Hair *et al.*, 2010; Saldanha *et al.*, 2013). In case of supplier relationship management second, third and fifth item have lower factor loadings of 0.54, 0.49 and 0.54 respectively. Hence, these items will be dropped from the final measurement model. These items include quality performance feedback to suppliers, communicating product specification and quality requirements to suppliers and working with supply chain partners to improve the overall supply chain flexibility. Reason for dropping of the second and third items is due to the fact that they have been covered by the first item of supplier relationship management that states shares quality improvement benefits and risks. Lastly, the item working with supply chain partners to improve the overall supply chain flexibility is dropped due to the fact that it has been covered by the fourth item of supplier relationship management that selects the supplier(s) based on their product flexibility performance (i.e. responsiveness to change processes according to the product design).

As per Figure 6, top management commitment's third (0.48), sixth (0.67) and seventh (0.63) items represent lower factor loading and hence are dropped. Third, sixth and seventh item includes places executives at the business facilities of its upstream supply chain partners to

facilitate collaboration, employees and suppliers understand that outcome of their work affects the work of their colleagues and employees are committed to protect the company's business related information as if it's their own respectively. Reason for dropping of third item is due to the fact that it has been covered by the fifth item of top management commitment that states top management encourages active participation of employees in the integrated production activities to assure quality. Reason for dropping the sixth and seventh items is due to the fact that it has been covered by the first item of top management commitment that measures employees are responsible for inspection of their work quality.

Process simplification's second (0.69) and seventh (0.59) items are dropped due to low factor loadings. These items cover puts effort in simplifying product design in order to reduce process complexity without sacrificing product functionality and through their supplier's quality certification(s), processes like source inspection, receiving inspection and count verification are eliminated or reduced. Reason for dropping the second item is because it is being covered by the sixth item of process simplification that measures employees aim to redesign work routines and processes for making them simpler. Whereas, seventh item is being measured by the fourth item of process simplification which states regularly evaluates whether there are redundant activities within various processes across firms.

The fourth item (0.64) of upstream supply chain flexibility is dropped due to low factor loading. This item covers supply chain process ability to minimize safety stock throughout the supply chain. Reason for dropping this item is due to the fact that it is being measured by the second item of upstream supply chain flexibility that states the supply chain ability to deliver shipment of variable sizes on a frequent basis to upstream supply chain partners.

The second (0.55), third (0.52) and fifth (0.58) items of customer satisfaction has also been dropped due to low factor loadings. These items covers systems ability to collect customer complains, emphasizes on integrating business processes with its supply chain partners to create value for customers and lays down roles, tasks, and responsibilities clearly to supply chain partners in order to create value for customers. Reason for dropping the second item is due to the fact that it is being covered by the item seventh item of customer satisfaction that emphasized on collecting and evaluating both formal and informal complaints for the satisfaction of its customers to strengthen long term relationships. Lastly, the third and fifth

items are being covered by the fourth item of customer satisfaction that measures cooperates extensively with customers with respect to selection of quality processes for improvement in product design. After dropping items with lower factor loadings, confirmatory factor analysis was performed again. Figure 7 represents the second iteration results of the measurement model and Table 10 represents the measurement model fit parameters results.

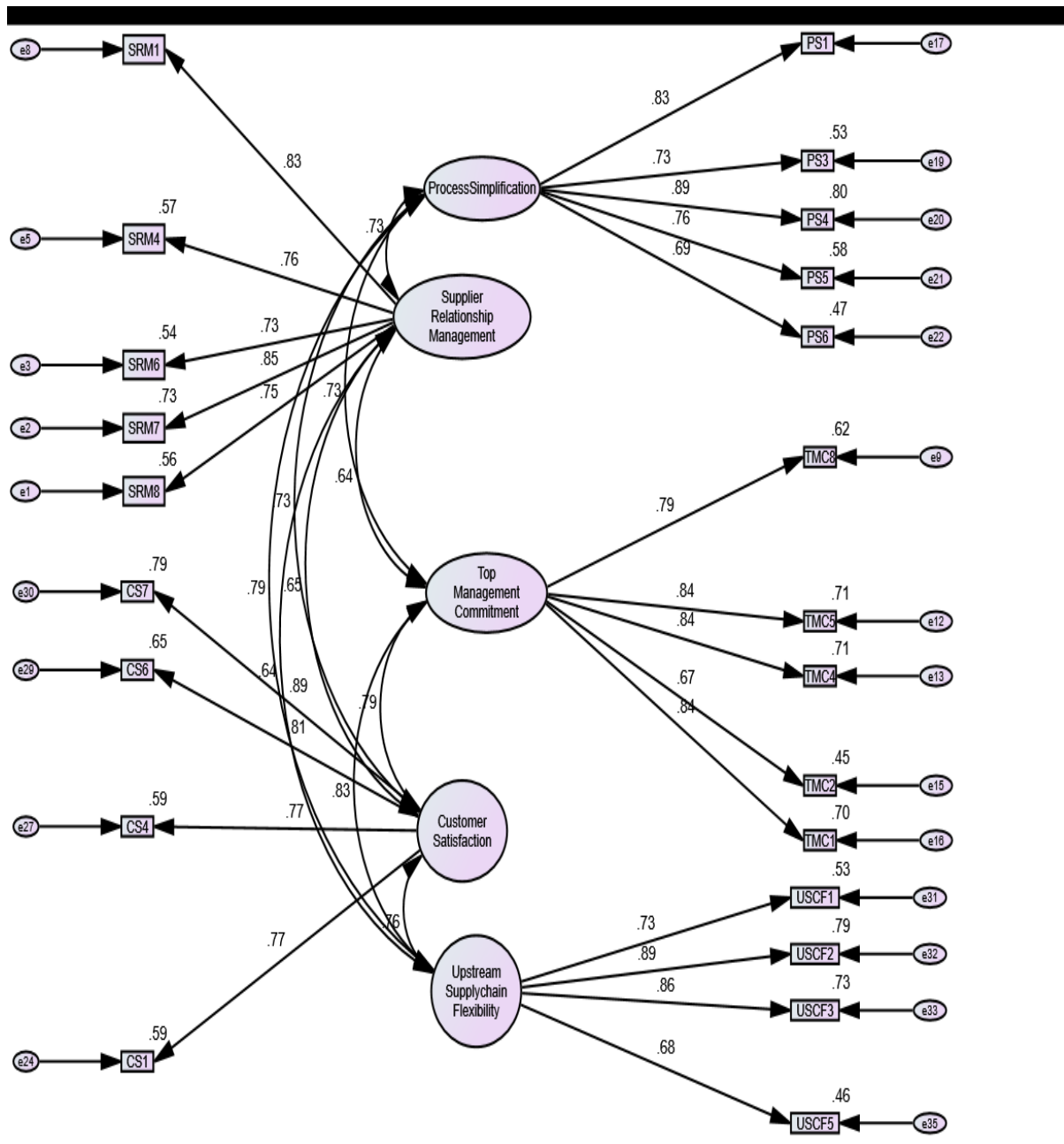


Figure 7: Second iteration confirmatory factor analysis model

**Table 10: Second iteration results using confirmatory factor analysis**

Sr No	Parameters	Analysis Results	Acceptable Range
1	CMIN/DF	1.862	1-3
2	Root Mean Residual (RMR)	<b>0.051</b>	<0.05
3	Goodness Fit Index (GFI)	<b>0.713</b>	>0.90
4	Adjusted Goodness Fit Index (AGFI)	<b>0.640</b>	>0.80
5	Tucker Lewis Index (TLI)	<b>0.842</b>	>0.90
6	Comparative Fit Index (CFI)	<b>0.863</b>	>0.90
7	Normed Fit Index (NFI)	<b>0.749</b>	>0.90
8	Root Mean Standard Error of Approximation (RMSEA)	<b>0.104</b>	<0.05
9	HOELTER's Criterion (0.05)	80	50

It can be noticed from Table 10 that the values of Root Mean Residual (RMR) (0.051), Goodness Fit Index (GFI) (0.713), Adjusted Goodness Fit Index (AGFI) (0.640), Tucker Lewis Index (TLI) (0.842), Comparative Fit Index (CFI) (0.863), Normed Fit Index (NFI) (0.749), Root Mean Standard Error of Approximation (RMSEA) (0.104) represent parameters which are very close to a good fitted measurement model. Whereas, chi-square and degree of freedom (CMIN/DF) (1.862) and HOELTER's Criterion (80, acceptable 50, 0.05) represent a good fit. Hence few more items are required to be dropped for ensuring the measurement model fit. As per Figure 7, low item loadings of < 0.7 are required to be dropped for ensuring model fit (Jackson *et al.*, 2009; Hair *et al.*, 2010; Saldanha *et al.*, 2013). The second item (0.67) of top management commitment covering measure focus on continuous improvement of supply quality is being dropped. Reason for dropping this item is due to the fact that it is being covered under the fifth item of top management commitment that states that top management encourages active participation of employees in the integrated production activities to assure quality.

