

EXECUTION OF TQM FACILITATOR & IT RESOURCES IN INDIAN INDUSTRY

Submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

In

COMPUTER APPLICATION

BY

PATEL MUHAMMAD UMAR MUKHATAR AHMAD

SUPERVISOR

DR. SURESH CHAND TYAGI



**Sri Satya Sai University of Technology &
Medical Sciences, Sehore**

2020

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2020

DECLARATION BY THE CANDIDATE

I declare that the thesis entitled “**EXECUTION OF TQM FACILITATOR & IT RESOURCES IN INDIAN INDUSTRY**” Is my own work conducted under the supervision of **Dr. Suresh Chand Tyagi** (Supervisor) at **Sri Satya Sai University of Technology & Medical Sciences, Sehore** (Center) Approved by Research Degree Committee. I have put in more than 240 days of attendance with supervisor at the center.

I further declare that to the best of my knowledge, the thesis does not contain any part of any work which has been submitted for the award of any degree either in this University or in any other University without proper citation.

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ABSTRACT

During the last one decade, ICT dramatically evolved and has become a part of everyday life for most people. ICT industry have been identified as the world's largest growing industry in terms of its GDP (Gross Domestic Product) contribution in the economy. The ICT industry of India contributed to about 9.5% of the national GDP, which is about 6 times its contribution in year 2000 (Nasscom, [4]). The ICT sector was grown up 13% in 2015 which is rapidly expanding domestic market. The internet (ICT) economy alone is approximated to gain US\$ 161 billion by 2018, accounting for around 5% of the national GDP by Swissnex report [5]. A large part of this is attributed to India's demographic situation. The ICT has been used by researchers of academic since 1980's and became popular after it was used in a reported to the government of UK by Dennis Stevenson in 1997 [6].

With the emergence of TQM and IT together, ICT organization initiated individual efforts to gain the philosophy of sustainability. Special attention should be given to the influence of IT on total quality information sharing with customers. With markets becoming global and versatile, for contemporary organization to survive therefore TQM facilitators and IT resources are adopted in the present research. In this research, the aim is to propose a solutions to a few problems. Quality has a different meaning in different references depending on their specific perspective. In order to compute customer expectation, quality is defined as meeting customer fulfilment.

The main aim of this research is to highlight the research entitled Execution of TQM Facilitator & IT Resources in Indian Industry. It will focus on the customer satisfaction by executing the TQM for IT and also by measuring the same as per objectives:

- To name the TQM facilitators and IT resources in ICT industry of India.
- To grade and categorize the TQM facilitators and IT resources for ICT industry and develop contextual relationships between them.
- To understand the awareness of TQM and IT program in ICT industry of India.
- To examine the degree to which TQM facilitators and IT resources are executed in the ICT industry of India.

- To examine the relationship among the named TQM facilitators and IT resources in the ICT industry of India.

The contributions of this research are listed as follows:

- This study contributes to execute TQM facilitators and IT resources in the Indian ICT organization. A few of study has been found on TQM and IT together to successfully fulfil the customer requirements.
- The literature review identified nine TQM facilitators namely Top management commitment and support, Customer Satisfaction, Empowerment, Total Employee Involvement, Continuous Training, Continuous Improvement, Teamwork, Culture Change and Democratic Management Style and eight IT resources Electronic Data Interchange, Computer Aided-Design, Computer Aided- Manufacturing, Enterprise Resource Planning, Computer Aided- Process Planning, Computer Aided- Engineering, Statistical Software Packages for Social Science and Structural Equation Modelling.
- A questionnaire survey has been adopted to check implementation of TQM facilitator and IT resources.
- This study accomplished by qualitative and quantitative methodological approach to have the execution of TQM facilitators and IT resources. Simultaneously, gathers knowledge regarding small and big organization towards TQM and IT.
- This study formulates hypotheses with the help of different tests like; descriptive statistics, exploratory factor analysis and Confirmatory factor analysis.
- The ISM-MICMAC modelling technique is used for identification and ranking of TQM facilitators and IT resources.
- This analytical study determines the degree to which Indian ICT organizations adopt TQM and IT and execute them for satisfied customers.

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CHAPTER – I

INTRODUCTION

1.1. INTRODUCTION TO THE CURRENT STUDY

Various studies have been done in the manufacturing and service industry (ICT industry, education sector, banking sector, health sector) [1,2,3] but later expand in only ICT industry. During the last one decade, ICT dramatically evolved and has become a part of everyday life for most people. ICT industry have been identified as the world's largest growing industry in terms of its GDP (Gross Domestic Product) contribution in the economy. The ICT industry of India contributed to about 9.5% of the national GDP, which is about 6 times its contribution in year 2000 (Nasscom, [4]). The ICT sector was grown up 13% in 2015 which is rapidly expanding domestic market. The internet (ICT) economy alone is approximated to gain US\$ 161 billion by 2018, accounting for around 5% of the national GDP by Swissnex report [5]. A large part of this is attributed to India's demographic situation. The ICT has been used by researchers of academic since 1980's and became popular after it was used in a reported to the government of UK by Dennis Stevenson in 1997 [6].

ICT industry bring a rapid change in the technology development services. In many countries, ICT has the highest priority area and is actively pursuing business in the global market. The effect of acquisition of ICT and its use on the TQM has received attention of practitioners and researchers. Positive effect of ICT on performance of business has been seen not only in terms of market value, market share, profitability and productivity, but also in intermediate measurement of performance, such as process efficiency, cost, service quality [7;8;9].

ICT involves any communication application or device comprising, television, mobile service provider, software development, information technology and many more [10]. ICT consists of technologies such as computers, peripherals, software, and internet connections that are planned to complete the functions of information processing and communications. ICT keeps cost down and the main additional use of ICT is in improving customer care due to larger customer base. ICT sector has been a powerful catalyst and a pioneer in addressing the interests and requirement of low-income

communities in developing countries [11]. The ICT sector is one of the significant parts of service sector that is growing fast. There are following reason for narrowing on ICT industry in the present study:

- Keep the business from being washed away in the technology tidal wave.
- Stay competitive in a thriving marketplace.
- Exchange of information is as much a part of trade as the movement of goods.
- Reducing risk in new e-business technologies.
- Educate employees on trends and developments of technology.
- ICT has moved from back office accounting to strategic assets.
- ICT influence direction and priorities of standards development by providing business requirements.

The significance of TQM has been recognized eventually since 1990's to 2000 in the ICT industry of India. The TQM movement generated fierce competitiveness in the market. Many industry conclude that effective execution of TQM can enhance competitive strength and provide a separate stand in the market. TQM has always been on the major agenda of many industry to improve quality, productivity and customer satisfaction. However, after sometimes markets need resource and technology to enhance the productivity and quality in performance. IT was identified as one of the parts establishing the effect of TQM on industrial performance. In another word, TQM was never addressed significantly without IT [12]. A decade ago, practitioners introduced IT with TQM to improve the quality performance, reduce cost [13] and increase productivity in business performance. With the growing of IT and TQM together, ICT industry began each efforts to gain the philosophy of sustainability.

Present research combined with facilitators and resources that have given birth to a new requirement, which is to successfully combine TQM and IT in any industry [14;15;16]. The quality experts need to know which TQM facilitators and IT resources will improve the industrial performance because with proper selection of facilitators and resources industry have right decision makers, managers, quality

experts and researchers concerning information technology for executing a quality program in the ICT industries of India. This study will develop the model to show the association between the named the TQM facilitators and IT resources for selecting the best facilitator and resource for execution in ICT industry. This also includes a survey based study has been done by collecting data in the selected Indian ICT industry.

1.2. TOTAL QUALITY MANAGEMENT

Prior to 1950's, the idea of TQM originated quickly in Japanese plants and later became a major management approach in the Japanese management philosophy. By early 1970's Japan imported TQM concept to USA, UK and other countries, due to its cheaper, higher quality products as compared to other countries [17]. Now a days, TQM has taken a new shape of an international series in the ISO 9000. The idea of TQM deliberately includes management in the concept's definition to ensure that history does not repeat itself. It makes it easy for management to disclaim its responsibility and send a clear message to the top management. TQM is a managerial approach which is focused upon the work procedure and people with the intention of satisfying customers and improving industrial performance. In different words, it has been indicated as a new way of managing an industry.

Also, TQM has been indicated as a new way of managing an industry. TQM builds on the following concepts; continuous improvement, quality priority, customer satisfaction and workforce involvement. Previously the TQM aim was to achieve quality in a broad scene but nowadays TQM has to achieve customer satisfaction as well as global competitiveness. In TQM, the industry can achieve only through long term planning, executing and by drawing up annual quality plans which serially lead the firm towards the fulfilment of vision. One of the most often recommended approaches of TQM is the structural way to organize management that seeks to enhance the products quality and services through ongoing refinement of continuous feedback [18;19]. Also, TQM attempts to combine all industrial functions to focus on meeting and outstanding customer's requirements and industrial objectives.

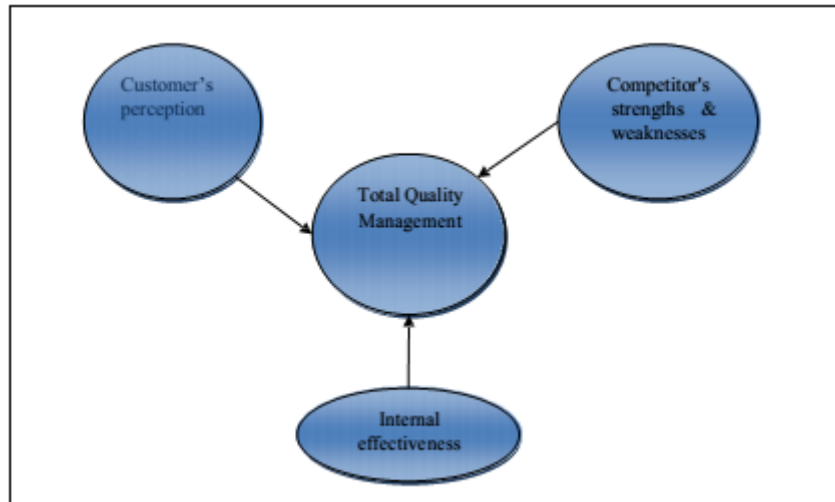


Figure 1.1. The idea of Total Quality Management

Figure 1.1. Shows that the concept of TQM philosophy is trying to fulfil the customer perception which increases the competitor's strength or decrease the weakness and enhance the internal effectiveness of market. The basic theory of the TQM is doing business to convince the customer, the supplier and continuously enhance the business processes [20]. TQM increases the products quality and customer satisfaction through continuous participation, involvement and impression of industry [21]. TQM empowers every member of the industry and offers the opportunity to everyone who participates, contributes and develops a sense of ownership [22]. It is a modern management philosophy and a journey, not a destination [23]. Kureshi et al., [24] found that TQM and business improvement are used exchangeable in the quality management research and showed important relationship between the two. TQM enhances the quality of work and employee satisfaction through participation and involvement in the industry [25]. Also, TQM by being a business management strategy, enhances the quality of industrial management, increases competitiveness and adds importance to the customer as well as gives competitive edges for the industry [26;27]. TQM gives better industrial performance, increased productivity and more effective products. Following effects of TQM are seen in ICT industry:

- Commit to continuous improvement of processes related to planning, production and service to achieve improvement goals.
- Provide job training to develop and maintain valuable staff.

- Encourage a continuous direction towards improving products and services.
- Give tasks to everyone towards achieving transformation goals of TQM.

According to McGregor & Palmer [28] TQM focuses on the whole industry that is involved in producing high quality outcome. Secondly, bringing continuous development of quality management and finally, it is achieving customer satisfaction. TQM became ideology relevant to any industry in order to satisfy effective public demands across size and motives [29;30]. TQM demands that theory of quality management must be applied at every stage, every level and in every department of the industry [31]. The idea of TQM philosophy must also be enhanced by the application of advanced quality management techniques [32]. To improve close collaboration with the suppliers, Total Quality works apart from the inner industry. The development of TQM since 1950 onwards can be assigned to the various experts. The following four stages of describes historical evaluation of TQM are discussed:

- 1) Quality Inspection
- 2) Quality Control
- 3) Quality Assurance

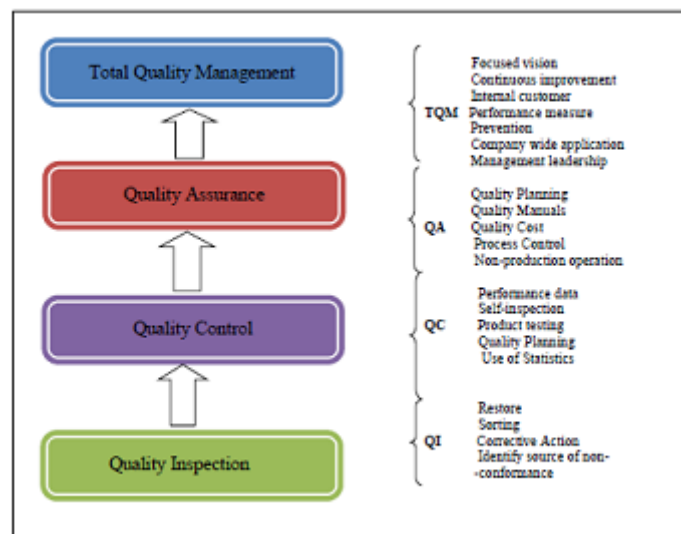


Figure 1.2. Different four stages in TQM (Dale [33][34])

1.3. INFORMATION TECHNOLOGY & TOTAL QUALITY MANAGEMENT

IT has emerged as the signal of growth in the development goals. Today's business environment is characterized by quick advances in technology, global competition and rising customer satisfaction [35]. IT provides free flow of information through deployed information systems and exchange of ideas, which can transform into an ICT industry. IT not only improves the productivity and service activity, it also enables enterprises to brilliantly alter themselves. With the support of IT, industry can collaborate with each other finding the best way to adapt to different customer's demand based changes in design, time and quantity while caring for cost. The impact of IT on industry systems can be separated into various categories:

- a) Speeding up activities
- b) Providing autonomous and intelligent decision making process
- c) Enabling distributed operations and collaboration along communication networks.

These categories of IT help lead to TQM. IT is increasing importance of companies and its effects on global trading are becoming greatly felt [36]. IT is quickly becoming the most significant factor in improving productivity as well as reducing cost [37;38]. Weston [38] found that IT acts as a feedback mechanism to the user who is determine to measure productivity and also serves more accurate information, improves communication links and facilitates execution of advanced tools, system and modelling. In addition, IT is growing to be used to understand, measure and improve an industry's level of sustainable quality. IT plays a critical role in development of real time correction of data in terms of customer satisfaction. It acts as an advanced communication and computational tools and information systems are the key success factors for TQM. Moreover, IT plays a main role in the TQM initiative through the strategic human resource and technology area.

1.3.1. IT RESOURCES

In present, the IT is a base of development for countries and a benchmark practices for leading and successful organization [46]. The effect of IT on an industry is increasing the importance and its effects on global markets. It is often used as the

most significant factor in reducing costs and enhancing productivity. When IT is linked its complementarity with other organizational resource or practices developing IT resources [47]. IT resources provide robust solutions to supervised business analytical skills and give the ability to deeply understand the organizations. According to Victor et al., [48] IT assist leaders to communicate with their employees to take right vision towards the accomplishment of quality also employees can do work their virtually anywhere and anytime. IT resources to interrelate with other human organizational resources as well as the nature of these resource have hardly been studied [49; 50; 47].

There are different studies has been covered by different authors. Brah & Lim [43] used different IT resources such as electronic data interchange, statistical software packages for social science extra to assists logistics operation of an organization. Dewhurst et al., [51] measures 28 constructs of IT resources to check the assessment of IT on TQM. Also, Sanchez-Rodriguez & Martinez-Lorente [52] use five resources to measures the performance of organization namely, electronic data interchange, computer aided-design, computer aided-manufacturing, enterprise resource planning and structural equation modelling. IT resources are open source software and technologies which give fast, robust result and help in empowering demanding users.

1.3.2. TQM FACILITATORS

Most of the industry recognize TQM and TQM facilitators for better business performance in order to improve their position in a global market. Robson et al., [39] suggests that TQM facilitators have the greatest influence upon operational performance and then business performance. Executing TQM facilitators in an industry can have positive or negative effects therefore proper care should be taken before execution of industrial performances. A survey approach in the innovation of TQM facilitators sets a new direction in the area of the research. TQM facilitators are a great achievement of industry. According to Wali et al., [40] TQM facilitators are those important few needs that must be current in a industry to support it to achieve its vision, and to be guided with respect to its vision. TQM facilitator as a whole contributes collectively to the development of performance [41]. Besides, Robson et al., [39] found that TQM facilitators support business sustainability as measured in the responsiveness to changes, in terms of growth and competitive advantages. There are

different studies which provide a set of facilitators to successfully execute the quality program in the different organizations. There is no study found which have similar facilitators which are made inconsistencies reach the conclusion for the TQM facilitators. In the essence, no study has found a common set of facilitators for the executing TQM and IT program.

There are various studies has been done on various sets of TQM facilitators by different authors. According to Tsang and Antony [42] named 6 TQM facilitators considered this study, top management commitment, customer focus and support, teamwork, training and development, supplier partnership, continuous improvement, and culture change. In a different study, Brah & Lim [43] explored 7 TQM facilitators: process management, top management leadership, information system and analysis, strategic planning, quality focus and customer focus, and human resource management,. Prakash et al., [44] identify 7 TQM facilitators such as top management commitment, employee participation, employee teamwork, continuous improvement in service production, an involvement of customer in service production and customer satisfaction. Singh & Sushil [45] construct 14 TQM facilitators to improving airlines performance these are top management commitment, communication, benchmarking, employee involvement, training & education, employee empowerment, teamwork, continuous improvement and continuous quality culture, customer involvement, improved service quality, process improvement, on-time performance, increased load factor and customer satisfaction.

1.4. PROBLEM STATEMENT

In this research, the aim is to propose a solutions to a few problems. Quality has a different meaning in different references depending on their specific perspective. In order to compute customer expectation, quality is defined as meeting customer fulfilment. With the help of quality management customers are becoming more aware of quality and services so that knowledge makes a customer more brand savvy and selective. Quality has been applied by different industry according to their objectives and needs. Quality is not unique; it is diversified into many forms in the manner of customer requirements. Simultaneously, many researchers suggest that TQM has been altered in different sectors to gain expectation of different customers. In a different

research, a claim has been made that TQM philosophy and practice produce visible and positive signs of productivity.

The use of IT in a TQM program requires significant changes in industrial culture by highly committed top managers. When top management does not effectively communicate to team members which make workers fearful it leads to resistance. When employees are not interested in works, it decreases the morale and productivity of the industry. Another problem is that when management does not provide required resources to employees, it reduces the productivity and customer satisfaction.

IT plays a crucial role in the TQM initiative through the strategic human resource and technology area. Also, IT act as advanced communication and computational tools and information system are the critical success of TQM. This chapter tries to successfully execute TQM facilitators and IT resources in the ICT industry of India. The problem statement, research purpose, research motivation, aim of the research has been carried out to identify the current study. The extensive review of literature on TQM and IT classified into different categorized such as an overview of TQM & IT, TQM facilitators & IT Resources, ICT industry of India. Further ICT industry divided into four sectors named as software development, information technology, business process outsourcing and telecommunication. It also provides naming and grading of TQM facilitators and IT resources with the use of number of occurrences in the different studies as well ISM (Interpretive Structural Modelling) methodology. The research methodology, research overview and outline of thesis also elaborated.

This study focuses on TQM and IT in the ICT industry. ICT industry is an internal aspect of a process that communicates the information to the customer from the industry. In this study, customers are the users of the ICT industry in India. The customers utilize and depend directly or indirectly on the ICT in the order of getting information on the daily basis. Therefore, ICT industry should execute and maintain TQM consistently. This study addresses contemporary issues and challenges of a customer base in ICT industries in India which can be resolved with the use of TQM and IT. This study approached development and execution of quality of products and services in the ICT industries of India.

1.5 PURPOSE OF THE RESEARCH

- The purpose of this research is to execute TQM facilitators and IT resources in the ICT industry of India. Some studies on TQM and IT propose that together they successfully fulfil the customer requirements. Many industry recognize that TQM philosophy improves quality achievement. Also by introducing IT with TQM impact of industrial performance has been increased.
- It is naming the TQM facilitators along with IT resources and establish the contextual relationship between among them and also will to understand the TQM facilitators and IT resources in terms of their independence and driving power.
- It distinguished the hierarchy of facilitators and resources and identified which action should be taken for the successful execution of the ICT industry.
- It also estimates the effects of successful quality programs and resource execution on financial development of ICT companies. This study accomplishes by qualitative and quantitative methodological approach the execution of TQM and IT. Simultaneously, it documents knowledge regarding small and big industry towards TQM and IT.
- The importance of quality and information technology has increased the competitive advantage in the world markets as ICT sector is considered as one of the major contributors to the Indian economy. This analytical study determines the degree to which Indian ICT companies adopt TQM and IT and execute them for a satisfied customer.

1.6. MOTIVATION OF THE RESEARCH

There is an extensive research scope for TQM and IT in the ICT industry as recognised by the number of gaps with the support of exhaustive review of literature. The following facts come out from the review of literature:

- Many International Journals regularly report the ongoing research in the area of TQM and IT. These journals provide a framework and guideline to researchers with explicit discussions and the research approach. There are various kinds of reported research i.e. literature review, empirical, case studies are good source of motivation.

Many of them point out International Journal such as Journal of Technology Management, Total Quality Management, Quality and Reliability Management, Industrial Management and Data system, Quality in Maintenance Engineering, Measure Business Excellence, Production Planning and Control, Journal of Computer Information System, Global Competitiveness, Production Economics Operations, European Management, TQM Magazine, Physical Distribution and Logistics Management, Technovation, Management Research News, Asian Journal of Quality, European Business Review, American Journal of Applied Science, World Journal of Science and Technology extra.

- Many digital libraries, which link articles with full text like ProQuest, EBSCO Business Source Premier, Science Direct, Emerald, Taylor and Francis, SpringerLink revealed many research publications on TQM and IT.
- The literature survey was carried out using the keywords such as “TQM and IT”, “TQM and Software Development”, “TQM and telecommunication”, “TQM and BPO”, “TQM and Mobile Service Provider”, “TQM and ICT”, “TQM Facilitators”, & “IT Resources” in the ICT industry of India.
- There was no model or instrument that has been developed to establish the level of TQM execution with the support of IT for ICT companies. This research shows how to evaluate the TQM facilitators and IT resources in the companies of India.
- The managerial implications of this study address the gaps of production and customer satisfaction that have not been addressed in Indian companies. Customer interaction, reduced response time and cost of identifying market requirements are to be focused upon.
- This study specifically being conducted in the ICT industry of India has a vibrant rationale because the Indian customer becomes more brand savvy.
- The review of literature suggests that no study has been done on the interaction between TQM facilitators and IT resources which have been investigated by ISM (Interpretive Structural Modelling).
- The Quality consciousness has made most producers of goods and services to change their products to meet the customer satisfaction.

