Major Project -II

SUPPLY CHAIN QUALITY MANAGEMENT- AN EMPERICAL STUDY

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By

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DECLARATION

I, hereby declare that the work embodied in the dissertation entitled "**SUPPLY CHAIN QUALITY MANAGEMENT- AN EMPERICAL STUDY"** in partial fulfilment for the award of degree of MASTER of TECHNOLOGY in "PRODUCTION TECHNOLOGY", is an original piece of work carried out by me under the supervision of Prof. S. K. Garg, Mechanical Engineering Department, Delhi Technological University. The matter of this work either full or in part have not been submitted to any other institution or University for the award of any other Diploma or Degree or any other purpose what so ever.

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CERTIFICATE

This is to certify that the above statement of the candidate is correct.

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ABSTRACT

Quality management and Supply Chain Management are two terms that have clearly stood out as management phenomenon in the past two decades. Organizations are implementing total quality management as an important tool to improve their business performance. In the past two decades there has also been an increasing emphasis on supply chain management as an important vehicle to gaining a competitive edge. Companies are more and more concentrating on improving the overall efficiency of their whole supply chains. With increased interdependence of one organization on another, it gets very tough to limit management strategies within the organization. Quality also is no more about quality in enterprise rather quality is a supply chain factor.

This thesis discusses integration of these two principles. It reviews earlier works by other authors as well. It draws a parallel between these two and discusses how Quality and supply chain management are critically related. We define supply chain management (SCM), total quality management (TQM) and supply chain quality management (SCQM) to operationalize and understand their effect and increased emphasis on supply chain. We review current research in quality management and identify common themes found in the literature. Next a research model is developed to study the relationship between supply chain management and total quality management. An empirical study was done with the help of a survey to study the relationship between total quality management and supply Chain management.

In the results a very strong relationship was found between quality performance and physical performance of an organization. Also strong relationships were found between other constructs of supply chain management and total quality management.

Keywords: Supply chain, Supply Chain Management, Total Quality Management and Supply chain quality management.

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CHAPTER 1

INTRODUCTION

1.1 SUPPLY CHAIN MANAGEMENT

In last three decades, the concept theory and methodologies of business management have undergone profound changes and improvements. The older ways of doing business have been challenged and many newer ideas and approaches have been searched for, among them are business process re-engineering, strategic management, lean thinking, total quality management, agile manufacturing, balanced scorecard… just to name a few. Supply chain management is undoubtedly one of those management approaches that has emerged and rapidly developed across all industries around the world.

Supply Chain Management (SCM) is a concept that is gaining in popularity and importance. More and more companies are investing on their supply chain to increase their customer satisfaction and enhance production capabilities. In this emerging competitive environment, the ultimate success of the business will depend on management's ability to integrate the organization's intricate network of business relationships. The members of The Global Supply Chain Forum refer to the management of this network of relationships as supply chain management. Companies view Supply chain management as an important part of their planning. In the harsh global environment of growing global competition and increasingly demanding customers, there is competition between the whole supply chains and not just individual organizations as autonomous entities. Success of an organization is heavily dependent on how well it manages its supply chain and how well its management can integrate the whole chain as a single system.

An organization centered management approach is no longer sufficient to deliver the required competitiveness. Managers must therefore understand that their businesses are only part of the supply chains in which they are participating and it is the supply chain that wins or loses the competition. Their success is totally much dependent on the success of the supply chain as a whole.

Thus, the arena of competition is moving from ‘organization against organization’ to ‘supply chain against supply chain’. The survival of any business today is no longer solely dependent on its own ability to compete but rather on the ability to cooperate within the supply chain. The seemingly independent relation between the organizations within the supply chain becomes ever more interdependent. You “sink or swim with the supply chain.” Supply Chain Management is needed for various reasons: improving operations, better outsourcing, increasing profits, enhancing customer satisfaction, generating quality outcomes, tackling competitive pressures, increasing globalization, increasing importance of E- commerce, and growing complexity of supply chains It is for these reasons that management of supply chain has an important effect on business performance of every party involved in it. Because of this research and implementation of supply chain management principals to improve supply chains is of key importance to any organization.

1.2 EXAMPLE OF A SUPPLY CHAIN

If you are a tea drinker – If you wonder how the tea makes its way onto your breakfast table? Have a look at the supply chain diagram in Fig. 1. What do you see? Firstly, let’s consider the flow of materials – these are depicted in the middle part of the diagram. They range from raw materials (tea leaves), to work in progress (silo), all the way to finished goods (a cup of tea). This goods flow encompasses the supplier’s supplier through to end consumer. Secondly, we have the flow of information, e.g. order confirmation or dispatch advice. In addition, there are also reverse flows. These reverse flows can be in the form of:-

- Goods, e.g. quality defect products or obsolete products
- Information, e.g. customer feedback
- Packaging material, e.g. outer cartons
- Transportation equipment, e.g. cages, pallets or containers

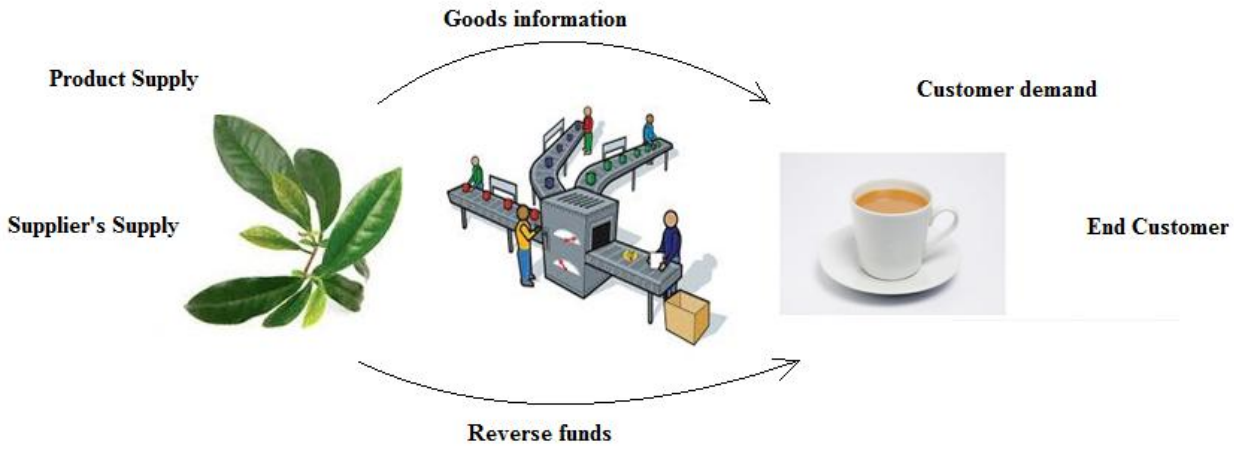

Figure 1.1:- Supply chain of a cup of Tea

We also have the reverse flow of funds. This is the money that flows back into the supply chain. Ultimately, the supplier's supplier wants to be paid for the delivery of tea leaves. Thus, tracking our breakfast drink all the way back from its source of raw materials shows a number of players and processes involved.

With greater focus from industry number of empirical studies and academic dissertations over the years on topics related to supply chain management has rapidly increased. Here in this work we have taken a quality management focused approach to supply Chain and an empirical study was carried out to study the effect of Quality management on Supply chain performance. Quality management along with supply chain has been two very important terms in management. Quality is one factor that every organization must take seriously if the organization wants to excel in its business. Since the 1980s, quality has become a major influence in the business world. Although, in general, for the major companies it all began with applying the theories of the quality gurus, especially doctors Deming and Juran, it is also true that the definitive push, especially for the small and medium-size companies, came about with the appearance of the quality assurance standard, ISO 9000. Without doubt, its increasing implementation in companies all over the world continues to be the main driving force behind improvements in quality management. Quality is now seen as one of the critical factors determining a competitive edge to organizations. It is an essential ingredient in building successful businesses and marketing. The success of quality focused companies

has dramatically changed how they and others see both quality and business management today. According to the International Standard ISO 9000:2000, quality is defined as "degree to which a set of inherent characteristics fulfills requirements". With time the focus of quality has gone well beyond just a product centered approach to all the processes, activities and services related to the product. Quality is no more just a matter of meeting customer expectations but of exceeding them. But successful implementation of strategic quality management is not an easy task. As Deming stated, "Everyone doing his best is not the answer. It is necessary that people know what to do. Drastic changes are required. The responsibility for changes rests on management*"* [1]. Continuous improvement of process, product and services supported by various techniques is required to stay ahead of competition. With this the philosophy and concepts of total quality management (TQM) have been received increased attention.

1.3 PURPOSE OF THESIS

The ultimate goal of this research is to explore the relationship between Quality management and Supply chain, and to develop a model explaining this relationship.

A number of fields such as purchasing and supply, logistics and transportation, operations management, marketing, organizational theory, quality management, management information systems, and strategic management have contributed to the explosion of SCM literature. From the myriad of research, it can be seen that a great deal of progress has been made toward understanding the essence of SCM. Although in the absence of clearly defined constructs and conceptual frameworks a there is lack of reliable conceptual base. Here we intend to contribute to the development of SCM by examining the effect of quality on supply chain. These two principles- Quality management and SCM, impact business performance to a great extent and both share the common goal of continuous improvement and customer satisfaction. The goal of supply chain management remains incomplete if we do not include quality management with it. If we can use TQM to great benefit for quality management assurance and improvement within the organization, then why not use it throughout the

supply chain. If we for greater industrial excellence we are concentrating on managing the whole supply chain then when it comes to quality management we should do the same.

Here in this work we have tried to do the same and explore the effect of quality management on Supply chain performance and then the effect of Quality performance and Supply chain performance on customer satisfaction to get a sense of how these two affect the business.

With the help of literature study, a strong theory and research hypotheses are developed and on the basis of those hypotheses a model of developed. An empirical survey and study was done to verify this model and get the relationship between quality management and supply chain management.

1.4 METHODOLOGY

To achieve the ultimate goal of finding out the relationship between Quality management and Supply chain management following methods were used:-

- First method used id review of relevant literature and theoretical findings on supply chain management, supply chain management implementation and quality management.
- This is followed by deduction of research hypotheses and validation of these hypotheses on the basis of literature and theory, and research items were developed to test these hypotheses.
- Next a model was developed on the basis of these hypotheses.
- A questionnaire was developed from literature study relating to the research items.
- Industrial survey was done, all the survey forms were physically delivered to the respondents selected.
- The feedbacks were used to prepare the data set for further analysis in IBM SPSS Statistics 20.0 software.
- The model was made in IBM SPSS Amos 20.0.0 and it was analyzed. The results were further analyzed.

CHAPTER 2

DEFINITIONS AND BASICS

2.1 SUPPLY CHAIN

Supply chain which was earlier viewed from a narrow logistics centered view only is now seen as from a much wider perspective. There has been paradigm shift in this field and a much broader system oriented customer centered view. Various researchers have defined supply chain and supply chain management in different words and some of them have been studied here.

Supply chain can be defined as integrated process wherein a number of various business entities (i.e., suppliers, manufacturers, distributors, retailers and customers) work together in an effort to: (1) buy or obtain raw materials, (2) convert these raw materials into specified finished final products, and (3) deliver these end products to customers,[2].

It is a conceptual framework in which networks are formed by a group of independent companies, with organizing roles initiated by one or more lead firms [3].

Supply chains encompass the companies and the business activities needed to design, make, deliver, and use a product or service. A supply chain consists of all stages involved, directly or indirectly, in fulfilling a customer request. The supply chain not only includes the manufacturer and suppliers, but also transporters, warehouses, retailers, and customers themselves [4].

Supply chain is “all of those activities associated with moving goods from the raw materials stage through to the end-user. This includes sourcing and procurement, production scheduling, order processing, inventory management, transportation, warehousing and customer services. Importantly, it also embodies the information systems so necessary to monitor all of those activities”[5].

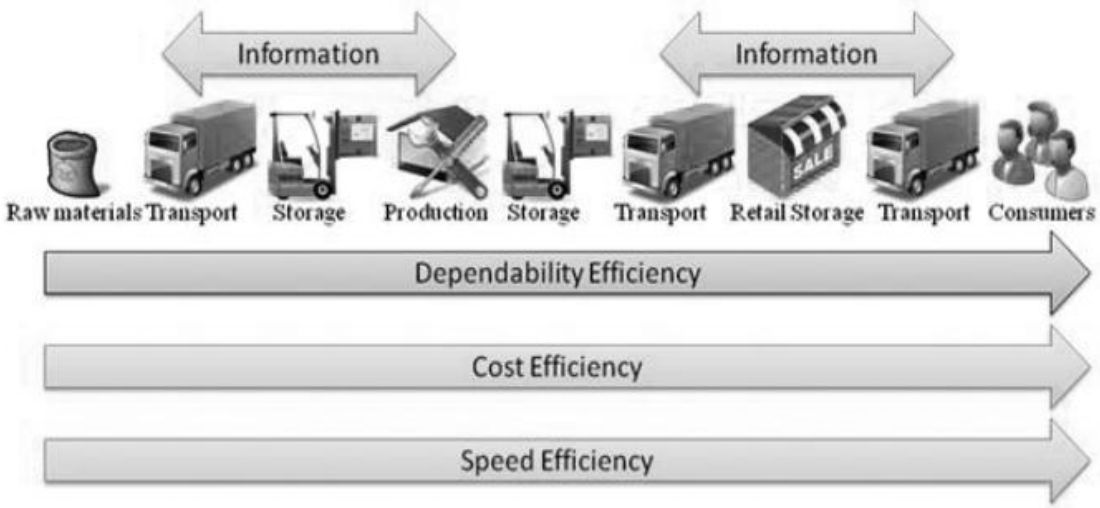

Figure 2.1:- Design of a fundamental supply chain

Source:- [6]

All the activities involved in delivering a product from raw material through to the customer including sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, delivery to the customer and the information systems necessary to monitor all of these activities.[5]

Supply chain is "a network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer."[7].

The supply chain includes suppliers, manufacturers, distributors, retailers, and customers. The customers are the main focus of the whole chain, since the primary purpose of the existence of any supply chain is to satisfy customer needs, in the process generating profit for itself.[7]

We have to embrace a far more liberal view of the supply chain. In effect, the supply chain is any combination of processes, functions, activities, relationships, and pathways along which products, services, information, and financial transactions move in and between enterprises. It also involves any and all movement of these from original producer to

ultimate end-user or consumer, and everyone in the enterprise is involved in making this happen.[8]

As per the definition of Supply Chain Council (2002), the supply chain encompasses every effort involved in producing and delivering a final product from the supplier's supplier to the customer's customer. This includes partnering with other firms in chains of relationships that result in down- stream benefits to customers [9].

A supply chain is defined as a set of three or more entities (organization or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer [10]

The linked set of resources and processes that begins with the sourcing of raw material and extends through the delivery of end items to the final customer. It includes vendors, manufacturing facilities, logistics providers, internal distribution centers, distributors, wholesalers and all other entities that lead up to final customer acceptance. The extended supply chain for a given organization may also include secondary vendors to their immediate vendors, and the customers of their immediate customers.

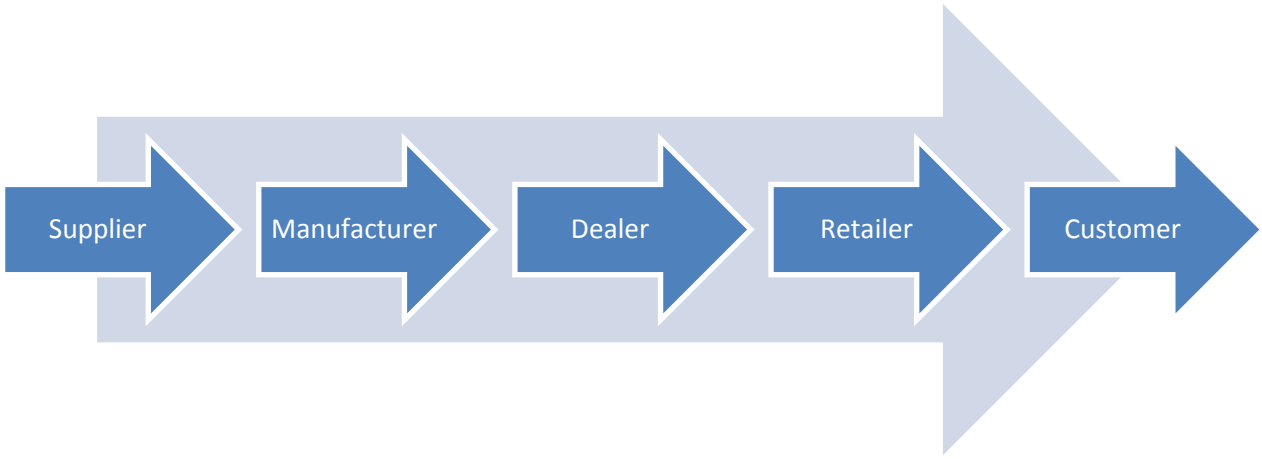

Figure2.2: A supply chain structure

A supply chain (SC) is a network of organizations that are involved in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer. SCM concerns the integrated and process-oriented approach to the

design, management and control of the supply chain, with the aim of producing value for the end customer, by both improving customer service and lowering cost. It integrates the management of the flows of goods and information throughout the supply chain, so as to insure that the right goods be delivered in the right place and quantity at the right time [11].