The standardized residual covariances are checked to see the covariance's of the items. It has been suggested by Jackson *et al.*, (2009) and Hair *et al.*, (2010) that if the standardized residual covariance is more than 1 the item must be dropped. Table 11 presents the standardized residual covariance matrices computed in AMOS 21.0. Result presented in Table 11 suggested in dropping of few items that cover fifth item of upstream supply chain flexibility, first item of customer satisfaction, third item of process simplification and sixth item of supplier relationship management. The fifth item of upstream supply chain flexibility covers that organizations have a good overall delivery performance system which is being covered by the second item of upstream supply chain flexibility that states that the supply

chain has the ability to deliver shipments of variable sizes on a frequent basis to upstream supply chain partners. Therefore, the fifth item of upstream supply chain flexibility is being dropped.

The first item of customer satisfaction measures ability to deliver desired quality and quantity to the customers. This item is being covered by the sixth item of customer satisfaction that states supply chain has the ability to respond quickly for solving problems of final customers, hence dropped. Whereas, the third item of process simplification measures common standards used to link processes smoothly with its supply chain partners. This is being covered by the first item of process simplification that measures compatibility among all relevant business processes. Hence this item is being dropped. Lastly, the sixth item of supplier relationship management measuring significant investments in their tooling and equipment from suppliers to improve organization's final product is being dropped. This item is being measured by the fourth item of supplier relationship management and states selecting supplier based on their product flexibility performance (i.e. responsiveness to changes processes according to the product design).

Table 11: Standardized residual covariance's

	PS1	PS3	PS4	PS5	PS6	CS1	CS4	CS6	CS7	USCF1	USCF2	USCF3	USCF5	
	1.41	1.93	0.753	0.782	-0.106	0.555	1.221	1.081	1.026	-1.174	-0.446	0.107	0	USCF5
	-0.552	0.482	-0.381	-0.858	0.039	-0.211	-0.913	0.051	-0.536	0.557	-0.015	0		USCF3
	0.201	0.931	0.443	-0.121	-0.317	0.097	-0.589	0.338	0.495	0.224	0			USCF2
	-0.961	0.066	-0.922	-1.13	-1.04	-1.452	-0.534	0.016	-0.201	0				USCF1
	0.47	0.651	-0.004	0.206	-0.572	0.036	-0.033	-0.128	0					CS7
	0.167	0.338	-0.512	-0.749	-0.368	0.073	0.15	0						CS6
	0.62	-0.444	-0.434	0.32	-0.348	0.092	0							CS4
	-0.015	-0.454	0.039	0.127	0.418	0								CS1
	0.19	-0.121	-0.179	0.06	0									PS6
	-0.292	-0.23	0.382	0										PS5
	-0.082	-0.138	0											PS4
	0.337	0												PS3
	0													PS1
														TMC1
														TMC2
														TMC4
														TMC5
														TMC8
														SRM1
														SRM4
														SRM6
														SRM7
														SRM8

**Table 11: Standardized residual covariance's (Cont...)**

	<b>SRM8</b>	<b>SRM7</b>	<b>SRM6</b>	<b>SRM4</b>	<b>SRM1</b>	<b>TMC8</b>	<b>TMC5</b>	<b>TMC4</b>	<b>TMC2</b>	<b>TMC1</b>	
1.22	0.323	-0.587	0.301	-0.162	1.504	0.678	0.729	1.319	-0.045	<b>USCF5</b>	
1.003	0.415	-1.576	0.471	0.669	0.65	-0.443	-0.809	0.457	0.083	<b>USCF3</b>	
0.663	-0.523	-1.469	-0.795	-0.02	0.367	0.134	-0.778	0.345	-0.171	<b>USCF2</b>	
0.899	0.145	-0.754	0.006	1.105	0.314	-0.354	-0.789	1.266	0.385	<b>USCF1</b>	
0.5	0.399	-0.579	-0.149	-0.52	0.242	0.402	-0.366	0.667	-0.091	<b>CS7</b>	
0.411	0.056	-1.079	0.81	-1.048	-0.184	0.695	0.109	-0.206	0.193	<b>CS6</b>	
0.854	0.486	0.073	0.178	0.223	-0.047	-0.232	-0.345	0.88	-0.381	<b>CS4</b>	
0.069	0.175	-0.817	-0.366	0.362	-1.204	0.509	-0.478	0.249	-0.531	<b>CS1</b>	
0.77	1.33	1.75	0.803	0.73	-0.737	-0.282	-1.568	0.298	-0.393	<b>PS6</b>	
-0.366	-0.064	-0.474	0.242	0.108	0.311	-0.277	-0.755	1.239	-0.804	<b>PS5</b>	
0.8	-0.151	-0.134	0.301	0.174	0.275	0.196	-0.935	1.06	-0.659	<b>PS4</b>	
0.499	-1.316	-1.428	-0.384	-1.546	1.279	1.039	0.338	0.797	0.11	<b>PS3</b>	
0.61	-0.479	0.051	0.088	-0.578	0.908	0.72	-0.256	0.604	0.321	<b>PS1</b>	
0.914	0.794	-0.202	1.039	0.372	0.12	-0.157	0.234	-0.288	0	<b>TMC1</b>	
1.334	1.979	1.33	0.387	1.55	-0.271	-0.322	-0.093	0		<b>TMC2</b>	
0.318	-0.591	-1.285	-0.738	-0.344	0.058	0.415	0			<b>TMC4</b>	
1.01	-0.751	-1.475	-0.412	-0.435	-0.373	0				<b>TMC5</b>	
0.856	-0.342	-1.625	0.26	-0.494	0					<b>TMC8</b>	
0.368	0.027	0.108	-0.33	0						<b>SRM1</b>	
0.294	0.074	-0.063	0							<b>SRM4</b>	
-0.572	0.518	0								<b>SRM6</b>	
-0.557	0									<b>SRM7</b>	
0										<b>SRM8</b>	

After dropping these items, the confirmatory factor analysis is performed again in AMOS 21.0 and results are presented in Table 12. Results indicate CMIN/DF of 1.648 (acceptable: 1 to 3), Root Mean Residual (RMR) of 0.036 (acceptable <0.05), Tucker Lewis Index (TLI) of 0.904 (acceptable > 0.90), Comparative Fit Index (CFI) of 0.921 (acceptable > 0.90), and HOELTER's Criterion of 80 (acceptable 59, 0.05). These results collectively represent a good model fit (Jackson *et al.*, 2009; Hair *et al.*, 2010; Saldanha *et al.*, 2013). The measurement model with acceptable item loadings is presented in Figure 8. As per Figure 8, all item loadings are found to be significant ( $\alpha \leq 0.05$ ) (Hair *et al.*, 2010; Saldanha *et al.*, 2013). Hence the model represents a good fit and is considered to be final confirmatory model.