- Further, a self-administered and structured instrument was designed to know the status of execution of TQM facilitators and IT resources and performance of ICT industries of India.
- This study used structural equation modelling to test the relationship between named the TQM facilitators, IT resources and customer satisfaction.

1.7. OBJECTIVES OF THE RESEARCH

The main aim of this research is to highlight the research entitled Execution of TQM Facilitator & IT Resources in Indian Industry. It will focus on the customer satisfaction by executing the TQM for IT and also by measuring the same as per objectives:

- To name the TQM facilitators and IT resources in ICT industry of India.
- To grade and categorize the TQM facilitators and IT resources for ICT industry and develop contextual relationships between them.
- To understand the awareness of TQM and IT program in ICT industry of India.
- To examine the degree to which TQM facilitators and IT resources are executed in the ICT industry of India.
- To examine the relationship among the named TQM facilitators and IT resources in the ICT industry of India.

1.8. METHODS OF RESEARCH

Many steps were undertaken to reach the ultimate draft of this research. An outline of the method adopted to collect data from respondents in ICT industry is given in this section.

- A questionnaire-based methodology has been adopted to gain the insight to TQM facilitator and IT resources in the ICT industry of India. Drawing from the existing parameter in literature review, a questionnaire survey was conducted with reference to their Indian context. The questionnaire has been conducted survey to name and

execute the TQM facilitator and IT resources in the ICT industry of India. The quantitative method implies the use of the questionnaire to collect data about the proposed model in the present research. Detailed questionnaire is developed into four sections. The First section deals with the company demographics including respondent's information and company profile. The second section named & grade the TQM facilitators and IT resources in ICT industry. The third section investigates the awareness of IT resources and TQM program in the context of India. Finally, the fourth section tests the relationship between IT resources and TQM facilitators and customer focus as perceived by manager's perspective in the industry of India.

- Two statistical techniques were used in the data analysis. The primary data was analyzed with the SPSS version 22 which gives the descriptive statistical analysis research samples such as mean, standard deviation, Kurtosis, Skewness.
- In the process of analyzing data using factor analysis first was used EFA to develop a scale and identify measured set of variables. Further, measurement model was tested by the SEM using CFA.

1.9. STRUCTURE OF THE THESIS

The organization of the present research has been divided into seven chapters which elaborate the topic, the requirement to justify it, detailed methods observed and the scientific defense of the research and its findings:

Chapter 1: It details the introduction of the present research of TQM and IT together, problem and purpose of the study, motivation for the present research, objectives of the research and a brief outline on the methodology adopted.

Chapter 2: This chapter contains exhaustive Review of literature on TQM and IT covering various definitions, development and benefits. The literature classification scheme runs through on overview of TQM & IT, TQM facilitator & IT resources, categorization of ICT industry including software development, information technology, Business Process Outsourcing, telecommunication and mobile service provider.

Chapter 3: This chapter elaborates the literature review related to the naming the TQM facilitator and IT resources. It lists the TQM facilitator and IT resources as well

as highlight major facilitator and resources which compose the foundation of the present research work. Further, identified TQM and resources are used in different models.

Chapter 4: This chapter is explains about the relation between the TQM (Total Quality Management) facilitators and IT (Information Technology) resources which could improve the performance of the ICT. The purpose of this chapter is to naming the TQM facilitators along with IT resources and establish the contextual relationship among them by using ISM (Interpretive Structural Modelling) and also to determine dependency and driving power of facilitator/resource with the use of MICMAC (Matrix of cross-impact multiplication applied to classification) analysis.

Chapter 5: This chapter explains the research methodology which includes exploratory research. Detailed descriptive statistics of the quantitative data collection techniques was adopted for the main part of the research. It comprises research design, sampling design, data collection, survey reliability, questionnaire validity, hypothesis testing, modelling, data analysis and statistical analysis to achieve the research aims.

Chapter 6: This chapter presents an overview of the research sample profile and provides an account of descriptive results regarding respondent's profiles. This chapter provides a detailed description of procedures and steps undertaken for testing the hypotheses. Also, it describes the procedure undertaken in evaluating the validity and reliability of each variable, as well as the evaluation of the models, fit through the indices procedures from the SEM results.

Chapter 7: This chapter presents the summary of research undertaken, major findings and significant contribution to this study. It encompasses the managerial implication and limitation of this research. Finally, scope and suggestion for the future scope are enumerated.

CHAPTER – II

REVIEW OF LITERATURE

2.1. INTRODUCTION

IT for TQM has been importantly executed on most industry. Many industries are giving better products and services with the support of introducing IT in TQM [53;52;54]. Global competition has increased the role of quality in the world of business but competition is adding to pressure on the organization. These challenges and demands have placed a renewed focus on quality improvement for the long-term survival of the organization. Technology is an enabling mechanism, results in improved jobs and increased job satisfaction [55]. TQM, management philosophy and asset for customer centric practices for delivering quality [56]. The TQM approach achieves business excellence, satisfying the customer demands, maintaining a competitive and healthy environment, providing leadership, developing infrastructure, vision and deploying state of the art technology [57]. The impacts of Information Technology on business performance have been studied periodically and reported by Kohli and Devaraj [7], Sriram and Stump [58]. Similarly, there have been many studies into the effects of Total quality Management execution on performance, for example, [59;60]. Weston [38] claimed that management interventions like TQM rely on IT, acts as a feedback mechanism and facilitates communication and the execution of advanced systems, tools and modeling techniques. Kock and McQueen [61] and Miller [62], considered how specific applications of IT might affect TQM, suggest that most significantly, IT has to be effective. For example, customers may select not to accept services from an organization if the systems used in the services are out of date or are unable to convince the customer's requirements. The literature surveyed in this chapter takes into account previously published literature on TQM and IT where the two broad focus areas under the purview of this study have been investigated upon collectively or separately. This research attracted practitioners, academicians and managers examining the various parameters of IT to find new business processes.

IT and quality management are complementary resources and owing to this IT has a positive effect on the quality program [52]. It is anticipated that IT application in quality management will extend the operational tasks of quality management and hence rise of quality output [63]. Service industries are investing steadily in technology, especially IT, to extend productivity, but with apparently very limited services. The application of IT in quality improvement through the following:

- Increasing quality awareness
- Online information regarding the level of quality
- Reducing quality costs

2.1.1. EMERGENCE OF TQM

TQM can be found to early 1920s when theory of statistics was first applied to product quality control. This idea was developed in Japan during 40s led by Americans, like Juran, Deming and Feigenbaum. The focus broadens from quality of products to issues relating to quality within an organisation – the start of TQM.

A new phase of quality control and management began from the 1980s to the 1990s and became known as Total Quality Management (TQM). It is observed that Japan's success of employing quality issues, western companies started to introduce their own quality initiatives. TQM, developed for the broad spectrum of quality-focused strategies, techniques and programmes during that period and became the centre of focus for the western quality movement.

TQM includes customer focus, continuous improvement, the involvement of all employees and the integration of quality management into the total organisation.

TQM became in the early 1980's when Hewlett Packard (HP) criticized US chip manufacturers for quality of product when compared with their Japanese competitors. It is ironic that W. Edward Deming first introduced TQM, Japanese acquired the philosophy but the USA rejected the principle. Higher quality points to greater productivity through reduced rework, wastes and rejects leading to lower costs and customer complaints and ultimately improved market share [64].

According to Deming [64] TQM , a management philosophy , makes application of a specific set of principles, techniques and practices to extend business and profits that give a bypass to improve productivity by avoiding rework, waste, rejects, high cost and customer complaints. According to Witcher [65] TQM has three terms; Total: means that every person is associated including customer and suppliers. Quality: implying that requirements of customer are met exactly & Management: indicating that senior executives are devoted. TQM, approach to management, by nature some guiding principles or core concept that incorporate the way the organization is expected to operate which is effectively linked together and will result to high performance [33;68].

Gaither & Frazier [69] says, TQM is the changing process, the basic culture of an organization and redirecting it towards service quality or superior product. According to Michael et al., [70] TQM , defined as a management philosophy and a set of tools , permit an institution to a means for attaining quality and pursue a definition of quality, with quality being a regular improvement ascertained by customer's contentment with the services they have received. TQM is defined as an organization wide philosophy requiring all employees at every level of an organization to focus his/her efforts to extent each business activity of the organization [71].

Hendricks et al., [72] and Flynn et al., [73] agreed, TQM, with its emphasis on the organizational and socio-behavioral matter of quality improvement, can add to previous research on systems quality management. TQM is an integrated management philosophy that has been found to strongly effect performance of organization. Terziovski et al., [74] say that TQM is an information intensive management practice. Information plays an important role as all quality improvement activities are based on informed decision-making. Wiele et al., [75] analyzed the idea of TQM using the “fad, fashion, and fit theory” for examining whether TQM can survive and become fit. It has been argued that if TQM is to move from being a fad to fashion or a fit, it must “be clearly defined and measurable” and must “have no direct link to short term major losses”. TQM can also be defined as fulfillment of customer needs and continuous improvement of quality, making it the responsibility of every employee etc. (Talib et al., [76]) concluded that TQM had affected manager's perceptions on several aspects of their day to day activities in the company. This effect generated mainly from their

familiarity with TQM concepts and practices and they argued that this indicated managers to hold a positive view of TQM.

2.1.2. TQM & IT

The objective of Total Quality Management in the information technology design is to assure the quality of information. Information technology play a vital role in companies which is used to re-engineer established business process and to redesign business market for today's information intensive environment [90]. This is done by verifying, ensuring and maintaining software integrity through a proper methodology. It constituted appropriate procedures with checks and controls in all the processes of information systems development. It ensures the choice of the design architecture, scope and the objective of the system and the development methodology. Further quality is ensuring processes and planned methodologies are correctly chosen. Past research on the IS quality phenomenon has predominantly focused on techniques and tools for software quality assurance, the quality impacts of software process innovations and design methodologies and development process management. Quality management is a critical issue for information system, as information is one of the most valuable assets of an organization. The application of IT supports the management to offload the routine and time consuming activities to the information system which allows the organization to begin important tasks that had been ignored [91] owing to this of this increased demand for information within the organization, IT professional should expect a greater focus on the quality and business value of products and services provided by the IT function. IT allows to explore many ways of providing accurate and accessible information to enhance quality awareness within an organization [63].

TQM and information system can be applied to organizations to improve quality of products and services offered to both external and internal customers [92]. According to Ayers [93] application of the TQM principles applied to IS support in decelerating wasteful expenditure in technology for the sake of technology. Also, Mjema et al., [63] found that IT Introduction on TQM has contributed greatly to the enhancement of quality awareness in the product quality improvement and the Quality Cost reduction. With efficient documenting, analyzing and measuring all work performed by IS organization, standardization and simplification of processes for limiting

variability and being focused on the systematic process and not the end product or the individual performing the act [94;95]. In the TQM application with information systems, the technologies play an important role. These are classified as current and growing technologies. The present technologies are object orientation, database management, parallel processing, data warehousing, distributed data processing and replication, communication and networks.

Past research on the phenomenon of Information System quality has predominantly focused on techniques and tools for software quality assurance, the quality impacts of software process innovations and design methodologies, and development process management. Jurison [97] suggested that TQM introduces changes in the firm's feedback loop and creates new requirements for the IS function. Almashaqba [98] has identified the effect of information system on TQM through the statement of the relationship between them and also investigated vulnerability of information system especially in industrial organization. Rahman & Siddiqui [87] considering IS as an integral part of the Indian firms the seek to investigate the relationship between IS and TQM. Previously, many studies have been done on TQM but IT that was introduced for improving industries performance has received scant scholarly attention with useful managerial implications. Few studies are devoted to investigating relationships between IT and quality management, the role of IT in a quality management system (Dewhusrt et al., [51]), and the development of measurement instrument to assess the level of IT use to support TQM [99;100;52].

Review of Literature for this research can be widely classified into various categories:1) Methodology of the research

2) Focus and objective of the study

3) Tools and techniques

4) Research type

5) Region (Countries)

Apart from other discussed categories, gaps related to TQM & IT were identified by researchers along with in-depth literature review that has been elaborated upon in this section on the gap identification.

Table 2.2. Different Studies on TQM & IT

Author	Research Approach	Objective	Tools & Techniques	Research Type	Region
Li <i>et al.</i> , [101]	Quantitative & Quantitative study	How to instill Deming's TQM Method in software development process & provide recommendations to TQM participants for avoiding pitfalls & ensuring success during TQM implementation.	Quality seven tools management seven tools, The product development life cycle	Research paper	US
Majumdar [102]	NA	Enhances the quality of the installed base of telecommunication infrastructure in the U.S.	NA	Empirical study	US
Kautz & Larsen [103]	Quantitative study	This paper analyzes a European wide dissemination project which aimed at spreading quality management and software process improvement approaches among organization in the IT sector.	Theoretical framework	Research paper	Norway

Antilla & Vakkuri [104]	NA	Examines the Sonera's approach for TQM based on developing its own superior implementation solutions by utilizing the best general international TQM principles, practices and recognizes different models including ISO 9000:2000 standards and quality awards models.	TQM framework	Research paper	Finland
Djerdjour & Patel [105]	Quantitative study	Quality system in TQM implementation in a few developing countries & focuses on the key issues of quality programs implementation.	NA	Case study	Fiji
Della Volpe <i>et al.</i> , [106]	Qualitative study	Presents NDB's experience in the implementation of software quality management by applying the experience, culture and successful practices of industrailization in an environment of TQM.	PDCA cycle for PCI, QDC concepts	Research paper	Brazil
Ang <i>et al.</i> , [99]	Qualitative study	Successfully coins a construct that can be used to evaluate the QM-IT relationship. Offers a set of nine dimensions of TQM that have been synthesized from various practitioners.	QMIT eight dimension, spilt half method, inter half method.	Research paper	Malaysia

Fok <i>et al.</i> , [107]	Qualitative study	This paper shows results of an exploratory study of the relationship between TQM maturity and IS development. TQM and IS have been proposed as vehicles for improving organizational efficiency and productivity.	Factor analysis, TQM maturity, system development, organization culture	Research paper	US
Ravichandran & Rai [90]	Qualitative study	The quality and system development were synthesized to identify and define eleven quality management dimensions and quality performance constructs.	LISERL, framework, statistical analysis, ANOVA, cluster analysis	Research paper	US
Douglas & Judge [59]	Qualitative study	It explores the relationship between degree to which TQM practices were adopted within the organizations and the corresponding competitive advantages achieved.	ANOVA, Factor Analysis	Empirical study	US
Palvia <i>et al.</i> , [108]	NA	Recommends a sociotechnical approach to determining the quality of computer information system.	SDLC, ANOVA, retest, pilot test	Research paper	North America
Cheon & Stylianou <i>et al.</i> , [92]	NA	Attempts to provide a benchmark of current TQM practices for IS. This study also provides information on the realized benefits from TQM and tests their relationship to the implemented TQM principles.	Mail questionnaire survey, seven point Likert scale, simple regression analysis, 142 Korean companies.	Empirical study	Korea

Muthu et al., [109]	NA	Discussed the application of TQM philosophy applied in maintenance engineering to achieve increased maintenance quality by introducing QS 9000 standards, through the careful exploitation of IT.	Simple mathematical model, ISO9000, KMQM-9000, Questionnaire method.	Research paper	India
Hsu & Su [110]	Qualitative study	Examines how quality management practices are implemented in Telecommunication industry.	Dimension QM, correlational analysis statistical control chart, QFD, Taguchi method, five- point Likert scale	Research paper	Taiwan
Lari [111]	NA	Provides the conceptual structure for a quality assurance with IS within organization	Conceptual framework	Research paper	US
Bandyopadhyay [112]	Qualitative study	Presents the results of a survey determining the information needs for implementing total quality management by auto parts manufacturers.	300 Michigan auto parts manufacture DBASE, ISO 9000/QS 9000.	Research paper	US
Yong & Wilkinson [113]	Quantitative study	Utilise aspects of the Baldrige criteria in order to determine the progress of QM practicing companies in Singapore towards the objective of TQM-IT.	Statistical analysis	Case study	Singapore

Chow & Lui [114]	Qualitative study	Examines the significance of a set of the original measurement items of TQM factors in IS function.	SEM, five point Likert, MANOVA test, SMC.	Research paper	Hong Kong
Chin et al.,[115]	Qualitative study	Presents a process-based quality management information framework to improve the productivity of the quality system (QS) process based on the new version of ISO 9000 approved in 2000.	SQL Server 2000	Research paper	South Korea
Martinez-Lorente et al., [116]	Quantitative study	Employed multiple case study methodology to investigate whether there is an underlying framework linking the extent of use of IT and TQM dimensions.	Sampling approach, EDI, CAD, JIT, Customer survey, SPC, FEMA, QFCD.	Case study	Spain
Jabnoun & Sahraoui [117]	Qualitative study	Introduction of TQM and organizational structure and the relationship between TQM and IT. It also deals with TQM structure and how it is enabled by IT.	Characteristics of a TQM	General review	UAE

Agus [118]	Qualitative study	Highlights the strong association between TQM, overall service performance and customer satisfaction and suggests that an emphasis on quality would result in an organizational goal.	SEM, ANOVA	Empirical study	Malaysia
Dewhurst et al., [51]	Quantitative study	Employed a multiple case study methodology to investigate whether there is an underlying framework linking the extent of use of IT and TQM dimensions.	Interview & questionnaire method, direct observation & data collection of quality awareness	Empirical study	Spain
Phillip & Mckewon [119]	NA	Examines the relationship between culture and business transformation by using the IS and TQM.	Grid model, hierarchical typologies, G/G model	Case study	UK
Prajogo [120]	Qualitative study	Examines the implementation of TQM in amongst different firms.	SEM	Research paper	Australia
Hemsworth et al., [121]	Qualitative study	Provide insight into current quality management and information systems theory and practice in the purchasing performance.	SEM	Research paper	Spain

Mjema et al., [63]	Qualitative study	IT-TQM enhanced quality awareness, product quality and reduced quality related cost. The use of IT in an organization supports leadership to formulate vision and mission towards organizations objectives including production quality.	ANOVA, four indicator of company performances	Case study	Tanzania
Brah & Lim [43]	Qualitative study	TQM and technology are becoming essential features of the business strategy for the success of many leading organizations in the world.	SPSS	Empirical study	Singapore
Sanchez-Rodriguez et al., [53]	Qualitative study	Examines the use of IT to support TQM initiatives and their contribution to operational quality performances in the manufacturing sectors provides a step towards understanding how TQM jointly adds value to manufacturing firms.	SEM, ANOVA, CFA	Research paper	Spain
Fuentes et al., [122]	Qualitative study	Examines the relationship between strategy and TQM implementation, as well as the impact of the adaption of both to organizational performance.	SEM, CFA	Empirical study	Spain

Sila [123]	Qualitative study	Developed a model combining the effects of seven TQM practices on four organizational performance indicators and the effect of these performance measures on each other by using survey method	SEM, CFA	Empirical study	US
Elizabeta & Violeta [124]	Quantitative study	This paper presents an application of the TQM concept in projecting of information system.	NA	Research paper	Europe
Siddiqui & Rahman [56]	Qualitative study	The purpose of this paper is to describe a study conducted in Indian companies to evaluate the role of TQM for IS in pragmatically realizing organizational goals.	ANOVA, Regression analysis	Research paper	India
Tawaissi et al., [125]	NA	Discusses the application of TQM in Communication Technology sector.	General review	Research paper	Jordan
Sohn et al., [126]	Qualitative study	It improves the quality of official statistics on the information and technology industry.	Factor analysis	Empirical study	Korea
Ginge & Samarasinghe [127]	Quantitative study	Presents an empirical study which examines the interrelationship between IT and TQM and the importance of these practices on organizational performance in terms of quality performance.	Factor analysis, multiple regression analysis	Empirical study	Srilanka

Vance et al., [128]	Quantitative study	Focuses on how system quality and culture significantly affect trust in the IT artifacts and point to reach the possibilities for future research in this areas.	Smart PLS 2.0	Empirical study	US & France
Keramati & Albadvi [129]	NA	Analysed the effects of integration of IT and TQM on performance of SMEs in car part suppliers	NA	Research paper	Sweden
Daghfous & Barkhi [130]	Qualitative study	Focuses on a recent survey of IT application and challenges in several hotels. This study presents the finding of an exploratory empirical investigation and the data collected on the interrelated practices of TQM enterprise initiatives.	Drop off method, DELPHI	Empirical study	UAE
Gunasekaran et al., [131]	NA	Proposes a framework for implementing a model called TQM integrated with software and information technologies (TSIT), which integrates the TQM foundations with the software and IT.	Framework	Case study	India
Kumar et al., [132]	Qualitative study	Investigates the impact of TQM implementation on different dimensions of company performances by using IT.	Statistical method	Research paper	Canada

Sit et al., [133]	Quantitative study	Develop model of TQM and HRM practices on KM (Knowledge Management) activities supported by IT.	Dimensions of TQM, evaluation method	Research paper	Malaysia
Martinez-Costa et al., [134]	Quantitative study	Compares the implementation Of quality management practices in the industries.	MACS analysis, ANOVA	Empirical study	Spain
Khan [135]	Qualitative study	Investigates the TQM, dimension based on Deming Management Model in telecommunication industry.	SPSS & AMOS	Empirical study	Pakistan
Marcus et al., [136]	Qualitative study	Propose a construct of development of quality as the key determinant of software development productivity and product quality.	NA	Empirical study	India
Gorla & Lin [138]	Qualitative study	Determines that software quality is important for the success of any information system (IS).	Factor analysis	Empirical study	USA
Sharma et al., [138]	Qualitative study	Theorise the changes surrounding the introduction of a management control innovation and TQM techniques in telecom industry.	Theoretical framework	Research paper	Fiji

Geraldi et al., [139]	Qualitative study	Explores the attributes of quality in projects, based on interviews conducted within a large IT-service company.	NA	Research paper	UK
Durmusoglu & Barczak [140]	Qualitative study	Examines if, and how, particular IT tools used in the discovery, development, and commercialization phases of the new product development	MANOVA	Empirical study	US & Canada
Sajjad & Amjad [141]	Qualitative study	Determines the various benefits an organization can derive from the application of TQM practices, or the relationship between TQM and quality outcomes/benefits in services sector of telecom industry.	Theoretical framework	Research paper	Pakistan
Sanchez-Rodriguez & Martinez-Lorente [53]	Qualitative study	Draws on operational management and IT literature to evaluate the effect of the three IT resources and three related quality management capabilities and their effects on a firms quality performance.	SEM	Research paper	Spain
Valmohamadi [142]	NA	Develops a framework to be used on how information technology can support the TQM practices.	Seven basic quality tools, QFD, COQ, FEMA	Empirical study	Iran