Supply Chain is the group of manufacturers, suppliers, distributors, retailers and transportation, information and other logistics management service providers that are engaged in providing goods to consumers. A Supply Chain comprises both the external and internal associates for the corporate[6].

Supply chain is defined as a group of inter-connected participating companies that add value to a stream of transformed inputs from their source of origin to the end products or services that are demanded by the designated end-consumer [12].

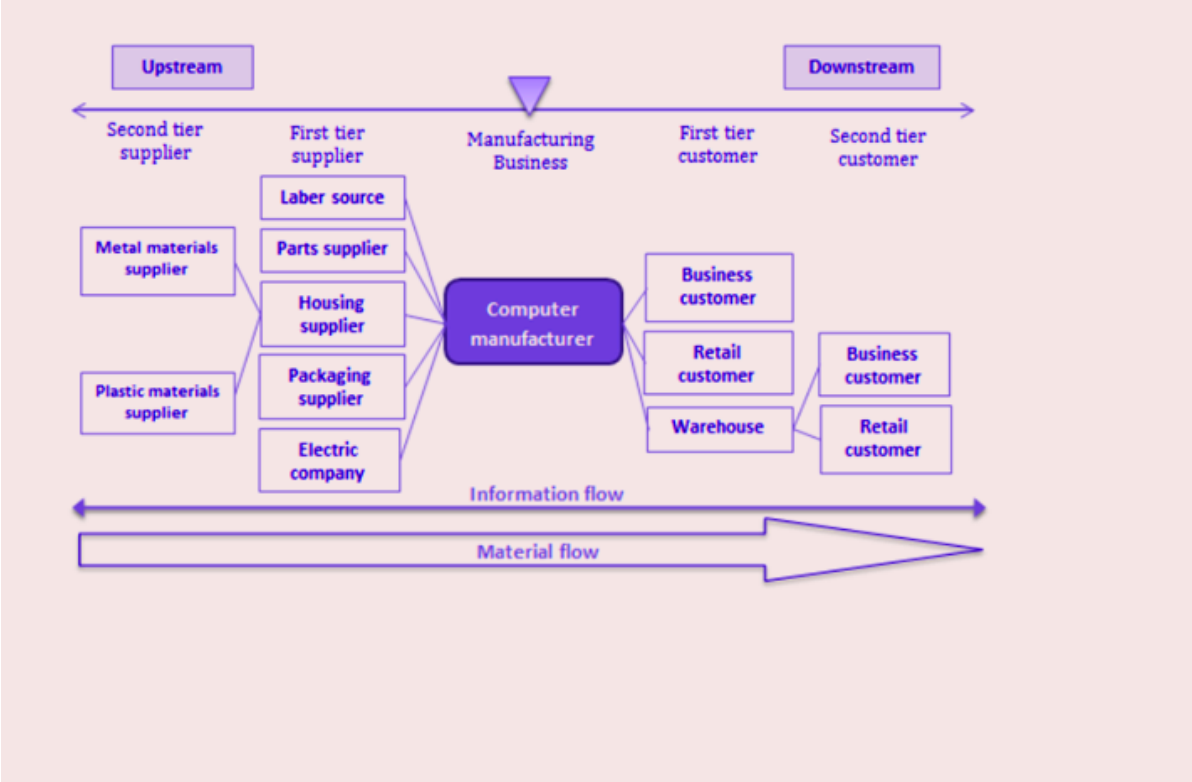

Figure2.3:-Example of the supply chain of a computer manufacturer

The APICS Dictionary describes the supply chain as the processes from the initial raw materials to the ultimate consumption of the final product linking across supplier, user

companies; and the functions within and outside a organization that enable the value chain to make products and provide services to the customer [13].

A supply chain is all the activities that are associated with transformation and the flow of product/services with the involving information flow, from the state of raw materials to the final customers. Every step involved, from the raw material with supplier to final final product delivery to the customer, are involved in a supply chain.

2.2 SUPPLY CHAIN MANAGEMENT

Although there is much confusion among supply chain researchers for having a single agreed upon definition of supply chain management, many definitions have been proposed in the last two decades. While most scholars agree that SCM includes coordination and integration, cooperation among various chain members, and the movement of materials and products to the final customer; still there is a need to have a consensus about how supply chain management should be defined. Stock and Boyer (2009)[14], have studied the definitions put forward by various researchers and have explored multiple definitions that have been put forward in the literature, by reviewing 173 definitions of SCM in multiple journals and books.

The simultaneous integration of customer requirements, internal processes, and upstream supplier performance is commonly referred to as supply chain management (SCM)[15].

“The management of a network of relationships within a firm and between interdependent organizations and business units consisting of material suppliers, purchasing, production facilities, logistics, marketing, and related systems that facilitate the forward and reverse flow of materials, services, finances and information from the original producer to final customer with the benefits of adding value, maximizing profitability through efficiencies, and achieving customer satisfaction”[14]

Supply chain management is the management of relationships in the network of organizations, from end customers through original suppliers, using key cross-functional business processes to create value for customers and other stakeholders.

Supply chain strategy includes: " Two or more organizations entering into a long-term agreement. The development of trust and commitment to the relationship. The integration of logistics activities involving the sharing of demand and sales data. The potential for a shift in the control and management of the logistics process." [16].

Supply chain management coordinates and links all the activities into a seamless process. It links all of the partners in the chain including departments within an organization and external partners including suppliers, carriers, third-party companies and information systems providers.[5]

Supply Chain Management is the systematic and strategic coordination of the traditional business functions within a particular organization and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole. [10]

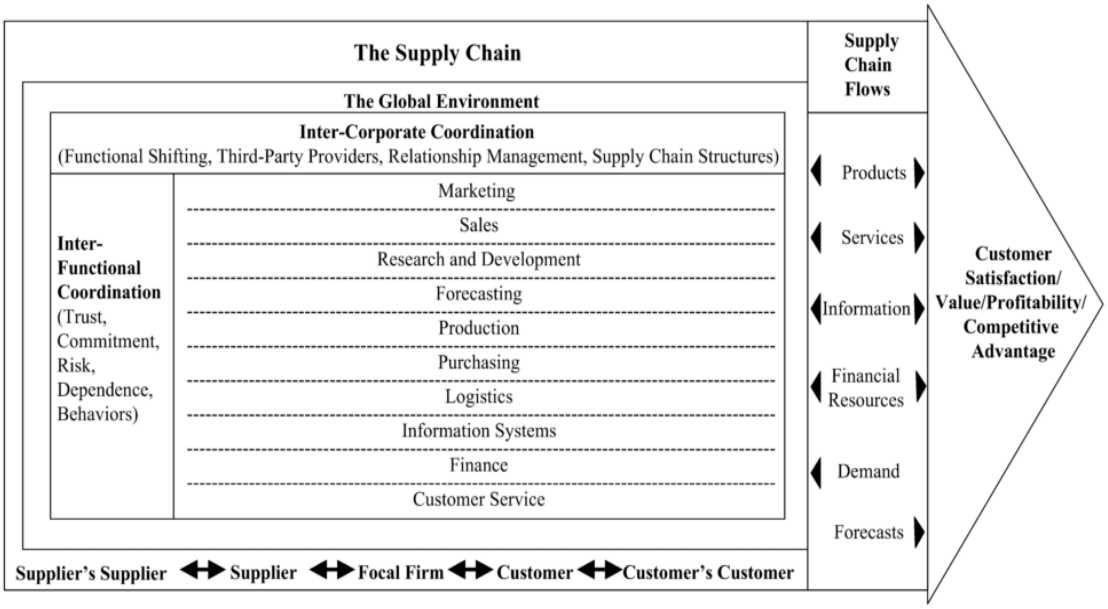

Figure2.4:- A model of supply chain management

Source:- [10]

Supply chain management involves the management of flows between and among stages in a supply chain to maximize total profitability. SCM was initially related to the management of inventory within a supply chain. This concept was later broadened to include the

management of all functions within a supply chain. Supply chain management involves the management of flows between and among stages in a supply chain to maximize total profitability". This definition suggests that SCM involves management of the flows of products, information, and funds upstream and downstream in the supply chain. SCM also entails making decisions about the locations of production facilities, which products to produce, how to produce them, and finally, how to distribute these products.[17].

The members of the Global Supply Chain Forum (2009) have developed the following definition which neatly encapsulates the aspects of SCM: Supply chain management is the integration of key business processes from end-user through original suppliers that provides products, services, and information that add value for customers and other stakeholders.

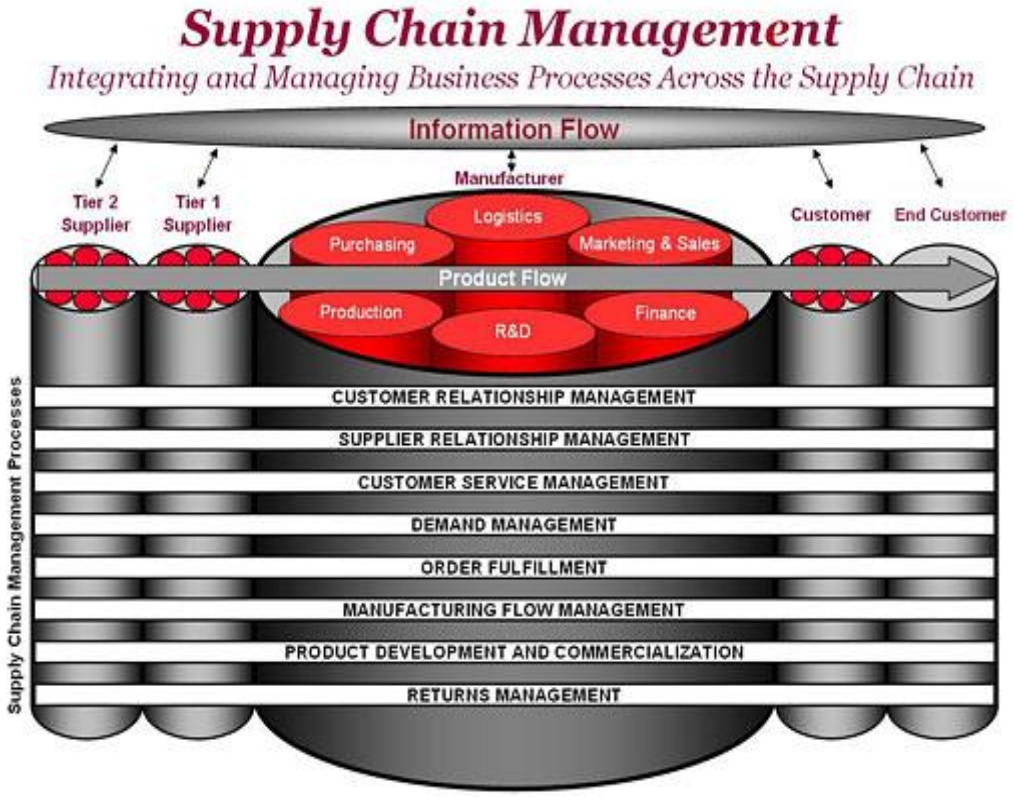

Figure 2.5:- SCM model

***Source:-* [82]**

The Council of Supply Chain Management Professionals (CSCMP) (2014), (formerly The Council of Logistics Management (CLM)), a leading professional organization promoting SCM practice, education, and development, defines SCM as: "SCM encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities, including coordination and collaboration with suppliers, intermediaries, third-party service providers, and customers" (Thus the supply chain encompasses all activities involved in the production and delivery of a final product or service, from the supplier's supplier to the customer's customer). In essence, supply chain management integrates supply and demand management within and across companies (CSCMP, 2014).

Council of Supply Chain Management has also proposed a definition for SCM, stating that it:

It encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all Logistics Management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, Supply Chain Management integrates supply and demand management within and across companies (CSCMP, 2014).

CSCMP (2014) also provides a brief description of the boundaries of SCM:

Supply Chain Management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. It includes all of the Logistics Management activities noted above, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, finance and information technology.

The objective of SCM is to incorporate activities across and within organizations for providing the customer value. The key activities that are required to achieve a successful

supply chain are integration, cooperation, long-term focus on partnerships, sharing information, extensive communication between supply chain parties, sharing of risks, rewards and goals. These key activities are involved in SCM, which is defined as "the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular organization and across businesses within the supply chain, for the purposes of improving the long term performance of the individual companies and the supply chain as a whole"[18].

Supply chain management is the integration of business functions within the organization as well as integration of business functions of different organizations that are joined together by a common supply chain, for better management of the whole supply chain and for enhanced organizational performance in every way.

Supply chain management is an approach to integrating suppliers, manufacturers, products are produced and distributed at the right distributors and retailers, such that quantities, to the right location, at the right time, with the mutual goals of minimizing system wide costs and satisfying customer service requirement, it synchronizes a firm's processes with its suppliers and customers with the goal of matching the materials, services and information with customer demand[19].

Supply chain management is a holistic and strategic approach to demand, operations, procurement, and logistics process management…. the formal coordination and integration of business processes involving all partner organizations in the supply chain channel [20].

Supply chain management is a fundamentally different philosophy of business organization and is based upon the idea of partnership in the marketing channel and a high degree of linkage between entities in that channel…Under the supply chain management model the goal is to maximize profit through enhanced competitiveness in the final market a competitiveness that is achieved by a lower cost to serve, achieved in the shortest time-frame possible[21].

Supply chain management coordinates and integrates all of the activities of a supply chain into a seamless process. It links all of the partners in the chain including departments within

an organization and the external partners including suppliers, carriers, third-party companies, and information systems providers[5]

In Supply chain management the primary objective is to integrate and manage the sourcing, flow, and control of materials taking a integrated perspective across multiple functions and multiple tiers of suppliers. In Supply chain management, "Supply" is a shared objective of every function of particular strategic importance because of its impact on overall sales, costs, profits and market share. Thus SCM calls for a different point of view on inventories that are utilized as a balancing mechanism of last, not first, resort. A latest approach to systems is required - integration rather than interfacing.[7]

SCM is the act of optimizing activities across the Supply Chain. Supply Chain management is the maintenance, planning, and Supply Chain processes activity for the satisfaction of consumers needs. It is aimed at examining and managing Supply Chain networks. The rationale for this concept is the opportunity (alternative) for cost savings and better customer service. An important objective is to improve a corporate competitiveness in the global marketplace in spite of hard competitive forces and promptly changing customer needs[6].

SCM is to create sourcing, making and delivery processes and logistics functions seamlessly across the supply chain as an effective competitive weapon. SCM is the systemic, strategic coordination of the traditional business functions and tactics across these businesses functions within a particular organization and across businesses within the supply chain for the purposes of improving the long-term performance of the individual organizations and the supply chain as a whole [22].

SCM practices have been defined as the set of activities undertaken in an organization to promote effective management of its supply chain. The various activities includes supplier partnership, outsourcing, cycle time compression, continuous process flow, concentration on core competencies, use of inter-organizational systems such as EDI, coordinating the flow of materials and information among suppliers, manufacturers, and customers elimination of excess inventory levels by postponing customization toward the end of the supply chain. information technology sharing, purchasing, quality, and customer relations [22].

SCM has been used to explain the planning and control of materials and information flows as well as the logistics activities not only internally within a organization but also externally between companies. It is an integrating function in terms of materials and information [23].

Supply chain is integration of customer requirements , internal processes and upstream supply performance [15].

Supply chain should be viewed as a single system, or the so-called “seamless supply chain” (SSC), which is defined as “the state of total integration in which all players think and act as one”. SCM has been described in various terms: supplier integration; partnerships; supply base management; supplier alliances; supply chain synchronization; network sourcing; supply pipeline management; value chain management; and value stream management; and as a demand chain[24].

Supply chain management (SCM) emphasizes the interdependence of organizations working collaboratively to improve the efficiency of the entire logistics channel.

Every chain is made up of linkages. A chain is only as strong as its weakest linkage. Similarly supply chain has various linkages like supplier, logistics, inventory, manufacturer, distributer, and retailer. Every single link, from raw material stage of a product till the delivery of the final product to the customer, is a part of supply chain. For a supply chain to be successful it is important that all these links perform. SCM revolves around the efficient integration and management of all these links. The success of the whole chain as well as that of every single link is very much dependent on the functioning of other links in the chain.

2.3 TOTAL QUALITY MANAGEMENT

The quality management issues have also impacted the performance of supply chain in one way or other. This principle of quality has exploded in the past 2 decades. Various researchers and academicians have defined it in different words. According to the American Society for Quality, the definition of quality is "A subjective term for which each person or sector has its own definition.

In technical usage, quality can have two meanings:

1. the characteristics of a product or service that bear on its ability to satisfy stated or implied needs.

2. a product or service free of deficiencies. According to Joseph Juran, quality means "fitness for use;" according to Philip Crosby, it means "conformance to requirements."