**Table 12: Confirmatory factor analysis results**

Sr No	Parameters	Analysis Results	Acceptable Range	Good/Marginal
1	CMIN/DF	1.648	1-3	Good
2	Root Mean Residual (RMR)	0.036	<0.05	Good
3	Goodness Fit Index (GFI)	0.800	>0.90	Marginal
4	Adjusted Goodness Fit Index (AGFI)	0.724	>0.80	Marginal
5	Tucker Lewis Index (TLI)	0.904	>0.90	Good
6	Comparative Fit Index (CFI)	0.921	>0.90	Good
7	Normed Fit Index (NFI)	0.826	>0.90	Marginal
8	Root Mean Standard Error of Approximation (RMSEA)	0.091	<0.05	Marginal
9	HOELTER's Criterion (0.05)	80	59	Good

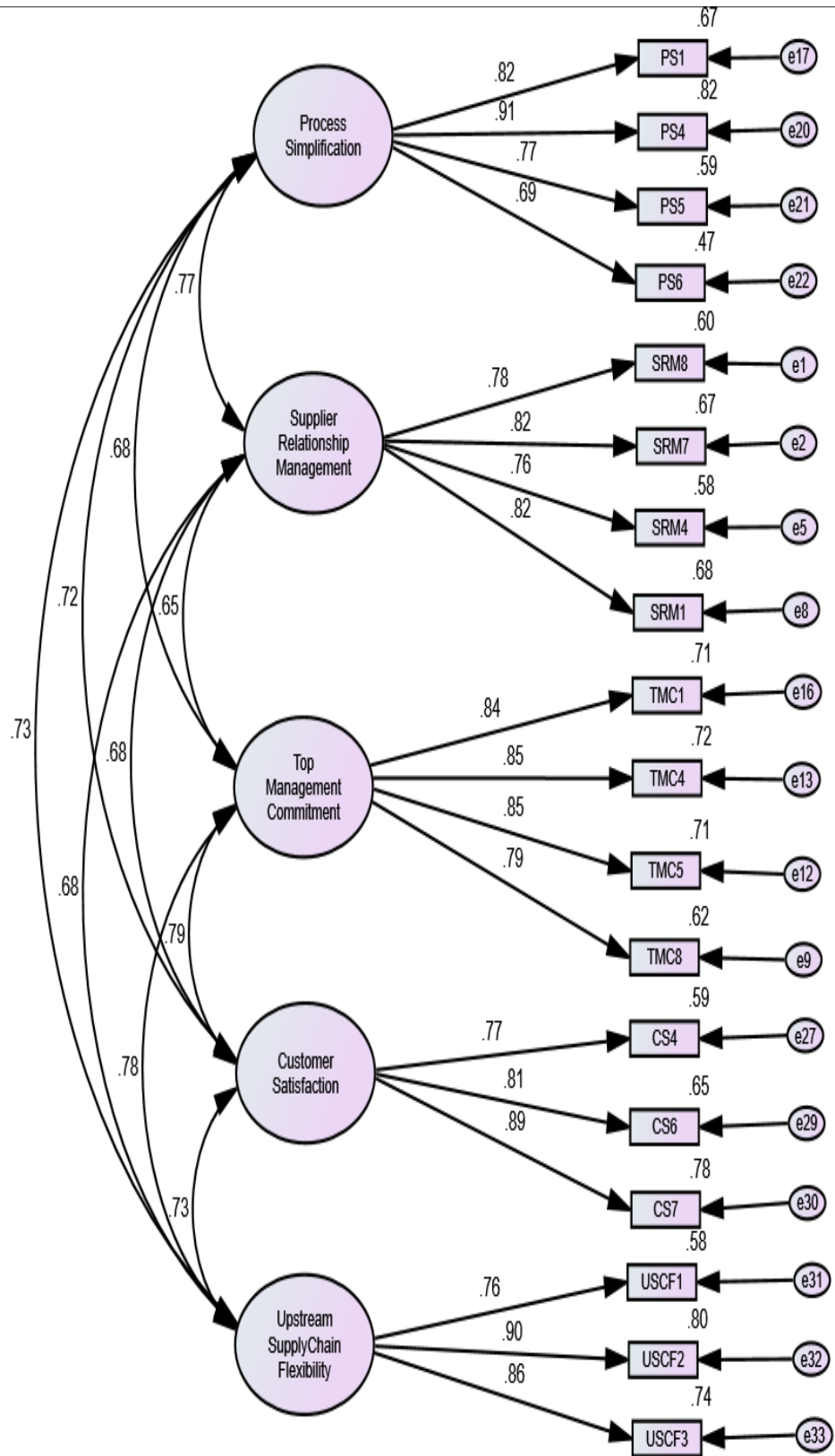


Figure 8: Final confirmatory factor analysis model

Composite Reliability (CR), convergent validity and discriminant validity of the measurement model are now required to be computed to check on the validity and reliability. Composite reliability must be above 0.7 to ensure reliability of the constructs (Hair *et al.*, 2010). This ensures that the respondents are responding in the right direction and they are clear about items of the scale.

Convergent validity refers to the degree to which construct measures that theoretically should be related are actually related. To ensure convergent validity of the measurement model, Average Variance Extracted (AVE) values must be above 0.5 (Hair *et al.*, 2010; Saldanha *et al.*, 2013). The AVE values of 0.5 indicate that the literature and respondents alike consider constructs to be related and valid. In other words, the latent factors are well explained by its observed variables. Whereas, discriminant validity checks whether concepts or measurements that are not supposed to be related are actually unrelated. For ensuring that the measurement model has discriminant validity, values of Maximum Shares Variance (MSV) must be less than AVE (Hair *et al.*, 2010; Saldanha *et al.*, 2013). This signifies that the latent factors are well explained by own observed variables rather than some other variables.

Composite reliability, convergent validity and discriminant validity are computed using Gaskin (2016) stats tool package. Analysis results for the measurement model are presented in Table 13. The composite reliability values of constructs are above 0.70. This validates the measurement model to be reliable. After confirming the reliability of the measurement model it is now required to confirm its validity. Result provided in the Table 13 suggests that all constructs exhibited high Average Variance Extracted (AVE) above 0.5 (Hair *et al.*, 2010; Saldanha *et al.*, 2013), thereby proving the convergent validity of the measurement model. Moreover, Maximum Shared Variance (MSV) is found to be less than AVE for all the constructs which signifies the discriminant validity of the measurement model. Overall results highlights that constructs of the study are related to each other in the measurement model. Thus, confirming that the measurement model is reliable and has no issues of convergent and discriminant validity.

**Table 13: Composite reliability, convergent validity and discriminant validity**

	<b>CR</b>	<b>AVE</b>	<b>MSV</b>	<b>MaxR(H)</b>	<b>SRM</b>	<b>TMC</b>	<b>CS</b>	<b>USCF</b>	<b>PS</b>
<b>SRM</b>	<b>0.872</b>	<b>0.631</b>	0.590	0.875	<b>0.794</b>				
<b>TMC</b>	<b>0.900</b>	<b>0.692</b>	0.629	0.942	0.646	<b>0.832</b>			
<b>CS</b>	<b>0.861</b>	<b>0.674</b>	0.629	0.959	0.678	0.793	<b>0.821</b>		
<b>USCF</b>	<b>0.878</b>	<b>0.707</b>	0.615	0.969	0.677	0.784	0.735	<b>0.841</b>	
<b>PS</b>	<b>0.875</b>	<b>0.638</b>	0.590	0.976	0.768	0.682	0.720	0.729	<b>0.799</b>

The above discussions confirm the measurement model fit as well as the reliability and validity of the measurement model. Structural Equation Modeling (SEM) is now required to be performed to confirm the mediating role of process simplification on the relationship between constructs of quality management and process simplification, and measures of supply chain performance.

#### ***4.4 Structural Equation Modeling***

Structural equation modeling is a multivariate statistical technique that is used to analyze structural relationships (Jackson *et al.*, 2009; Hair *et al.*, 2010). This technique combines factor analysis and multiple regression analysis to analyze the structural relationship between measure variables and latent constructs. This method has been preferred by the researchers as it estimates the multiple and interrelated dependence in a single analysis (Lai *et al.*, 2002; Vickery *et al.*, 2003; Qi *et al.*, 2009; Chiou *et al.*, 2011; Qi *et al.*, 2011; Zhu *et al.*, 2013; Esfahbodi *et al.*, 2016). This analysis uses two types of variables, endogenous variables and exogenous variables. The endogenous variables are equivalent to dependent variables, whereas exogenous variables are equivalent to independent variables.