Chandan et al., [143]	Qualitative study	Discusses the information system maintainability in terms of CRUT model and reviews the application of total quality management construct to suit organizational IS.	CRUT model, ITEC	Research paper	US
Perez-Arostegui et al., [144]	Qualitative study	Analyzes the impact of IT competence-composed of IT infrastructure, IT technical and managerial knowledge and the integration of IT strategy with firm strategy on quality performances.	Multiple Regression analysis, SPSS	Research paper	Spain
Sajjad & Amjad [145]	Qualitative study	Presents the importance of benchmarking in TQM and organizational performance	ANOVA	Empirical study	Pakistan
Steol et al., [146]	Qualitative study	Investigating how IT auditing has grown with increased reliance on IT for business operations and new regulations regarding the assurance of IT for these operations.	Factor analysis	Empirical study	US
Chen & Cheng [147]	Qualitative study	Centres on mobile phone service loyalty and explores the relationships between service quality, perceived value, satisfaction and loyalty of mobile telecom services.	SEM	Empirical study	Tawian

Siam et al., [148]	Qualitative study	Evaluates the extent to which information technology has been used to support TQM in order to identify the role in implementing TQM.	SPSS	Case study	Oman
Tiwari & Chaudhari [149]	Qualitative study	Profounds that IT and TQM have a significant impact on most organizations and each has been widely researched.	Eight TQM dimensions, ANOVA	Empirical study	India
Abdi et al., [150]	Both	Aimes to analyze the relevant knowledge of TQM theories & principle to facilitate improving IT product/services practices.	AHP method	Research Paper	UK
Almashaqba [151]	Qualitative study	Investigates the impact of management information system on some of the chosen criterion of total quality management.	Regression analysis	Empirical study	Saudi Arabia
Khanam et al., [54]	Quantitative study	Literature survey was conducted to find out the role of IT in TQM.	Literature review	Research Paper	India
Delic et al., [152]	Quantitative study	Examines the impact of quality management and application of IT on organizational performance in transitional economics.	LISREL, SEM	Empirical study	Serbia

Khanam et al., [153]	NA	Reflects the extent of work undertaken in the area of TQM and information technology as well as tries to restructure and organize the available knowledge on TQM and IT in the ICT organization.	Literature review	Research Paper	India
Khanam et al., [154]	NA	Utilises the AHP methodology to prioritise and grade the hierarchy levels of TQM facilitator and IT resources together for its implementation in the ICT organization.	AHP method	Research Paper	India
Khanam et al., [155]	NA	Formulated to identify 'vital few' factors of TQM facilitators and IT resources for the benefits of researchers and practitioners.	Pareto analysis	Research Paper	India
Khanam et al., [156]	NA	Identifies and analyzes TQM facilitators and IT resources as well as to evaluate their prominence and relation factor by using DEMATEL methodology.	DEMATEL method	Research Paper	India

2.2. TQM AND IT IN INDIA

TQM has a strong record in improving productivity, competitiveness and profitability by reducing rework dramatically. While TQM gains huge success it is helped potentially by IT. Tweedie [157] examines the potential use of TQM in the information technology sector and found that IT is improving the influence of TQM in other sectors of organizational behavior. The concept of TQM has spread in every sphere of the global corporate world and Indian companies are no exception, while

TQM & IT together in ICT companies-based study are limited. The new customer demand policy has entered in Indian markets and companies in global market are treating brand savvy customers by using TQM and IT.

A few studies have been done on TQM & IT in ICT companies in the last two decades as shown by data. Some selected studies of TQM and IT are summarized in the Table 2.3

Table 2.3. Studies of TQM and IT in India

Author	Research Approach	Objective	Tools & Techniques
Wali <i>et al.</i> , [158]	Qualitative study	Few key factors of information are identified which should be given special attention to ensuring successful implementation of TQM program.	Combination of LR
Isaac <i>et al.</i> , [159]	Qualitative study	Critical factors of TQM in software industry are identified. An instrument for measuring the level of quality management practices in software organization is also presented.	CFA
Rahman & Siddiqui [87]	Qualitative study	TQM for the organization is catching up fast amongst Indian organizations. Organizations in India are adopting TQM as they have several years of experience with TQM for IS.	Simple regression analysis
Gunasekaran <i>et al.</i> , [160]	Qualitative study	Proposes the TSIT model that integrates TQM foundation with software and information technologies.	Six case study, QFD, FIS, Qualitek 4, dBase 4,
Rothenberger <i>et al.</i> , [161]	Qualitative study	A construct of development quality as the key determinant of software development productivity is proposed.	CFA
Bhat & Rajashekhar [162]	Quantitative study	Barriers of TQM are implemented and identified in order to make them known to the managers of Indian	Factor analysis

Malik et al., [163]	Qualitative study	Addresses an unexplored theoretical gap of developing market-based organisational learning capabilities in business process outsourcing firms. Using a capabilities lens, this study assesses the impact of quality management capabilities in developing market-based organisational learning	Conceptual model
Jain & Gupta [164]	Qualitative study	Examines the effects of TQM practices in software organizations on employee's perceptions on perceptual human resource management outcomes within India.	NA
Himabindu & Susan [165]	Qualitative study	The quality of work life of employees with special reference to BPO industry in Hyderabad India is studied.	Chi-square analysis
Khanam et al., [155]	NA	Identifies TQM facilitators and IT resources and establishes the contextual relationship among them by using ISM-MICMAC.	ISM-MICMAC method

2.3. HISTORY OF ICT IN INDIA

ICT has grown from strength to all organizations. It has occurred and taken for the developmental to work as a necessary tool [166]. In 1965 many Indians professionals migrated for research opportunities in the USA, due to fast growing IT sectors in USA, IT professionals were needed outside the USA. India had a population that is educated, technically strong and possesses English speaking skills. Hence, this led to a huge boom in the IT sector in India. In 1968, TCS (Tata Consultancy Services) started to give software development services in India. First, software services like punching card facility were developed by TCS employees. After some time TCS grabbed many project. Today's TCS is India's top company with a turnover of more than \$10 billion. After some time, other reputed IT companies were introduced for example WIPRO, Patni computer systems, Infosys extra.

Last quarter of the 20th century, ICT was largely seen as having heralded an information age in which economic and social work has been widened, deepened and transformed. ICT offers the assurance of improvement in the efficiency of benefits of rural and urban development programs and poverty alleviation schemes. The Government of India is making efforts for improving the availability of ICT data for policy making and research related activities. There is a large amount of data exists in the ICT organization, collected by NASSCOM (National Association of Software and Service Companies). Similarly, data on ICT manufacturing is measured by Communication and Manufacturing Association in India, a private body. A large set of data is produced on a regular basis in IT and BPO sectors, whereas some more exists in the telecommunications sector. India has considered as a pioneer in software development and a favorite destination for IT enabled services.

IT-BPM exports grew by 7.7 per cent to US\$126 billion in 2017-18 and is estimated at US\$136 billion for 2018-19. E-commerce market is estimated at US\$43 billion for FY 2018-19, at the growth rate of 12 per cent(Nasscom, [4]).

Recently, Ministry of Statistics and Programs Implementation (MOSPI) has signed a memorandum of understanding to participate in the project on a statistical compilation of the ICT sector and policy analysis undertaken by Orbicom [167]. This project is trying to compile data on the contribution of the ICT sector to Gross Domestic Product (GDP) and employment to the Indian economy (International Telecommunication Union, [168]).

2.4 BACKGROUND OF ICT INDUSTRY

The Information Communication and Technologies became popular in early 1997. ICT is a term that consists of any communication application or device, incorporate: television, radio, , cellular phones, computer, software, network hardware, satellite system as well as various application and services associated with them [169]. In the era of globalization environment, ICT organization is widely accepted as one of the key forces for shaping the economic landscape [170]. ICT organization makes a rapid change in the advancement of technological services. The past two decades have shown that ICT organization has been one of the fastest growing businesses. In many

countries, ICT has the highest priority area and is actively pursuing business in the global market reported by task force [171].

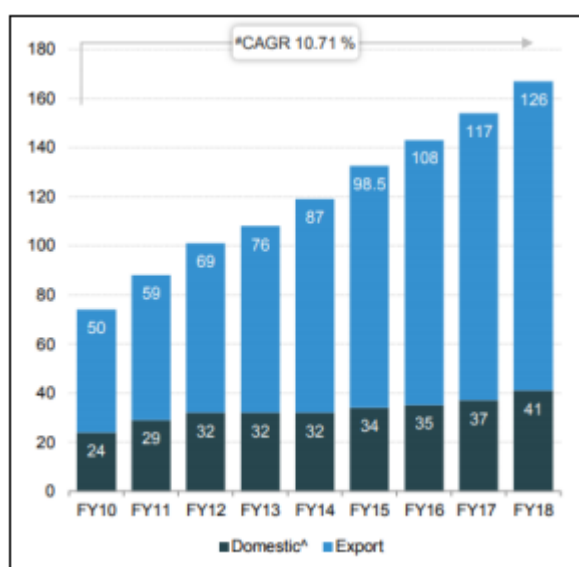
The effect of selection of ICT and its use on the QM has received special attention of practitioners and researchers [172]. Positive impact of ICT on business performance has been seen not only in terms of profitability, productivity, value market share, market but also in intermediate performance measures, such as service quality, process efficiency, cost savings, process flexibility, organizational, and CS [7]. ICT adoption has drastically modified communication, sales, and information methods [173], enabled firms to achieve a strong competitive advantage, in both production and other areas. ICT usage and ways of increasing the positive impact of ICT on firm performance (Gretton et al., [174]) have been documented.

ICT can be broadly seen under two parts, information technology & communication. For the past couple of decades, these sectors have made significant growth. In the present study ICT organizations, including different four sectors named as information technology, software development, Business Process Outsourcing (BPO) and telecommunication are studied. In India, IT sector is formed by software services and information technology enabled services which comprise BPO. Secondly, telecommunications and mobile service provider comprise telecommunication from one end to another end.

2.4.1. INFORMATION TECHNOLOGY

IT has to lead the economy transformation of the country and altered the perception of India in the global economy. IT has produced fundamental changes in the US economy, leading to a permanent improvement in growth prospects [175]. Similarly, Jorgenson [176] found the development and deployment of IT behind the America's growth resurgence. IT can play a major role in economic development in a broader scene, beyond just economic growth. IT is one of the important emerging sectors of Indian economy. IT industries are providing IT services about 3-4 times cheaper than the US. IT is the backbone of its unique selling proposition (USP) in the global outsourcing market [177]. India also achieved prominence in terms of intellectual capital with several global IT companies setting up their innovation centers in India. India is the world's the largest sourcing destination for the information

technology sector, accounting for approximately 55 per cent market share of the US\$ 185-190 billion [178].



Source: NASSCOM, Gartner, Aranca Research. Market size of IT industry in India (Visakhapatnam port traffic (million tonnes) US\$ billion)

Figure 2.1. Indian IT market growth [179]

India's IT & ITeS industry grew to US\$ 181 billion in 2018-19. Exports from the industry increased to US\$ 137 billion in FY19 while domestic revenues (including hardware) advanced to US\$ 44 billion. Spending on Information Technology in India is expected to grow over 9 per cent to reach US\$ 87.1 billion in 2018. Revenue from digital segment is expected to comprise 38 per cent of the forecasted US\$ 350 billion industry revenue by 2025.

IT BPM industry revenues (excluding hardware) was estimated at around US\$ 154 billion in FY 2016-17 and grew to US\$ 167 billion in FY2017-18. The contribution of the IT sector to India's GDP stood at 7.9 per cent in 2017-18. The domestic revenue of the IT industry is estimated at US\$ 41 billion and export revenue is estimated at US\$ 126 billion in FY18. The market size of India's IT-BPM sector is expected to grow to US\$ 350 billion by 2025 and BPM is expected to account for US\$ 50-55 billion out of the total revenue. Spending on Information Technology in India is expected to grow over 9 per cent to reach US\$ 87.1 billion in 2018. Outsourcing of large technology contracts by clients is expected to accelerate the growth of the industry in FY20.

2.4.2. SOFTWARE DEVELOPMENT

The software sector in India began in 1970 with the entry of Tata Consultancy Service in the domain of outsourced application migration work. The software sector of India, one of the world's successful industries, has grown more than 30 % annually for 20 years. The software sector is considered a highly successful growth engine in India [180]. The growth in the recent year has been achieved by Indian exports of software services to above 60 countries which are two third of the United States and half of the Fortune 500 [181]. Indian software sector moved up the value chain performing low cost programming to provide extensive software development services from for overseas clients [181]. A number of software product firms grew over the last decades from a little over 100 in 2000 to nearly 2400 in 2013 [182].

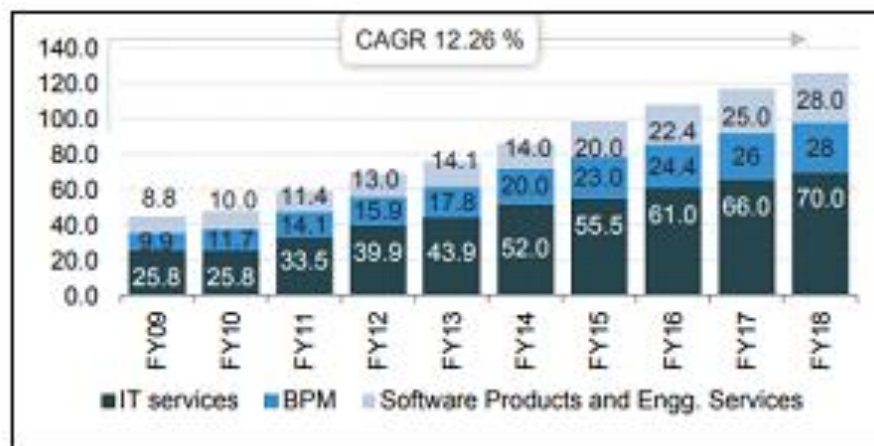


Figure 2.2 Growth in export revenue (US\$ billion)

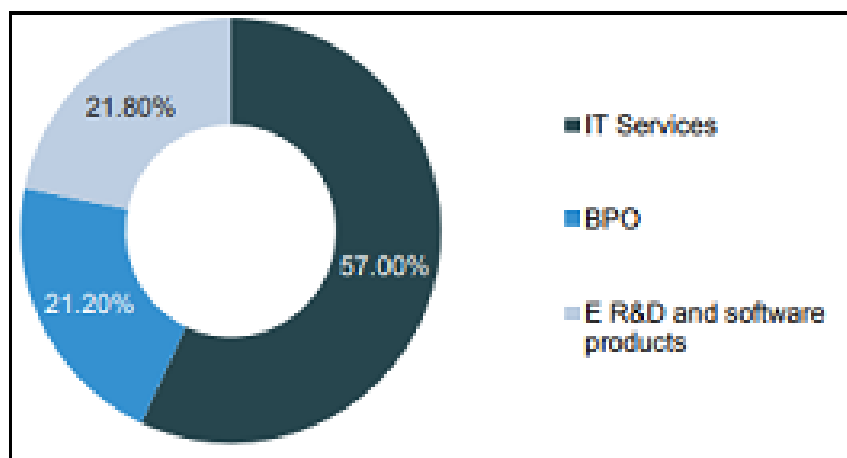


Figure 2.3: Sector-wise breakup of export revenue (FY18)

As per the report of NASSCOM, the revenue for the software product segment currently stands at 2.2 billion USD , is expected to reach 10 billion USD by 2020.

From the figure 2.3, it is shown that total exports from the IT-BPM sector (including hardware) were estimated to have been US\$ 126 billion during FY18; exports rose at a CAGR of 12.26 per cent during FY09–18. Export of IT services, the major contributor, accounting for 55.56 per cent of total IT exports (including hardware) during FY18. ITeS and Software products accounted for 22.22 per cent and 22.22 per cent of total IT exports during FY18, respectively. Exports from the sector are expected to reach US\$ 135-137 billion in FY19.

2.4.3. BUSINESS PROCESS OUTSOURCING

BPO, the outsourcing functions in which the organization outsources, specific activity/process related to its business to a third party service provider. BPO, fastest growing sectors of ICT organizations [183]. Indian BPO started in mid 90's and has grown by leaps and bounds. India is now world's favored nation for BPO companies, among other companies [184]. BPO service provider usually administers and manages a particular business process for another company. BPO is using technologies in a new way to improve a particular business process. BPO allows organizations to keep entrepreneurial speed and agility which they would otherwise sacrifice in order to become efficient as they expand. BPO only boosts efficient, but also enables significant time savings. Also, BPO automatically results in significant cost savings. Business that chooses outsourcing does not have to spend dollars in recruiting and managing human resource, something that enables instant cost savings [185].

BPO helps increase an organization's flexibility. By increasing the speed of business process. Presently, India, number one destination for business process outsourcing as most companies in the US and UK outsources IT related business process to Indian service providers. Figure 2.4 presents, various Indian BPO services offered such as customer support, technical support, telemarketing services, insurance processing, data processing, forms processing, bookkeeping and tech supporting web research.

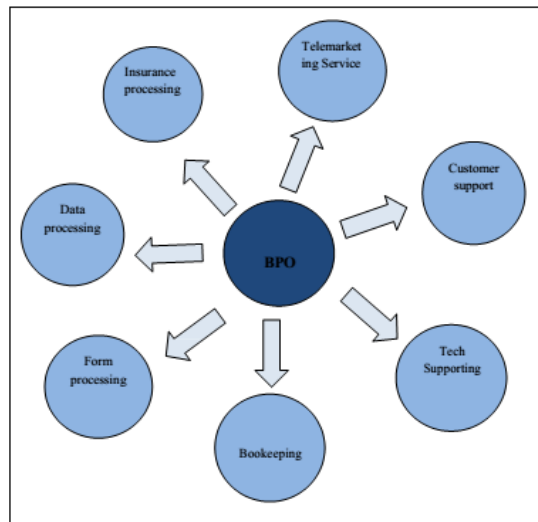
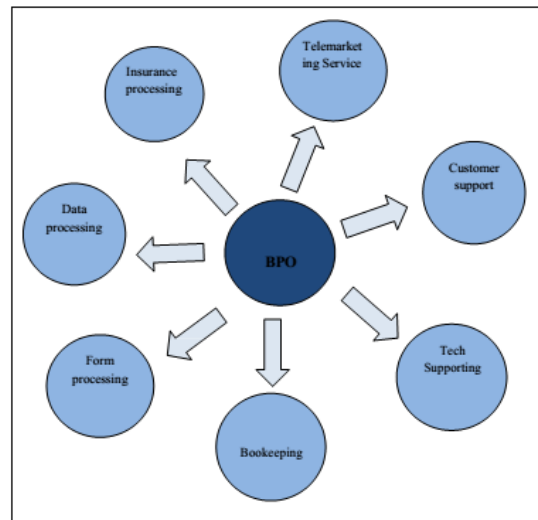


Figure 2.4. Different functions of BPO

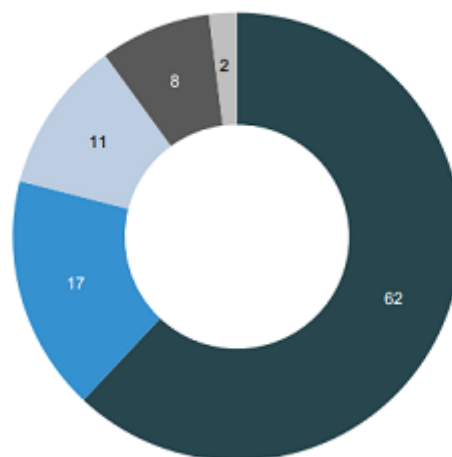


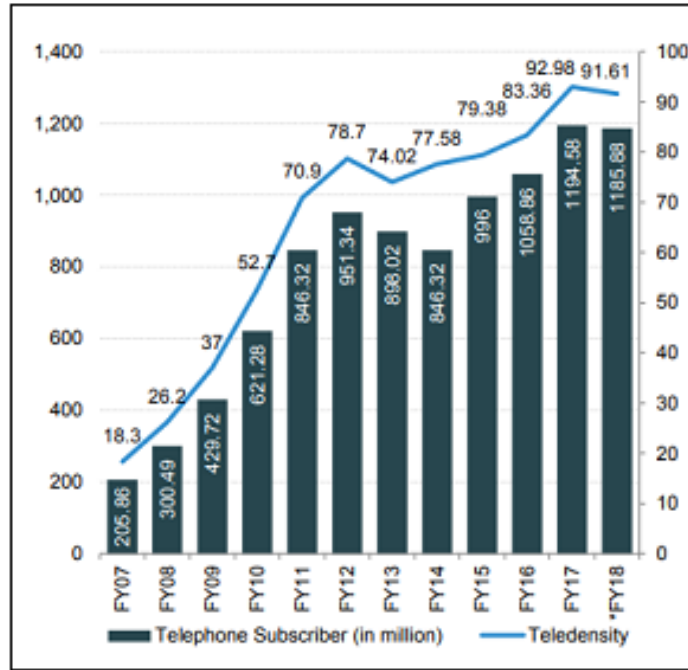
Figure 2.5. Geographical distribution of BPO sectors [186]

US has traditionally been the biggest importer of Indian IT exports; over 62 per cent of Indian IT-BPM exports were absorbed by the US during FY18. Non US-UK countries accounted for just 21 per cent of total Indian IT-BPM exports during FY18. As of FY18, US and UK are the leading customer markets with a combined share of nearly 80 per cent. However, there is growing demand from APAC, Latin America and Middle East Asia. Being the low cost exporter of IT services, India is going to attract more markets in other regions in the same manner it tapped US markets.

2.4.4. TELECOMMUNICATION

India is currently the world's second largest telecommunications market and has registered strong growth in the past few decades [188]. The Indian mobile economy is growing rapidly and will contribute substantially to its GDP. Indian government's liberal policies have been instrumental in this growth besides customer demands for abrupt growth of the Indian Telecom sector. The government telecom equipment easily available at affordable prices for consumers. The Indian telecom sector has emerged as one of the critical components of economic growth required for overall socio- economic development of the country as there is a positive correlation between the penetration of mobile services and internet on the growth of GDP. According to Ernest and Young [189], Indian telecom is an economic miracle in the making because it is connecting more than a billion people together. The development of Indian telecom sector has experienced a major process of transformation in terms of growth, technological content and market structure which is introduced by the government of India [190].