The quality definition as specified by Joseph Juran, "Quality is the fitness of use" i.e. it is the value of the goods and services as perceived by the supplier, producer and customer. The measure also pertains to the degree to which products and services conform to specifications, requirements and standards at an acceptable price. Some of the definitions of Quality, provided by quality gurus are as follows:

The efficient production of the quality that the market expects (DEMING)

Quality is what the customer says it is (FEIGENBAUM)

Quality is the loss that a product costs to the society after being shipped to the customer (TAGUCHI)

Quality is the totality of features and characteristics of a product or services that bear on its ability to satisfy stated or implied needs of the customers (ASQC).Total Quality Management (TQM) is a management philosophy which focuses on the work process and people, with the major concern for satisfying customers and improving the organizational performance. It involves the proper coordination of work processes which allows for continuous improvement in all business units with the aim of meeting or surpassing customer's expectations. It emphasizes on totality of quality in all facets of an organization with the aim of reducing waste and rework to reduce cost and increase efficiency in production.

TQM aims at improving all the steps of a process. It can be seen as a "policy of small steps". When you are convinced that all the optimized steps cannot return more, the time is come to put the whole process into questions. Also, the TQM approach will clearly tell you what is needed, which feature are necessary and which process are not performing as well as you

would like. In other words, the TQM will tell you where PR could be necessary and will provide you with the required data. Similarly, TQM will give you methods and techniques to be sure that the new process design works as expected.

TQM is an integrated approach, consisting of principles and practices, whose goal is to improve the quality of an organization's goods and services through continuously meeting and exceeding customer's needs in most competitive ways. TQM focuses on enhancing customer satisfaction. It is a total system approach which works horizontally across functions and departments, involving all employees, top to bottom, and extends backwards and forwards to include the supply chain and customer chain[25].

TQM is a set of management practices applicable throughout the organization and geared to ensure the organization consistently meets or exceeds customer requirements.

A core definition of total quality management (TQM) describes a management approach to long–term success through customer satisfaction. In a TQM effort, all members of an organization participate in improving processes, products, services, and the culture in which they work. The methods for implementing this approach come from the teachings of such quality leaders and quality masters as Philip B. Crosby**,** W. Edwards Deming**,** Armand V. Feigenbaum, Kaoru Ishikawa, and Joseph M. Juran.

Total quality management can be summarized as a management system for a customer-focused organization that involves all employees in continual improvement. It uses strategy, data, and effective communications to integrate the quality discipline into the culture and activities of the organization.

Customer focused- The customer ultimately determines the level of quality. No matter what an organization does to foster quality improvement—training employees, integrating quality into the design process, upgrading computers or software, or buying new measuring tools the customer determines whether the efforts were worthwhile.

Total employee involvement- All employees participate in working toward common goals. Total employee commitment can only be obtained after fear has been driven from the

workplace, when empowerment has occurred, and management has provided the proper environment. High-performance work systems integrate continuous improvement efforts with normal business operations. Self-managed work teams are one form of empowerment.

Process centered- A fundamental part of TQM is a focus on process thinking. A process is a series of steps that take inputs from suppliers (internal or external) and transforms them into outputs that are delivered to customers (again, either internal or external). The steps required to carry out the process are defined, and performance measures are continuously monitored in order to detect unexpected variation.

Integrated system- Although an organization may consist of many different functional specialties often organized into vertically structured departments, it is the horizontal processes interconnecting these functions that are the focus of TQM.

Micro-processes add up to larger processes, and all processes aggregate into the business processes required for defining and implementing strategy. Everyone must understand the vision, mission, and guiding principles as well as the quality policies, objectives, and critical processes of the organization. Business performance must be monitored and communicated continuously.

An integrated business system may be modeled after the Baldrige National Quality Program criteria and/or incorporate the ISO 9000 standards. Every organization has a unique work culture, and it is virtually impossible to achieve excellence in its products and services unless a good quality culture has been fostered. Thus, an integrated system connects business improvement elements in an attempt to continually improve and exceed the expectations of customers, employees, and other stakeholders.

Strategic and systematic approach-A critical part of the management of quality is the strategic and systematic approach to achieving an organization's vision, mission, and goals. This process, called strategic planning or strategic management, includes the formulation of a strategic plan that integrates quality as a core component.

Continual improvement. A major thrust of TQM is continual process improvement. Continual improvement drives an organization to be both analytical and creative in finding ways to become more competitive and more effective at meeting stakeholder expectations.

Fact-based decision making. In order to know how well an organization is performing, data on performance measures are necessary. TQM requires that an organization continually collect and analyze data in order to improve decision making accuracy, achieve consensus, and allow prediction based on past history.

Communications. During times of organizational change, as well as part of day-to-day operation, effective communications plays a large part in maintaining morale and in motivating employees at all levels. Communications involve strategies, method, and timeliness.

TQM provides a set of practices that emphasizes, among other things, continuous requirements, reducing rework, long-range thinking, increased improvement, meeting customers' employee involvement and teamwork, process redesign, competitive benchmarking, team-based problem-solving, constant measurement of results, and closer relationships with suppliers[26]

TQM is a "customer focused management philosophy that aims at the continuous improvement of the processes and management of an organization through statistical control, procedure design, policy deployment and human resource management techniques"[27]

TQM process as a total corporate focus on meeting and exceeding customers' expectations and significantly reducing costs resulting from poor quality by adopting a new management system and corporate culture. The principles of TQM have been described by many authors and encompass elements such as management leadership and commitment, employee involvement, supplier partnership, continuous improvement, etc. It is a way of managing an enterprise towards achieving business excellence [28].

2.4 SUPPLY QUALITY MANAGEMENT

SCQM is the formal coordination and integration of business processes involving all partner organizations in the supply channel to measure, analyze and continually improve products, services, and processes in order to create value and achieve satisfaction of intermediate and final customers in the marketplace [29]

Supply chain quality management (SCQM) is defined as a systems-based approach to performance improvement that leverages opportunities created by upstream and downstream linkages with suppliers and customers.[30]

The supply chain quality management encompasses all quality management activities associated with the flow and transformation of goods from raw material stage through the end users(final product) stage along with flow of all information related to quality [31].

Lin et al. [32]has defined Supply chain quality management (SCQM) with three simple equations where each equation represents the letters that make up SCQM. The definition is as follows:

SC=a production–distribution network;

Q=meeting market demands correctly, and achieving customer satisfaction rapidly and profitably;

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

CHAPTER 3

LITERATURE REVIEW

3.1 INTRODUCTION

Supply chain was initially constrained to logistics and inventory management in an organization. Although the concept is as old as the times of Alexander the great, but successful use of SCM principles in business is rather recent. SCM involves management of the flows of products, information, and funds upstream and downstream in the supply chain. SCM also entails making decisions about the locations of production facilities, which products to produce, how to produce them, and finally, how to distribute these products[17]. SCM involves challenges such as developing trust and collaboration among supply chain partners, identifying best practices that can facilitate supply chain process alignment and integration, and successfully implementing the latest collaborative information systems and Internet technologies that drive efficiencies, performance, and quality throughout the supply chain.

[29]defines the concept of SCQM and explains its relevance in academic and industrial practice. To gain a competitive edge organization, consultants, practitioners and academicians are focusing on supply chain integration. Organizations are using newer techniques to manage their supply chains like ERP, SAP software for a improved response, control costing, less wastage, and perfect ordering. Greater effort is now put in it by academics too.

Quality management is something that has effect on every aspect of a firm's performance. Till now some work has been done separately by researchers in the field of quality and supply chain management. Various studies have investigated the effect of quality management practices on firm's performance. But there is still a lack of research work that combines there two phenomenons.

3.2 LITERATURE REVIEW

Lin et al. [32] identified the factors that influence supply chain quality management using empirical data collected from Taiwan and hong kong. It finds that Quality Management

(QM) practices are significantly correlated with the supplier participation which in turn effects organizational performance and influences tangible business results, customer satisfaction levels, and supplier selection strategy. Results show that supplier selection strategy has no direct but indirect influence on organizational performance. Also result show that quality management practices has no direct but has indirect influence on organizational performance.

Noori et al.[33] investigated the implementation of continuous collaborative improvement activities in the supply chains of Canadian industries, including the automotive, electronics and aerospace sectors. It finds that companies are placing greater strategic importance on supply chain performance. Supply chain nodes are engaging in joint strategic planning to a greater extent than they did a decade ago. The most effective tools are quality standards such as ISO 9000, EDI usage, improvements process such as JIT and lean manufacturing, and the establishment of performance targets for suppliers.

Stanley & Wisner[15] [34]discussed the association between implementation of cooperative purchasing/supplier relationships, internal service quality, and an organization's ability to provide quality products and services to its external customers. Its finds that the existence of strong positive relationships between implementation of cooperative purchasing/supplier relationships, internal service quality, and the service and product quality provided to external customers.

Lee et al. [35] discussed the application of TQM principles to increase supply chain security with lesser cost incurred on it.

Yeung [36] examines the organizational impacts of strategic supply management (SSM) and the contexts of organization size, process type, ISO 9000 certification, and quality management (QM) implementation that facilitate such an endeavor. It reveal that SSM is essentially a quality management initiative that requires bilateral efforts for continuous improvement.

SCQM is the formal coordination and integration of business processes involving all partner organizations in the supply channel to measure, analyze and continually improve products, services, and processes in order to create value and achieve satisfaction of intermediate and final customers in the marketplace[29].

It finds the following linkages between SCM and QM- communication and partner activities, process integration and management, management and leadership, strategy, best practices.

Assadej et al. [24]identifies the similarities between the principles of TQM and SCM, where TQM is an internal management principle , SCM is external coordination principle integration of these two is necessary to emphasize the term total in TQM. It advocates internal participation and external participation and thereby integration of TQM and SCM.

Foster [30] in his paper identified the key variables of SCQM through an extensive literature review and classified the various variables related to SCQM according to their commonality and uniqueness. It defines supply chain quality management (SCQM) to operationalize and understand the effect of increased emphasis on supply chain management on the practice of quality management in a firm. It reviewed current research in quality management and identified common themes in the literature. Key quality management content variables identified are customer focus, quality practices, supplier relations, leadership, HR practices, business results, and safety. It defines supply chain quality management (SCQM) is defined as a systems-based approach to performance improvement that leverages opportunities created by upstream and downstream linkages with suppliers and customers.

Kaynak and Hartley [37] developed a structural equation model exploring quality management (QM) in a supply chain context. It uses two quality management practices- supplier quality management and customer focus as variables to study quality management practices extending into the supply chain. It examine eight QM practices in their paper management leadership, training, employee relations, customer focus, quality data an reporting, supplier quality management, product or service design, and process management. It shows the need to integrate quality management process and supply chain, quality should not be an internal function of a firm but it should be extended to suppliers and customers too.

Lo et al. [38]in its work identifies critical supply quality management practices conducted in hong kong. It identifies ten critical factors- supplier quality culture, supplier quality system, direct involvement, credibility, purchasing practice, buyer-supplier interaction, strategic

aspect, buyer supplier relationship, operational aspect, alliance. These are segregated in three major groups- supplier selection, supplier development, supplier integration.

Chu-Hua Kuei et al. [20]Integrated supply chain quality and technology management (SCQTM) helps to ensure successful supply chain management. Supply chain technology management, emphasizes the development of the technical base to facilitate the sharing of information on knowledge, markets, products, and processes among supply chain trading members. In their work developed a two stage frame work on supply chain quality and technology relate to only upstream of supply chain.

Fynes et al. [39]in their work on the impact of supply chain relationship quality on quality performance has developed a conceptual framework incorporating dimensions of SC relationships and quality. These dimensions include trust, commitment, communication, power/dependence, adaptation and collaboration. It finds that supply chain relations quality has a positive impact on design quality and not on conformance quality.

Beamon et al. [2] proposed a process quality model for the analysis, improvement and control of supply chain. Improved quality of all supply chain processes results in reduced costs, improved resource utilization, better customer satisfaction and improved process efficiency. It defines supply chain is an integrated set of business functions, encompassing all activities from raw material acquisition to final customer delivery. Delivering the right product at the right time in the right amount are essential objectives of efficient and effective supply chain systems.

Seth et al. [40]devised a model for assessing the quality of service at various interfaces of supply chain using third party logistics. It focuses on the service industry of supply chain and not on the supply chain on a whole and devel the performance gaps at various levels and interfaces.

Das [3], worked on placing a quality-oriented coordination process between the supply side and receiving partners by following the mathematical model which supports the development of an effective supply chain network that is aimed at maximizing profit. It optimizes supplier selection process by evaluating the capability and quality management system of the organization on the basis of five quality indices quality certification index,

scrap rate index, process capability index, safety record index and quality management index.

Romano et al. [41], has shown how supply chain can be used as tool for quality management in an organization with a case study conducted on Marzotto, an important Italian textile and Apparel Organization, and its supply chain relationships. It advocates Applying innovative procedures and establishing new, more frequent and closer relationships with suppliers and customers in the co-ordinated sub network. Although it means increased production cost but it has also improved final product and customer satisfaction. It also uses increased customer feedback using questionnaires to be filled by customers with the product. It also confirms the view that SCM goes beyond logistics and involves other processes like quality management.

Ramos et al.[18]addresses the blending of QM and SCM and says that their blending in would result in higher benefits than their sole application. It identifies many issues that fall into domains of both TQM and SCM - systemic approach, process orientation, customer and supplier focus, long term relationships, cooperation, information sharing, and continuous improvement.

Talib et al. [25], identified various TQM and SCM practices with the help of literature study. The results reveal six major TQM and SCM practices from as many as 50 TQM practices and 40 SCM practices. Major TQM and SCM practices as identified are:-

Total quality management

- Top-management commitment (includes leadership, management support and management commitment)
- Customer focus (includes customer satisfaction and orientation)
- Training and education.
- Continuous improvement and innovation.

- Supplier management (includes supplier relationship, supplier quality and supplier partnership, collaboration)

- Employee involvement

Supply chain management

- Customer relationship (includes complaints handling, customer satisfaction, and long term relationship establishment, close partnership with customer, customer service management, customer needs, increased customer responsiveness)

- Re-engineering material flows/Lean practices (including management of material flows, reducing inventory, elimination of waste, JIT delivery/JIT capability, manage inventory investment in the chain)

- Strategic supplier partnership (includes many supplier relationship, supplier involvement, supplier quality management, collaboration)

- Employing information and communication technologies (including information technology sharing/ communication, information systems)

- Changing corporate culture (including management support and commitment, leadership, participative management, cooperation, top-management leadership)

- Close partnership with suppliers (includes long-term relationship, partnership, reliable suppliers)

Kuei et al. (2002) developed a two-stage framework on supply chain quality and technology management. This is based on a survey of the perceptions of practicing managers from Hong Kong's business corporations. The two-stage process involves empirical assessment of the strategic supply chain quality and technology variables, and then using quality function deployment as a tool to deploy them to improve the competitiveness of the supply chain[42].

Chang (2008) discussed the application of the eight modern TQM principles of ISO9000 in supply chain quality management, namely customer focus, leadership, involvement of

people, process management, system management, continual improvement, factual approach to decision making, and mutually beneficial supplier relationships. It concludes that the application of the eight modern TQM principles of ISO9000 in supply chain quality management will promote the improvement of operation efficiency and competition ability of the whole supply chain system [43].

CHAPTER 4

RESEARCH MODEL AND HYPOTHESIS

4.1 RESEARCH MODEL

In this chapter the research model that was taken to study the effects of Quality Management and Supply Chain Performance on Customer Satisfaction has been prepared and further studied. The arrangement of the connections between and among variables constitutes a complex model, which is analyzed to measure their effect. Various research items were chosen from the literature study and were taken in to study the measure of various variables and their effects on other variables in the model.

The model developed here is based on common constructs of total quality management and supply chain management- Management leadership and commitment, supply quality management, customer focus, information flow and quality data, product/service design. These are various constructs as taken from the literature.

Figure 4.1:- Common factors of TQM and SCM

Quality performance is the output for total quality management in an organization and physical supply performance is taken as the output variable for supply chain performance of the organization. Customer satisfaction is taken as the output for overall organizational performance. To measure these variables different research items were selected to measure the constructs/variables for model. A questionnaire is developed in the later stages of this thesis works which is used to get inputs for these research items.

4.2 MANAGEMENT LEADERSHIP

Management leadership refers to how top management guides and supervises personnel of a firm in an appropriate manner. Taking the TQM and SCM philosophy from theory to practice seems to be a difficult task for companies, without a good support from management it is not possible to deliver quality and supply performance. Therefore an often mentioned key enabler, and a necessary prerequisite for performing SCM and TQM in real life, is top management support. Commitment of top management has been cited as one of the most important factors impacting the success potential of total quality management and supply chain management in a firm. Leadership provides the necessary direction to the firm in any endeavor and there is no difference in case of quality and supply chain.

To meet the requirement of customers, top management should clarify the expectations of its customers. Organizational strategy should also be developed based on customers' needs. Senior management have the influence and authority to dominate and direct the organization to deliver exactly what the customer expects from the product. A dedicated commitment from top management towards greater customer satisfaction and delivery is certainly a necessity. Thus management leadership has a direct relationship with customer satisfaction.