In structural equation modeling two types of model, measurement model and structural model, are considered for analysis. Measurement model represents the theory that specifies how measured variables come together to represent the theory. Confirmatory factor analysis is used to test the measurement model and ensure that the measurement model fit is achieved. After confirming the measurement model fit structural model is prepared for testing. The structural model represents the theory that shows how constructs are related to the other constructs.

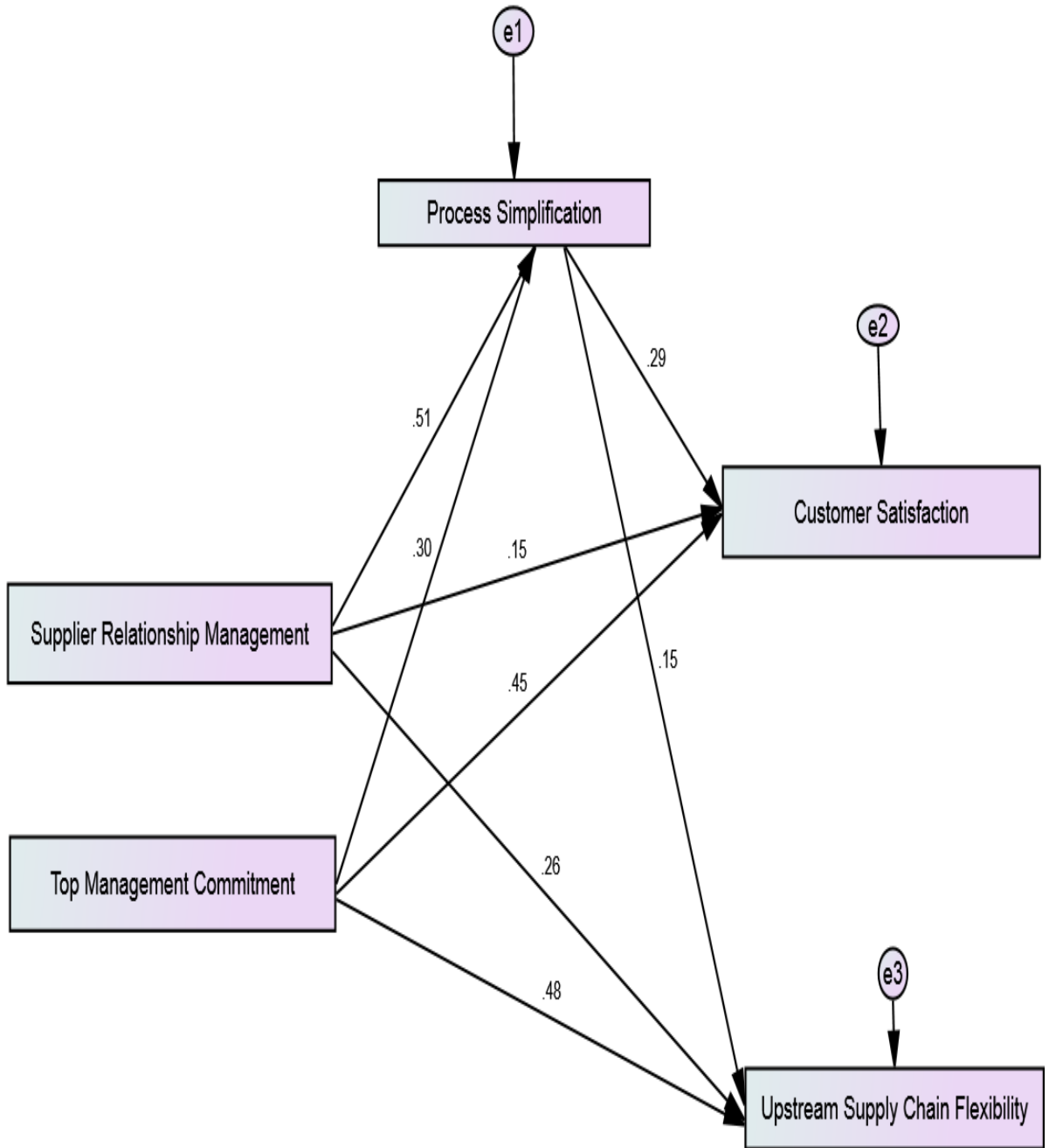
Confirmatory factor analysis has concentrated on the measurement model fit. Result of confirmatory factor analysis highlighted that almost all indexes have acceptable values; therefore the model is represented as a good fit. Moreover, the measurement model doesn't have composite reliability, convergent validity and discriminant validity issues. Hence, it is required to prepare and statistically validate the structural model.

The thesis has performed the structural equation modeling on a sample size of hundred and five automotive organizational responses. These automotive organizational responses represent a substantial automotive market share in terms of average financial standalones. For preparing the structural model, construct items are required to be computed to represent the construct. Hence, the construct items are computed using SPSS 21.0 to represent them as individual constructs. Quality management and process integration constructs (top management commitment and supplier relationship management) are considered to be independent variables/endogenous variables whereas, supply chain performance measures (upstream supply chain flexibility and customer satisfaction) are considered to be exogenous variables. Process simplification is considered to be a mediator in the relationship between quality management and process integration constructs, and supply chain performance measures. The structural model is developed among the constructs in AMOS 21.0 and is presented in Figure 9. It is clearly evident from Figure 9 that endogenous variables, exogenous variables and mediator are represented by a rectangle. Straight lines are used to represent the hypothesized relationships among the constructs. Mediation analysis is performed on the developed structural model to validate the hypothesized relationships and subsequently the structural model. Three steps are performed to confirm the mediating role of process simplification. These three steps are explained as below:

Step 1: Direct effects between independent and dependent variables are computed without considering mediator.

Step 2: Considers the mediator while computing the direct effects between independent and dependent variables.

Step 3: Indirect effects are calculated by performing bootstrap with bias-corrected confidence intervals to confirm the mediating effect.



**Figure 9: Structural equation modeling model**

According to Baron & Kenny (1986) and Hayes (2013), the following two conditions need to be fulfilled for the existence of the mediation effect.

**Condition 1:** The independent construct must impact the mediator as well as the dependent construct.

**Condition 2:** It is also mandatory to have a weaker relationship between the independent construct and the dependent construct when the mediating construct is considered than when it is not.

The step 1 computes the direct impact of independent variables, top management commitment and supplier relationship management, on the dependent variables, upstream supply chain flexibility and customer satisfaction, without considering the mediator, process simplification. Results of the three-step analysis are presented in Table 14. Results presented in Table 14 depict that the regression coefficient of top management commitment ( $\beta = 0.530$ ,  $p < 0.05$ ) with respect to upstream supply chain flexibility is positive and significant. Moreover as per results of Table 8, top management commitment and upstream supply chain flexibility are highly correlated ( $r = 0.657$ ,  $p < 0.01$ ). These results highlight that top management commitment has a positive direct impact on the upstream supply chain flexibility of automotive organizations. It also validates the hypothesized relationship  $H_{1a}$  that suggested that top management commitment positively affects the upstream supply chain flexibility. Thus, automotive organizational management must have an emphasized focus on improving their supply chain flexibility issues by including it as one of their strategic goals. This might enable automotive management to improve the delivery time, production time and quality issues that might overall reduce their cost of production.

The regression coefficient of top management commitment ( $\beta = 0.534$ ,  $p < 0.05$ ) with respect to customer satisfaction is positive and significant (Table 14). It is also evident that top management commitment and customer satisfaction are highly correlated ( $r = 0.648$ ,  $p < 0.01$ ) (Table 8). These results validate that top management commitment positively impacts the customer satisfaction of automotive organizations. This impact significantly validates the hypothesized relationship represented by  $H_{1b}$  that highlights the positive direct impact of top management commitment on the customer satisfaction. A satisfied customer might helps in

boosting sales as well as profit margins, thus automotive management must have an emphasized focus on improving customer satisfaction. This might enable the automotive groups in improving their market positioning.