Indian telecom sector's revenue grew at a CAGR of 7.31 per cent from US\$ 19.6 billion in FY06 to US\$ 42.6 billion in FY17. During the first half of FY18, gross revenues of telecom sector in India reached US\$ 20.4 billion. Revenues from the telecom equipment are expected to grow to US\$ 26.38 billion by 2020. As per Union Budget 2018-19, Government of India is expecting a 58 per cent increase to Rs 48,661.42 crore (US\$ 7.52 billion) in telecom sector revenue



Growth in total subscribers traffic

Source: Telecom Regulatory Authority of India

Figure 2.6. Telecommunication sector growth [191]

India is currently the 2nd largest telecommunication market and has the 3rd highest number of internet users in the world. India's telephone subscriber base expanded at a CAGR of 19.22 per cent, reaching 1,194.58 million during FY07–17. Tele-density (defined as the number of telephone connections for every 100 individuals) in India, increased from 17.9 per cent in FY07 to 91.61 per cent in FY18.

2.5. RESEARCH GAP

It is apparent from the literature that ICT industry make serious penetration with TQM and IT. There is evidence that IT will improve the impact of TQM in the business organization. Extensive literature review in the present study has identified and also addressed those gaps. TQM and IT together gained competitively and provided a lead for future research work, identifying gaps in the existing literature. There are many studies discussed on TQM in different areas, but little work was noticed on exploring a relationship between TQM and IT. Siam et al., [148] identify which TQM and IT factors support TQM in order to fulfill the role of IT in executing

TQM. Also, Dewhurst et al., [51] investigated the relationship between how TQM and IT affect the organization. On the other hand, Perez Arostegui et al., [144] suggests that IT competence is composed of IT infrastructure, IT technical and managerial knowledge integration of IT strategy with firm strategy and quality performance.

2.6 SUMMARY

This chapter presents the background to main problem of the research and how to understand the TQM and IT framework, importance and their competitive limitations available in various published studies. The present literature review classified into different categories of overview on TQM, overview on TQM and IT which is covered by different research approaches, tools and techniques, research type and region. It covers history of ICT industry and their role of ICT in Indian growth, an overview of the ICT industry of various sector, information technology, software development, business process outsourcing and telecommunication. It also represents a comprehensive literature review on TQM & IT in ICT industry of India. At the end, research gaps are identified on the basis of the current study.

This literature review has also provided knowledge on various concepts and structural relationships between them. Moreover, the review must help in providing insight into the research philosophy and methodology, execution of TQM facilitators & IT resources - An analysis.

CHAPTER – III

NAMING THE TQM FACILITATORS & IT RESOURCES

3.1. INTRODUCTION

There are several studies that have been conducted by different researchers on TQM and IT. IT could be and already used for enhancing quality management. In most organizations, TQM has been executed by using IT. IT, critical success factors determines the influence of TQM on organizational performance. Competitive environment of the market enhancing the contribution of quality in the world of business. Greater competition increases business pressure and integrates businesses into a new market. Market challenges and pressures emphasis on quality improvement with the objective of survival for long term. By introducing technology in TQM the quality of performance enhances. IT has a positive impact on operational and quality performance of the organization [1]. TQM is a management philosophy that intends to continuously improve customer satisfaction and organizational objectives. There are many definitions of TQM and IT given by different authors [22]. Mjema et al., [63] say that innovation of IT in TQM has been taking part in the enhancement of quality awareness, product quality and reduction of quality cost. Brah and Lim [43] emphasize that association of TQM and IT plays an important role in improving the performance of quality management. Also, Douglas and Judge [59] say that TQM relies upon IT; that facilitates communication and the execution of advanced tools, system and modelling techniques. Ang et al., [99] say that IT is a highly developed instrument for understanding and supporting quality management. Further, Talib et al., [1] developed an instrument for measuring the key practices of total quality management in ICT industry which could help the quality managers in understanding the major TQM practices as well measuring the quality performance in the industry.

The overall summarization of all author's definitions state that application of IT will enhance the operational task of quality management and increase quality output. IT is just a tool for performing several tasks faster and cheaper. Top management initiatives can streamline procedures to make information more accessible by reducing costs and responding to the customer needs without wasting any time. IT

resources can be fruitful in TQM facilitators for improving quality of products to the customers.

It is also require, understanding the TQM facilitators and IT resources execution in the ICT organization. Wali et al., [158] state that the needs for TQM facilitators in ICT industry become highly relevant. According to Hsu and Su [110] quality management facilitators studied in the ICT organization and extracted poor training of staff's and weak supplier management, improving the performance of the organization. A significant number of TQM and IT studies have been done in the ICT [42;105;135] which resulted in increase in the efficiency and effectiveness of the organization. Recently ICT have become critical components in various service industry such as the banking, education etc.

Goal of this chapter is to naming the TQM facilitators & IT resources for the benefits of researchers in industries. The results of this study will help researchers to choose TQM facilitators and IT resources for developing a framework/model. Furthermore, this scrutiny investigates the solution to the problem faced by researchers as to which facilitators and resources are more useful for developing a theoretical model. In the present study, the researcher discussed the TQM facilitators and IT resources in the organization. Then provides the objective and methodology of this study and in the next section applied the frequency of occurrences on the TQM facilitators and IT resource.

3.2. OBJECTIVES AND METHODOLOGY OF RESEARCH

Briefly Study objectives of this chapter, what is to be acquired by the research. This study is considered because of important studies of TQM facilitators and IT resources. This paper is two-fold as follows:

- To observe TQM facilitators and IT resources from the previous studies on them.
- To apply frequency of occurrence method on the TQM facilitators and IT resources to help researchers find which facilitators and resources are frequently used by the ICT industry and have a greater effect on it.

Research Methodology is a set of scientific process which is guides researchers as to what steps need to be taken to meet the research objectives. The literature review was

employed in this study and focused on TQM facilitators in the IT industries. Several papers have been published on TQM facilitators, but this study identifies those research papers published in between 2000 and 2016. In the previous study Karuppusami and Gandhinathan [197] and Talib et al, [15] considered TQM facilitators as TQM CSFs, TQM dimensions and quality practices. The online databases were searched greatly to recognise research papers in the refereed journals. This survey has been observed to recognise articles published in peer referred journals and online database such as ProQuest, Infilbnet, EBSCOHOST and many more. These databases identify 116 TQM and IT studies on facilitators chosen for further study. Secondly, a frequency of occurrences is used as a methodological tool, where factors were analyzed and sorted in descending order, according to their use in the study.

3.3. TQM FACILITATORS IN INDIAN INDUSTRY

ICT industry makes a fast change in the development of technological services. Industries picture reflect that past two decades, ICT industry has been one of the fastest growing businesses. In many countries of world, ICT has got highest priority area and actively pursuing success in the global market. The effect of adopting ICT and its application on the Quality Management has received unique attention from researchers and practitioners. Positive effect of ICT on business performance has been seen not only in terms of market value, market share, profitability and productivity, but additionally in intermediate measures of performance like service quality, process efficiency, organizational and process flexibility, cost savings and customer satisfaction (CS) [7]. ICT adoption has drastically changed information methods, sales and communication (Wang et al, [173]), thus enabling firms to realize strong competitive advantage in the production and other areas. ICT usage and ways of increasing the positive effect of ICT on performance of firm [174].

Tsang and Antony [42] examined the facilitators of TQM in ICT industry, six facilitators are explored in this study, top management commitment and support, customer focus, training and development, teamwork, continuous improvement, supplier partnership and culture change. Khanam et al., [54] also examined nine TQM facilitators and 8 IT resources in ICT industry. This study will help equip quality

experts and managers in TQM execution in a more effective and fruitful way in ICT industry.

Brah and Lim [43] explored TQM facilitators- top management leadership, strategic planning, process management, information system and analysis, human resource management, quality focus and customer focus in IT sector, seeking to set up the relationship among quality management practices, technology and performances of the logistics companies. Siddiqui and Rahman [56] investigated the TQM-IS (Information System) relationship and surveyed the 5 TQM facilitators- top management commitment, customer centric advancement, benchmarking, relentless improvement and strengthening the base. These facilitators investigate the fulfillment of pragmatic goal through the establishment of IS in TQM.

Many software companies facing difficulties from financial setbacks therefore, they are trying to low investment and control the cost. Quality of software gets more attention by the concept of TQM. The need of quality management becomes highly relevant in software projects (Wali et al., [158]). Many software advancement enterprises apply philosophy of TQM for improving the software quality and to enhance their efficiencies of development [192].

Hsu and Su [110] recognises the TQM facilitator in 39 telecommunication industry in Taiwan. This study observed the facilitator's human resource development, quality leadership and quality information, turns to the customer satisfaction improvement and business. The below Table 3.1 shows different studies on TQM facilitators in the ICT organization.

Table 3.1. Some selected studies on TQM facilitators in the ICT industry

TQM Facilitators									
Authors	TMCS	CS	EMPW	TEI	CI	CT	TW	CC	DMS
Ang <i>et al.</i> , [99]	✓	✓							
Hsu & Su [110]	✓		✓	✓					
Stylianou & Kumar [198]	✓	✓				✓	✓	✓	
Sanchez-Rodriguez <i>et al.</i> , [52]	✓	✓	✓						
Brah & Lim [43]	✓	✓							

Sanchez- Rodriguez & Martinez- Lorente [53]		✓							
Khan [135]	✓	✓	✓	✓	✓		✓		
Wai <i>et al.</i> , [199]	✓	✓			✓				
Talib <i>et al.</i> , [200]	✓	✓	✓	✓	✓	✓	✓	✓	
Valmohmmadi [201]	✓	✓	✓	✓		✓			
Dewhurst <i>et al.</i> , [51]	✓		✓	✓	✓				✓
Gustaffson <i>et al.</i> , [193]	✓	✓			✓				
Siam <i>et al.</i> , [148]	✓	✓			✓				
Jain [202]		✓	✓				✓	✓	
Hoang <i>et al.</i> , [203]	✓	✓	✓	✓		✓	✓	✓	
Teh Pei-Lee <i>et al.</i> , [204]	✓	✓							✓
Lee <i>et al.</i> , [27]	✓	✓							✓
Sureshchandar <i>et al.</i> , [205]	✓				✓	✓		✓	✓
Kaynak [60]	✓		✓	✓		V			✓
Ooi <i>et al.</i> , [206]		✓					✓		✓
Hemsworth <i>et al.</i> , [121]	✓						✓	✓	
Issac <i>et al.</i> , [159]	✓	✓	✓	✓	✓			✓	
Claver & Tari [207]	✓	✓			✓	✓		✓	
Talib & Rahman [15]	✓	✓	✓	✓	✓	✓	✓	✓	
Dale <i>et al.</i> , [208]	✓	✓	✓	✓					
Harrington <i>et al.</i> , [209]	✓	✓	✓	✓	✓		✓		
Behara & Gundersen [210]	✓				✓				
Sadikoglu & Zehir [211]	✓		✓	✓			✓		
Samat <i>et al.</i> , [212]	✓	✓	✓	✓	✓	✓			
Rahman & Siddiqui [87]	✓	✓			✓	✓			

3.4.IT RESOURCES IN INDIAN INDUSTRY

IT resources are considered like vehicles for process improvement in the company. Resources retrieve and transfer more accurate information, improve communication links and facilitate execution of TQM. The use of resources also brings competitive posture in the industry. IT resources are used as specially used for accessing and growing quality management. From different studies by different researchers it is demonstrated that IT resources are ever-increasing elements for TQM and result in increasing the impact of IT on TQM (Ang et al. [99]; Dewhurst et al., [51]). Technology gives better integration of supply chain in the industry.

Johnson et al., [213] found that EDI resource is an application that allows sharing data and information flow with customer and supplier electronically rather than manually. CAD systems are widely used resources to facilitate communication and provide pattern analysis between designers. CAD system can be conveniently redeveloped as design clients and linked together by the server with information exchange and collaboration, coordination functionalities [214]. Jiang and Chiu [215] explored CAM technology that can be applied for statistical process control. It is ideal technology for understanding the relation between IT and Product Process Management (PPM) [53]. It also facilitates the communication between designers. ERP technology is to handle production planning and control for uncertain customer demand. ERP plays a key role in today's enterprise management and is beginning to be the backbone of organizations [216]. Culler and Burd [217] emphasized that resource CAPP includes cost saving reduction in process planning effort, standardize the work practices, saves material and tools. For the successful execution of TQM, CAPP uses software programs and optimization techniques [218]. Shuai et al., [219] found resources CAE reduces the exploitation periods of products and has been more and more broadly introduced into design and manufacturing. Software packages for social science resource were used by many market researchers, survey companies, government, education researchers, marketing organizations, and others. It is particularly well suited procedure for factor analysis and is very popular among social scientists [220]. Prajogo and Sohal [221] employed the SEM approach to examine the multi dimensionality of TQM in association with organizational performance. SEM helps gain insight into the interaction and association among the different facilitators of the conceptual model. There are selected studies on IT resources shown in the Table 3.2. Moreover, based on the above discussions of TQM facilitators and IT resources

identified by many authors are shown in the Table 3.3 & 3.4. In the different studies, researchers found facilitators and resources are used for various purposes sometimes having another name also for example dimensions, critical success factors extra.

Table 3.2. Some selected studies on IT resources in the ICT industry.

Authors	IT Resources							
	EDI	CAD	CAM	ERP	CAPP	CAE	SPSS	SEM
Ang <i>et al.</i> , [99]					✓			
Hsu & Su [110]	✓						✓	
Stylianou & Kumar [198]	✓	✓	✓					
Sanchez-Rodriguez <i>et al.</i> , [53]	✓	✓	✓	✓	✓	✓		✓
Brah & Lim [43]	✓				✓			
Sanchez- Rodriguez & Martinez- Lorente [51]	✓	✓	✓	✓		✓		
Khan [135]	✓							
Wai <i>et al.</i> , [199]		✓	✓	✓	✓			
Talib <i>et al.</i> , [200]							✓	
Valmohmmadi [201]		✓	✓				✓	
Martinez- Lorente <i>et al.</i> , [100]	✓	✓	✓	✓	✓	✓		
Dewhurst <i>et al.</i> , [51]	✓	✓	✓	✓				
Gustaffson <i>et al.</i> , [193]						✓		✓
Perez- Arostegui <i>et al.</i> , [222]	✓			✓			✓	
Kaynak & Hartley [223]	✓	✓	✓			✓		
Agus <i>et al.</i> , [84]	✓				✓			
Grover <i>et al.</i> , [224]		✓	✓	✓				
Hemsworth <i>et al.</i> , [121]	✓	✓	✓	✓		✓		
Sit <i>et al.</i> , [133]	✓	✓	✓	✓	✓		✓	
Sadikoglu & Zehir [211]	✓			✓				
Jafari <i>et al.</i> [225]				✓				
Lucchetti & Sterlocchini [226]	✓	✓	✓					

Table 3.3. Several studies on TQM facilitators

	TQM Facilitators	Symbols	References
1.	Top Management Commitment & Support (Leadership, management commitment, role of top management, Genuine top management commitment)	TMCS	Ugboro & Obeng [227], Lee <i>et al.</i> , [228], Li <i>et al.</i> , [101], Sureshchander <i>et al.</i> , [229][205], Ahire & Ravichandran [230], Flynn & Saladin [231], Kaynak [60], Siakas & Georgidau [232], Sadikoglu & Zehir [211], Talib <i>et al.</i> , [76;2;233], Talib & Rahman [15], Mustafa & Boon [234], Oruma <i>et al.</i> , [235], Sadikoglu & Olcay [236], Shahin & Dabestani [237], Fening <i>et al.</i> , [238], Arshida & Agil [239], Irfan & Knee [240], Siddiqui & Rahman [56] Glowalla & Sunyaev [241]
2.	Customer Satisfaction (Customer focus, Customer orientation, Service culture, Customer cooperation's, Customer satisfaction orientation, Customer citizenship, Closer customer relationship, Customer perception of quality, Customer resources, Customer driven quality)	CS	Zairi [242], Ugboro & Obeng [227], Lagrosen [243], Adam <i>et al.</i> , [244], Zhang [245], Li <i>et al.</i> , [101], Dimitriades [246], Phusavat <i>et al.</i> , [247], Siddiqui & Rahman [56], Sanchez- Rodriguez <i>et al.</i> , [53], Piskar [248], Mahmoodifar <i>et al.</i> , [249], Mehra & Ranganathan [250], Manu [251], Nagaprasada & Yogesha [21], Sadikoglu & Olcay [236], Makkar [252], Shahin & Dabestani [237], Wali <i>et al.</i> , [253]
3.	Empowerment (Employee fulfilment, Employee satisfaction, Employee suggestion, Employee attitude and behaviour, Employee focus, Worker empowerment, Employee relations, Decision making, Proper recognition, Time based evaluation, Quality based incentive, Reward)	EMPW	Page & Curry [254], Gale [255], Truss [256], Harrington <i>et al.</i> , [209], Karia & Assari [257], Jun <i>et al.</i> , [258], Ooi <i>et al.</i> , [206], Ooi <i>et al.</i> , [259], Fening <i>et al.</i> , [238], Arshida & Agil [239], Thamizhmanii & Hasan [260], Gonzalez <i>et al.</i> , [261], Ugboro & Obeng [227], Badiger & Laxman [262], Chandra [263], Shahin & Dabestani [237], Gul <i>et al.</i> , [264], Mandava & Bach [265], Wali <i>et al.</i> , [253]
4.	Total Employee Involvement (Continuous involvement, Open communication, Employee and management involvement, Visionary leadership, Group meeting)	TEI	Deming [266], Taylor & Wright [267], Daily & Bishop [268], Prajogo & Cooper [269], Talib <i>et al.</i> , [220], Sadikoglu & Zehir [211], Ooi <i>et al.</i> , [270], Wali <i>et al.</i> , [253], Matlhape & Lessing [271], Welikala & Sohal [272], Velury [273], Sharma <i>et al.</i> , [138], Luburic [89], Denham Lincon <i>et al.</i> , [274], Kaur [275], Jain [202], Gharakhani <i>et al.</i> , [276], Sila & Ebrahimpour [277]

5.	Continuous Training (Education and training, Learning, Knowledge and education, Training development, Employee training, Worker empowerment, Visionary leadership)	CT	Goetsch & Davis [278], Hirotsu [279], Talib et al., [1], Vermeulen & Crous [280], Goh [281], Talib & Rahma [15], Sadikoglu & Olcay [236], Shahin & Dabestani [273], Wali et al., [253], Gul et al., [264], Sila & Ebrahimpour [277]
6.	Continuous improvement (Technology utilization, Continuous innovation, Important innovation, Motivation and job design, Causes of quality variations, Influence of other programs)	CI	Goetsch & Davis [278], Walsh et al., [282], Goyal & Islam [283], Talib et al., [1], Ahmed [284], Harrington et al., [209], Wali et al., [253], Sharma et al., [138], Sadikoglu & Zehir [285], Luburic [89], Plura [286], Ibrahim [287], Irani et al., [288], Jung & Wang [289], Khan [135], Sila & Ebrahimpour [277]
7.	Teamwork (A group of employees, Cross functional coordination, Employee collaboration, Small group of employees)	TW	Tsang & Antony [42], Molina & Colleagues [290], Rezgui [291], Cabrera & Cabrera [292], Rungtusanatham [293], Kossek & Block [294], Vouzas & Psychogios [295], Wali et al., [253], Irani et al., [288], Hoonakker et al., [296], Sofijanov et al., [297], Sila & Ebrahimpour [277], Daily & Bishop
8.	Culture Change (A TQM culture Service culture, behavioral factors, TQ and measurement, Familiar with TQM, Business culture)	CC	Guangming et al., [298], Detert et al., [299], Corbett & Rastrick [300], Yusof & Ali [301], Claver et al., [207], Sila & Ebrahimpour [302], Lagrosen [243], Bose [303], Kujala & Lillrank [304], Gallea & Ghabadian [305], Hoogervorst et al., [306], Prajogo & McDermott [307], Anwar & Jabnoun [308], Ooi et al., [206], Jung et al., [309], Jancikova & Brychta [310], Baird et al., [311], Ooi et al., [312], Sharma et al., [138]
9.	Democratic Management Style (Organizational goal, Growth satisfaction, Organization culture, Personal management, The organization as a Total system)	DMS	Kanji & Wallace [313], Vouzas & Psychogios [295], Talib et al., [76], Love et al., [314], Hellesten & Klefsjo [315], Issac et al., [159], Dewhurst et al., [51], Ooi et al., [206], Oriaku [316], Mansor et al., [317], Abbas [318], Parumasur & Govender [319]

Table 3.4. Several studies on IT resources

	IT Resources	Symbols	References
1.	Electronic Data Interchange	EDI	Cripps <i>et al.</i> , [320], Lee & Hong [321], Morris <i>et al.</i> , [322], Johnson <i>et al.</i> , [231], Sanchez-Rodriguez <i>et al.</i> , [53], Martin & Andy [323], Pawar & Driva [324], Perez- Arostegui <i>et al.</i> , [16]
2.	Computer Aided Design	CAD	Dewhurst <i>et al.</i> , [51], Sanchez-Rodriguez <i>et al.</i> , [53], Jiang & Chiu [215], Manas <i>et al.</i> , [325], Jin- Hai <i>et al.</i> , [326], Toussaint & Cheng [327], Bajgoric [328]
3.	Computer Aided Manufacturing	CAM	Dewhurst <i>et al.</i> , [50], Sanchez-Rodriguez <i>et al.</i> , [51], Jiang & Chiu [215], Manas <i>et al.</i> , [325], Jin- Hai <i>et al.</i> , [326], Toussaint & Cheng [327], Bajgoric [328]
4.	Enterprise Resource Planning	ERP	Rao [329], O' Leary [330], Jacobs & Whybark [331], Lee & Hong [321], Gupta & Kohli [332], Foster & Ogden [333]
5.	Computer Aided Process Planning	CAPP	Al-Aomar <i>et al.</i> , [334], Yuen <i>et al.</i> , [218], Culler & Burd [335], Cecil & Rodriguez [336], Shaw [337]
6.	Computer Aided Engineering	CAE	Shuai <i>et al.</i> , [219], Martinez-Lorente <i>et al.</i> , [100], Parzinger & Nath [192], Ahmed & Hassan [338], Das <i>et al.</i> , [25], Huang <i>et al.</i> , [339]
7.	Statistical Packages for Social Sciences	SPSS	Miyagawa <i>et al.</i> , [340], Siam <i>et al.</i> , [148], Wai <i>et al.</i> , [199], Behara <i>et al.</i> , [210], Khan [135], Shams- Ur-Rahman [341]
8.	Structural Equation Modelling	SEM	Zakuan <i>et al.</i> , [342], Rohani <i>et al.</i> , [343], Prajogo & Sohal [344], Sanchez-Rodriguez <i>et al.</i> , [53], Lei & Wu [345]

3.5 SUMMARY

The finding of this chapter is review TQM facilitators and IT resources by different authors. This study was conducted in different ICT organizations and explored facilitator and resources. This study is suggesting that which TQM facilitators and IT resources were highly supporting the ICT industry. The extensive literature explored a total of 66 TQM facilitators and eight IT resources for successfully execute the TQM and IT program in the ICT organization. The study named 17 major factors from those nine facilitators and eight resources. These 9 TQM facilitators and 8 IT resources were frequently used by different researcher in their studies named as: Top management commitment & support (TMCS), Customer Satisfaction (CS), Empowerment (EMPW), Total employee involvement (TEI), Teamwork (TW),

Culture Change (CC), Democratic Management Style (DMS), Electronic Data Interchange (EDI), Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Enterprise Resource Planning (ERP), Computer Aided Process Planning (CAPP), Computer Aided Engineering (CAE), Statistical Packages for Social Science (SPSS) and Structural Equation Modelling (SEM).