To get the desired supply chain performance and quality from the firm it is imperative that the top management takes the lead. Management level provides the necessary resources for training employees to meet the new requirements and/or changes that are resulted from TQM implementation, and consequently, creates a work environment which is conductive to employee involvement in the process of changes. Thus management leadership directly affects Quality performance of an organization.

Lack of top management commitment is often cited as the reason for supplier partnership failure. Top management commitment towards greater supplier coordination is an absolute necessity. In addition, effective management leadership is critical to influence the decision of selecting qualified suppliers, certifying suppliers for quality material and to ensure a supplier quality rating system so that from time to time the suppliers are rated on the basis of their supply performance. Kaynak and Hartley [37] have proposed that management leadership is directly related to five QM factors: (1) customer focus, (2) training, (3) employee relations, (4) supplier quality management, and (5) product/service design.

Here we have taken eight research items to measure the top management leadership commitment, which are:-

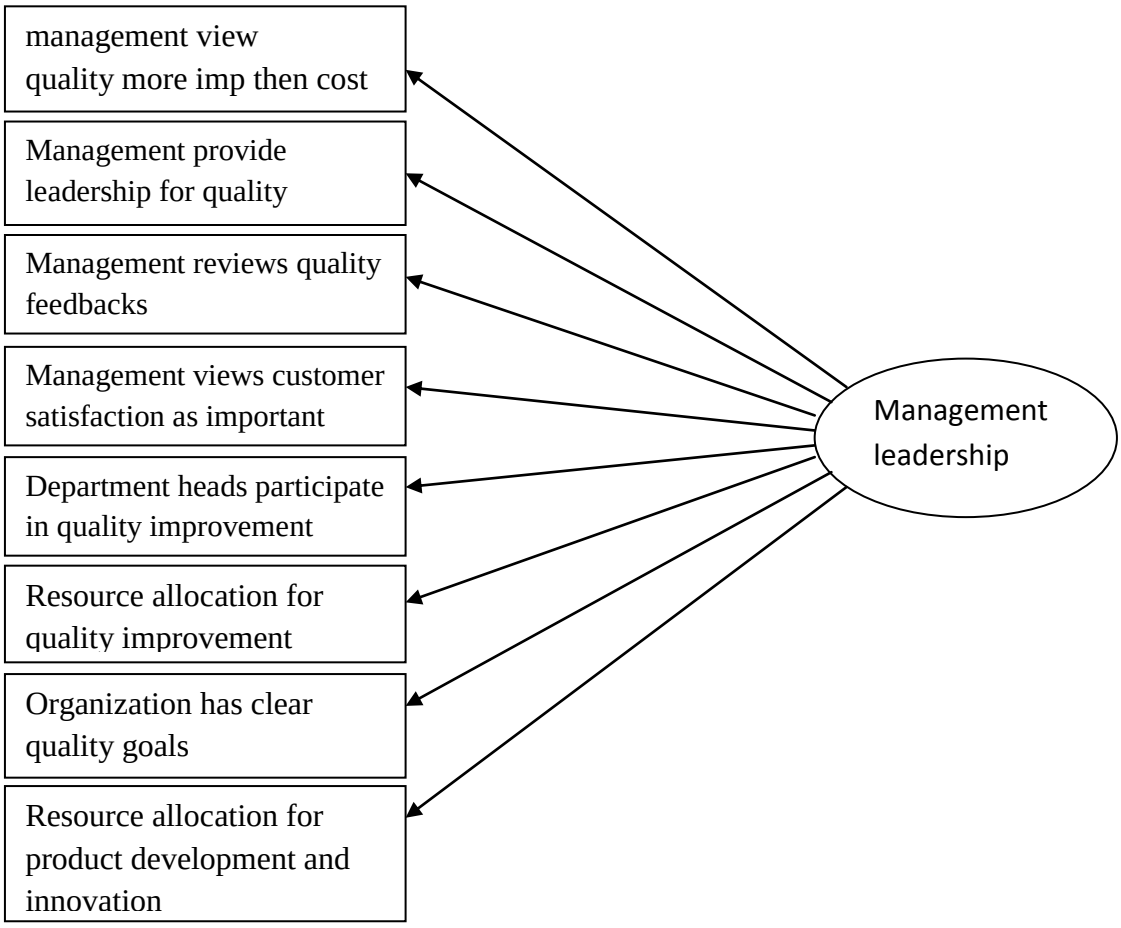

Figure 4.2-Research items for management leadership

- Extent to which top-level managers view quality as being more important than cost.
- Top management provides necessary leadership in enabling conditions for quality.
- How often does top management reviews customer feedbacks on product, product/service quality.
- Top management views satisfying customer needs is the central purpose of business.
- Degree of participation by major department heads in quality improvement process.
- Top-level managers allocate adequate resources toward efforts to improve quality.
- Organization has clear quality goals identified by top-level managers.
- Organization allocates resources towards product development and innovation.

Here we have taken three hypotheses to analyze the effects of top management commitment on quality performance, physical supply performance and customer satisfaction with the help of this model.

4.2.1 Top Management positively effects quality performance (H1a).

Top management leadership is the extent to which top management and leaders in an organization, sets up quality objectives and strategies, provides and allocates necessary resources, participates and contributes in quality improvement efforts, and assesses QM implementation and performance. The commitment of top management is generally a critical point for deploying and practicing TQM to enhancing performance of an organization. It is totally impracticable to adopt QM and improve performance without strong top management support. Top management carries the primary responsibility for an organization's commitment to quality and support efforts necessary to successful TQM implementation[44]. Hence, the most critical factor contributes to successful TQM program is top management [45]. Top management has positive role in ISO 9000 maintenance and QM system outcomes[46][47]. Ab Wahid et al (2011) investigated the role of top management in maintenance of ISO 9000 and the outcomes of QM system and its practices and implementation in two large service organizations. The investigation concerned with top management commitment and leadership from different approaches such as involvement in quality improvement, providing necessary resources and showing steady commitment to

quality perfection. Through applying different analysis techniques, the results showed a variation in extent of top management commitment role in ISO 9000 maintenance and QM system and practices between the two organizations. The respondents of the first organization reflected higher positive statements on their top management. The final conclusion of the study emphasized on the positive role of top management in ISO 9000 maintenance and QM system outcomes Leadership as TQM construct has strong positives association with service quality[48]. Sit et al (2011) proved in context of their study that leadership as TQM construct has strong positives association with service quality in the commercial banks in Malaysia.

Samat et al (2006) [49]explored the relationship between management support and commitment and service quality as well as the relationship between management support and commitment and market orientation. The authors concluded that this construct had no significant effect on service quality as well as on market orientation comparing with other constructs of TQM examined in the study. Service organizations put under study were from different business activities such as banking, education, private and public utility service and consulting service. All organizations practiced TQM in their operations and located in northern Malaysian states. This however is in contrast to our research hypothesis but still we find it important to consider it in our work.

In logistic business area top management initiative is a major drive to implement TQM programs and practices[50]. Furthermore, the study findings indicated that senior executives were not one of the obstacles of TQM implementation funding. These findings are based on data analysis results in their study. The data collected from total of 113 firms listed in FMM and Kuala Lumbur Stock Exchange (KLSE). Of the 113 firms, 45 were services firms and majority of them implemented TQM programs. The overall purpose of the study was to examine the implementation of TQM practices in the logistic function.

Thus various researchers have supported this hypothesis that top management leadership and commitment is positively related to Quality performance. The role of top management is critical and vital in deploying TQM in an organization and it directly affects quality performance of an organization.

4.2.2 Top management leadership and commitment positively affects customer satisfaction (CS) (H1b).

An increasing number of service organizations are committed to investing in employee development to improve the quality of the services that customers want. Customers should of course be counted in any objective evaluation of a firm's service outcomes. The purpose of this study is to examine the relationship between management commitment and customer satisfaction. Management should consider satisfying customer as the central purpose of a business. It is imperative that the management encourages customer involvement, feedbacks and time to time review of customer aspirations and expectations.

The ultimate test of success of a supply chain is weather the customer is satisfied or not. Customer is the focal point of a supply chain. Sit et al [48]performed a study resulted that leadership as a TQM dimension in Malaysian service firms has significant positive impact in enhancing customer satisfaction. The authors furthered arguing that criticality of leadership role, especially within service context, fall into one core principle "making the right management decisions" in order to "pleasing customers" by creating one-vision culture in the organization through reflecting high commitment and effective leadership

Management commitment to service quality is a distal construct because management does not directly deal with customers but indirectly influences the degree of satisfaction that customers feel about the service that they have received[51]. ugboro et al. [52]finds a strong relationship between top management leadership and commitment and customer satisfaction. It suggests a visible role of top management in creating and sustaining an organizational culture that focuses on customer satisfaction.

top management is the most important factor impacting the success for implementation of total quality management practice in a firm, with customer satisfaction one of the indicators of TQM.

Sit *et al.* [48]performed a study resulted that leadership as a TQM dimension in Malaysian service firms has significant positive impact in enhancing customer satisfaction. The authors furthered arguing that criticality of leadership role, especially within service context, fall

into one core principle “making the right management decisions” in order to “pleasing customers” by creating one-vision culture in the organization through reflecting high commitment and effective leadership.

Thus various researchers have advocated and empirically verified a positive relationship between top management commitment and customer satisfaction. Top management should take lead in developing a customer oriented environment in the organization that revolves around the central idea of satisfying customers. Higher managers should frequently review customer feedbacks on product, product/service quality and should take necessary step and should allocate resources in the form of man and money to see that improvement required are implemented in the system. Management should actively seek ways to improve product and services for greater customer satisfaction. Thus we hypothesize that a positive relationship exists between top management leadership and customer satisfaction.

4.2.3 Top management positively effects physically supply performance (H1c).

Lack of top management commitment is often cited as the reason for supplier partnership failure. Lacking top management commitment the resources prohibits capability, there will be no firm intention to cooperate, and certainly the supplier or the supply manager cannot be counted on to consistently performed[53].

However there is not much enough literature proof that top management leadership directly effects physical supplier but researchers support that top management critically affects supplier relationships and supplier coordination. Successful relationships will usually fail in the absence of top management commitment. the reasons for this are varied, but many are obvious. Successful supply chain relationships are boundary spanning relationships spanning both corporate boundaries and functions.

kothandaraman et al. [54] says that explicit and public support of cooperative business relationships, commitment, and governance by the top management of the organization is important to the success of a supply chain alliance. it has been posited that “the presence of constructive leadership capable of stimulating cooperative behavior between participating firms” is essential to business relationships.

Better supplier relations will be positively associated with satisfaction with overall supplier performance[55]. Field et al. says that better supplier coordination, cooperation and long term supplier relationship positively effects supplier satisfaction and overall supplier performance. Better supplier relationships make it easier to design and implement operational processes at the supplier-customer interface and thereby increases the increases the overall supply chain efficiency and supplier performance.

Thus an indirect effect of top management leadership and commitment is supported in the literature but a direct effect has not been researched to that extent. But there is enough literature reference for us to consider a positive relationship between supplier quality management and quality management. Here we have tried to find out that relationship and have hypothesized that top management leadership and commitment had a positive effect on physical supply chain performance. Top management acts as a catalyst for improved physical supply chain performance.

4.3 SUPPLIER QUALITY MANAGEMENT

Supplier Quality management is a key TQM tool and also the key to SCM. An effective suppliers' quality management will enforce the cooperation between suppliers and firms by allowing suppliers' involvement and/or participation not only in the design process but also in the production process, and help the procurements of materials or parts meet firm's requirements and be efficiently utilized. The quality of materials provided by suppliers is important and the starting point for firms to produce quality products. Eventually, a good quality of raw materials will reduce.

Successful relationships encourage suppliers to become involved early in the buying firm's design of products/services and to offer suggestions regarding product and/or component simplification. Supplier quality management can be used to streamline the suppliers' base to facilitate the following tasks such as managing suppliers' relationship, developing strategic alliances with suppliers, cooperating with suppliers to ensure meeting the customers' expectations of product and delivery, involving suppliers early in the product development process, and enhancing the organizational performance, which indirectly affects customer satisfaction in an organization. But in our hypotheses we have considered a direct a direct

effect on customer satisfaction as it has been seen that firms with better supplier quality management and supplier integration has more customer satisfaction. Quality supply results in reduced occurrences of rework, scrap, and/or defective outputs an therefore a better quality product that too in lesser cost. This directly effects customers' response to the products and ultimately results in greater customer satisfaction.

Therefore here we have hypothesized that supplier quality management positively affects quality performance and customer satisfaction in an organization.

To measure supplier quality management here we have taken seven research items have been included in this model.

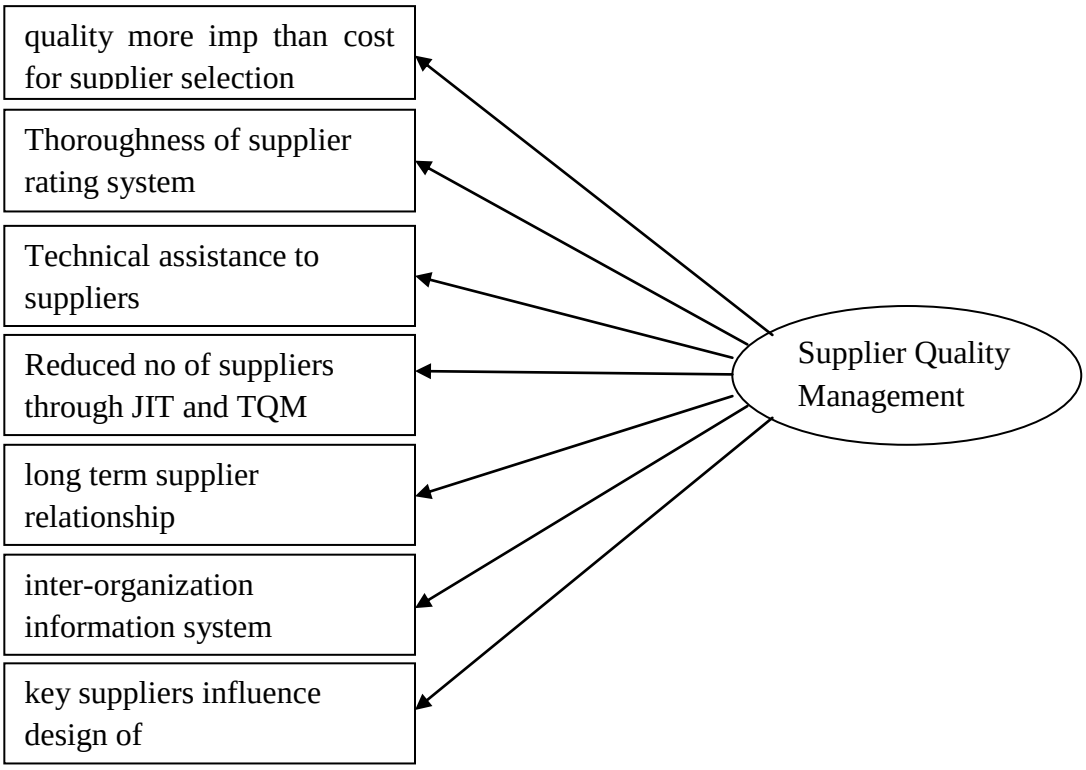

Figure 4.3- Research items for supplier quality management

- Quality is a more important criterion than price in selecting suppliers of the major component.

- Organization provides technical assistance to our suppliers.
- Thoroughness of our supplier rating system considering the supplier's engineering capability, financial stability, delivery performance, quality performance.
- Extent to which long-term relationships are developed with suppliers.
- Reduction in the number of suppliers since implementing just-in-time purchasing and/or total quality management.
- Extent to which key suppliers have major influence on the design of new products.
- Top management supports the need for inter-organizational information systems.

4.3.1 Supplier quality management positively effects quality performance (H2a).

Numerous studies have addressed how a supplier effectively improves the performance of its purchasing units in a dynamic environment as far as consumer expectations are concerned. These studies have discussed how supplier quality management (SQM) can enhance organizational performance across the supply chain by minimizing operational costs, shortening process cycle, refining quality performance and enhancing customer satisfaction[56].

The term "SQM" refers to various management-driven efforts, which are aimed at enhancing the overall quality performance through more effective management of quality on the supply side. These efforts include adopting quality-conscious purchasing policies, opening effective communication channels with suppliers, providing assistance to suppliers, involving suppliers in product and process developments, and establishing long-term corporative relationships with suppliers[38].

Organizations should have a supplier rating system considering the supplier's engineering capability, financial stability, delivery performance, quality performance. By selecting a supplier based on its implemented supplier systematic procedures of daily operations to ensure the quality of its delivery and selecting a supplier based on its established Supplier organizational culture toward continuous improvement we can ensure good quality suppliers for an organization. Also its important to have long term relationship with supplier, which is

characterized by greater integration and technological coordination, thus leading to supplier development and supplier quality management. Thus developing a quality culture of suppliers, this is reflected in our product and quality performance.

The impact of supplier quality on an organization's performance is large and direct, and the general understanding is that a firm's quality performance (output) can only be as good as the quality performance of its suppliers (input). An increasing tendency towards supplier development by organizations as supplier quality integration is found to be a critical dimension of quality excellence[57].