Table 14 results suggested that the regression coefficient of supplier relationship management ( $\beta = 0.334$ ,  $p < 0.05$ ) with respect to upstream supply chain flexibility is positive and significant. Furthermore as per results of Table 8, supplier relationship management and upstream supply chain flexibility are highly correlated ( $r = 0.579$ ,  $p < 0.01$ ). Validating that supplier relationship management positively impacts upstream supply chain flexibility of automotive organizations. This impact significantly validates the hypothesized relationship represented by  $H_{2a}$  that highlights the positive direct impact of supplier relationship management on the upstream supply chain flexibility. This result highlights the need for automotive groups to concentrate on improving flexibility issues of their selected set of suppliers that might ultimately improve their upstream flexibility issues.

The regression coefficient of supplier relationship management ( $\beta = 0.302$ ,  $p < 0.05$ ) with respect to customer satisfaction is found to be positive and significant (Table 14). The correlation coefficient (Table 8) between supplier relationship management and customer satisfaction is highly correlated and significant ( $r = 0.648$ ,  $p < 0.01$ ). These results validate that supplier relationship management positively impacts the customer satisfaction of automotive organizations. This impact significantly validates the hypothesized relationship represented by  $H_{2b}$  that highlights the positive direct impact of supplier relationship management on the customer satisfaction. Various suppliers are required to coordinate and work together for producing an automobile as per customer requirement. Thus, it becomes imperative that various suppliers must manage their relationships to fulfill the customer requirement in a timely and cost effective manner.

**Table 14: Mediation analysis results**

<b>Structural Path</b>	<b>Step 1: Direct without Mediator</b>	<b>Step 2: Direct with Mediator</b>	<b>Step 3: Indirect Effect</b>	<b>Mediation / No Mediation</b>	<b>Hypothesis</b>	<b>Significant/Not Significant</b>
TMC → PS → USCF	0.530* (0.000)	0.484* (0.000)	0.055	No Mediation	H <sub>1d</sub>	<b>Not Significant</b>
TMC → PS → CS	0.534* (0.000)	0.445* (0.000)	0.004**	Mediation	H <sub>1e</sub>	<b>Significant</b>
SRM → PS → USCF	0.334* (0.000)	0.257* (0.004)	0.045**	Mediation	H <sub>2d</sub>	<b>Significant</b>
SRM → PS → CS	0.302* (0.000)	<b>0.154* (0.078)</b>	0.006**	Mediation	H <sub>2e</sub>	<b>Significant</b>

\* Constructs  $\beta$  values statistically significant at  $\alpha = 5\%$ ,  $p < 0.05$

\*\* Indirect impact significant at  $p < 0.05$

Results of the direct hypothesized relationships are also presented in the Table 15. These results have considered the direct impact of independent variables, top management commitment and supplier relationship management, on the mediator, process simplification. As per results presented in Table 15, the regression coefficient of top management commitment ( $\beta = 0.304$ ,  $p < 0.05$ ) with respect to the mediator, process simplification, is found to be positive and significant. Result presented in Table 8 also suggests that top management commitment and process simplification are highly correlated ( $r = 0.559$ ,  $p < 0.05$ ). Thereby, results collectively support and validate the hypothesized relationship represented by H<sub>1c</sub>. Accordingly, it can be concluded that top management commitment has a direct impact on process simplification in automotive organizations.

**Table 15: Direct hypothesized relationship results**

<b>Structural Path</b>	<b>Hypothesis</b>	<b>Coefficient</b>	<b>p-value</b>	<b>Significant/Not Significant</b>
TMC → USCF	H <sub>1a</sub>	0.530*	0.000	<b>Significant</b>
TMC → CS	H <sub>1b</sub>	0.534*	0.000	<b>Significant</b>
TMC → PS	H <sub>1c</sub>	0.304*	0.000	<b>Significant</b>
SRM → USCF	H <sub>2a</sub>	0.334*	0.000	<b>Significant</b>
SRM → CS	H <sub>2b</sub>	0.302*	0.000	<b>Significant</b>
SRM → PS	H <sub>2c</sub>	0.507*	0.000	<b>Significant</b>

\* Constructs  $\beta$  values statistically significant at  $\alpha = 5\%$ ,  $p < 0.05$

Moreover, results presented in Table 15 suggests that the regression coefficient of supplier relationship management ( $\beta = 0.507$ ,  $p < 0.05$ ) with respect to process simplification is positive and significant. Also, the correlation coefficient (Table 8) between supplier relationship management and process simplification ( $r = 0.609$ ,  $p < 0.05$ ) is significant. The statistical significance of regression coefficient and the correlation coefficient validates the

hypothesized relationship presented by H<sub>2c</sub>. Hence, supplier relationship management has a positive direct impact on process simplification.

The above discussed results significantly validate the step 1 results as well as the condition one (Baron & Kenny, 1986; Hayes, 2013) that the independent variables have a direct impact on the dependent variables as well as the mediator. Step 2 will now consider the mediator to determine the direct impact of independent variables on dependent variables. Results of the step 2 are computed in AMOS 21.

The regression coefficient of top management commitment when mediator is considered ( $\beta = 0.484$ ,  $p < 0.05$ ) with respect to upstream supply chain flexibility is positive and significant (Table 14). Highlighting that top management commitment along with process simplification has a direct impact on upstream supply chain flexibility. It can also be noticed that the regression coefficient from step 1 to step 2 decreased from 0.530 to 0.484. These results confirm that there exists a direct partial mediating role of process simplification in the relationship between top management commitment and upstream supply chain flexibility.

Results of Table 14 further depict that the regression coefficient of top management commitment when process simplification is considered ( $\beta = 0.445$ ,  $p < 0.05$ ) with respect to customer satisfaction is positive and significant. Moreover, the regression coefficient from step 1 to step 2 decreased from 0.534 to 0.445. Thereby, confirming that there exists a direct partial mediating role of process simplification in the relationship between top management commitment and customer satisfaction. Results presented in Table 14 also suggests that regression coefficient of supplier relationship management when mediator, process simplification, is considered ( $\beta = 0.257$ ,  $p < 0.05$ ) with respect to upstream supply chain flexibility is positive and significant. Highlighting that supplier relationship management along with process simplification has a direct impact on upstream supply chain flexibility. It can also be noticed that the regression coefficient from step 1 to step 2 decreased from 0.334 to 0.257. Thus, confirming that there exists a direct partial mediating role of process simplification in the relationship between supplier relationship management and upstream supply chain flexibility.

Table 14 results further depict that the regression coefficient of supplier relationship management when process simplification is considered ( $\beta = 0.154$ ,  $p < 0.05$ ) with respect to customer satisfaction is positive and insignificant. Moreover, the regression coefficient from step 1 to step 2 decreased from 0.302 to 0.154. Thereby, confirming that there exists a direct and complete mediating role of process simplification in the relationship between supplier relationship management and customer satisfaction.

Results presented in step 2 collectively signifies that the process simplification possesses a mediating impact of independent variables, top management commitment and supplier relationship management, on the dependent variables, upstream supply chain flexibility and customer satisfaction. Results also validate the condition 2 of Baron & Kenny (1986) and Hayes (2013) and confirms the mediating role of process simplification. Only the case of supplier relationship management and customer satisfaction a complete mediation impact is noticed, whereas partial mediation impact is noticed in all other relationships.

Mediation analysis procedure proposed by Baron & Kenney (1986) is considered to be most traditional approach to mediation analysis with a limitation of use of descriptors such as complete and partial mediation (Preacher & Kelley, 2011). Researchers have advocated that bootstrapping, a nonparametric resampling method, is a robust alternative to overcome this shortcoming (Mackinnon *et al.*, 2002; MacKinnon *et al.*, 2004; Preacher & Kelley, 2011). The bootstrapping confirms the indirect impact of the mediator on the relationship between independent and dependent variables. The indirect impact exists if the statistical results computed in AMOS 21 are significant at  $p < 0.5$  (Jackson *et al.*, 2009, Hair *et al.*, 2010).