CHAPTER – IV

GRADING AND CATEGORIZING OF TQM FACILITATORS AND IT RESOURCES

4.1. INTRODUCTION

Due to emergence of new products and improved management, Total Quality Management has become the buzz word in the management practices and it has grown competition in the world of business. Organizations that wanted to enhance the business optimization process improvement, operations engineering and waste reduction are passed over to acquire the TQM. Many researchers have identified TQM as a origin of competitive advantage for business organization to build up the strength of the organization [54; 346]. Aim of TQM is to achieve the effective system with respect to design, planning, production, customer satisfaction and quality tools and techniques [347]. It is just not a management philosophy but a culture of an organization committed to total customer satisfaction through CQI (Continuous Quality Improvement Programs) [76; 296].

Information Technology is introduced with Total Quality Management to provide product and services with much better way. IT is substantially executed with TQM in most of the company for enhancing the role of quality in the business world. IT is acting as a feedback mechanism and smooth communication and the execution of advanced tools, systems and modelling techniques. TQM acts as facilitators, adapt the quality principles and practices while IT provides suitable resources for successful execution the TQM program by many applications like design, development, execution, communication, support or management of computer-based information systems. Bessen [13] told that IT investment with TQM will increase the productivity and reduced the cost. When TQM and IT are applied together; they have the potentiality for supporting an organization for attaining new levels of competitive strength [1]. A different study reflected that IT and TQM improved financial and operations performance [348; 349]. The organization faces many challenges such as recession, global competition, competitive pressure and regulatory changes. So researchers applied TQM and IT combined way that facilitates the internal

information transfer within the company and also the management of external customers and business partners.

Facilitators and resources together have given birth to a new requirement, which is to successfully amalgamate TQM and IT in any organization [22]. No study has been found using ISM (Interpretive Structural Modeling) approach on TQM and IT facilitators; so this is considered as the first study in this direction. Use of the ISM approach on TQM facilitators and IT resources, is taken from ICT organization (Khanam et al., [54]) makes a conceptual framework which can be applied to understand the relationships between them in the ICT organization. TQM execution is often unsuccessful in organizations for a different focus on key variables of TQM without knowing their driving and dependence power and their inter-relationship between the variables [350]. This study will support for understanding the TQM facilitators and IT resources with respect to their interdependence and their driving and dependence power with the support of MICMAC analysis.

- To name and grade TQM facilitators and IT resources in the ICT industry.
- To find out the contextual relationship among named TQM facilitators and IT resources by using the ISM approach.
- To categorize the naming of TQM facilitators and IT resources by using MICMAC analysis.

4.2. TYPES OF TQM FACILITATORS

Facilitators are defined as one that enables another to achieve an end, where “enables” implies to make able or give power, competency or ability. So facilitator is considered as a variable that gives the ability to maintain the sustainability in TQM and IT. Talib *et al.*, [22] studied 17 TQM facilitators and provides a rich contribution towards TQM theory. This study can help business managers and quality practitioners in a better understanding of TQM, service systems concept as well as TQM execution in the service sector. Siddiqui and Rahman [56] explored five facilitators in IT/IS (Information System) and gave description of a study conducted in Indian companies for evaluating the role of TQM is pragmatically realizing organizational goals to the IS. Parzinger and Nath [192] identified 8 TQM facilitators in the software company

and examined empirically the linkage between TQM execution and software quality. Khanam *et al.*, [54] explored 9 TQM facilitators and 8 IT resources which help managers in smoother execution of TQM and IT in ICT industry. These facilitators are discussed as follows:

- *Top Management Commitment and Support (TMCS)*: *Top management acts as the main driver for TQM and creates an environment that ensures its success. Top management is responsible for each and every activity at all levels of the organization [351]. It must enable creativity to be nurtured and accordingly chalk out the strategy. It must also provide initiative and resource support. Commitment of top management is also highlighted as a critical factor by several empirical studies [246; 76; 2; 234; 14].*
- *Customer Satisfaction (CS)*: *The goal of this facilitator is to identify and then meet the need of the customer. TQM facilitator customer satisfaction is considered as the major success of quality management efforts [243; 352]. CS can be considered as the degree of organization which continuously fulfills the customer needs and expectation to enhance their performance [246]. According to Vouzas and Psychogios [296] customer satisfaction influence the organization to improve the performance of the organization.*
- *Empowerment (EMPW)*: *TQM philosophy is empowering all employees to seek out quality problems and correct them. Employee empowerment is focused to strengthen the employee's self-efficacy accomplishing the task [228]. Employee's contributions are highly valued, and their suggestions are executed in order to perform the function of organization. Empowerment gives extensive training and quality measurement tools among organizations to increase the competition in organizations.*
- *Total Employee Involvement (TEI)*: *All employees participate in working toward common goals. Companies should utilize all employees' skills and abilities. Total employee involvement in the decision making process, quality improvement process and policy making issues [211; 353]. Employee involvement gives a better understanding of the importance of the product quality in employees and makes them committed to the quality improvement.*
- *Continuous Improvement (CI)*: *A major driver of TQM is continuous process*

improvement. Continuous improvement is achieved by satisfying the customer through the product design and services. It is important for a company to be both analytical and creative in finding ways to be more competitive and more effective to meet stakeholder expectations. Jugersen [354] investigated that continuous improvement, enhance the success of products and services.

- *Continuous Training (CT)*: Employee's get regular training on the methods and concepts of quality which is based on total quality management's vision, hence it is essential before the detailed design phase [355]. It is important requirement for the successful execution of TQM and be viewed as a process which is continuous in nature. Training helps employee's at all organizational levels to understand the quality management system and their roles and responsibilities within the system [42].
- *Teamwork (TW)*: Teamwork is important factor of TQM, involve the organization of cross-functional teams within the company. Team approach helps employees in knowledge sharing, problem identification and opportunities available to the organization. Teamwork allows employees belong to all levels to be more involved in the job and to work together company-wide [356] and arrangement is changed continually to meet new objectives and respond to new management fads and fashions.
- *Culture Change (CC)*: The culture of the company should aim at developing the employee's ability to work together to improve quality. Mohamed and Yuan Jian [357] identified that culture will affect people's belief in the execution of TQM. Culture change is capable of supporting TQM execution when it is needed. Culture shows the organizational behavior and same creates an environment where people can help each other and achieve their goals [1].
- *Democratic Management Style (DMS)*: Democratic management is known as style where manager lets participate employees in the process of decision making, in the business. This style helps in the decision making by the majority of the people. Through this manager and employees interact and communicate with each other. Management style successfully executes the organizational change and covers organizational goal, culture and growth, satisfaction of the organizations [234; 159; 353].

4.3 TYPES OF IT RESOURCES

Resources are services, materials, or other assets that are converted to create benefits and, in the process, may be consumed or made unavailable. IT resource is a owned technical recruiting and consulting firm focused on the IT industry. IT resources are virtual or physical component of limited availability within the organizations. There are different types of resources applied by authors and IT resources are ever increasing elements of TQM and result in the impact of IT on TQM [99; 51].

- *Electronic Data Interchange (EDI)*: EDI is a set of standards that define common formats for the information so it can be exchanged in this way. EDI is growing rapidly and shows better performance in the transaction function. It allows sending data and information flow with customer and supplier electronically rather than manually [213; 324]. Many researchers have found that, EDI will have an effect on economic and business enterprises by enhancing the significance of the information system and operational link between the organizations.
- *Computer Aided Design (CAD)*: CAD system is used by the computer system to assist in the creation, modification, analysis or optimization of a design. This resource is used to increase the productivity of the designer, improve the quality of design and improve communication through the design [358]. It is formally redeveloped the model as design clients' requirements and linked together by exchange information, collaboration and coordination facilities. It is the most appropriate resource used to understand the relationship between IT and product process management among the suppliers [53].
- *Computer Aided Manufacturing (CAM)*: CAM system strongly influencing the manufacturing organization by transferring data, information and knowledge in the organizations [328; 327]. It is the most appropriate resource used to understand the relationship between IT and product process management among the suppliers [53]. CAM is used to plan, manage and control the operation of businesses involved in the manufacturing of engineered products.
- *Enterprises Resources Planning (ERP)*: It is business management software and a vital organizational tool because it integrates various organizational systems and facilitates an error-free transaction and production. ERP can be used not only in

manufacturing companies, but in any company that wants to enhance competitiveness more effectively using all its assets, including information [359]. Schniederjans and Kim [360] reveal that both TQM and ERP system have a significant impact over business performance successfulness.

- *Computer Aided Process Planning (CAPP)*: CAPP is computer technology which assists in the planning process of a product. The CAPP system plays a key role to integrate the design and manufacturing or assemble systems properly considering available resources and design constraints [361]. CAPP has various jobs including cost savings, reduction in process planning effort, standardization of work practices and saving direct labor, material, scrap and tooling [217]. CAPP is the link between CAD and CAM in a way that it provides planning of the process to be used in producing a designed part.
- *Computer Aided Engineering (CAE)*: CAE is the broad use of computer software to aid in engineering analysis task. CAE is used as a tool to shorten the exploitation periods of products and has been more and more broadly introduced into the design and manufacturing while investigating TQM and CAE [338; 100; 192]. Earlier CAE is used in the design stage for the cost as well as time effectiveness.
- *Statistical Packages for Social Sciences (SPSS)*: SPSS is among the most widely used programs for statistical analysis in social science. SPSS is used in calculating wide variety of statistics, managing and analysis of collected data [210; 135; 148]. It is a comprehensive and flexible statistical analysis and data management solution. Furthermore, SPSS can take data from almost any type of file and use them to generate tabulated reports, charts, and plots of distributions and trends, descriptive statistics, and conduct complex statistical analyses.
- *Structural Equation Modelling (SEM)*: SEM is a statistical technique for testing and estimating causal relations using a combination of statistical data and qualitative causal assumptions. Structural equation models (SEMs), also called simultaneous equation models, are multivariate (i.e., Multi equation) regression models. The SEM is used to examine the relationship between TQM and quality performances as well as innovative performance simultaneously [334]. Also, the SEM approach provides insight into current IT and TQM theory and practices on operational and quality

performance [53].

4.4 ISM (INTERPRETIVE STRUCTURAL MODELLING)

ISM is one of the interactive management tools, which is identifying and summarizing the relationship between specific elements. It is used by researchers and practitioners to understand the relationships among various variables. ISM transforms unclear, poorly articulated mental models of a system into a visible well defined hierarchical model [362]. According to Chander *et al.*, [363] ISM is a technique for identifying and depict relationship among parts of an issue or a problem. ISM is operation research approach, an interactive learning process and systematic application of a graphical method which efficiently construct a directed graph and contextual relationship among elements. It represents the information either by direct graph or by a matrix. ISM model portrays the hierarchy of variables, the structure of a complex issue in a system of a field of study. According to Singh and Kant [350] ISM is interpreted as based on judgment of groups and decision whether and how the system's elements are linked. Talib *et al.*, [364] applied an ISM method understanding the mutual relationship between the TQM practices and presents a hierarchy based model of the practices. It is applied to concentrate on understanding the elements involved and to make the subjective relationship between each pair of facilitators.

The ISM's ability to connect with cognitive levels of those involved in complex situations is pronounced and has been recorded. Mostly ISM is used to determine the influence of facilitators or inhibitors on a system as well as to examine their interweaving relationships [365]. Manoharan *et al.*, [366] use ISM methodology for examining the interrelationship between factors and plan to train employees. According to Singh *et al.*, [367] used this technique for the implementation of knowledge management in engineering organizations, while Raj *et al.*, [368] conducted a case study and applied ISM approach for modelling the facilitators of flexible manufacturing system. Besides this Quershi *et al.*, [369] have applied ISM approaches to model logistics outsourcing variables. ISM methodology suggest to understand the interactions of criteria among the supplier selection for the original equipment manufacturing company which works in a build-to-order supply chain environment [370].

In addition, another study Thakkar *et al.*, [371] used ISM as a tool like the cause effect diagram and AHP (Analytic Hierarchy Process) to develop a balanced scorecard using quantitative and qualitative approaches. Jhakaria and Shankar [372] say that ISM is used to inspect information technology to supply chain management. While Faisal *et al.*, [373] used ISM in supply chain mitigation to understand dynamic between various facilitators. Hasan *et al.*, [374] used this technique to establish a relationship among the barriers in agile manufacturing. Sahney *et al.*, [375] proposed a quality framework for the Indian higher education system particularly for administrative staff. ISM approach is also used to model the crucial parameters “facilitators and barriers” of technical education [376]. ISM based methodology is applied to study the interrelationship among the variables and check the performance of the variables in the automotive service center [377]). Above literature review reflects that ISM various features and gives its application in different fields.

4.4.1. ISM METHODOLOGY

This research work carried out an extensive literature review and expert opinion from organization and academia. A total of 21 participants, including 9 quality experts, 7 industrialists from the ICT sector and 5 from academia were consulted. After the end of three brainstorming session a total of 17 variables, including 9 TQM facilitators and 8 IT resources were identified in this paper. ISM methodology is mainly intended as a group learning process, but can also be used individually [370]. The following steps are involved in the ISM techniques [376; 378].

- Step 1. Naming the facilitators/ resources relevant to issues or problem with the help of expert opinion and literature review.
- Step 2. A contextual relationship is established between facilitators/resources and examined pairwise facilitators.
- Step 3. Structural self-interaction matrix (SSIM) is evolved for facilitators/resources and have shown relationship between pairwise facilitators.
- Step 4. Construct reachability matrix (RM) from the SSIM.
- Step 5. After construction of RM partition into different levels.

- Step 6. Revised RM again: make the transitivity relationship between facilitators/resources and obtained the FRM (final reachability matrix).
- Step 7. Based on the FRM developed an ISM model and the transitive links are removed.
- Step 8. Develop ISM digraph
- Step 9: Apply MICMAC analysis on the model.

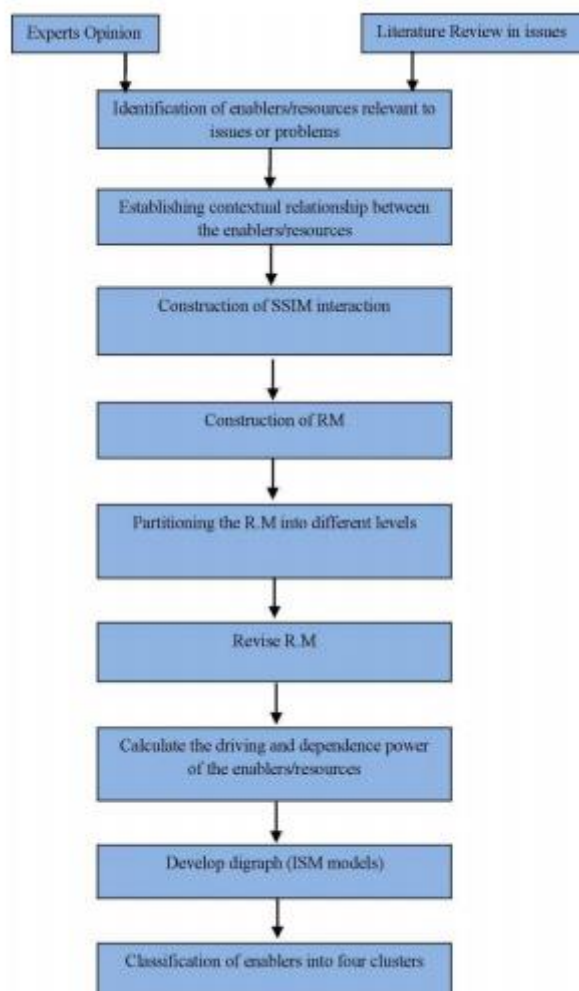


Figure 4.1 Depicts the steps followed in modelling ISM

4.4.1.1. STRUCTURAL SELF-INTERACTION MATRIX (SSIM)

To analyze the contextual relationship between the variables a lead type must be chosen. In other words, a contextual relationship means that one variable lead to

another variable (i and j). To develop SSIM, four symbols are used to represent the relationships between the variables (i and j).

1. V: facilitator/resources i will alleviate facilitator/resources j.
2. A: facilitator/resources j will alleviate facilitator/resources i.
3. X: facilitator/resources i and facilitator/resources j will alleviate each other i.e. relation in both directions.
4. O: facilitator/resources I and facilitator/resources j is unrelated, i.e. no relationship exists between facilitator/resources.

The developed SSIM model is based on the contextual relationships and recognized as 9 TQM facilitators and 8 IT resources from the ICT industry.

- TQM facilitator 1 (Top management commitment and support) helps to lead cell 1 i.e. TQM facilitator 1 (Top management commitment and support). Thus, the relationship between TQM facilitators is represented by Symbol 'V'.
- TQM facilitator 2 (Customer satisfaction) can be achieved by cell TQM facilitator 5 (Continuous improvement). This means that continuous improvement will lead to the customer satisfaction in ICT organization. These relationships are represented by symbols 'A'.
- TQM facilitator 3 (Empowerment) and facilitator 4 & 8 (Total employee involvement and Culture change) can be achieved by each other; it means to change the culture need empowerment and total employee involvement. Similarly, for the employee empowerment need total employee involvement and culture in the organization. Thus, the relationship is represented by the symbol 'X'.
- TQM facilitator 7 (Teamwork) has no relationship with the TQM facilitator 9 (Democratic management style) means 'democratic management style' have no role play in 'teamwork'. Symbol 'O' is represented there is no relationship exist between the facilitator.
- IT resource 7 (statistical package for the social sciences) helps to lead the IT resource 8 (structural equation modeling) meaning SEM will be achieved by SPSS. It

is denoted by symbol ‘V’

- IT resource 1 (electronic data interchange) can be alleviated by other resources meaning all the resources will lead to “electronic data interchange”. Thus the relationship is denoted by the symbol ‘A’.
- IT resource 2 (computer aided design) and IT resource 3 (computer aided manufacturing) can be achieved by each other. Thus the relationship is denoted between them by symbol ‘X’.
- IT resource 4 (enterprise resources planning) have no relationship with the IT resources 8 (structural equation modeling) meaning ‘enterprises resources planning’ can’t be affected by ‘structural equation modeling’. Thus the relationship between the two resources is denoted by ‘O’. The SSIM matrix of TQM facilitators and IT resource shown in the Table 4.1 & 4.2.

Table 4.1: Structural self-interaction matrix (SSIM) of TQM facilitators

SL. No.	TQM Facilitators	9	8	7	6	5	4	3	2
1	Top Management Commitment and Support	V	V	V	V	V	V	V	V
2	Customer Satisfaction	A	A	A	A	A	A	A	-
3	Empowerment	O	X	A	O	V	X	-	
4	Total Employee Involvement	O	X	V	A	V	-		
5	Continuous Improvement	A	A	A	A	-			
6	Continuous Training	O	V	V	-				
7	Teamwork	O	V	-					
8	Culture Change	V	-						
9	Democratic Management Style	-							

Table 4.2. Structural self-interaction matrix (SSIM) of IT resources

S.L. No.	IT Resources	8	7	6	5	4	3	2
1	Electronic Data Interchange	A	A	A	A	A	A	A
2	Computer Aided Design	O	A	X	X	O	X	-
3	Computer Aided Manufacturing	O	A	V	V	O	-	
4	Enterprises Resources Planning	V	A	O	V	-		
5	Computer Aided Process Planning	O	A	V	-			
6	Computer Aided Engineering	O	A	-				
7	Statistical Packages for Social Sciences	V	-					
8	Structural Equation Modelling	-						

4.4.1.2 REACHABILITY MATRIX (RM)

The RM is obtained by conversion of SSIM. The SSIM is into the binary form of various symbols V, A, X and O representing the relationship between facilitators and resources, these symbols are replaced by binary digits (1 and 0) in the SSIM. The given rule has been followed by reachability matrix:

- If the (i, j) entry in the SSIM is V, then the (i, j) entry in the reachability matrix becomes 1 and (j, i) entry becomes 0.
- If the (i, j) entry in the SSIM is A, then the (i, j) entry in the reachability matrix becomes 0 and (j, i) entry becomes 1.
- If the (i, j) entry in the SSIM is X, then the (i, j) entry in the reachability matrix becomes 1 and (j, i) entry becomes 1.
- If the (i, j) entry in the SSIM is O, then the (i, j) entry in the reachability matrix becomes 0 and (j, i) entry becomes 0. The initial reachability matrix below shown in the Table 4.3 & 4.4.

Table 4.3. Initial reachability matrix of TQM facilitators

S.L. No.	TQM Facilitators	1	2	3	4	5	6	7	8	9
1	Top management Commitment and Support	1	1	1	1	1	1	1	1	1
2	Customer Satisfaction	0	1	0	0	0	0	0	0	0
3	Empowerment	0	1	1	1	1	0	0	1	0
4	Total Employee Involvement	0	1	0	1	1	0	1	1	0
5	Continuous Improvement	0	1	0	0	1	0	0	0	0
6	Continuous Training	0	1	0	1	1	1	1	1	0
7	Teamwork	0	1	1	0	1	0	1	1	0
8	Culture Change	0	1	1	1	1	0	0	1	1
9	Democratic Management Style	0	1	0	1	0	0	0	1	1

Table 4.4. Initial reachability matrix of IT resources

S.I. No.	IT Resources	1	2	3	4	5	6	7	8
1	Electronic Data Interchange	1	0	0	0	0	0	0	0
2	Computer Aided Design	1	1	1	0	1	1	0	0
3	Computer Aided Manufacturing	1	1	1	0	1	1	0	0
4	Enterprises Resources Planning	1	0	0	1	1	0	0	1
5	Computer Aided Process Planning	1	0	0	0	1	1	0	0
6	Computer Aided Engineering	1	0	0	0	0	1	0	1
7	Statistical Packages for Social Sciences	1	1	1	1	1	1	1	1
8	Structural Equation Modelling	1	0	0	0	1	1	0	1

In the next step, the final reachability matrix is obtained by incorporating with the transitivity. Transitivity implies a situation in which, if a variable 'a' is related to 'b' and 'b' is related to 'c', then 'a' is related to 'c'. The final reachability matrix is

presented in the Table 7 and 8 were transitivity is marked as 1*. The Tables (4.5 & 4.6) also show the, driving power and dependence along with the grade of the TQM facilitator and IT resources, respectively. The horizontal summation of 1's called driving power and vertical summation of 1's called dependence power. The higher the driving power, higher the grading. In the tables (4.5 & 4.6) facilitator 1 (top management commitment and support) and resource 7 (statistical package for social science) have the maximum driving power are given the first grade. Whereas facilitator 2 (customer satisfaction) and resource 1 (electronic data interchange) having minimum driving power and lowest grade.