Shin et al. [56]investigated the impact of SQM on organizational performance, and they concluded that companies could reduce operational costs by improving the quality and delivery performance of the supply functions along the chain of business units.

Yeung [38]shows that supply quality is a function of buyer-supplier relationship, effective communication and quality system of supplier. It also shows that organizational quality is supported by supply quality, by buyer-supplier relationship and by direct assistance.

Since purchased parts/accessories are a major source of quality problems TQM studies have included quality-focus supplier selection in their models. SQM also emphasizes the establishment of a long-term relationship with critical suppliers. Quality-conscious companies therefore tend to emphasize quality rather than cost in supplier selection [57].

A customer-oriented supplier should have the following characteristics. These characteristics include a reliable quality assurance system , effective control of operations for maintaining expected quality, build in quality in day-to-day activities , continuous quality improvement; awareness of quality policy within the organization , and the international quality certifications, such as the ISO 9000, the BS 7850, the QS 9000 and the Malcolm Baldrige Quality Award criteria [38].

Fynes et al. [39] indicate Supply Chain Relationship Quality has a positive impact on design quality, but not on conformance quality. This suggests that by developing and engaging in true partnership types of SC relationships, suppliers can become much more proactive in the design and new product development process.

Managing supplier quality is a key to achieving good quality leading to a world-class successful supply chain. Many researchers and organizations have devoted their time to the management of the quality of finished goods than to supplier quality management forgetting the fact that the quality of the finished good is largely influenced by the quality offered by initial suppliers [57]. Thus it is visible that literature supports that supplier quality management has a clear positive effect on performance, hence take this as a hypotheses in our model.

4.3.2 Supplier quality management positively effects customer satisfaction (H2b).

The concepts of SQM can be viewed as an integration of strategic practices, and such practices need to stretch across inter-organizational boundaries to satisfy both existing and new customers[58].

Practices such as measuring the performance of suppliers, engaging suppliers in quality management systems, supplier audits, supplier development, integration and competitive supplier selection are a great opportunity to improve organizational performance in terms of customer service delivery levels and operational costs reduction. supplier quality management include reduced lead times, increased responsiveness to customers‟ orders and enquiries, customer loyalty, increased profitability, reduced opportunity cost from lost sales and effective communication between the organization suppliers as well as customers [57].

Selecting suppliers based on product quality, delivery reliability, and product performance will have a significant total positive effect on customer satisfaction. Involving suppliers in product development and continuous development program will have a significant positive effect on customer satisfaction [59].

Supplier quality management is a set of activities in most cases initiated by the management to improve organizational performance. Such activities include measuring and tracking the cost of supplier quality, using performance based score cards to measure supplier performance, conducting supplier audits and establishing effective communication channels with suppliers among many more, with an aim of achieving customer satisfaction. Firms

need to strategically acquire the materials and services that will enhance their ability to meet their customer's need[60].

Supplier quality management is very important activity to achieve customer satisfaction. Organizations now want a reliable supply which is synchronized with the demand from their customers. Also having good quality supply lead to reduced development lead times, better communication, substantial costs savings from higher productivity, more reliable products with fewer recalls, enhanced customer satisfaction. With SQM, not only the organization but also the customer is directly benefitted. Customer will only get good quality supply only if its suppliers are getting good quality supply from its suppliers. Thus there is direct influence of Supplier quality management on customer satisfaction.

4.4 CUSTOMER FOCUS

Customer focus is central to both total quality management and supply chain management. For any firm, the significant driving force to establish the quality goals basically originates from customer needs. The customers are the main focus of the chain since "the primary purpose of the existence of any supply chain is to satisfy customer needs, in the process generating profit for itself". Generally speaking, customer needs identify the operational goals for firms to meet. Each entity in a supply chain is both a supplier and a customer. Thus, it is important to have a customer focused corporate vision in place while striving to implement the TQM and SCM practices effectively both upstream and downstream. A customer driven vision can produce a number of competitive advantages for the supply chain by helping improve productivity, reducing inventory and cycle time, and boosting customer satisfaction, market share, and profit. Thus customer focus has a direct relationship with all the three output variables of our model- quality performance, physical supply performance and customer satisfaction. This relationship has been further studied through literature review and tested empirically.

The practice of customer focus is most likely of value to the customer by ultimately improving the overall quality of the products. Customer focus streamlines our quality improvement efforts by recognizing what the customer expects in terms of product quality and performance. Since customer expectation is continuously changing due to the dynamic environment, firms have no other way but to continuously improve the processes and

products delivered to customers. An effective and frequent interaction with customers had been reported as a key for a firm to be an innovative firm. The product cycle life today is comparatively shorter than before. New competitors are coming into market almost daily with more innovative products, more innovative marketing strategy, and more innovative approaches of managing their customers. It requires the firms to continually seek new ways of doing and managing all matters, thus resulting in the innovation of products, processes, and ultimately the organization. The wide use of information technology in handling customer complaints and feedback is an example of innovation that is related to the practice of customer focus.

Also not just product quality but firms need to align their product supply and delivery with respect to customer demands. With growing competition, shorter product lives and more rigorous production cycles customer demand delivery with shorter lead time, delivery in smaller quantity, just-in-time delivery, defect free delivery and that too with lesser cost. This supply performance cannot be maintained if the whole supply chain is not customer focused.

Although customer satisfaction is not a direct result of customer focus but customer focus is directly affected by customer focused approach from the organization. Thus we have hypothesized that customer focus directly effects customer satisfaction. Also two other hypotheses are taken which states that customer focus has a direct effect on quality performance and physical supply performance. To measure customer focus six research items are included in the model, which are:-

- Extent to which customers are involved in product or service design
- Extent to which customer satisfaction surveys are used in determining/identifying customers' requirements
- Manufacturing managers are aware of the results of customer satisfaction surveys.
- How regularly is summary of customer complaints is given to managers.
- How actively does the organization seeks ways to improve product and services for greater customer satisfaction.
- Extent to which individual customer demands, short notice orders and complaints are entertained.

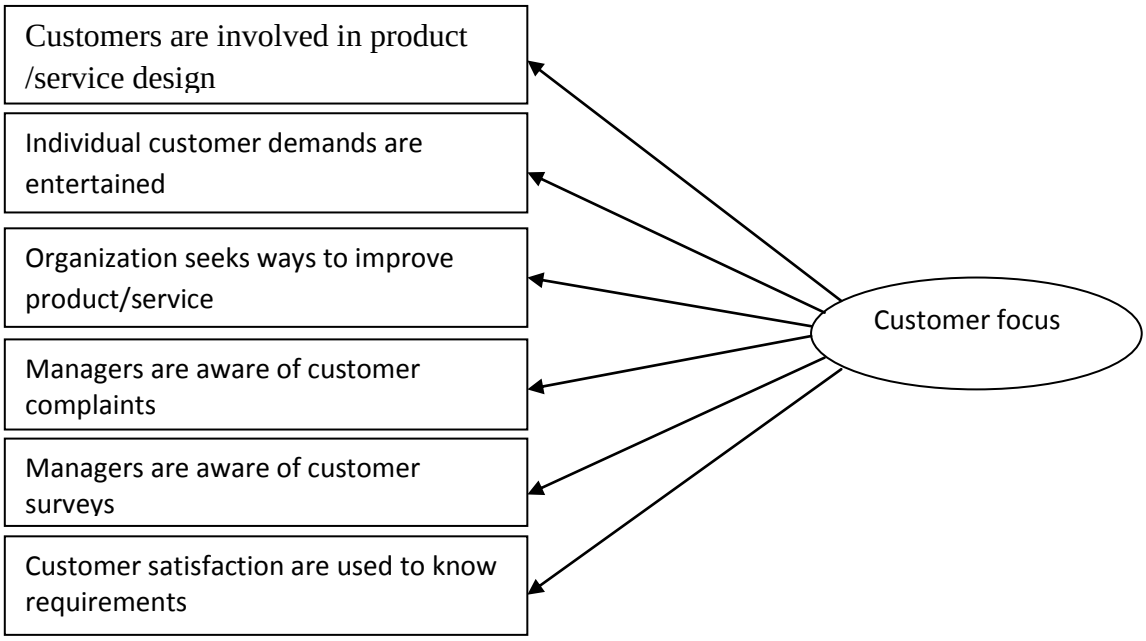

Fig 4.4:- Research items for customer focus

4.4.1 Customer focused approach positively affects Quality performance (H3a).

Various researchers have considered customer focus in their Quality related work and there is consensus that customer focus approach is a crucial factor in quality management [61]. Quality is for the customer, all the products/ services are to be designed and manufactured keeping the customer in mind. If it is the customer that we are manufacturing for then its important that the aspirations of the customer must be kept in mind. Companies must shift their focus toward customer satisfaction [62]. Customer expectations are dynamic in nature, organizations need to assess them regularly and adjust their operations accordingly [23]. Focusing on customers requires identifying the customers, their current and future expectations, and their level of satisfaction. Product/services should be developed keeping customer's need in mind. companies should have regular feedbacks from customers about their products, services and quality of products and services compared to other competitors in the market.

Yeung [36]states that Business performance is directly dependent on customer satisfaction. SCM seeks to integrate and coordinate processes throughout all entities involved to ensure that the quality of the product or service results in the final customer's satisfaction.

Terziovski et al. [63]found that the individual element found to contribute most to business performance was customer focus. The principle motivation to pursue ISO 9000 certification was found to come from customer pressure. Customer focus has a significant effect on product/service quality[61].

TQM is customer focused approach that aims at continuous improvement [27].Only those customer-centered organizations that can deliver superior value to their customers will survive in the cut-throat business arena. Customer involvement and satisfaction were essential factors and relevant to organizational performance from a TQM perspective. To yield highly satisfied and loyal customers, organizations throughout the world are striving to produce products and services of superior quality.

The key to quality management is maintaining a close relationship with the customer in order to fully determine the customer's needs, as well as to receive feedback on the extent to which those needs are being met. The customer should be closely involved in the product design and development process, with input at every stage, so that there is less likelihood of quality problems once full production begins [64].

There is a lot of literature advocating the relationship between customer focus and quality performance and that customer focus is the most important factor in TQM approach as well. Taking it all in consideration here we hypothesize that customer focused approach has a direct relationship with quality performance and that having a customer focused approach positively affects the quality performance of an organization.

4.4.2 Customer focus positively effects customer satisfaction (H2b).

There is consensus in the literature that a focus on the customer is crucial to effective QM and achieving the ultimate objective: customer satisfaction[53,37,17]. Similarly, SCM seeks to integrate and coordinate processes throughout all entities involved to ensure that the quality of the product or service in the final customer's satisfaction [29]. Researchers have also found that information integration with customers is related to firm performance [15].

customer satisfaction is the central measure for quantifying the organization's success in serving its customers' needs, which could also be called supply chain effectiveness. So we need to focus various activities of an organization on customers we target, know the customer expectations. Analyze and improve performance from customer point of view. Customer should be involves in product/service design. Managers and employees should have understanding of who their customers are and what their expectations are.

For an organization the perception of quality in the mind of its customers is very important. If the customer knows that the organization is working towards the improvement of product keeping his needs in minds, it forms a better image of the organization for the customer and helps improve the customer satisfaction. Also for the customer to be satisfied, he should get the product he want, with the right quality standard, quantity, conditions as well and that too for minimal cost. This can only happen if the organization has a clear idea about customer's aspirations and expectations. Thus here we hypothesize that customer satisfaction is a direct affected by a customer focused approach from organization.

4.4.3 Customer focus positively effects physical supply performance (H3c).

Customer satisfaction is commonly acknowledged as one of the most important parameters of system success. For both internal customers (manufacturers) and external customers (end consumers), an logistics service provider is concerned with achieving cost-effective satisfaction of customer requirements through buyer–supplier integration[65].

Third party suppliers and logistic service providers perform various functions for their customers including traditional logistics activities (such as transport, warehousing, and packaging) and less-conventional activities (such as customs clearance, billing, and tracking and tracing)[66]. The quality and performance of physical supply can only be maintained if the service provider has a clear idea of the requirements of its customer. Physical supply should be coordinated with the production, if it is not so then it can lead to increased inventory, greater material loss, short supply, production loss, business loss from customer side.

A customer-oriented approach to performance management is appropriate to an LPS because it usually provides process-based services (rather than function-based services) that are aimed at the integration of a whole process on behalf of the client [65]. Thus we hypothesize that a customer focused organization will fare well in physical supply performance and physical supply performance is positively affected by a customer focused approach from organization.

4.5 INFORMATION AND DATA FLOW

Information and data flow is a key factor in both supply chain management and total quality management. The term SCM has been used to explain the planning and control of materials and information flow. Various information sharing related key activities that are required to achieve a successful supply chain are cooperation and long-term focus on partnerships, sharing information, extensive communication between supply chain parties, sharing of risks, Sharing of information about production schedule, targets, risks etc with key partners, suppliers and customers to get the supply schedule synchronized with production schedule. It improves coordination between supply chain processes, and this enables material flow and reduces inventory costs.

When information is properly shared within the supply chain, it increases the understanding of the basic methods necessary for the effective running of the supply chain. For information to perform its function within the supply chain, information when gathered must be shared between partners. Information and information sharing should not be concentrated on the internal environment, but rather should be also made to set a foundation for companies across the supply chain.

Supply chain partners can only improve their coordinated or collaborative effort if they can access various types of critical information that is available to individual supply chain partners. Only an integrated and well coordinated organization can give us quality performance. Thus information sharing has an impact on the quality performance of a supply chain by integrating it. Information sharing acts as a lubricant for the system, It is vital for the smooth functioning of the whole system.

Within the organization it is important to have a suitable information channel so that sensitive and useful information is passed down various levels in a more efficient way. Information sharing is very important to get the quality standard up in an organization because effective decision making is based on factual data and efficient information flow. To raise the quality standards and to apply total quality management it is important to have values and norms conducive to learning, information sharing, and a holistic approach to problem solving. Information should be frequently shared both vertically and horizontally without people fearing the loss of power and status. When managers are aware about quality standards, customer feedbacks it becomes easy for them to view the problems and solve them to enhance quality performance. Quality data collected and disseminated throughout the organization in a timely manner is also crucial for effective design for manufacturability, concurrent engineering, and quality function deployment. It also facilitates the effective use of cross-functional teams in building quality into the product at the design stage

Thus we hypothesize that information flow has a direct effect on both physical supply performance and quality performance in an organization.

The various research items considered to measure information and data flow are as following:-

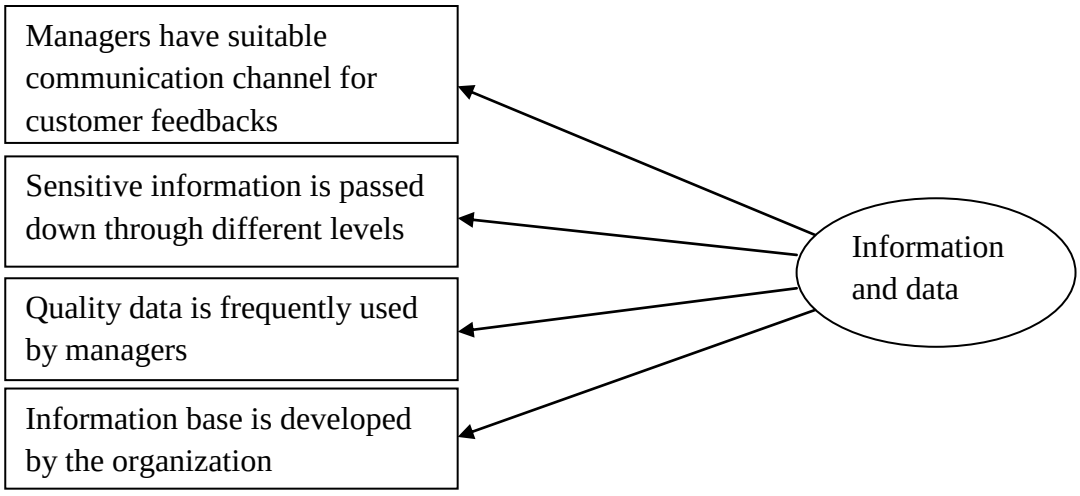

Figure 4.6- Research items for information flow and data flow

- Manufacturing managers are provided with summary of customer feedbacks and complaints through suitable communication channel
- Extent to which quality data (cost of quality, defects, errors, scrap, etc.) are used as tools to manage quality.
- Sensitive information (financial, production, design, research, customer feedbacks and/or competition) is passed down through different levels of organization
- Maintenance of an information-base system that provides critical

4.5.1 Information flow and data flow positively effects quality performance (H4a).

Quality data collected and disseminated throughout the organization in a timely manner is also crucial for effective design for manufacturability, concurrent engineering, and quality function deployment. It also facilitates the effective use of cross-functional teams in building quality into the product at the design stage [37].

Quality data and reporting involve using costs of poor quality such as rework, scrap and warranty costs, and control charts to identify quality problems and provide information on areas of possible. The positive effect of quality data and reporting on firm performance is through three other TQM techniques: supplier quality management, product/service design, and process management.