Results of the indirect impact are computed in AMOS 21 and are presented in step 3 of Table 14. Result presented by step 3 of Table 14 statistically suggests that process simplification doesn't possess or in other words has an insignificant mediating impact ( $p < 0.05$ ,  $p = 0.055$ ) between the relationship of top management commitment and upstream supply chain flexibility. This result is not in alignment with results presented in step 2 (Barron & Kenney, 1986, Hayes, 2013). As a result, the direct and indirect impact collectively signifies that process simplification doesn't mediate the relationship between top management commitment and upstream supply chain flexibility. This result doesn't significantly validate the hypothesized relationship presented by  $H_{1d}$ . The partial mediating direct impact and no

indirect impact signifies that there are other constructs along with process simplification that impact the relationship between top management commitment and upstream supply chain flexibility. Hence, automotive organizations must work on identification of these other mediating constructs for improvement in upstream supply chain flexibility issues related to automotive groups.

Whereas, results presented in step 3 of Table 14 suggests that process simplification is found to have a significant mediating indirect impact ( $p < 0.05$ ,  $p = 0.004$ ) on the relationship between top management commitment and customer satisfaction. This result is in alignment with results presented in step 2 (Barron & Kenney, 1986, Hayes, 2013). Therefore, the direct and indirect impact collectively signifies that process simplification mediates the relationship between top management commitment and customer satisfaction. These results significantly validate the hypothesized relationship presented by  $H_{1e}$ . Thereby, automotive organizations must develop a strategic focus on improving their process simplification to improve on their customer satisfaction. The reasons for improving the simplified processes is that the customer is unaware about the back end production operations performed at the manufacturing set up. Thereby, customers can only suggest what they want but will not be in a position to suggest what can be improved due to its lower manufacturing skill level. As a result, it becomes the responsibility of the top management to gather customer feedback through simplified processes and based on this feedback improve their manufacturing setups to improve organizational process integration and hence product quality.

Step 3 results of Table 14 empirically validates ( $p < 0.05$ ,  $p = 0.045$ ) that process simplification mediates the indirect impact of supplier relationship management on upstream supply chain flexibility of automotive organizations. Result of step 2 and step 3 of Table 14 collective validates the direct and indirect impact of process simplification on the relationship between supplier relationship management and upstream supply chain flexibility. Hence, these results significantly validate the hypothesized relationship presented by  $H_{2d}$ . Hence, automotive organizations must aim at simplifying the integrated processes for improving the quality related issues of their upstream supply chain partners. This will help organizations in developing strategies for improving the supplier related issues related to product quality and process integration. The developed strategies will also motivate the supplier for ensure that

they produce the right quality product at the right time and deliver that at the right place. This will increase the upstream supply chain flexibility as well as market positioning of the automotive organizations and enables them to gain competitive position with respect to their competitors.

The mediating indirect impact of process simplification on the relationship between supplier relationship management and customer satisfaction is found to be significant ( $p < 0.05$ ,  $p = 0.006$ ) as per step 3 of Table 14. This result is in alignment with results of step 2 of Table 14. The direct and indirect mediating impact of step 2 and step 3 collectively validates the mediating impact of process simplification on the relationship between supplier relationship management and customer satisfaction. The direct and indirect impact also validates the hypothesized relationship presented by H<sub>2e</sub>. Result of this analysis helps automotive organizations to form strategies for managing improvement in their supplier relationships with respect to their customers. The suppliers want the customer's feedback to reach them through simplified integrated quality processes. Consequently, automotive groups are required to form strategies that must improve the flow of information from the customers till their upstream supply chain partners. This will require organizational focus on forming strategies that will help all their upstream supply chain partners, themselves and their customers.

It is clearly evident from the above discussion that process simplification mediates the impact of top management commitment on customer satisfaction, supplier relationship management on customer satisfaction and supplier relationship management on upstream supply chain flexibility. Whereas, no mediating impact of process simplification is noticed in case of top management commitment and upstream supply chain flexibility as Indirect effect exceeds 0.05 (Hair *et al.*, 2010). The managerial and theoretical implications with respect to these results are presented in the next chapter, discussion and implications. The focus of the next chapter is to enrich the literature as well as suggests strategies to automotive organizational management for rectifying their upstream supply chain flexibility and customer satisfaction issues.

## CHAPTER V - DISCUSSION AND IMPLICATIONS

This chapter of the thesis presents the managerial implications and theoretical contribution of this thesis. Managerial implications emphasizes the importance of mediating impact of process simplification on the relationship between quality management and process integration constructs (top management commitment and supplier relationship) and supply chain performance measures (upstream supply chain flexibility and customer satisfaction) in Indian automotive organizations. Theoretical contribution highlights how this study has enriched the present literature.

### *5.1 Managerial Implications*

Results presented in the last chapter clearly signifies that process simplification has a mediating direct and indirect impact on the relationship between top management commitment and customer satisfaction, supplier relationship management and upstream supply chain flexibility, and supplier relationship management and customer satisfaction. Whereas, process simplification has a partial mediating direct impact and no indirect impact on the relationship between top management commitment and upstream supply chain flexibility. Thus, implication of this mediating impact to Indian automotive management is now requires to be discussed in detail.

#### *5.1.1 Mediating Impact of Process Simplification on the Relationship between Top Management Commitment and Upstream Supply Chain Flexibility*

Non-existence of indirect mediation impact of process simplification on the relationship between top management commitment and upstream supply chain flexibility emphasizes that there are other constructs which influence this relationship. The thesis has suggested that some of the additional constructs that might impact the relationship includes role of new technology and innovation, and employees training. Corporations and researchers alike have suggested that process simplification is a crucial element of supply chain quality and integration, thus an emphasized focus by organizational management will enable organizations to access various resources and capabilities in the form of knowledge embedded within upstream supply chain members. This knowledge will subsequently

increase company's innovativeness towards new technology and innovation (Craighead *et al.*, 2009; Cao & Zhang, 2011; Mattos *et al.*, 2013). Automotive organizations must form strategies for gathering information from their upstream supply chain partners on new technology and innovations. Automotive organizations can motivate and support their niche manufacturing suppliers for improvement in their quality processes. This motivation and support will help automotive organizations to develop strong relationships with these suppliers. The strong relationships might help automotive management to reach a position whether they can learn from their niche manufacturers on how to improve their technology.

Moreover, continuous training of employees is essential for manufacturing organizations and it needs to be ensured by top management (Arianto *et al.*, 2016). If employees are unaware of advancement in new technologies and innovations, they will not be able to respond to the variations in demand. This will result in late delivery of finished product to manufacturing units of automotive organization which can further lead to loss of customer orders. In today's highly competitive Indian environment, this can severely damage the image and profitability of the respective automotive organization. To remain profitable, Indian automotive organizations are required to simplify their integrated quality processes by providing appropriate training at regular intervals to their respective employees (Vanichchinchai, 2012) Agarwal *et al.*, 2015; Srivastava & Dhar, 2016).

#### *5.1.2 Mediating Impact of Process Simplification on the Relationship between Top Management Commitment and Customer Satisfaction*

Mediating direct and indirect effects of process simplification on the relationship between top management commitment and customer satisfaction suggests that top management of automotive organization(s) must focus to improve their integrated quality processes for achieving customer delight. The automotive groups must understand that customer is unaware about the back end production operations performed at the manufacturing set ups. Thereby, customers can only suggest what they want but will not be in a position to suggest what can be improved in the manufacturing processes, due to its lower manufacturing skill level. Thus, it becomes the responsibility of the top management to gather customer feedback

through simplified integrated quality processes and based on this feedback improve their manufacturing setups.

Automotive units must also stress on simplification of processes with respect to frequent offering of new products. By doing so, management of automotive units will be in a position to shorten the product development time and results in establishing a superior competitive positioning (Swafford *et al.*, 2006; Saunila *et al.*, 2014). In the latest report of September 2016 by India Brand Equity Foundation (IBEF), India is considered to be a potential manufacturing choice by most of the leading automotive organizations and these organizations are expanding their product portfolio in the Indian Market. Therefore, top management of Indian automotive organizations must emphasize their focus to simplify their upstream inter-organizational integrated quality processes to shorten the product development time and achieve customer delight.

### *5.1.3 Mediating Impact of Process Simplification on the Relationship between Supplier Relationship Management and Upstream Supply Chain Flexibility*

Analysis results validate the mediating impact of process simplification on the relationship between supplier relationship management and upstream supply chain flexibility. Therefore, Indian automotive organizations must aim at simplifying the integrated quality processes for improving the quality related issues of their upstream supply chain partners. Automotive units must form strategies related to improvement in product quality and process integration for enhancing their upstream supply chain flexibility.