Similarly for dependence, facilitator 2 (customer satisfaction) and resource 1 (electronic data interchange) have highest dependency and grade. On the other hand TQM facilitator 1 (top management commitment and support) and resource 7 (statistical package for social science) has a minimum dependency and last grade. These driving powers and dependency will be used in MICMAC analysis. In the MICMAC analysis facilitator and resources will be divided into four clusters named autonomous (cluster 1), dependent/dominant (cluster 2), linkage/relay (cluster 3) and independent/dominant (cluster 4).

4.4.1.3. LEVEL PARTITIONS

According to Warfield [379], reachability set and antecedent set are obtained from the final reachability matrix. The reachability set consists of facilitator/resources itself and other facilitator/resources may help to achieve, whereas antecedent set consist of facilitator/resources itself and other facilitator/resources helps in achieving it. For example, facilitators 3 have reachability set consists of the horizontal entry with 2,3,4,5,8 and antecedent set consist of vertical entry with the 1,3,7,8 (Table 4.7). Then the intersection of reachability and antecedent sets is iterated and levels derived from all the elements. The element for whom the reachability set and intersection set is same the top level element in the ISM hierarchy. Those elements have a top level hierarchy would not lead to achieve any other element above their own level. From the Table 4.7 & 4.8, found that facilitator (customer satisfaction) and resource (electronic data interchange) cited at level I. That means they are positioned at the top of the ISM model. After identifying top level element, one by one it is separated out from other elements. The same process is repeated until the each level of the element

is obtained. The level is driven to build the digraph and the final model of the ISM.

Table 4.5. Final reachability matrix of TQM facilitators

S.I. No.	TQM Facilitators	1	2	3	4	5	6	7	8	9	Driving Power	Grade
1	Top Management Commitment and Support	1	1	1	1	1	1	1	1	1	9	I
2	Customer Satisfaction	0	1	0	0	0	0	0	0	0	1	VII
3	Empowerment	0	1	1	1	1	0	0	1	0	5	IV
4	Total Employee Involvement	0	1	0	1	1	0	1	1	0	5	IV
5	Continuous Improvement	0	1	0	0	1	0	0	0	0	2	VI
6	Continuous Training	0	1	0	1	1	1	1	1	1*	7	III
7	Teamwork	0	1	1	1*	1	1*	1	1	1*	8	II
8	Culture Change	0	1	1	1	1	1*	0	1	1	7	III
9	Democratic Management Style	0	1	0	0	1	0	0	1	1	4	V
10	Dependence Power	1	9	4	6	8	4	4	7	5		
11	Grade	VII	I	IV	VI	II	IV	IV	III	V		

Table 4.6. Final reachability matrix of IT resources

S.I. No.	IT Facilitators	1	2	3	4	5	6	7	8	Driving Power	Grade
1	Electronic Data Interchange	1	0	0	0	0	0	0	0	1	VI
2	Computer Aided Design	1	1	1	0	1	1	0	0	5	II
3	Computer Aided Manufacturing	1	1	1	0	1	1	0	0	5	II
4	Enterprises Resources Planning	1	0	0	1	1	1*	0	0	4	III
5	Computer Aided Process Planning	1	0	0	0	1	1	0	0	3	IV
6	Computer Aided Engineering	1	0	0	0	0	1	0	0	2	V
7	Statistical Packages for Social Sciences	1	1	1	1	1	1	1	1	8	I
8	Structural Equation Modelling	1	0	0	0	0	0	0	1	2	V

9	Dependence Power	8	3	3	2	5	6	1	2		
10	Grade	I	IV	IV	V	III	II	VI	V		

Table 4.7. Partitioned Reachability Matrix at final level VI

SL. No.	Reachability Set	Antecedent Set	Intersection Set	Level
1	1,2,3,4,5,6,7,8,9	1	1	VI
2	2	1,2,3,4,5,6,7,8,9	2	I
3	2,3,4,5,8	1,3,7,8	3,8	IV
4	2,4,5,7,8	1,3,4,6,7,8	4,7,8	IV
5	2,5	1,3,4,5,6,7,8,9	5	II
6	2,4,5,6,7,8,9	1,6,7,8	6,7,8	V
7	2,3,4,5,6,7,8,9	1,4,6,7	4,6,7	V
8	2,3,4,5,6,8,9	1,3,4,6,7,8,9	3,4,6,8,9	V
9	2,5,8,9	1,6,7,8,9	8,9	III

Table 4.8. Partitioned Reachability Matrix at final level VI

S.I. No.	Reachability Set	Antecedent Set	Intersection Set	Level
1	1	1,2,3,4,5,6,7,8	1	I
2	1,2,3,5,6,8	2,3,7	2,3	V
3	1,2,3,5,6,8	2,3,7	2,3	V
4	1,4,5,6,8	4,7	4	IV
5	1,5,6,8	2,3,4,5,7	5	III
6	1,6	2,3,4,5,6,7,8	6	II
7	1,2,3,4,5,6,7,8	7	7	VI
8	1,8	2,3,4,7,8	8	II

On the Table (4.7-4.8), the elements have shown their level along with reachability set, antecedent set and intersection set.

4.4.1.4 FORMATION OF CONICAL FORM MATRIX

Conical matrix is achieved by reachability matrix. Level of elements is obtained by the intersection of reachability and antecedent sets and it can be transformed in lower triangular matrix. Customer satisfaction (facilitator 2) and electronic data interchange (resource 1) are found at level 1 whereas top management commitment and support

(facilitator 1) and statistical package for social science (resource 7) situated on the last level. Table (4.9-4.10) shows conical matrix and later this will help in digraph and ISM model.

Table 4.9. Conical matrix of TQM facilitators

TOM Facilitator	2	5	9	3	4	6	8	7	1
2	1	0	0	0	0	0	0	0	0
5	1	1	0	0	0	0	0	0	0
9	1	1	1	0	0	0	1	0	0
3	1	1	0	1	1	0	1	0	0
4	1	1	0	0	1	0	1	1	0
6	1	1	0	0	1	1	1	1	0
8	1	1	1	1	1	1	1	0	0
7	1	1	1	1	1	1	1	0	0
1	1	1	1	1	1	1	1	1	1

Table 4.10. Conical matrix of IT resources

IT Resource	1	6	8	5	4	2	3	7
1	1	0	0	0	0	0	0	0
6	1	1	0	0	0	0	0	0
8	1	0	1	0	0	0	0	0
5	1	0	0	1	0	0	0	0
4	1	1	0	1	1	0	0	0
2	1	1	0	1	0	1	1	0
3	1	1	0	1	0	1	1	0
7	1	1	1	1	1	1	1	1

4.4.1.5 DEVELOPING DIGRAPH

Structural model is generated from the final reachability matrix and if a relationship exists between the variables will be shown by a digraph. Finally developed digraph is transformed into the ISM model.

Debnath and Shankar [376] investigate and examine the opportunities (facilitators) and issues (barriers) with help of facilitator and barriers model in the technical education in the India. Simultaneously, in this study author proposed to a model of

TQM facilitator and Information Technology resources for successfully execute the ICT organization. From the figure 4.2, It is evident that facilitator 2 (customer satisfaction) which is assigned at the level I while facilitator 1 (top management commitment and support) has been located at the last level VI. Top management commitment and support is a very significant TQM facilitator for the organizations as it forms the base of the ISM hierarchy. It is promoting organization at the top level and provides the leadership and vision to the employees so that they can effectively lead the teams and continuously improve the performance of the organization. Facilitator 1 (Top management commitment and support) leads to the flow of facilitator 6 (continuous training), facilitator 7 (teamwork) and facilitator 8 (culture change). These facilitators are interrelated to each other and hence they appear at the same level of the hierarchy in the model. Facilitator 3 (empowerment) and facilitator 4 (total employee involvement) have two way relationships between them and lead to facilitator 9 (democratic management style). Schneider and Bowen [380] asserted that, when employees are treated as valuable resources, then they in turn will also consider their customers as valuable.

Further, facilitator 9 (democratic management style) leads to the facilitator 5 (continuous improvement), organizations needs democratic management style to be a winner and to meet global standards for the continuous improvement. Facilitator 5 (continuous improvement) leads to facilitator 2 (customer satisfaction) and it can be achieved through successful execution of TQM. It has been found at the top of the hierarchy of ISM model. Continuous improvement increase organizations competitive advantages and profits, if they understand what customers really want and provide product or service to meet their requirement (Yusuf et al., [381]).

Similarly, from Figure 4.3, it is evident that EDI (resource 1) is assigned at the level I while SPSS (resource 7) is assigned at level VI. SPSS (resources 1) will lead to computer aided design (resources 2) and computer aided manufacturing (resource 3). Statistical software packages for social science are software package which is used by a researcher and practitioner for collecting and analyzing data. It is the vital IT resource to successfully execute the TQM program. Resource 2 (computer aided design) and resource 3 (computer aided manufacturing) having two way relationships,

which provides communication among those involved in the design, manufacturing and other process.

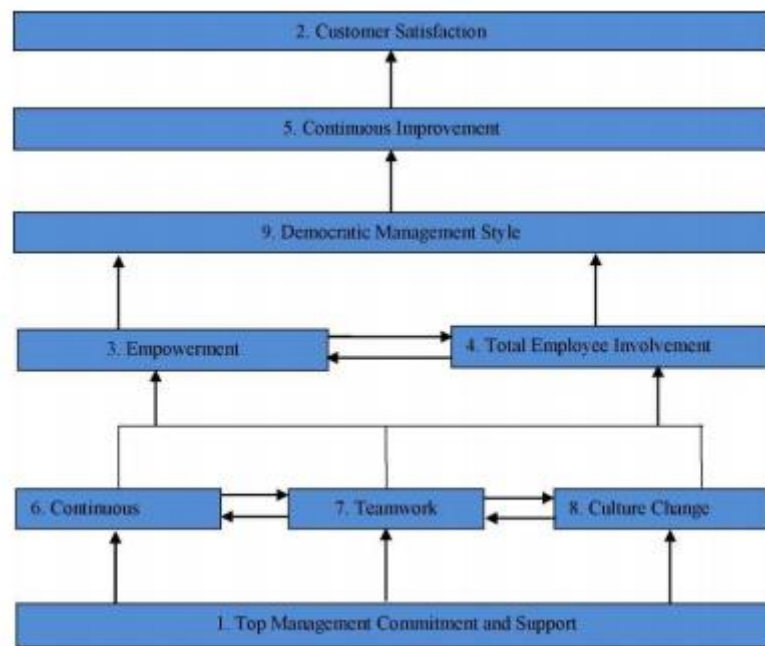


Figure 4.2. Interpretive Structural Modelling (ISM) of TQM facilitators

As shown in the figure 4.3, resource 4 (enterprise resource planning) leads to resource 5 (computer aided process planning) i.e. it integrates different business and organizational performances. Enterprises resource planning is a way of doing business for productivity improvement for effective decision making across the whole organization with the integration in the philosophy of TQM. Resource 6 (computer aided engineering) and resource 8 (structural equation modelling) leads to resource 1 (electronic data interchange). Resource 6 (computer aided engineering) has been introduced in order to increase productivity while resource 8 (structural equation modelling) tests and estimates causal relations of production by using a amalgamation of statistical data and qualitative causal assumptions. IT resource 6 & 8 provide information to the electronic data interchange about increment and the relations of production. Resource 1 (electronic data interchange) is important for companies as it can significantly reduce the cost of sending documents because it can automatically send the electronic data to the vendors. Electronic data interchange has been found on top of the hierarchy and it is the driven of the model.

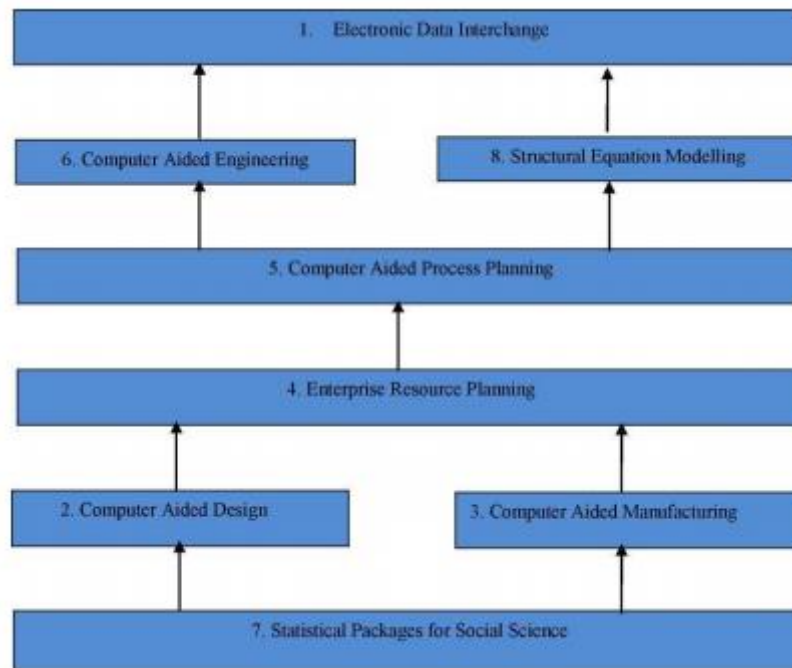


Figure 4.3. Interpretive Structural Modelling (ISM) of IT resources

4.4.1.6 MICMAC (MATRIX OF CROSS-IMPACT MULTIPLICATION APPLIED TO CLASSIFICATION) ANALYSIS:

MICMAC analysis, classification assist to clarify behavior of a variable in the system and how it should be managed. MICMAC technique analyzes the dependency and driving power of the variables [382]. In this analysis, variables are plotted on the graph with dependence on X- axis and driving power on Y-axis. The MICMAC method reveals hidden variables by taking account of indirect relationships and feedback loops [383]. The indirect relationships are analyzed by using matrix multiplications. This multiplication process continues until the cross-impact matrix is raised to a certain power in which the variables' order proves to be stable, the row and column classification becomes stable [383].The variables are divided into four categories.

- The first category variables are those which have weak dependency and weak driving powers are called “autonomous variables”. These variables are disconnected from the system. Figure 4.4 & 4.5 shows there is no autonomous variation in the matrix.

- The second category of variables has high dependence and low driving powers are called “dependent variable”. These variables are strongly connected with the entire system. Facilitator’s customer satisfaction (facilitator 2), continuous improvement (facilitator 5), democratic management style (facilitator 9) and resources computer aided process planning (resource 5), computer aided engineering (resource 6), and structural equation modelling (resource 8) and electronic data interchange (resource 1) are dependent variable. Among these variables customer satisfaction and electronic data interchange are driven of the system.
- The third category of variables having high dependence and high driving power are called the “linkage variable”. Linkage variables affect higher level variant, but they themselves are dependent on lower level variables. There are two linkage facilitators culture change (facilitator 8) and total employee involvement (facilitator 4), that are unstable and before making any changes in them care should be taken care of consecutively in other variables.
- The last and fourth category variables having low dependency and high driving powers are called “independent variable”. These are the most important variables as they influence the other variable. The last category has the four facilitators, top management commitment and support (facilitator 1), teamwork (facilitator 7), continuous training (facilitator 6), empowerment (facilitator 3) and computer aided design (resource 2), computer aided manufacturing (resource 3), enterprise resource planning (resource 4) and statistical package for social science.

Both models represent the major hindrance, and they are the duties of the ICT organization. As hierarchy is followed, it is observed that the TQM facilitators and IT resources have enhanced the quality of product and services in the ICT.

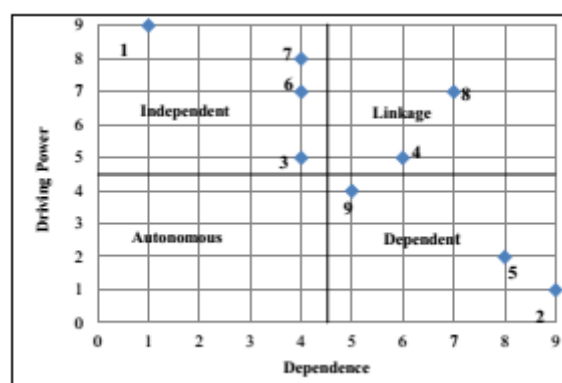


Figure 4.4. MICMAC matrix of TQM facilitators

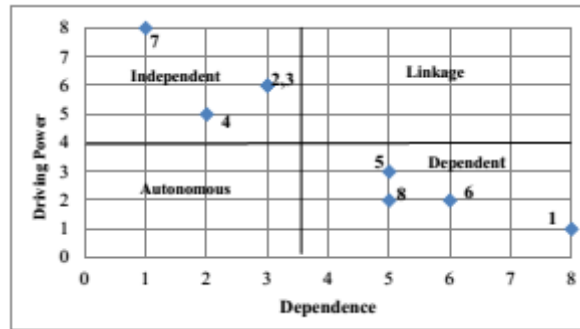


Figure 4.5. MICMAC matrix of IT resources

4.5 RESULTS AND DISCUSSIONS

In the current research ISM model was developed to understand the contextual relationship between TQM facilitators and IT resources that would importantly help managers and practitioners of the ICT industry. The ISM model has been developed to analyze the interactions among the TQM facilitators and IT resources. It distinguished the hierarchy of facilitators and resources and identified which actions should be taken for the successful execution of the ICT industry. From this study, 9 TQM facilitators and 8 IT resources have been identified from the literature review and expert opinion. The interrelations between the TQM facilitators and IT resources were obtained from a group of expert opinion. The following things were observed from the MICMAC analysis.

- From the MICMAC matrix, it is observed three facilitators namely customer satisfaction, continuous improvement, democratic management style and four IT resources, namely computer aided process planning, computer aided engineering, structural equation modelling, electronic data interchange are the dependent variable and have strong dependency and weak driving power. They are at the top of the ISM model, therefore management should give high priority to tackle these variables.
- The MICMAC matrix indicates that four TQM facilitators top management commitment, teamwork, continuous training, empowerment and four IT resource computer aided process planning, statistical package for social science, computer aided engineering, electronic data interchange are independent variables. They

have weak dependency and strong driving power. These variables are found at the bottom of the hierarchies of the ISM model and help to achieve the outcomes of the variables. It can be anecdotal that management should work out strategies to facilitate these independent variables in order to enhance the business performance and customer satisfaction.

- It is seen from the Figure 4.4, TQM facilitators namely culture change and total employee involvement are the linkage variables. They have strong dependency as well as strong driving powers are found in the middle of the ISM model. If any change occurring to these variables will have an effect on others and also a feedback on themselves. Hence, these variables are unstable in nature which may affect the successful ICT organization either in a positive or negative way. But Figure 4.5 shows that there is no linkage resource means all IT resources are stable.
- MICMAC matrix shows that, there is no autonomous variable. Autonomous variables have weak dependency and also weak driver power. The absence of autonomous variables indicates that management considered all variables to influence in the execution of the ICT industry.

4.6. SUMMARY

The aim of this research is to naming the significant TQM facilitators and IT resources and analyze them. Previously TQM facilitators and IT resources relationship model were not developed in the ICT organization. A contextual relationship can be easily developed between TQM facilitators and IT resources by using brainstorming and ISM, thus produced model depicting interaction would be of great help to managers and practitioners in the organization.

This is the study that discovered nine TQM facilitators and eight IT resources with the help of ISM and MICMAC method. This study highlighted on top management commitment and support and electronic data interchange and their role in executing ICT industry. Commitment of Top management and support facilitator and electronic data interchange resources was found as the major factor and lead to all facilitators and resources (Figure 4.2 & 4.3) meaning that can be treated as a base for the execution of an industry.

The major finding of the current study gives significant guidelines for both managers as well as the academicians. This study draws attention on top management commitment and supports that continuously giving effort to customer services for never ending customer satisfaction. The statistical packages for social science are one of the resources used for large data analysis, which is time effective for the researcher.

MICMAC analysis categorized the TQM facilitators and IT resources according to their dependence and driving power. Strong driving power, influence the customer focus thus strong driving facilitator and resources continuously achieved the customer satisfaction.

CHAPTER – V

RESEARCH METHODOLOGY

5.1 INTRODUCTION

During the recent couple of decades, industry have been discovering to global environment changes (Ghoshal, [384]), with increasingly competitive environment (David, [385]) further complicated by technological changes (Wanberh & Banas, [386]) and unstable economic environment [387]. The speed of changes has become greater than ever before (Todnem, [388]) and for the sake of survival, industry focus on anticipating with an aim to adapting to these changes [389; 390; 391; 392]. We are mainly looking at the ICT industry in order to describe the TQM facilitators and IT resources and also how satisfied the customers are regarding the quality. The main aim of this research is to naming the TQM facilitators and IT resources in the ICT industry of India, which involves empirical investigation and different methods to address the research questionnaire in depth interview were conducted by e-mail survey. It focuses on TQM facilitators and IT resources in the ICT industry to successfully satisfy the customer's demands for quality products and services. The rationale for selecting the ICT sector is that it has played a pivotal role, its contribution in total GDP close to 7% in 2011-2014 and it will be 10%. The basic methodology was taken for this research is a questionnaires based survey. The aim of this research is to examine the degree of association between TQM facilitators, IT resources (independent variables) and customer satisfaction (dependent variable). The target population has been divided into different sectors. The result of the survey was subjected to different analysis. The different procedures that were followed by researchers in collecting data is explained in the below sections. It also includes sample characteristics of variables and the formation of the questionnaire.

5.2 RESEARCH METHODOLOGY

Research methodology is a systematic way of solving problems. It can guide the researchers on what steps are need to be taken to achieve the purpose of the study (Tsang & Antony, [42]). It explains the research methodology for research hypothesis and questions. The objective of section is described the method by which research

question and hypothesis are tested. A questionnaire survey methodology was adopted and a designed questionnaire was sent to selected ICT industry. The aim of this research is to execute TQM & IT in ICT industry of India that could improve the operational performances that significantly satisfied the customers. To fulfill the objective of this study, we evaluate the TQM facilitators & IT resources in previous Chapter 2. This study also, discovers which TQM facilitators & IT resources are perceived to be important for the success of quality program and suggests improvement of quality program for customer satisfaction in the ICT industry.