Juran define a quality information system as an organized method of collecting, storing, analyzing and reporting information on quality to assist decision makers at all levels. This conception requires inputs from a variety of functional areas and recognizes that information consists not only of data but also of other knowledge needed for decision making. Required inputs include: market research information on quality, product design test data, information on design evaluation for quality, information on purchased parts and materials, process data, final inspection data, field performance data and results of audits.

Information Technology is making possible fundamental changes in the way production, coordination and management work is done. As far as production work is concerned, physical production, information production (clerical work), and knowledge production

(design/engineering) are affected by Information Technology. As far as co-ordination work is concerned, communication networks reduce the effect of physical distance, change the time dimension and increase organizational memory. As far as management work is concerned, better direction is allowed by timely internal and external information exchange and better control is supported by the possibility of measuring the organization's performance following whatever set of critical success factors have been defined as relevant[67].

Lari [68] analyzed the information requirements of ISO 9000 standards and identified the areas where a decision support system could be used. They developed a conceptual framework for organization-wide information management, which explained the modular approach to the system development by introducing and empirically testing the prototype model in a corrective and preventive actions module. The proposed system will provide the conceptual structure for quality assurance information system within organizations.

With the database and information companies can accurately track such quality measures as parts-per-million defective, reliability, process capability ratios, and percent parts rejected as well as on-time delivery performance and percent of incoming materials acceptable[61].

Thus various researchers have discussed and advocated the positive effect of information and data flow on quality performance and quality related factors of an organization. A good information system is important for organization performance as well as quality performance in the organization. Thus here we hypothesize that information flow and data flow is positively related to quality performance in an organization.

4.5.2 Information flow positively effects Physical supply performance (H4b).

Information is considered an integral component of a supply chain network because it is the connection between all it components, activities and operations. Ajayi et al.[69] To achieve success, a organization must possess and share information about the different aspects of the supply chain. Therefore, for activities to be synchronized, the different partners in a supply chain have to share information. Information flow improves coordination between supply chain processes, and this enables material flow and reduces inventory costs. To achieve

success, a organization must possess and share information about the different aspects of the supply chain. Therefore, for activities to be synchronized, the different partners in a supply chain have to share information

suhong li et al. [70]states that sharing of information has improved its management within the supply chain, which consequently improves the management of the overall chain in areas which include: a) Standardization of Supply Chain processes. b) Improvement in the level of system integration. c) Improvement in the quality of material and information flow**.**

ajayi et al. [71]states that information sharing in a supply chain has the following effects:-

- Better integrated system.
- Better information management within supply chain.
- Better business process planning.

One of the main characteristics of an integrated system is that it combines separate records relating to the same subject into one related record held in the computer. Also, with an integrated system, information belonging to more than one application can also be updated simultaneously. For example, a sales transaction may update both account receivable and inventory records. Moreover, Bourdé and Butner [72] showed that a reasonable percentage of companies are planning to invest in integration: both internal supply chain integration and external integration with trading partners. A organization can commit to a more reliable delivery time if its sales order entry and manufacturing software packages are integrated**.**

Information sharing helps building trust and relationship with supplier organization. Without a foundation of effective inter organizational relationship, any effort to manage the flow of the information or materials across the supply chain is likely to be unsuccessful. Trust and commitment are needed to build long-term cooperative relationships between supply chain partners [70].

Information flow gives us better inventory performance, reduces inventory and waste in the supply chain reducing inventory costs through effective supply management is a goal of SCM). By working with suppliers to improve quality, less safety stock inventory is needed and thus improving physical supply chain performance.

Information flow helps managers to tackling any change in demand and supply more easily. An informed manager in the supply and dispatch department, having full knowledge about the production, design, critical logistics information, can take better decision and that too more swiftly, giving us less scrap, less defective supply and delays and better customer satisfaction. Thus we hypothesize that information flow has a direct impact on physical supply performance.

4.6 PRODUCT/SERVICE DESIGN

Product/service design is an important factor for quality deployment in an organization. By designing a quality product we can check quality performance by anticipating and elimination defects and any process that may cause defects during the process of designing. Thereby considerably reducing the production cost and quality cost and also ensuring a good quality final product. Dr. Genichi Taguchi estimates that as much as 80 percent of all defective items are caused by poor product design. Taguchi stresses that companies should focus their quality efforts on the design stage, as it is much cheaper and easier to make changes during the product design stage than later during the production process. From a designing point of view quality defects can arise due to either faulty design or from faulty process design. Keeping customer's expectations in mind, we need to design the product in such a way that any quality issue is resolved during the time of designing. The designing process should integrate various departments in this process to make sure that the design is feasible too.

To get the sense of what are the quality expectations of the customer, it is important to integrate product customer in the designing process. The organization need to do frequent surveys and get feedback from the customers about their present products. This ensures that organization knows what it is designing and what for is it designing the product.

Today, many companies have a representative residing at their supplier's location, thereby involving the supplier in every stage from product design to final production. Kuei et al. [42] says that many purchasing firms have indicated that product design is one of the critical supplier improvement areas. High on quality performance firms tends to be different from low performing firms on product/service design. From a supply chain perspective, including

customers and suppliers in product/service design can reduce process complexity and process variance. Integration with suppliers and customers during product design improves design quality.

Thus we here hypothesize that product/service design has a positive effect on quality performance and customer satisfaction.

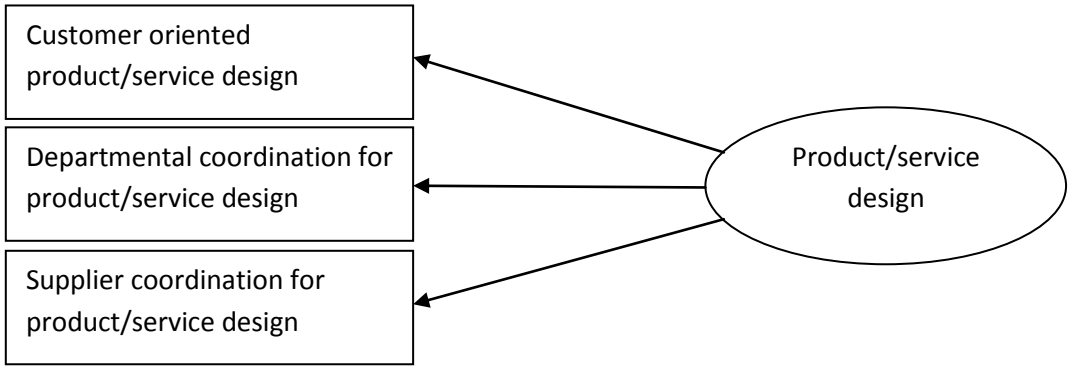

Figure 3.7- research items for product/service design

Various research items to measure product/service design are as following:-

- Extent to which implementation/ producability is considered in the product/service design process.
- Degree of Coordination with suppliers in the product/service development process.
- Emphasis on customer oriented product/service design.
- Degree of Coordination among affected departments in the product/service development process.

4.6.1 Product/service design positively effects quality performance (H5a).

From a supply chain perspective, including customers and suppliers in product/service design can reduce process complexity and process variance. Integration with suppliers and customers during product design improves design quality.

Design for manufacturability provides a method for designing parts that are easy to manufacture and assemble, with cost and cycle time reduction and quality improvements as a result[73].

Product and service design examines an organization's quality and service delivery performance in terms of timeliness, errors, costs of quality, responsiveness, and customer satisfaction. Product and service design for TQM practices is positively correlated with quality performance [25].

The design of a product/service is an important factor in the quality performance of an organization. If the design is optimized or not for easy and defect free production as well as for cost efficiency? if the product with the present design is producible or not? Can the cost of production or the lead time be reduced by further optimization of the design? Can the wastage and scrap cost be reduced by further optimization or not? These are the questions that need to asked while designing the product/services.

Thus design quality affects the various factors of quality performance in many ways like scrap cost, lead time, product quality for customer etc. So here we hypothesize that product/services design directly effects quality performance of an organization.

4.6.2 Product/services design positively effects customer satisfaction (H5b).

It is the customer for whom we are designing and manufacturing the product. When customers' needs and expectations are achieved through product design and quality performance is improved, only then satisfaction is established. Organizations are investing more and more time, money and energy of theirs into newer designs. World over organizations integrate customers in the designing activities by taking surveys and feedbacks from customers about design quality and performance, so that they can get the idea of what is the expectations of customer from their designs

Product and service design examines an organization's quality and service delivery performance in terms of timeliness, errors, costs of quality, responsiveness, and customer satisfaction[74].

Whenever the product has a higher performance, customers receive more satisfaction; non-fulfillment of performance requirements in the product will cause dissatisfaction. Only complete and suitable fulfillment of them will be followed by customers' satisfaction [75].

Companies should identify customers' demands and performance expectations in the planning and design process of the product/services.

By gaining a better understanding of customer needs and the use of this knowledge to design better products and services, a customer orientation should have a direct impact on customer satisfaction[76].

Thus various researchers have stated and analyzed the relationship between product/services design and customer satisfaction. So here we hypothesize that product/services design positively affects customer satisfaction.

4.7 QUALITY PERFORMANCE

From a supply chain perspective quality performance, customer satisfaction and physical supply performance are seen three important firm performance measure. The effect of all the five variables earlier explained is to be seen and analyzed later on these three performance outcomes

Kaynak[61]found support for quality performance being related to higher financial and market performance. Quality can increase customer satisfaction and enable a firm to charge higher prices or to reduce costs, leading to higher profit. Companies implementing TQM experience high inventory turnover, a situation which enables the identification of scheduling and production problems and encourages continuous improvement of processes and product quality. Terziovski[63] found a positive relationship between total quality management element strength and organizational performance. Quality performance can be seen as a direct measure for firm performance as scrap cost is reduced with application of quality practices, a trend of continuous improvement, meeting customers' requirements, reducing rework, long-range thinking, increased employee involvement and teamwork,

process redesign, competitive benchmarking, team-based problem- solving, constant measurement of results, and closer relationships with suppliers is set in the organization.

Quality performance also has a direct relationship with customer satisfaction. With the ever rising expectations of customers, they expect beast quality ant the lowest price. Companies that satisfy the quality expectations of a customer and that get lesser product complaints per thousand products have a clear edge in terms of customer satisfaction. Also with rising quality standards the cost of scrap also decreases, which directly affects cost of the product. Thus quality deployment gives us a product with lesser complaints and that too at much lesser cost.

Quality performance also positively effects physical supply performance in a supply chain. With improved quality not only can we reduce the no of defective supplies with improved quality, we can also the overall production time of a product and thus reduce the lead time and can improve the physical supply performance.

Various research items used to measure quality performance in an organization are as following:-

- Delivery lead time of final products/services to customer.
- Cost of scrap and rework as a % of actual product cost.
- Product/service quality (no. of complaints per 1000 products).

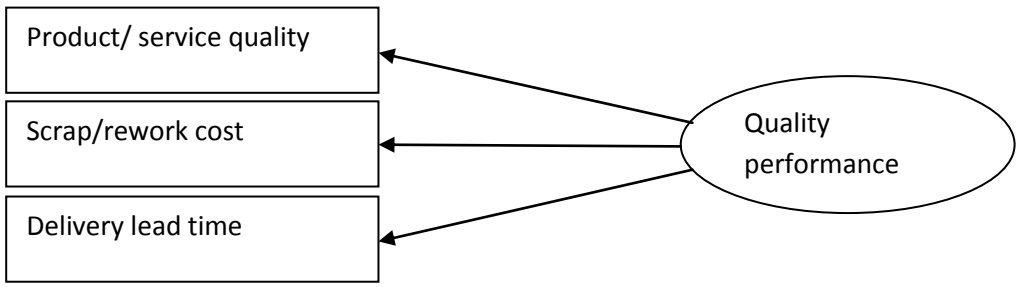

Figure 4.7- Research items for quality performance

Thus we can say that quality performance is in direct relationship with customer satisfaction and physical supply performance.

4.7.1 Quality performance positively affects physical supply performance (H6a).

Supply chain and quality has been two widely researched topics, lots of literature is there discussing various aspects related to both. In this thesis work, it is hypothesized that quality performance is positively related to physical supply performance. Quality performance is taken as an output variable for total quality management and all the quality related activities considered here. While physical supply performance is taken as one of the two output variables to measure the success of the supply chain management system of an organization. The validity of this hypothesis can be drawn from the wide literature available related to quality and supply chain management.

Sharma et al. [4]has done a literature survey of the open literature available on quality management in supply chain. During review of the open literature available in this area, the authors investigated that in present scenario there are number of quality related issues (either at the suppliers end or at manufacturers end) in supply chain management which needs immediate attention of the researchers.

Supply chain management has become important and critical aspect to the profit making of any organization. But, the quality management issues have also impacted the performance of supply chain in one way or other[4].

Starting from product design to supplier certification, the total quality management (TQM) approach can be effectively implemented in a supply chain for achieving quality excellence and competitiveness in a world market place[31]. yeung et al. [77]has identified critical SQM practices that conducted in Hong Kong. C. Madu et al. [32]has empirically shown that that Quality Management (QM) practices are significantly correlated with the supplier participation strategy and this influences tangible business results, and customer satisfaction levels. It is also observed that quality management can be significantly correlated to supplier selection strategy.

Successful supply chain (SC) design outlines a process for selecting compatible and competent partners and details their interrelationship at different nodes located in different echelons of the order fulfillment process.

lynn A. fish [73]has reviewed the positive impact of quality management on supply chain management, and discussed the best practice recommendations, relationship between total quality management factors and transition to supply chain quality management that follow from these results.

Thus on the basis of plenty of literature available on quality and supply chain, discussing effects, relations and their interdependence, we hypothesize that quality performance positively affects physical supply chain performance.

4.7.2 Quality performance positively effects customer satisfaction (H6b).

Customer satisfaction is a measure of how products and services supplied by a organization meet or exceed customer expectation. It is driven by the quality of services and products. Quality and customer satisfaction are the central mission of every function of an organization. From supply chain perspective customer satisfaction is the second factor that we have considered as output measure for the success of supply chain management in an organization. Various researchers have analyzed these two factors and also have advocated the positive relationship between them.

The key to sustainable competitive advantage lies in delivering high quality service that will in turn result in satisfied customer[78]. nilsson et al. [76]in their study takes research inside organizations to analyze and investigate how key internal quality practices of product versus service organizations (employee management, process orientation, and customer orientation) influence customer satisfaction and business results. The results proposes that process orientation has a greater positive impact on customer satisfaction for service organizations than for product organizations..

khuong et al. [79]conducted a study to identify the relationship between customer satisfaction, service quality and product quality of Phu Nhuan Jewelry (PNJ) stores in Ho Chi Minh City (HCMC). The study suggests that in order to achieve high customer satisfaction, PNJ stores should increase level of service and product quality.

Thus we derive it from the literature that quality performance is positively related and we hypothesize here that Quality Performance positively effects Customer satisfaction.

4.8 PHYSICAL SUPPLY PERFORMANCE

Physical Supply performance is the second performance outcome that we have taken here. It includes performance of all the activities involved in moving goods, both from the supplier to the beginning of the production process and from the end of the production process to the consumer. The objective of supply chain is to attain the required level of customer service and to do so at least cost, with least defects and on time delivery. Various research items used to measure the physical supply performance are:-

- Average no of delays (no. Of delays per 1000 order)
- Average no of defective supply (no. Defects per order)
- Overall supply service satisfaction(0-10)

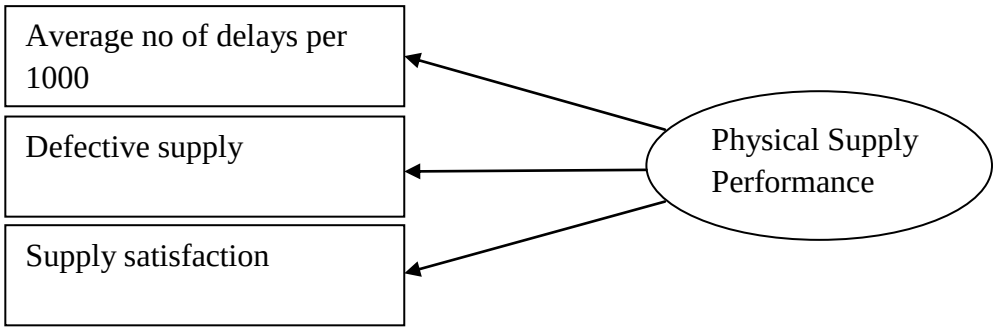

Figure 4.8- Research items for physical supply performance

4.8.1 Physical supply performance positively effects customer satisfaction (H7a).

An aggressive and high performing supply management process is a critical element of operational success, and a key component of satisfying customer [80]. Many supply chain management processes focus strongly on supply side issues, the critical link of supplier performance to customer satisfaction.

A.T. Kearney [81]in its works described how logistics excellence can be used as way to satisfy customer. It explains how by logistics excellence we can achieve total supply quality and bring a customer satisfaction mission to life.

Companies these days are following JIT to reduce their cycle time. To gain total customer satisfaction organizations are not only competing at product level, but also at supply level. Only those companies will succeed at gaining customer satisfaction, who can deliver the right product, at the right quality, at the right cost, in the shortest time, with no delays.