Automotive organizational suppliers are required to be extremely responsive to any variations in demand for improvement in upstream supply chain flexibility. Customer demand varies with time and advancements in technology and innovations. So, it is required that the management of automotive units must inform their respective supplier(s) to incorporate changes with respect to advancement in technology and innovations (Majumdar & Manohar, 2016; Peng *et al.*, 2016). Automotive units can invite their suppliers in their corporate meetings and must take their input for improvement in product quality. This will result in simplification of processes and helps organizations to cope with sudden variations in

demand and ultimately pave the way for improved upstream supply chain flexibility (Weingarten *et al.*, 2015).

The latest industry report (CII & EY, 2016) suggests that India is to be considered as an emerging market by the prominent automotive organizations for manufacturing automobiles. Therefore to gain competitive positioning, Indian automotive units need to simplify their process technological changes with respect to their suppliers. Indian automotive organizations are required to upgrade their suppliers by providing them appropriate training on advancements in technology and innovation (Mattos *et al.*, 2013; Saunila, 2016). For doing so, commitment from the Indian automotive organizations is required to continuous vigilance of their supplier requirements. This will in turn result in suppliers meeting up the variations in demand and thereby increasing the suppliers' responsiveness for achieving enhanced upstream supply chain flexibility (Weingarten *et al.*, 2015; Weingarten *et al.*, 2016).

#### *5.1.4 Mediating Impact of Process Simplification on the Relationship between Supplier Relationship Management and Customer Satisfaction*

Analysis results significantly validate the direct and indirect impact of process simplification on the relationship between supplier relationship management and customer satisfaction. Mediating impact suggests that automotive organizations must have a strategic focus for managing and improving their simplified integrated quality processes between their suppliers and customers. Automotive units must ensure that they pass the customer quality requirements at the earliest to their suppliers. Therefore, they must have a system of collecting customer's complaints and suggestions and that system must pass on the customer information to the supplier. This will enable the supplier to get direct feedback from the customer rather than from multiple channels. The quick feedback will help suppliers to make necessary changes in their manufacturing set-ups and meet customer expectations at the earliest (Mellat-Parast & Spillan, 2014; Lin & Tseng, 2016).

As per the latest industry report of CII & EY (2016) India is to be considered as an emerging market by the prominent automotive organizations for manufacturing automobiles. Thus, if Indian automotive organizations possess a system that suggests quick improvement in

supplier quality based on customer feedback, they may be in a position to capture a substantial market share as well as competitive positioning.

## ***5.2 Theoretical Contribution***

This study is an effort to address and establish the mediating role of process simplification in the relationship among quality management and process integration constructs (top management commitment and supplier relationship management) and SCP measures (upstream supply chain flexibility and customer satisfaction) in the context of Indian automotive firms. This thesis has contributed in enhancing the literature by considering transaction cost economics, resource based view and contingency theory of leadership in development of the conceptual framework. The different aspects of these theories have provided a unique direction in formulation of the unique conceptual framework.

The thesis has also boosted literature with a unique validated research model. The proposed research model is different from the exiting automotive research models (Sanchez & Perez, 2005; Thun & Hoeng, 2011; Thome *et al.*, 2014) as it emphasizes simplification of integrated quality processes for improvising the upstream supply chain flexibility and customer satisfaction issues.

The thesis has enriched the literature by validating that process simplification partially mediates the relationship between top management commitment and upstream supply chain flexibility. The reason for not achieving the indirect effect is due to the fact that there are other constructs that mediates the relationship between top management commitment and upstream supply chain flexibility. This result has provided the path for the future researchers to investigate the current literature and investigate for the additional mediators.

Another vital contribution in the theory is the mediating impact of process simplification on the relationship between top management commitment and customer satisfaction. This result has enriched the current literature with the fact that commitment from the top management for simplifying the integrated quality processes will have a positive impact on customer satisfaction. This result is being supported by the contingency theory of leadership which stresses that the best way to organize depends on the nature of the environment to which

organizations must relate (Scott, 1981). Further, the resource based view also emphasize that firms reach a sustainable competitive advantage by managing its heterogeneous set of resources (Barney, 1991; Barney, 1995). Consequently, it becomes the responsibility of the leader to stress on improvement in simplification of the integrated quality upstream processes and this can help them to enhance their competitive positioning.

Enhancement in theory is also achieved by the mediating impact of process simplification on the relationship between supplier relationship management and upstream supply chain flexibility. Scannell *et al.* (2000) has stressed on the upstream supply chain flexibility issues of automotive groups for improving the competitive performance but was unable to capture the mediating role of simplified processes. This thesis has contributed the literature with a validated research framework that covers this aspect.

Theory has also been deepened by the mediating impact of process simplification the relationship between supplier relationship management and customer satisfaction. This result stresses on the fact that supplier relationship management impacts the simplified processes which further impacts the customer satisfaction. As a result, automotive groups must simplify their integrated upstream quality processes to manage their supplier relationship. This will enable the automotive groups to improve their integrated upstream supply chain system which in turn will help them to improve customer satisfaction.

The extant literature has so far focused on various supply chain issues of automotive organizations covering supply chain flexibility issues for improving the competitive performance (Scannell *et al.*, 2000), linking the dimensions of supply chain flexibility and firm performance (Sanchez & Perez, 2005), suggesting ways to improve the supply chain risk (Thun & Heong, 2011) and analyzing the flexible supply chain capabilities at various tiers (Thome *et al.*, 2014). Yet, there is a lack of understanding in the literature on the role of process simplification in improving the upstream supply chain flexibility and customer satisfaction. This thesis clearly analyzes the mediating role of process simplification in integrating quality supply chain processes for improvising the upstream supply chain flexibility and customer satisfaction for better performance.

The above discussion has elaborated on the managerial and theoretical contributions. Now the strategic directions, limitations and future directions are required to be discussed. The subsequent discussion will elaborate on the conclusion and future scope of this thesis. The main emphasis of the next chapter is to provide strategic directions to automotive managers, present the limitations of the study and suggest future research directions for researchers.

## CHAPTER VI - CONCLUSION AND FUTURE SCOPE

Analysis results empirically validates that process simplification mediates the relationship between quality management and process integration constructs (top management commitment and supplier relationship management), and supply chain performance measures (upstream supply chain flexibility and customer satisfaction) in context of Indian automotive organization. Result also validates that there is a direct and indirect mediation impact of process simplification on the relationship between supplier relationship management and upstream supply chain flexibility, supplier relationship management and customer satisfaction, and top management commitment and customer satisfaction.

Whereas, the study also suggests that there is no indirect mediation impact of process simplification on the relationship between top management commitment and upstream supply chain flexibility. Managerial implications have suggested that the non-existence of indirect mediation impact of process simplification on the relationship between top management commitment and upstream supply chain flexibility is due to the fact that there are other constructs that may impact this relationship. This thesis suggests that other construct may include role of new technology and innovation, and employee training.

### *6.1 Strategic Directions*

Managerial implications have also suggested that India is considered to be an emerging market by prominent automotive organizations, therefore Indian automotive units must have a strategic focus towards simplifying the upstream integrated quality processes to improve the upstream supply chain flexibility and customer satisfaction. Top management of automotive organizations must develop a strategic direction by providing appropriate training to their suppliers on improving integrated upstream quality processes with respect to the introduction of new technology in the industry. Accomplishing this strategic focus will result in a dual benefit of ensuring simplification of integrated supplier quality processes and suppliers coping with the organizational expectations for meeting variations in customer demand. Further, management of automotive units must gather customer feedback through simplified integrated quality processes and based on this feedback must improve their

manufacturing setups. The improved manufacturing setups will enable automotive groups to produce quality product for achieving customer delight. The top management must also stress on simplification of processes with respect to offering of new product. This will enable automotive groups to shorten their product development time for establishing superior competitive positioning.