5.2.1. RESEARCH DESIGN

Research design is a blueprint for carrying out research works. It presents the research procedure to how to achieve the information needed for solving the research problem. It can be divided into two groups; exploratory and conclusive. The exploratory research aims to explore specific aspects of the research area and does not give ultimate and conclusive answers to research questions. Exploratory study gives researcher an idea of the observed variables and seeks to understand more about it. It is defined as the early research into theoretical or hypothetical data. According to Zikmund [393] exploratory research is flexible and adaptable to changes. Moreover, it is useful for classifying ambiguous problems.

The conclusive research adopts advanced analytical techniques and large sample, ([395]) and is more likely to use quantitative rather than qualitative techniques [396]. Further, conclusive research is divided into two categories, descriptive research and casual research. In the present study descriptive nature is adopted because it helps researchers, generate data that can explain the composition and characteristics of relevant groups. In other words, descriptive research is used to explain the characteristics of a population. A descriptive research deals with the conditions, practice structure, differences or relationships that exists, suppositions held, forms that are going on a pattern that is obvious. Descriptive research comprises of collecting data to determine whether and to what extent a correlation exists between cause and symptoms. It surveys the correlation between dependent and independent variables.

This research uses cross-sectional design. The cross sectional design proves to be cost

effective and consumes less time as compared to longitudinal study design. It involves a fixed population's sample element that is measured often on the same variable over an extended period of time [397]. Moreover, this study also adopted survey method, which is to collect data and information from members of population to check the current status of that population. There are various types of survey methods to collect data from the respondents. The most common type of questionnaire survey can be named as: telephonic interview, personal interview, postal interview, e-mail interview. In this study e-mail survey has been taken to collect the data and information from the population.

5.2.2 SAMPLE DESIGN

According to Sekaran [398] sampling is the process of choosing a satisfactory and the right number of elements for study from a certain population. The principle of statistical sampling to secure representative sampling is employed for economy and speed. The aim of statistical sampling is to maximize the chance of uncovering particular mean difference, which is also statistically important. Sample design is the most critical component of research for almost every organization. Questions like population, sample size, sample frame and sample unit must be considered by the researchers at the time designing of a sample.

5.2.2.1 TARGET POPULATION

According to Malhotra [396], the target population be defined in terms of elements, sampling units, extent and time. The target population covered these steps:

- An element is the object from which or about which the information is desired, e.g. the respondents. In present study top manager's information is desired to execute TQM and IT in the ICT industry of India.
- A sampling unit is an element that is available for selection at some stages of sampling process. Here sampling unit is ICT industry.
- Extent refers to the geographical boundaries. This study geographical area is India.

5.2.2.2. SAMPLING FRAME

Sampling frame is the sources of material from which the sample is drawn. It contains

a list of directions for identifying the target population. The sampling frame chosen for this study is National Association of Software & Service Companies (NASSCOM 2015, India) [4]. Nasscom 2015 was selected because it increases the country's pool of relevant and skilled talent and harnesses the benefits of ICT to drive inclusive and balanced growth. The goal of the Nasscom to use ICT for development and to catalyse corporate social responsibility (CBR) initiative by the Indian industry. It has also channelized the immense potential of the ICT industry towards the socioeconomic development of the nation. This list provides the name of companies, telephone numbers, email addresses, complete addresses, and website to contact the top managers of that industry.

This study covers ICT industry of India, including four sectors (Table 5.1), namely Information Technology (IT), Software development, telecommunication, Business Process Outsourcing (BPO) and mobile service provider. A total number of 801 sample size was finalized from Nasscom [4] list.

Table 5.1. Different sector percentage

Sector	No. of Companies	Percentage
Information Technology	390	48.6%
Software Development	230	28.7%
Telecommunication	63	7.9%
Business Process Outsourcing	118	14.8%
Total	801	100%

Also, Nasscom helps the ICT industry to be trustworthy, respected, innovative and society friendly. India's IT industry contributed around 7.7% to the country's GDP and is expected to contribute 10 per cent of India's GDP by 2025. The Indian IT-BPM sector in grew at a CAGR of 10.71 % to US\$ 167 billion in FY18 from US\$ 74 billion in FY10, which is 3 to 4 times greater than IT-BPM growth globally. It is approximated that the size of the industry will expand to US\$ 350 billion by 2025 and the telecom industry's contribution to GDP is estimated to reach 8.2% by 2020.

5.2.3 SAMPLE TECHNIQUES

This study adopted convenience sampling. Convenience sampling is available to the researcher by virtue of its accessibility. According to Malhotra [397], Convenience

sampling try to acquire a sample of convenient elements. Often respondents are chosen because they happen to be in the right place and at the right time. The major advantage of convenience sampling is that it is extremely quick, readily available, cost effective, making it an extremely attractive option for most researchers. There are many researchers who used convenience sampling of data collection in their studies [399; 400; 401]. There are several benefits of using convenience sampling such as simplicity of sampling and ease of research, helpful for pilot studies and for hypothesis generation, data collection can be facilitated in short period of time. There are two reasons for choosing convenience sampling in the present study:

- 1) Respondents were distributed all over Indian it is not possible to build the sampling frame from the researcher themselves, so non probability purposive convenience sampling was done.
- 2) Secondly, here researcher was interested only in customer satisfaction in the ICT sector. By using convenience sampling researcher could get a good response rate for this study which could provide the beginning of future research.

5.2.4. SAMPLE SIZE

The sample size is a significant feature of any study in which aim is to make inferences about a population from the sample. A sample size for a questionnaire must be significant number to represent the population, which governs estimated non response rate, cost, time and operational constraints, with the results being able to be generalized to the population as a whole. To measure the sample size Green [402] suggests a desirable sample size formula:

$$n > 50 + 8V$$

Where ‘V’ is the number of independent variables. Hair et al., [403] found that sample size could affect the generalizability of the results of the observations to independent variables. Further, in another study found that 300 cases are best for research using factor analysis. To calculate the internal consistency of the scale the sample size should be 150-200. Finally, to apply SEM the minimum sample size is required to 100-150.

The current study divided sample size into four sectors (Figure 5.3), Information

Technology (390), software development (230), telecommunication (63) and Buisness Process Outsourcing (118) and total sample size is n=801.

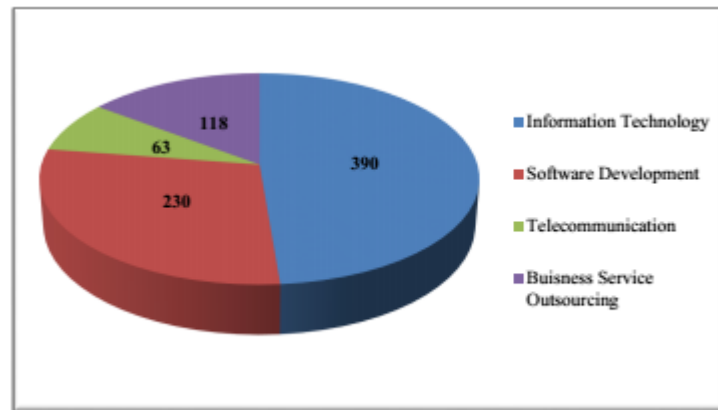


Figure 5.1 Sample size of different four sectors (total n=801)

5.3 SAMPLING UNIT

Data collection is the way of gathering information. Primary data were collected to accomplish the purpose of research objectives. However, primary data were directly collected from managers through the questionnaire, while population details were obtained from a previous study conducted by NASSCOM [4] annual report. Primary data collection using research instrument, including questionnaire and interview schedules that have been made for the purpose of specific study. Here, researcher's main motive is to ensure that the result of the research is specific and applicable. The questionnaire survey was conducted by email. If any respondents were not emailed those respondents were communicated by follow up phone calls. Each mail survey contained covering letter explaining the objectives and rationale of the survey.

5.4 DEVELOPMENT OF RESEARCH INSTRUMENT

In developing the structured research instrument for this study, an important source of input, which was used in the designing the research instrument were derived from a variety of important issues related to TQM and IT which were reflected from the literature (Chapter 2). The literature helps in creating items that the questionnaire needed to analyze the research question for the study. This describes the research instrument and research techniques undertaken to secure the validity and reliability of the instrument. The following instrument were separated in four parts and

accomplish the research objectives.

Section I, included the demographic factors, this part of the questionnaire was split into two parts, company profile included name of respondents (optional), gender, age, respondent's qualification, job designation, and length of services. Second part of the section I, having name of industry, types of business sectors, total number of employees, annual turnover and dose your industry apply TQM & IT.

Section II collects information on naming and grading the TQM facilitators and IT resources in the ICT industry.

Section III gathers information to understand the awareness of IT resources and TQM program in the ICT industry.

Finally, Section IV examines the degree to which IT resources and TQM facilitators are executed as well as the relationship among the named TQM facilitator and IT resource on customer satisfaction in the ICT industry.

Also, a total number of 145 items were initially created from the 17 TQM facilitator and IT resource. There are the following number of items of TQM facilitators and IT resources are listed below:

1. Top management commitment & support (TQM facilitator) having eight items to improve quality performance, effectively support quality awareness to the industry.
2. Customer satisfaction (TQM facilitator) containing nine items, it is related to the customer requirement, improvement in quality programs, designing new product and services use the required customer satisfaction.
3. Empowerment (TQM facilitator) comprises eight items, allow employees to use their skills and gives an opportunity to employees to develop their career.
4. Total employee involvement (TQM facilitator) containing eight items, it encourages employees suggestion and innovation, continuous improvement of employees.
5. Continuous improvement (TQM facilitator) including 9 items, used to identify

area of improvement, reduce order processing and service deployment cycle time.

6. Continuous training (TQM facilitator) comprises 8 items, it provides an opportunity to reform employees about the goal of the industry, ensures
7. Total employee involvement (TQM facilitator) containing 8 items, it covers the employee involvement, develop trust and encourage leadership traits.
8. Culture change (TQM facilitator) including 9 items, it is related with TQM, measure the total quality, access the behavior factors of TQM.
9. Democratic management style (TQM facilitator) having 9 items, investigate the improvement of industrial goal, increases job satisfaction, gives feedback and motivates the employees.
10. Electronic data interchange (IT resources) comprising ten items, improves the communication link with suppliers, facilitates electronic exchange of good and services, contributes to quality data, reconfiguring industry function.
11. Computer aided design/ Computer aided manufacturing (IT resources) containing nine items, it is related to the elimination of unnecessary hand-off delays in the information & material flows, designing product at faster rates, increasing the probability of business by reducing design and manufacturing cost.
12. Enterprise resource planning (IT resources) comprises 9 items, improves the working capital and execution of TQM culture, increasing productivity & empowering the customer to modify the business process and alleviates the arduous job of supporting inflexible systems.
13. Computer aided process planning (IT resources) including 8 items, identifies all aspects of production planning, optimizes the industry performance in a global context.
14. Computer aided engineering (CAE) containing 8 items, covers the robustness and performance of quality, gives information to assists support design teams in decision making and reduces the exploitation period of products.
15. Statistical packages for social science (IT resources) having 9 items, it is

analyzing the collected data, facilitate the statistical for large amount of data, formulate hypothesis, examine the relation between data.

16. Structural equation modelling (IT resources) having 8 items, examines the dependent and independent variables, integrates standard method, proposes the newest procedure to handle missing data.

5.4.1 MEASUREMENT SCALE

The present study uses 5-point Likert Scale. The Likert scale was developed by Rennis Likert, consists of statements that express either favorable or unfavorable attitude towards the object of interest. The participants are asked to agree or disagree with each statement. Each response is given a numerical score to consider its degree of attitudinal favorableness [404]. The survey used Likert scale which reduced to time taken by the respondents to fulfill their responses and also reduced the unwillingness to offer their time. Since the target respondents were senior managers who are usually on a time bound schedule, this feature proved to be an advantage. Moreover, while forming the questionnaire as a whole, the researchers focused on making it appears user friendly and pertinent to the respondent's.

5.5 PILOT TEST

A preliminary test will be done on the data collection tools and procedures to identify likely problems. To validate the instrument with a group of 25 experts including ten academicians and 15 quality experts who have knowledge related to the TQM and IT. Each participant was asked to assess the instrument for the readability, bias, ambiguous items, understandability, and appropriateness of each item in significance to the Indian service company setting. The participants were also asked to comment upon the instrument with regard to wording, length, sequencing, and timing. The feedback resulted in the modification of several items in the layout of the instrument. Further, the pre-test also indicated that the time needed for answering the instrument was too long. The format of the instrument was later redesigned and some less important items were deleted to shorten the time spent. All the 20 participants were contacted personally.

5.6 QUESTIONNAIRE & DATA COLLECTION PROCESS

A Questionnaire is a research instrument consisting the series of questions and other prompts for the determination of gathering information from respondents. The questionnaire is a written question's sets to which responses are recorded [398]. A number of researchers have used questionnaire in the area of quality of management. The researchers developed their questionnaire for data collection purpose, every researcher has a different purpose so that their questionnaire is different from others. The survey was done with the assist of semi-structured questionnaire including closed and open- ended questions. Questionnaire survey examined whether the questionnaire met the requirement of the research or not. Thus, it was necessary researchers develop a new questionnaire. In fact, the design of the research questionnaire was highly dependent on the concepts and operationalization of theoretical constructs. The questionnaire survey is designed to measure the specific behaviors of respondent's. This questionnaire acts as a tool because it gives a wide range of data from the people. It should be considered that questionnaire survey was used to execute TQM facilitators and IT resources in the ICT industry. It was developed to measure the performance of quality programs in the ICT industry, which is based on TQM facilitators and IT resource in the ICT industry of India. The questionnaire was developed in English because it was collecting information in India. Here participants were only managers from the industry because they had knowledge of quality management and information technology. The ultimate version of questionnaire consists of 170 items, from those 17 items to measure the grading of TQM facilitators and IT resources, 10 items to measure the awareness of TQM and IT program & finally 143 items to calculate customer satisfaction with the assist of TQM facilitators and IT resources.

The final version questionnaire was mailed to managers who worked in the ICT industry. The questionnaire was split into four sections, first section dealing with naming and grading of utility of TQM facilitators and IT resources based on the scale (not value added=1, very little value added=2, some value added=3, significant value added=4, great value added=5) and second section covered the awareness of TQM facilitator and IT resources, responses were recommend on the scale of 5 point Likert scale (SDA=1, DA=2, N=3, A=4, 5=SA) [Strongly Disagree (SDA), Disagree (DA), Neither agree no disagree (N), Agree (A), Strongly Agree (SA)] and final section covered the customer satisfaction with the assists of facilitators and resources, also

response are measured by 5-point Likert scale.

The data collection procedures were personal visits, postal surveys and e-mail based surveys. They were the means to forward the research questionnaire to likely respondents. The industries were visited personally, through contacts, and friends employed in those industries. Also, a few professionals carried the questionnaires personally to their senior executives to obtain responses. Since, most of the targeted respondents were occupied with their busy schedule, some of them were not interested in responding. Personal visits took a lot of time and in return few responses were collected. So, it was decided to obtain responses through postal survey. In addition, electronic mail (e-mail) was also chosen for the purpose. E-mail based surveys are basically defined as survey instruments that are delivered through electronic mail applications over the internet or corporate internets.

Flaherty et al., [405] concur that email provides an easier and more instant means of response. In the present research, the prospective respondents were informed about the purpose of the research and their permission with willingness to fill in their responses was received. At first, questionnaires were e-mailed to 801 ICT companies. In the present study questionnaire survey were completed into four waves. At first wave i.e.

376 questionnaires were sent among them only 58 questionnaires returned (Table 5.2). The mails were resent to those who did not respond initially. 550 questionnaires was sent and returned questionnaire was 143. Hence, the response rate was significantly higher than the first wave survey. In the third wave 757 questionnaire were e-mail, 73 questionnaires were returned. The remainders were continuously sent after every two weeks to the potential respondent either through e-mail or telephonic calls. At the final wave, 801 questionnaires were sent, 45 questionnaires were returned. In the last wave response rate very low as compared to other three wave survey.

Table 5.2: Collection of responses from different categories of ICT industry

ICT Industry	1st wave survey		2nd wave survey		3rd wave survey		4th wave survey		Total no. of Responds Received
Category	No. of Questionnaire sent	No. of responses received	No. of Questionnaire sent	No. of responses received	No. of Questionnaire sent	No. of responses received	No. of Questionnaire sent	No. of responses received	
Information technology	119	15	239	02	390	12	390	15	104
Software Development	150	24	<i>no</i>	19	218	32	230	13	<i>88</i>
<i>BP0</i>	85	11	101	53	110	24	118	9	97
Telecom	22	<i>8</i>	40	9	39	5	42	<i>8</i>	<i>30</i>
Total	376	58	550	143	757	73	<i>801</i>	45	319

5.7 DATA ANALYSIS

The evidence of the study has highlighted the major element of TQM and IT resources in the ICT industry in India. The present chapter assembled the findings and interpreted data that alter them into useful information which is significant for the study. The measurement instrument was used to test reliability, face and content analysis and finally construct analysis. SPSS program was used to interpret the quantitative data analysis. This test produces final items by using mean, S.D. (Standard Deviation), Pearson correlation coefficient, Cronbach alpha. The mean and S.D measures the differences of each factor while the correlation coefficient find out the strength of the factors whether they are highly correlated or linearly related. On the other hand, Cronbach alpha was computed to check the internal consistency of items of the 17 variables. To interpret the qualitative analysis, Structural Equation Modelling (SEM) was used to construct analysis including Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). SEM provides hypothesis testing approach to the analysis of a structural theory bearing on the same phenomenon. Ullman [406] found SEM is a substantially valuable technique for personality assessment researchers to add to their analysis toolkit.

5.8 SUMMARY

This chapter has discussed the choice of research samples and research design. It provides a brief description of research design and methodology to execute the study. This chapter also includes data collection process, identification of sampling units, the development of the instrument, pilot testing of instruments, questionnaire and data analysis procedures. The questionnaire based survey was planned for primary data collection. Also, to accomplish the objective of the study research questions and hypotheses are formulated. The testing of hypotheses and results are presented in the Chapter 6. It has highlighted the various statistical tests that are used to test the hypotheses are descriptive statistical, scale reliability, exploratory factor analysis, confirmatory factor analysis and finally SEM mainly used to validate the model by testing hypotheses. The applied detailed research methodology and data collection procedure will confirm that result supported familiar.

CHAPTER – VI

DATA ANALYSIS AND RESULTS

6.1. INTRODUCTION

In the era of present high competitive environment, product quality and services becomes a major component for the business. Quality is considered to be one of the competitive strategic tools and it has become as important as price component. With the growing competition, market looks for a higher level of success across all the functions and process and select a TQM as a strategy to stay in the business organizations [346]. Increasing demand of quality organization combined IT resources with the TQM. IT is introduced with TQM to provide better product and services to the customers. IT is substantially executed with TQM in most of the organization to improve the role of quality in the business world. A different study found that IT and TQM improved financial and operations performance [72; 349]. The organization faces many challenges such as recession, global competition, competitive pressure and regulatory changes.

It is anticipated that application of IT in different areas including quality management is increasing and continually expands. In addition, IT has been used to improve quality management. IT can be defined as computer and telecommunications hardware and software that aid in collection, processing, and transmission of text, and pictorial information, and voice. IT can improve the value utility of many distinct parts of an organization. Spangler and Gal-Or [91] commented that application of IT supports the management to time-consuming activities and off load the routine to the information system, which provides the company to start emphasizing significant managerial tasks that here to for had been neglected TQM and IT together was to ensure the product's quality and services in terms of software and hardware which are mainly computer based information system. The present research, conducting a survey-based study to the recognition of TQM facilitators and IT resources which gives the quality performance. Moreover, executing a set of TQM facilitators and IT resources and finally developing a model.

6.2. DEMOGRAPHIC PROFILE OF THE RESPONDENTS AND COMPANIES

Demographic data seeks the characteristics of respondents have a very significant role to play in expressing and giving the responses about the problem. It is used in marketing and broadcasting to explain a segmentation of marketing. Essentially, demographics were divided into two parts, the first section of demographic describes the profile of respondents, and second parts explore the characteristics of ICT industry.

6.2.1. RESPONDENTS' PROFILE

6.2.1.1. GENDER BIAS

It is found from the Table 6.1 & Figure 6.1, that industry of India support males because they positively effect the economic development by participating at different levels like managerial administrative and human resource position. A very few female respondents have participated in the survey. Therefore, it is concluded that female participation rate may fall the economic development in the ICT industry. Many highly reputed industries prefer to hire male employees at senior level management because management understands how to enhance their organization quality performance.

Table 6.1. Sample characteristics of respondent.

Characteristics	Variables	Frequency	Percentage
Gender	Male	223	68.9%
	Female	96	31.1%
Age	25-30 years	106	33.3%
	31-35 years	154	48.3%
	36-40 years	35	10.9%
	More than 40 years	24	7.5%
Qualification	Undergraduate	17.2%	55
	Graduate	30.4%	97
	Postgraduate	45.2%	144
	Others	7.2%	23

Job designation	Managers	18.8%	60
	General managers	12.5%	40
	Senior managers	10.1%	32
	Engineers	46.1%	147
	Others	12.5%	40
Length of service	Less than a year	10.1%	32
	1-5 year	41.1%	131
	5-10 year	27.2%	87
	More than 10 years	21.6%	69
Organization Scope	Information Technology	37.4%	119
	Software Development	22.2%	71
	Business Process	16.3%	52
	Outsourcing	24.1%	77
	Telecommunication		
Total number of employees	Less than 50	21.4%	68
	50-200	30.4%	97
	200-500	20.7%	66
	More than 500	27.5%	88
Annual Turnover	Less than a crore	26.9%	86
	1-100 crore	31.6%	101
	100-500 crore	18.7%	60
	More than 500	22.8%	72
Does your organization apply TQM and IT	Yes	67.3%	215
	No	32.6%	104

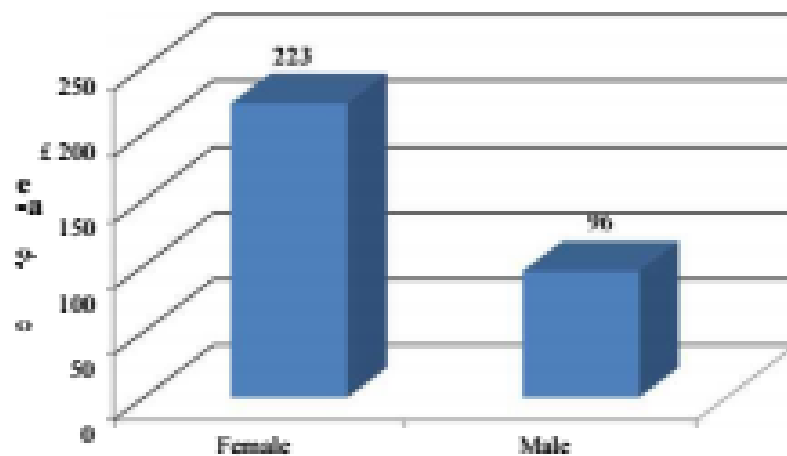


Figure 6.1. Gender –Bias

6.2.2.2. RESPONDENT'S AGE

With regarding the 'respondent's age' shown that in the Table 6.1 & Figure 6.2, 106 respondents are coming under age between 25-30 year. While 154 employees age between 30-35 working in the organization. Whereas, 35 respondents belonging age group of 35-40 year. Finally, 24 respondents are more than 40 year old. As shown in the table 25-35 age group employees majority as compared to older employees. ICT industry has found that the median age of employees at many of the most successful information on gender and year of experience.