Thus supply performance has an important and positive relationship with customer satisfaction. We hypothesize that physical supply performance positively effects customer satisfaction.

4.9 CUSTOMER SATISFACTION

Customer satisfaction is the ultimate goal of a firm's operations. Both TQM and SCM aim to achieve customer. There are many strategies to accomplish this ultimate goal. Basically, customers require better product quality, faster delivery and cheaper costs, or quality-delivery-cost. Organizations must meet these requirements to achieve customer satisfaction.

Customer satisfaction with the order fulfillment process depends on the extent to which the expectations of customers are met by the firms. There is consensus in the service quality and customer satisfaction/dissatisfaction literature that ‘‘expectations serve as standards with which subsequent experiences are compared, resulting in evaluations of satisfaction or quality. La Londe[16] find that customers rate the physical distribution service items as some of the most important attributes that a firm has to offer, and illustrate the role of customer service and physical distribution in affecting the level of customer satisfaction, attitudes, and repurchase intention. Customer impressions provide evidence that customer satisfaction is a leading indicator of financial performance. Customer satisfaction research demonstrates a positive impact of satisfaction on both market value and accounting returns [76].

Thus customer satisfaction is taken as the final output variable in the model. Various SCM and TQM practices can only be seen as effective if the ultimate goal of customer satisfaction id satisfied. Various research items to measure the customer satisfaction are as following:-

- Customer response to product/ service quality.
- Customer response to product/service cost.
- Customer response to product/service in comparison with other competitors.

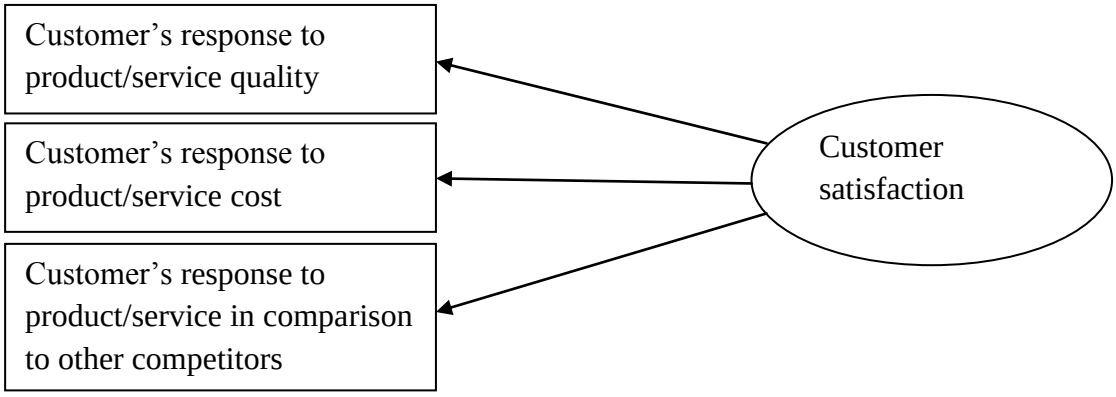

Figure 4.9- Research items for customer satisfaction

4.10 CONCEPTUAL MODEL

Using the above theoretical background and hypotheses a conceptual model is drawn from SEM approach. In our model each construct has a number of constrains which are the research items to measure these latent variables for example physical supply performance had supply satisfaction, defective supply and average no of delays per 1000. The SEM model was drawn in IBM SPSS AMOS 20.0.0. This model was further analyzed in AMOS, a Confirmatory factor analysis (CFA) was performed to evaluate the measurement properties of the model constructs and to find out the factor loadings of these constructs on each other to find out their relationship. The conceptual model developed is as shown in the figure below:-

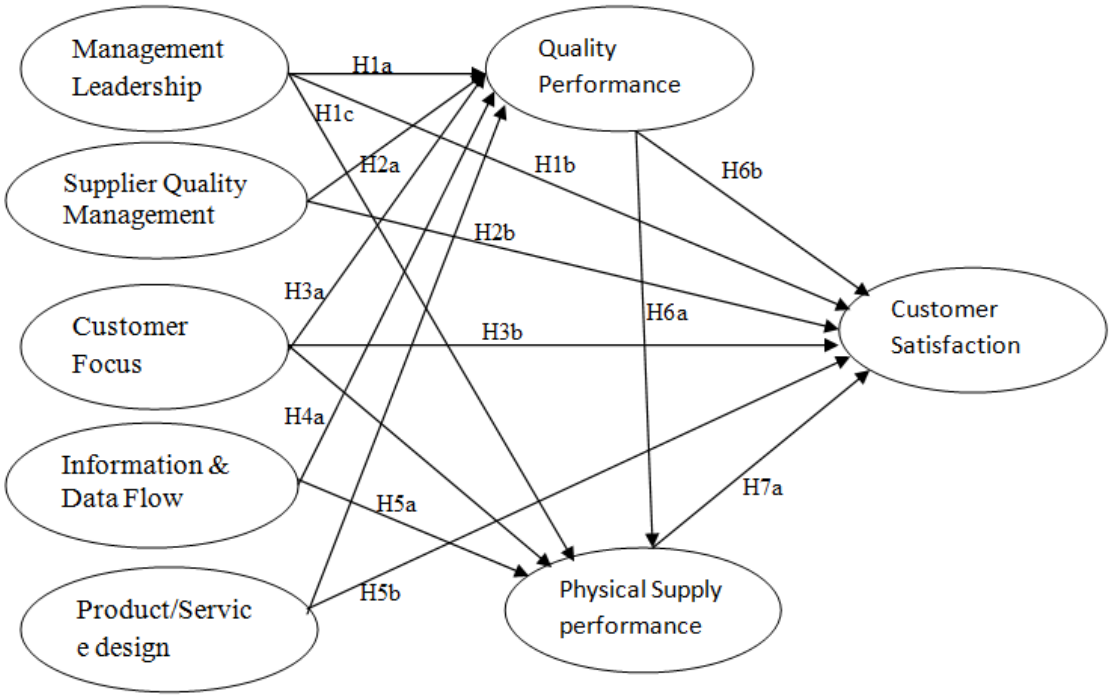

Figure 4.10- research model for supply chain quality management

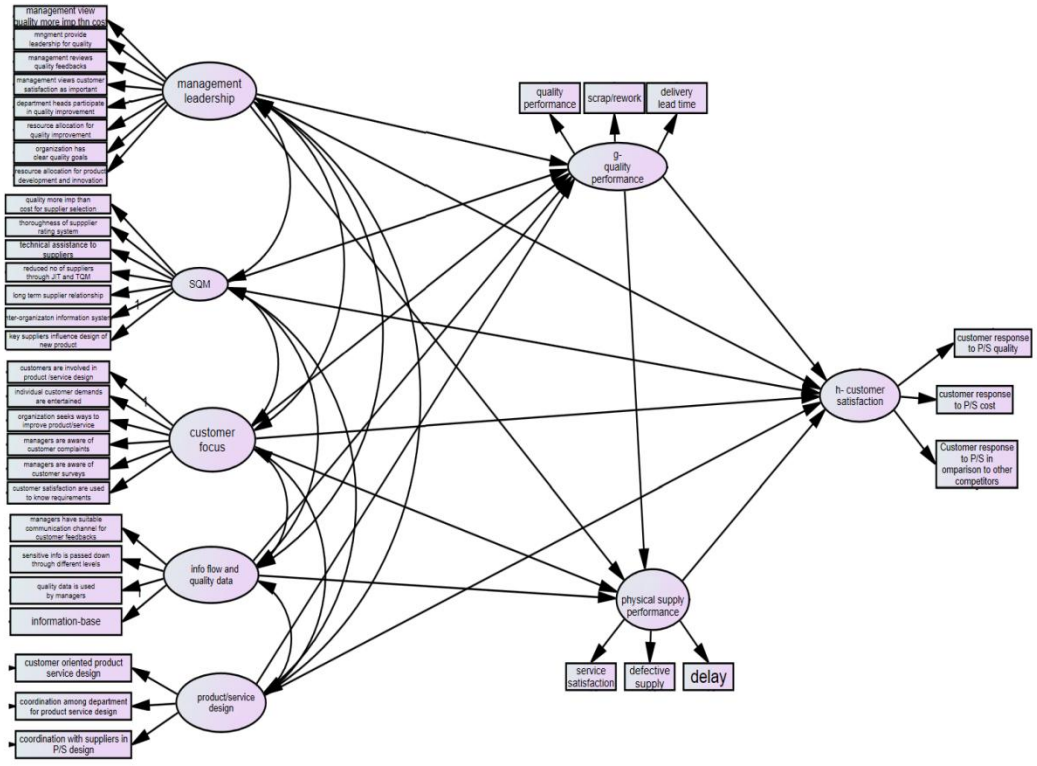

Figure 4.11- Supply chain quality management model as developed in AMOS 20.0

CHAPTER 5

METHODOLOGY AND DATA COLLECTION

5.1 INTRODUCTION

The model and hypothesis taken were validated and analyzed using structural equation modeling (SEM). SEM is a tool for analyzing multivariate data. It goes beyond normal regression models to incorporate multiple independent and dependent variables as well as hypothetical latent constructs that clusters of observed might represent, which in our case here are the research items used to measure the constructs in the model.

One of the routes to construct validation of a test is predicting the test's factor structure based on the theory that guided its construction, followed by testing it. One method for such testing is confirmatory factor analysis (CFA). In CFA, the predicted factor structure of a number of observed variables is translated into the complete covariance matrix over these variables. Next, this matrix is adjusted to the actual covariance matrix, and subsequently compared with it. The discrepancy between the two, the "goodness of fit" (GOF), is expressed by a number of indices. An assessment of how well the predicted factor structure is corroborated by the sample data, and whether it could be generalized to the population, is often based on the values of these indices.

5.2 SURVEY AND DEMOGRAPHICS

A questionnaire was developed using the research items that were taken from the literature earlier. A survey was conducted on the questionnaire; the methodology of survey was to physically collect it from individually. The survey mainly targeted two industries- automobile industry and their vendor companies mainly situated in gurgaon area and food processing industry in Delhi/NCR. Both the industry differs in the functioning of their supply chain. Individuals working in these companies who had good or at least basic knowledge of supply chain were contacted and were asked to fill the questionnaire. The survey was done in 11 companies which belonged to different sectors of operations as shown below:-

- Supply chain solution provider-1
- Food processing industry- 3
- Automobile industry- 3
- Vendor organization of major automobile companies- 4

All these companies are major players in the market, with successful supply chains and turnover ranging from 43000 crore to 1500 crore the least.

The survey had 90 participants from these 11 companies with all of them working at managerial position. After going through the data it was found that only 78 of the feedback were usable. The participants were asked their fill their names, designation, education qualification, experience and organization name. Of the participants 8 had an experience of 0-5 years, 19 had an experience of 5-10 years, 23 had an experience 10-15 years, and 28 had an experience of more than 15 years. In terms of education qualification 4 were diploma holders, 54 were graduates, 18 were post graduates, and one participant had PhD.

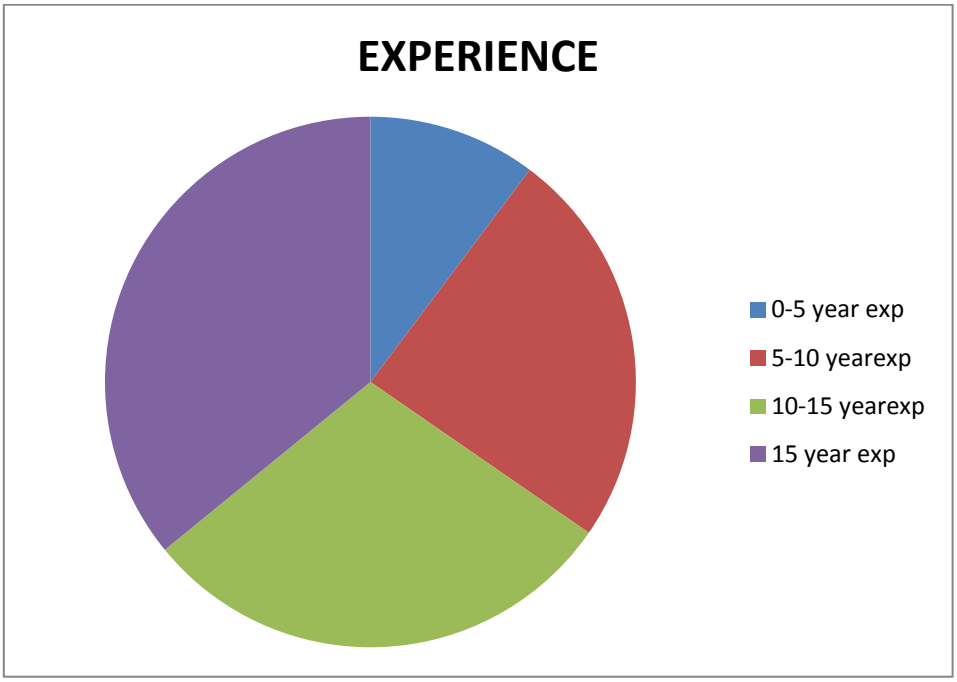

Figure 5.1- Experience pie chart of the participants

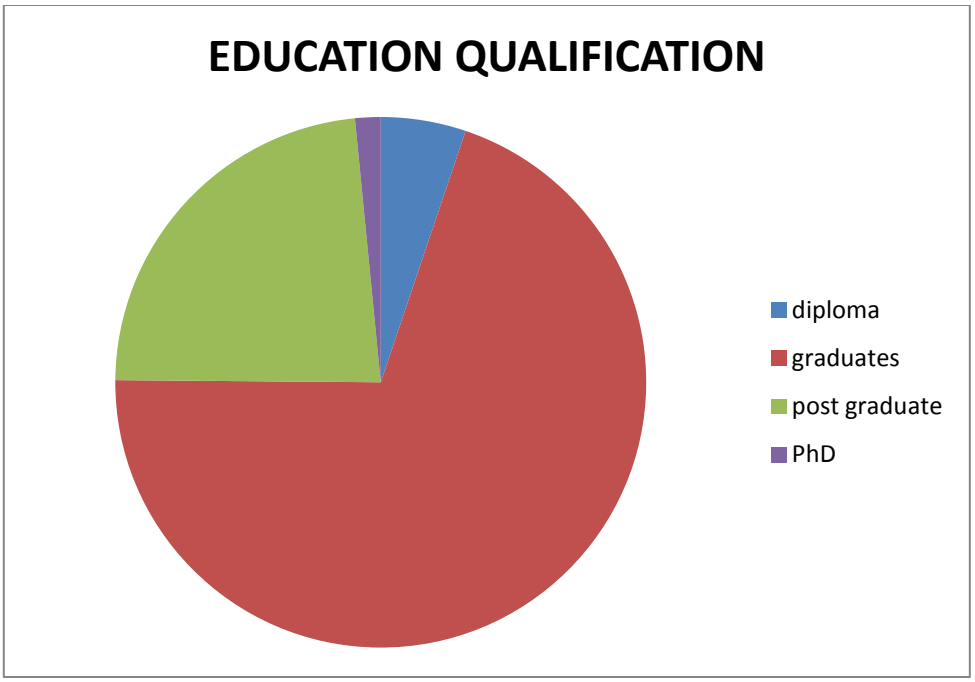

Figure 5.2- education qualification of the participants

5.3 QUESTIONNAIRE

1. Management leadership (rate each item on a scale of 0-10)

Measurement item	Rating (0-10)
a) Extent to which top-level managers view quality as being more important than cost.	
b) Top management provides the necessary leadership in enabling conditions for quality.	
c) How often does top management reviews customer feedbacks on product, product/service quality.	
d) Top management views satisfying customer needs is the central purpose of business.	
e) Degree of participation by major department heads in the quality improvement process.	
f) Top-level managers allocate adequate resources toward efforts to improve quality.	
g) Organization has clear quality goals identified by top-level managers.	

h) Organization allocates resources towards product development and innovation.	

2. Supplier quality management (rate each item on a scale of 0-10)

Measurement item	Rating (0-10)
a) Quality is a more important criterion than price in selecting suppliers of the major component.	
b) Thoroughness of our supplier rating system considering the supplier's engineering capability, financial stability, delivery performance, quality performance.	
c) Organization provides technical assistance to our suppliers.	
d) Reduction in the number of suppliers since implementing just-in-time purchasing and/or total quality management.	
e) Extent to which long-term relationships are developed with suppliers.	
f) Top management supports the need for inter-organizational information systems.	
g) Extent to which key suppliers have major influence on the design of new products.	

3. Customer focus (rate each item on a scale of 0-10)

Measurement item	Rating (0-10)
a) Extent to which customers are involved in product or service design	
b) Extent to which customer satisfaction surveys are used in determining/identifying customers' requirements	
c) Manufacturing managers are aware of the results of customer satisfaction surveys.	
d) How regularly is summary of customer complaints is given to managers.	

e) How actively does the organization seeks ways to improve product and services for greater customer satisfaction.	
f) Extent to which individual customer demands, short notice orders and complaints are entertained.	