Automotive organizations with respect to supplier relationship management must involve strategies covering involvement of suppliers for improving product quality and process integration, inviting suppliers to corporate meetings for feedback on product quality and having a system to directly link suppliers and customers. Automotive groups by following these strategies will be in a position to maintain and improve their supplier relationship management through simplified processes. Thus, results in maximizing the upstream supply chain flexibility and customer satisfaction which enhances the organizational profitability.

The thesis on the basis of three theories, transaction cost economics, resource based view and contingency theory of leadership, contributed to the supply chain literature by proposing and validating a unique research model. The validated research model suggests the mediating impact of process simplification on the relationship between quality management and process integration constructs (top management commitment and supplier relationship management), and supply chain performance measures (upstream supply chain flexibility and customer satisfaction) in the Indian automotive organizations.

## ***6.2 Limitations***

There are a few limitations of this thesis. Firstly, considering the focus on Indian automotive organizations the sample collected for the study is relatively small but an effort has been made to cover a substantial number of units in terms of market share. Secondly, this research has not captured the secondary data (like internal manufacturing data) to crosscheck the upstream supply chain flexibility and customer satisfaction issues. The reason for not using secondary data is the unwillingness of the Indian automotive organizations to provide the secondary data due to their organizational policies.

### ***6.3 Future Research Directions***

For future studies, researchers can use the same model in any other manufacturing based industry like electronics, construction, beverages and bakery requiring improvement in integrated quality processes of upstream supply chain partners. The reasons for choosing these manufacturing units is due to the fact that they are quite similar to automotive units in terms of production and supply chain structure. Moreover, the researchers after validating their model can also compare their results with the present thesis. Further, the researchers can extend the model by identifying and including any additional mediation constructs that impact the upstream supply chain flexibility and customer satisfaction of other manufacturing industrial units covering electronics, construction, beverages and bakery. This thesis has also proposed that role of new technology and innovation, and employee training can be few of the other mediators that impact the research model. Thus, the future researchers can investigate the mediating impact using these constructs as well as they have an opportunity to investigate more mediating constructs that impact the research model. Lastly, the researchers can work on the limitations of the study and improve the proposed research model.

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## **APPENDIX I - Research Questionnaire**

### **Research Questionnaire**

The survey is part of an academic research and the data provided by you will be kept confidential and would be used for this academic research purpose only. You are therefore requested to provide your responses candidly.

\* Required

### **A. Company Profile**

#### **1. Number of Employees \***

- a) Less than 100
- b) 100-499
- c) 500-999
- d) 1000-4,999
- e) Above 5000

#### **2. Annual Sales (In Million Rupees) \***

- a) Less than equal to 49
- b) 50-499
- c) 500-999
- d) 1000-4999
- e) Above 5000

#### **3. Ownership \***

- a) State Owned
- b) Collective Owned
- c) Private Owned
- d) Wholly foreign owned
- e) Joint-Venture

#### **4. Position of Company in Supply Chain \***

- a) Raw Material Supplier
- b) Component Supplier
- c) Manufacturer
- d) Distributor
- e) Retailer

### **B. Employees Profile**

#### **5. Name of Respondent**

#### **6. Name of Organization \***

#### **7. Designation \***

#### **8. Department \***

#### **9. Email ID \***

#### **10. Contact Number**

#### **11. Years of Service in Present Organization. \***

- a) Less Than 5 Years

- b) 5-10 Years
- c) 11-15 Years
- d) 16-20 Years
- e) Above 20 Years

**12. Educational Qualification \***

- a) Graduation
- b) Post Graduation
- c) Other

**C. Supply Chain Profile of the Organization:**

The statements mentioned below relate to supply chain profile of YOUR ORGANIZATION. Rate these statements on (1-5) Likert scale according to your opinion:

(1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree)

**C.1 Quality related statements for your organization.**

- 13. Shares both quality improvement benefits and risks. \*
- 14. Periodically provides quality performance feedback to suppliers. \*
- 15. Has ability to produce products with varied specifications (viz. features, options, sizes, colors and special specifications). \*
- 16. Communicates clearly the product specifications and quality requirements to supply chain partners. \*
- 17. Employees are responsible for inspection of their work quality \*
- 18. Supply chain has the ability to deliver desired quality and quantity(s) to final customers. \*
- 19. Focuses at continuously improving supply quality of the product by making it as one of its organizational goal. \*
- 20. Has a system to collect complaints on product quality aspects. \*

**C.2 Supplier related statements for your organization.**

- 21. Selects the supplier(s) based on their on their product flexibility performance (i.e. responsiveness to change processes according to the product design). \*
- 22. Works with its supply chain partner's in teams to improve upon the overall supply chain flexibility. \*
- 23. Supply chain partners have made significant investments in their tooling and equipment for the improvement of organization's final product. \*
- 24. Committed to develop long-term relationship with suppliers by improving their processes in the long run. \*
- 25. Places executives at the business facilities of its supply chain partners to facilitate collaboration. \*
- 26. Emphasizes on integrating business processes with its supply chain partners to create value for customers. \*

**C.3 Top management and employee related statements for your organization.**

- 27. In case of a mishap in the supply chain, senior managers are committed to find out the reason for the same.\*
- 28. Top management encourages active participation of employees in the production activities to assure quality. \*
- 29. Employees and suppliers understand that outcome of their work affects the work of their colleagues.\*
- 30. Top management creates supply chain management improvement teams that include members from its supply chain partner organizations for improvising its supply chain activities. \*
- 31. Employees are committed to protect the company's business related information as if it's their own. \*
- 32. Senior managers ensure that employees have access to the right tools, equipments and materials to get the job done. \*

**C.4 Customer statements related to your organization.**

- 33. Lays down roles, tasks, and responsibilities clearly to supply chain partners in order to create value for customers. \*
- 34. Cooperates extensively with customers with respect to selection of quality processes for improvement in product design. \*
- 35. Supply chain has the ability to respond quickly for solving problems of final customers. \*
- 36. Collects and evaluates both formal and informal complaints for the satisfaction of its customers to strengthen long term relationships. \*
- 37. Supply chain has the ability to deliver shipments of variable sizes on a frequent basis to final customers. \*
- 38. Has the ability to rapidly adjust production capacity in response to changes in customer demand. \*

**C.5 Process related statements for your organization.**

- 39. Ensures compatibility among all relevant business processes. \*
- 40. Puts effort in simplifying product design in order to reduce process complexity without sacrificing product functionality. \*
- 41. Supply chain processes have the ability to minimize safety stock throughout the supply chain.\*
- 42. Common standards are used to link processes smoothly with its supply chain partners. \*
- 43. Regularly evaluates whether there are redundant activities within various processes across firms\*
- 44. Ensures reduction in performing identical jobs by employees in various departments. \*
- 45. Employees aim to redesign work routines and processes for making them simpler. \*
- 46. The organization has a good overall delivery performance system. \*

**APPENDIX II - Research Publications**

<b>Manuscript Title</b>	<b>Authors</b>	<b>Journal/Conference</b>	<b>Journal/Conference Details</b>	<b>Acceptance Date</b>
Mediating role of process simplification in process integration and upstream supply chain flexibility	Goyal, G., Samalia, H.V. & Verma, P.	Journal (B category in ABDC List)	International Journal of Productivity and Performance Management	22 <sup>nd</sup> May, 2017.
Interpretive Structural Modeling for integrating quality management in manufacturing and service counterparts	Goyal, G., Samalia, H.V. & Verma, P.	Journal (B category in ABDC List)	International Journal of Quality and Reliability Management.	11 <sup>th</sup> December, 2016
Cataloging Frequently Used Theories in the Supply Chain Management Literature: An Appraisal	Goyal, G., Mahindroo, A. & Samalia, H.V.	Conference	XVIII Annual International Conference of the Society of Operations Management: IIT Roorkee, India	2 <sup>nd</sup> November, 2014
Quality Management Practices' Grounded Pathway to Higher Supply Chain Performance: An Appraisal	Goyal, G., Samalia, H.V., Verma, P. & Singh, H.	Conference	ARC 2014-II International Conference on Applied Research in Business, Management, Economics and Finance, Pattaya, Thailand	2 <sup>nd</sup> July, 2014