4. Information flow and quality data reporting (rate each item on a scale of 0-10)

Measurement item	Rating(0-10)
a) Manufacturing managers are provided with summary of customer feedbacks and complaints through suitable communication channel	
b) Sensitive information (financial, production, design, research, customer feedbacks and/or competition) is passed down through different levels of organization.	
c) Extent to which quality data (cost of quality, defects, errors, scrap, etc.) are used as tools to manage quality.	
d) Maintenance of an information-base system that provides critical logistics and production information to operations employees and managers, thus enabling easy info availability for better decisions making.	

5. Product/service design (rate each item on a scale of 0-10)

Measurement item	Rating(0-10)
a) Emphasis on customer oriented product/service design.	
b) Degree of Coordination among affected departments in the product/service development process.	
c) Degree of Coordination with suppliers in the product/service development process.	
d) Extent to which implementation/ producability is considered in the product/service design process.	

6. Physical Supply Quality

Measurement item		Rating
a)	Average no of delays (no. Of delays per 1000 order)	
b)	Average no of defective supply (no. Defects per order)	
c)	Overall supply service satisfaction(0-10)	

7. Quality performance (rate each item in terms of actual number or percentage)

Measurement item		Rating
a)	Product/service quality (no. of complaints per 1000 products).	
b)	Cost of scrap and rework as a % of actual product cost.	
c)	Delivery lead time of final products/services to customer.	

8. Customer satisfaction (rate each item on a scale of 0-10)

Measurement item		Rating(0-10)
a)	Customer response to product/ service quality.	
b)	Customer response to product/service cost.	
c)	Customer response to product/service in comparison with other Competitor	

CHAPTER 6

RESULT AND DISCUSSION

6.1 RESULTS

Having received the desired feedbacks, all the feedbacks were compiled in the data package of IBM SPSS data editor. The data was sorted and analyzed for any redundancy or missing value. Those feedbacks with more than 5% missing values were removed from the data set. Since the data set was not very large so we could not afford too much data removal. The missing values in the rest of the feedbacks were replaced with the series mean of that variable.

Next a Cronbach's a reliability estimate test was conducted to assess the internal consistency of the constructs. Reliability refers to the consistency of the item-level errors within a single factor. Reliability means just what it sounds like: a "reliable" set of variables will consistently load on the same factor. The way to test reliability in an EFA is to compute Cronbach's alpha for each factor. Cronbach's alpha should be above 0.7; although, the value will generally increase for factors with more variables, and decrease for factors with fewer variables. Each factor should aim to have at least 3 variables, although 2 variables is sometimes permissible.

Table 6.1- Case Processing Summary

Cases	N	%
Valid	75	96.2
Excluded[a]	3	3.8
Total	78	100.0

a. Listwise deletion based on all variables in the procedure

Table 6.2- Reliability statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.976	.976	37

A cronbach's alpha value of .976 is considered very good, so here we deduce that data is internally reliable and we can continue for our further analysis. Here the constructs and hypotheses are already decided from literature study and their validity is proved that so we don't need to run any validity tests here and we can go straight to the confirmatory factor analysis of our hypothesized model.

On the next step model earlier hypothesized was made on Amos 20.0. a confirmatory factor analysis (CFA) was done to analyze the proposed model and relationships between various latent variables.

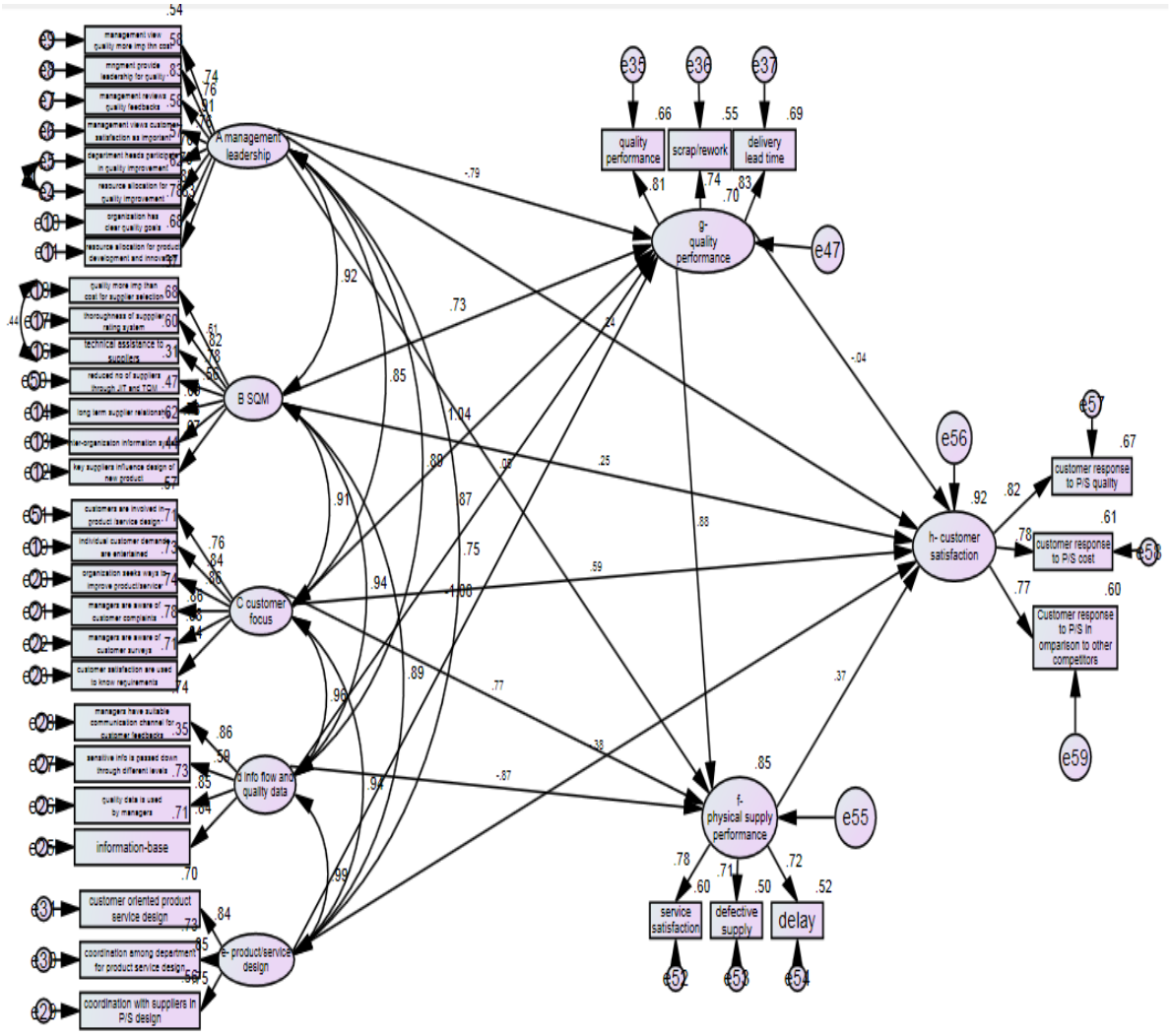

Figure 6.1- research model with result factor loadings

Table 6.3- Standardized Regression Weights, Key Hypothesis and Factor loadings:-

			Estimate
Quality Performance	<---	Product/service design	-1.075*
Quality Performance	<---	Supplier quality management	.730#
Quality Performance	<---	Customer focus	1.035#
Quality Performance	<---	Physical Supply Performance	.872#
Quality Performance	<---	Management leadership	-.787*
Physical Supply Performance	<---	Management leadership	.045
Physical Supply Performance	<---	Customer focus	.775#
Physical Supply Performance	<---	Information flow and data flow	-.868*
Physical Supply Performance	<---	Quality Performance	.877#
Customer satisfaction	<---	Physical Supply Performance	.367
Customer satisfaction	<---	Quality Performance	-.035*
Customer satisfaction	<---	Product/service design	-.384*
Customer satisfaction	<---	Customer focus	.586#
Customer satisfaction	<---	Supplier quality management	.246
Customer satisfaction	<---	Management leadership	.240

#- Significant factor loadings

*- opposite result expected

Table 6.4- Correlation estimation

			Estimate
Management leadership	<-->	Customer satisfaction	.846
Product/ service design	<-->	Customer satisfaction	.943
Customer satisfaction	<-->	Information flow/ data flow	.962
Management leadership	<-->	Supplier quality management	.917
Product/ service design	<-->	Management leadership	.746
Product/ service design	<-->	Supplier quality management	.895
Supplier quality management	<-->	Information flow/ data flow	.942
Product/ service design	<-->	Information flow/ data flow	.990
Management leadership	<-->	Information flow/ data flow	.891
Supplier quality management	<-->	Customer satisfaction	.912
e4	<-->	e5	.407
e16	<-->	e18	.445

SEM allows the analysis of observable variables as causal factors together with latent variables in a structural equation system, and such an application is not without precedence. The analysis of the full structural model yields a number of goodness-of-fit indices as shown below. Various model fit analysis are done to get the model fit analysis of the hypothesized model.

The chi-square does not have to indicate a complete fit in order to accept the model with a large sample, the chi-square's p-value is always likely to be small. The following alternative fit indices are provided in the text output. AMOS automatically compares your model to a "saturated model" (all variables correlated with all others) and to an "independence model" (all variables uncorrelated with all others), to ensure that your model is a better fit. The various fit indices are described below:

CMIN/DF – a value below 2 is preferred but between 2 and 5 is considered acceptable.

Table 6.5- CMIN results

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	138	1019.255	602	.000	1.693
Saturated model	740	.000	0		
Independence model	74	3199.587	666	.000	4.804

CMIN – minimum value of the discrepancy between the model and the data. This is the same as the chi-square statistic in the "notes for model" section. CMIN/DF – the chi-square divided by its degrees of freedom. Acceptable values are in the 3/1 or 2/1 range. Using this criterion, our model (without the added path from PIQ to COMP) was also acceptable (CMIN/DF = 1.693)

Table 6.6- Baseline comparison results

A CFI, TLI value above .9 is acceptable for a complex model.

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.681	.648	.839	fds.818	.835
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

NFI [Normed Fit Index] shows how far between the (terribly fitting) independence model and the (perfectly fitting) saturated model the detaulf model is. In this case, it's 68% of the way to perfect fit. RFI [Relative Fit Index] is the NFI standardized based on the df of the models, with values close to 1 again indicating a very good fit. IFI [Incremental Fit Index], TLI [Tucker-Lewis Coefficient], and CFI [Comparative Fit Index] are similar. TLI is usually between 0 and 1, but is not limited to that range. The baseline comparison here is not very satisfactory, the sample size here a NFI value of .681 is not good but CFI, TLI and IFI values are reasonably good.

Table 6.7- Parsimony adjusted measures

Model	PRATIO	PNFI	PCFI
Default model	.904	.616	.755
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

The PRATIO [Parsimony Ratio] is an overall measure of how parsimonious the model is. It is defined as the df of the current model divided by the df of the independence model. It can be interpreted as "the current model is 90% as complex as the independence model." The difference between this number and 1 is how much more efficient your model is than the independence model. PRATIO is used to calculate two other statistics: PNFI [Parsimonious Normed Fit Index] is another modification of the NFI that takes into account the df (i.e. complexity) of the model. Similarly, the PCFI [Parsimonious Comparative Fit Index] is a df-adjusted modification of the CFI. These two measures are likely to be lower than the NFI and CFI, because they take model complexity into account. For PNFI and PCFI a value of zero indicates poor fit and a value of 1 indicates good fit. Here PCFI, with a value of .755 is reasonably good but PNFI, .616 is less.

Table 6.8- NCP results

Model	NCP	LO 90	HI 90
Default model	417.255	332.995	509.385
Saturated model	.000	.000	.000
Independence model	2533.587	2361.118	2713.499

NCP – the noncentrality parameter. The columns labeled "LO 90" and "HI 90" give the 90% confidence interval for this statistic. This statistic can also be interpreted as a chi-square, with the same degrees of freedom as in CMIN. FMIN – F0 is the noncentrality parameter

(NCP) divided by its degrees of freedom. This is similar to the CMIN/DF statistic. The results also give the lower and upper limits of a 90% confidence interval for this statistic (LO 90 and HI 90 under the FMIN heading).

Table 6.9- FMIN results

Model	FMIN	F0	LO 90	HI 90
Default model	13.774	5.639	4.500	6.884
Saturated model	.000	.000	.000	.000
Independence model	43.238	34.238	31.907	36.669

Value of RMSEA index should be below .1, LO90<.1, HI 90 <.12.

Table 6.10- RMSEA results

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.097	.086	.107	.000
Independence model	.227	.219	.235	.000

RMSEA is a corrected statistic that gives a penalty for model complexity, calculated as the square root of F0 divided by DF (RMSEA stands for "root mean squared error of approximation"). Again, upper and lower bounds of a 90% confidence interval are given. RMSEA values of .05 or less are good fit, <.1 to >.05 are moderate, and .1 or greater are unacceptable. RMSEA = .00 indicates perfect fit. A RMSEA value of .097 if good enough.

The model was found recursive but because of low sample size all results were not confirmative to the research hypothesis.

There are several observations that need to be addressed in our result findings. First, the following proposed hypothesis were confirmed by the empirical analysis-

- H1c- management leadership positively affects physical supply performance- 0.45
- H2a- Supplier Quality Management positively affects Quality Performance- .78
- #H3a- Customer focus positively affects Quality Performance- 1.04
- #H3b-Customer focus positively affects Customer Satisfaction- .59

- #H3c- Customer Focus positively affects Physical Supply Performance- .77
- #H4a- Info Flow and Quality Data positively affects Quality Performance- .87
- #H6a- Quality Performance positively affects Physical Supply Performance- .88

Apart from the above hypotheses that are accepted, following hypotheses are rejected:-

- H1a- Management leadership positively effects quality performance- -.787
- H1b- Management leadership positively affects Customer satisfaction- .24
- H2b- Supplier Quality management positively effects customer satisfaction-.246
- H4b- Information and data flow positively affects physical supply performance- -.868
- H5a- Product/service design positively affects Quality Performance- -1.075
- H5b- Product/service design positively affects customer satisfaction- .384
- H6b- Quality performance positively affects customer satisfaction- -0.035
- H7a- Physical supply performance positively affects customer satisfaction- .367

Factor loadings above .7 are considered significant. In case of the factor loading of customer focus on quality performance, the factor loading is .59 which is slightly below the taken standard but given that the theory supporting it is very strong we have taken it as positive results. Again in case of H1c- management leadership positively affects physical supply performance the theory supporting it is very strong but its factor loading is a bit low. Still it is accepted because of strong theoretical support. Therefore we can say that –

- Supplier quality management positively effects quality performance in a supply chain.
- Customer focus has a very strong and positive effect on quality performance in a supply chain.
- Customer focus has a positive effect on customer satisfaction.
- Customer focus has a strong positive effect on physical supply performance of a supply chain.

- Information flow and quality data flow strongly and positively effects quality performance in a supply chain.
- Quality performance has a strong positive effect on the physical supply performance in a supply chain.

The proposed model is found acceptable as it is found to have a CMIN/DF value less than 2. Also the CFI value is also .835, which should be considered a borderline case and should be considered acceptable. The RMSEA, LO 90 and HI 90 value for the model is also within the specified limits. Thus the model is accepted and critical relationships between quality factors and supply chain factors are accepted.

6.2 CONCLUSIONS

The primary objective of this study is to develop a Supply Chain Quality Management (SCQM) model and a research framework that can be used as a guide to an effective SCQM approach to Indian service sector. Although, past studies on SCQM have undertaken the identification and implementation of SCQM practices successfully but still the literature on the investigation of linkage between SCQM practices and organizational performance in context with the Indian service sector is in nascent stage. In line to this, the present study attempts to bridge this gap and contribute to the development of SCQM research framework model particularly for Indian companies.

To carry out this study key practices that are common Supply chain management and total quality management, management leadership, supplier quality management, customer focus, information flow/data flow and product/service design have been extensively investigated as presented earlier. These practices act as input variables to the model. Three output variables, quality performance, physical supply performance, customer satisfaction, are proposed. Based on this review, a research model of Supply chain quality management has been proposed. 16 hypotheses were formulated from the model, 3 hypotheses based on the inter-relationship between output variables and 13 based on the relationship and effect of input variables on the output variables.

Moreover, in developing such a framework on SCQM, the present study can help in:

- Understanding the effect of various TQM and SCM practices on quality performance, physical supply performance and customer satisfaction.
- Understanding the inter-relationship between quality performance, physical supply performance, customer satisfaction.
- This research will provide valuable knowledge in SCQM regarding the practices and relationships between quality practices and supply chain performance.
- The proposed model allows the practitioners and managers to assess how their quality practices effect supply performance and customer satisfaction.
- Finally, the study will provide a significant contribution in developing a better understanding of the SCQM practices Indian industries.

The results here prove that quality management in itself performs a great role in implementing a successful supply chain management system. Quality is not just a organizational activity but an supply chain phenomenon.

Future research involves further testing of this model in service industries, software, electronics and other industries. With more data and empirical analysis a better framework can be developed. Also the present model can be further modified to analyze the effect of quality on other aspects of supply performance, like supplier customer relationship, supply cost effectiveness, apart from physical supply performance.

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