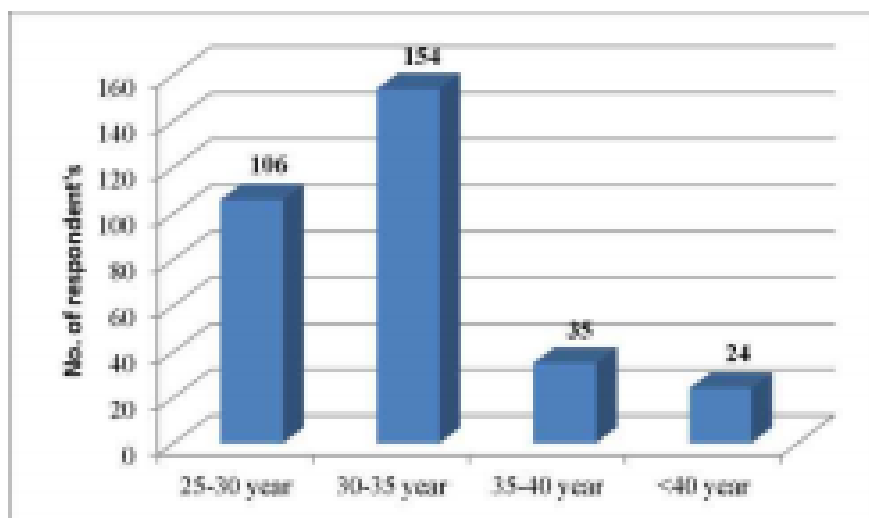


Figure 6.2 : Respondent's age

6.2.2.3. RESPONDENT'S QUALIFICATION

The qualification engages the procedural memory system which helps to perform in better way. Therefore, based on this argument the respondent's qualification was incorporate in the demographics and divided into four levels; undergraduate, graduate, postgraduate and others. As shown in Table, 6.1 & Figure 6.3, respondents were undergraduate, 97 respondents were graduate, 144 respondents were postgraduate and 23 respondents had other qualification. It is indicated that majority respondents were highly qualified. Highly qualified employees successfully execute the procedure time and accomplish the derived goal of the organizations.

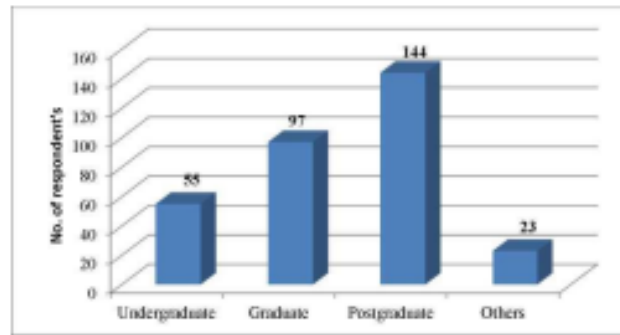


Figure 6.3. Qualification of Respondent's

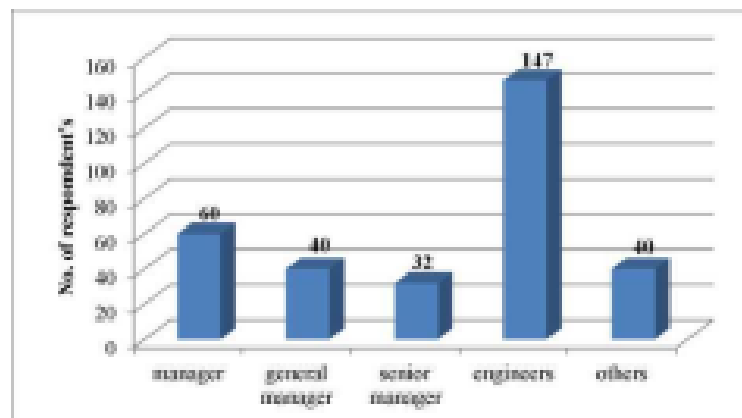


Figure 6.4. Job designation of Respondent's

6.2.2.4. JOB DESIGNATION

This study conducted job designation of the respondents. With regarding designation (Table, 6.1 & Figure 6.4), 60 respondents were manager, 40 respondents were general manager, 32 were senior managers and 147 were engineer's respondent's and last 40 were other respondents. It is evident that the majority respondents are from top management level who are directly executing TQM facilitators & IT resources in the ICT industry in India.

6.2.2.5. LENGTH OF SERVICES

With respect to the length of services, survey received responses from experienced respondent's, who are currently working in ICT industry of India. 32 respondents have less than a year of experience, while 131 respondent's had 1-5 year experience, 87 respondent's worked in industry from 5 to10 years and remaining 69 respondent's worked more than 10 year . It was found from the Figure 6.5 that majority of

respondent's job tenure at their present industry is 1-5 year.

6.2.3. INDUSTRY PROFILE

6.2.3.1. INDUSTRY SCOPE

This study, conducted respondents from ICT industry which comprises from different four sectors: Software Development, Information Technology, Business Process Outsourcing and telecommunication. It is shown from the Figure 6.6, 119 IT companies' employees are involved in the survey while 87 software development companies' employees and 52 BPO companies' employees and finally 77 telecommunication companies' employees take place in the survey of the present study. The sector wise break up of responses indicated that a majority of respondent's the instrument was from IT sector.

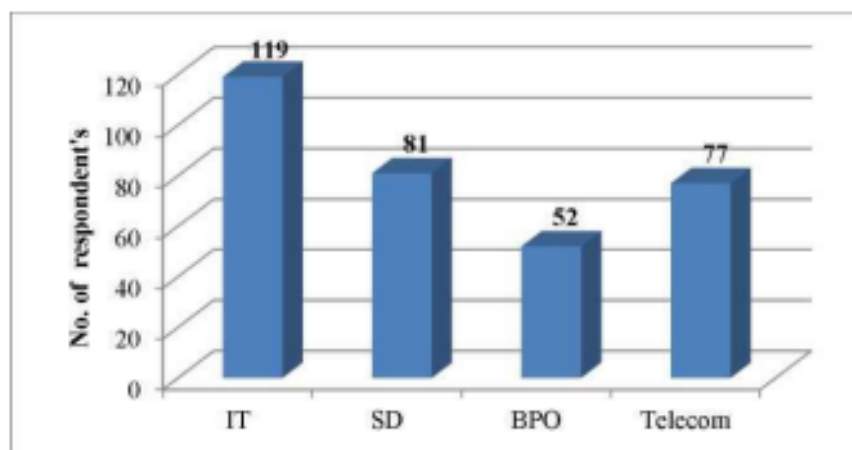


Figure 6.5. Types of Companies respondent's

6.2.3.2. NUMBER OF EMPLOYEES

It is depicted from the Figure 6.7, a total number of employees working in the ICT industry were split into four groups, and first 68 companies reported that they had less than 50 employees. Followed, 97 companies who reported that number of employees between 50-200. 66 companies shows an employment range of 200-500. Finally, last group represents that 88 companies having more than 500 employees.

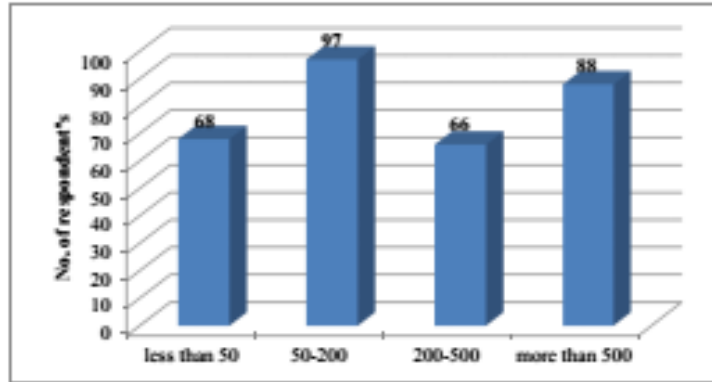


Figure 6.6. No. of employees

6.2.3.3. ANNUAL TURNOVER

With regard to annual turnover, ICT industry performed very well reported in the Figure 6.8. The annual turnover were split into four groups; less than a crore, 50-200 crore, 200-500 crore and more than 500 crore. The annual turnover less than a crore for 68 ICT companies, 50-200 crore turnover for 101 companies, 100-500 crore turnover for 60 companies and at the end more than 500 crore turnover for 72 ICT companies. Hence, majority of the participated ICT industry have high turnover.

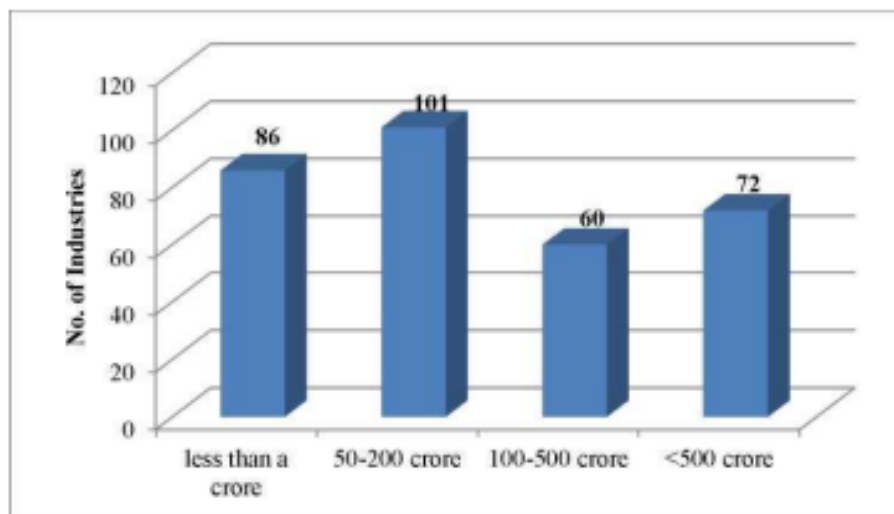


Figure 6.7. Annual turnover of industry

6.2.3.4 APPLYING TQM & IT PROGRAM

A question was asked from the respondents ‘Does your industry apply TQM & IT program. It is shown from the Figure 6.9, 215 respondents says that yes they are using TQM and IT and they were aware of TQM & IT program. While, remaining 104 respondent’s answered that they don’t know about TQM & IT program. The majority, received response were favorable and it represents the necessary information as per the desired objective of the study.

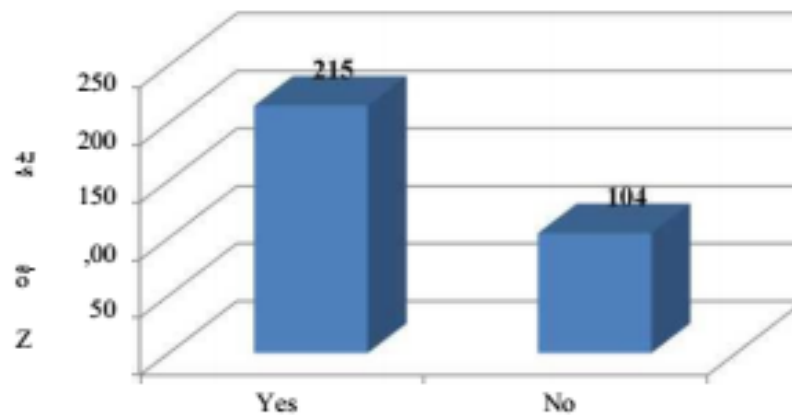


Figure 6.8: Awareness of TQM and IT program

6.3. AWARENESS OF TQM & IT IN THE ICT INDUSTRY OF INDIA.

This is the first objective of the research which accesses the awareness of TQM and IT program together. A research question was formulated and hypotheses were proposed to accomplish the objective.

Rq1: Are ICT industry of India aware of TQM and its program?

The corresponding hypothesis of this research question is:

H1: ICT industry is aware of TQM & IT program.

To achieve this objective a 5-point Likert scale was used in this study to show the respondent’s awareness regarding TQM and IT. The 5-point Likert scale ranging from 1=strongly disagree and 5= strongly agree. Computer based statistical package SPSS- 22 was used to achieve the research objective, a descriptive statistical analysis and correlation analysis were used to assess the awareness of TQM and IT program.

Ten statements were used to measure the awareness in ICT industry of India. The Figure 6.10 show that perceived level of eight statements with the mean value based on the 5-point Likert scale. On the basis of 5-point scale, the mean score of statement (TQM is a management and practices to ensure efficient and effective use of available resources) is 3.24, for statement (IT is act as the feedback mechanism to facilitate communication tools & technique to industries) is 3.94, for statement 3 (awareness of importance of TQM & IT in the industry) is 3.28, for statement 4 (TQM & IT programs are successful in the industry) is 4.11, for statement 5 (TQM & IT together makes customer satisfaction as the focus of industry) is 4.38, the mean score statement 6 (IT investment with TQM raised the productivity & reduce cost) is 3.25, for statement 7 (TQM & IT together can has the potential to help industry to help industry attain a new level of competitive strength) is 3.63, mean score 3.44 for statement 8 (IT provides adequate resources for execution of TQM program), for statement 9 (TQM & IT together can help to solve the managerial problem in the industry) is 3.34 and the mean score of statement 10 (There are strong relationship between TQM & IT concepts & hence success of the industry) is 3.52. The standard deviation ranges from 0.87 to 1.27. Table 6.2 shows that present research received fair measurement of awareness from the respondent's with mean score higher than the 3, it implies that they have moderates to high awareness. The higher value of S.D (Standard Deviation) and mean suggests that dispersion in a widely spread distribution (Table 6.2).

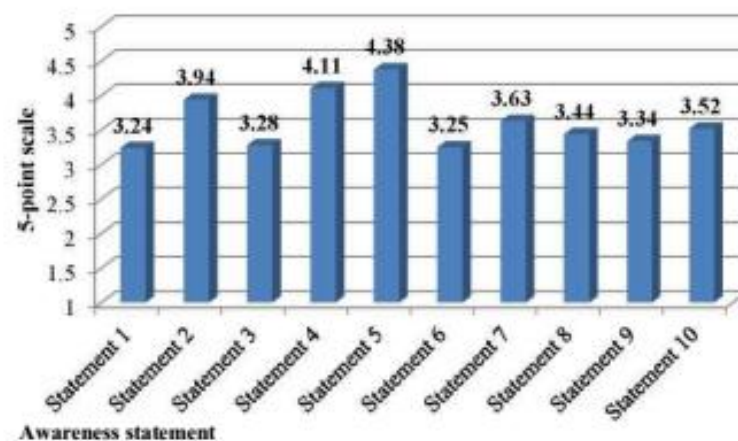


Figure 6.9 : Descriptive statistics of awareness statement

Moreover, Table 6.2 indicates the Skewness and Kurtosis are closely to zero means

assumption of normality appears not to be violated. It can be seen from the Table 6.2 mean value ranges from 3.24 to 4.38 for all statements, statement ‘TQM & IT together makes customer satisfaction as focus of an industry’ have the highest mean score value 4.38. It is indicate that industries stress upon customer satisfaction, TQM & IT together gives to the importance of customer satisfaction. The second highest statement highlight the statement ‘TQM & IT programs are successful in the ICT industry’ with score of 4.11. It demonstrates that TQM & IT together increase the production and quality improvement which is beneficial for ICT industry. Whereas, statement 1 i.e. ‘TQM is a management philosophy to ensure effective & efficient use of available resource’ and statement 6 i.e. ‘IT investment with TQM raised the productivity and reduce cost have the lowest mean score was 3.24. This suggests that need to focus on how to effectively use TQM & IT in the industry and to improve quality performance which is satisfied the customer.

Table 6.2. Descriptive statistics of awareness

Statement	Mean	S.D.	Variance	Skewness	Kurtosis
1. TQM is a management philosophy to ensure effective and efficient use of available resource.	3.24	1.26	1.60	-.295	-.956
2. IT is act as feedback mechanism & facilitate communication tools & techniques in the organization.	3.94	.842	.710	-.363	-.578
3. Awareness of TQM & IT in your organization is high.	3.28	1.21	1.47	-.313	-.920
4. TQM & IT program are successful in the ICT organization.	4.11	.963	.929	-.898	.000
5. TQM & IT makes CS as the focus of an organization.	4.38	.874	.765	-1.48	1.87
6. IT investment with TQM facilitators raise the productivity and reduce the cost.	3.25	1.18	1.40	-.223	-.728
7. TQM & IT together has the potential to help an organization attain new levels of competitive strength.	3.63	1.13	1.29	-.506	-.573
8. IT provides suitable resource to execute QM program.	3.44	1.09	1.14	-.169	-.801

9. TQM & IT together can help to solve managerial problems in the organization.	3.34	1.15	1.34	-.244	-.923
10. There are strong relationship between TQM & IT concept & hence success to the organization.	3.52	1.07	1.15	-.421	-.498

Pearson Correlation Analysis of the Awareness Statement

A Correlation analysis was conducted in this study for the two purposes. First, to investigate the relationship between two variables and secondly, to measure dependency between variables.

Rowntree [407] formed guidelines for the interpreting correlation value ranges. These are the following ranges:

1. If correlation values (r) ranges between 0.0-0.2 means relationship is very weak and negligible
2. If correlation value (r) ranges between 0.2-0.4 means relationship is weak or low.
3. If correlation value (r) ranges between 0.4-0.7 means relationship is moderate.
4. If correlation value (r) ranges between 0.7-0.9 means relationship is strong and high.
5. If correlation value (r) ranges between 0.7-0.9 means relationship is very high.

Table 6.3: Correlation matrix of awareness of TQM and IT in the ICT

Statement	1	2	3	4	5	6	7	8	9	10
1. TQM is a management philosophy and practice to ensure effective and efficient use of available	1									

2. IT is act as the feedback mechanism to facilitate communication tools & techniques to the organization.	.201**	1								
3. Awareness of TQM & IT in your rganization is high.	.209**	.158* *	1							
4. TQM & IT are successful in the ICT	.164**	.167* *	.188* *	1						
5. TQM & IT together make customer satisfaction as the focus of an organization.	.198**	.176* *	.216* *	.252* *	1					
6. IT investment with TQM practice raise the productivity and reduce cost.	.316**	.213* *	.430* *	.229* *	.231 **	1				
7. TQM & IT together has the potential to help company attain a new level of competitive strength.	.116**	.154* *	.258* *	.207* *	.119**	.121* *	1			
8. IT provides suitable resources to execute TQM program.	.281**	.268* *	.344* *	.310* *	.223 **	.344* *	.298**	1		
9. TQM & IT can help to solve the managerial problem in the organization.	.244**	.244* *	.417**	.230* *	.113 **	.323* *	.320**	0.416	1	

10. There are strong relationship between TQM & IT concepts and hence success of the organization.	.268**	.363*	.447*	.253*	.291**	.395*	.324**	.362**	.344**	1
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A Pearson Correlation analysis examines the relationship between the TQM and IT awareness statement. These 10 TQM and IT statements had correlations value generally in the range of 0.11 to 0.50 and were positively and moderately correlated with each other (Table 6.3). From the correlation matrix in the Table 6.3, investigated that correlation coefficient between the ten statements & show the value lies between 0.10 to 0.50. (There is strong relationship between TQM & IT concepts and hence success of the industry) and statement 10 (Awareness of TQM and IT in your organization) have highest correlation value 0.447. Similarly, statement 9 (TQM & IT can help to solve the managerial problem in the industry) and statement 8 (IT provides adequate resource for execution of TQM programs) have the second highest correlation value 0.416. The weakest correlation value 0.016 is detected between statement 7 (TQM & IT together has the potential to help company attain a new level of competitive strength) & statement 1 (TQM is management philosophy and practice to ensure effective and efficient use of available resource). It is from the Table 6.3; all correlation coefficient value is above 0.11 which is below the cut of 0.90 for the multicollinearity problem shown that relationship between coefficients is below than 0.90 for the multicollinearity problem. So, it means from there is no collinearity and multicollinearity problem in the data. It is indicated that respondents perceived the awareness of TQM & IT program in a more positive and favorable way.

6.4. GRADING OF TQM FACILITATORS AND IT RESOURCES.

RQ3: What are TQM facilitators IT and resources for execution of TQM and IT programs in the ICT industry in India.

The corresponding hypothesis is:

H3: There are 9 facilitators and 8 resources for executing the TQM and IT programs for ICT industry in India.

The 9 TQM facilitators and eight IT resources were named through extant literature were discussed in the previous chapter. The named 9 facilitator & 8 resources were examined by descriptive statistical analysis, which is shown by graphical representation. The grading was done by the most and last usable TQM facilitator and IT resources.

Table 6.4 and 6.5 shown the descriptive statistics of TQM facilitators and IT resources in the ICT industry in India. The Tables 6.4 and 6.5 demonstrated the grading and recognition of TQM facilitators and IT resources on the basis of mean score, standard deviation and responses count. The 5-point Likert scale used for responses where 5 represents the high value and 1 represents the low value. It is observed from descriptive statistics TQM facilitators mean score value range exists between 4.06 to 2.78 whereas standard deviation values between 0.895 to 1.143. It is found that three TQM facilitators scored to highest value (>3.35) and eight facilitators (between 3.35 to 3.0) to a moderate level and but there is no lowest mean score facilitators (<2.5).

Table 6.4. Descriptive statistics of TQM facilitators

TQM Practice	Response Counts					Mean Score	Standard Deviation	Grade
	1	2	3	4	5			
Top-management commitment & Support (TMCS)	6	15	37	156	105	4.06	0.895	1
Customer Satisfaction (CS)	5	18	80	120	83	3.77	0.995	2
Empowerment (EMPW)	8	33	88	115	75	3.68	1.024	3
Total Employee Involvement (TEI)	16	49	93	108	53	3.42	1.090	5
Continuous Improvement (CI)	18	59	82	101	59	3.39	1.149	6
Continuous Training (CT)	22	60	97	101	39	3.24	1.104	7
Teamwork (TW)	16	48	81	115	56	3.47	1.098	4
Culture Change (CC)	30	81	99	89	20	2.96	1.078	8
Democratic Management Style (DMS)	45	96	83	75	20	2.78	1.143	9

Table 6.5. Descriptive statistics of IT resources

IT Resource	Response Counts					Mean Score	Standard Deviation	Grade
	1	2	3	4	5			
Electronic Data Interchange (EDI)	1	20	76	130	92	3.92	0.895	1
Computer Aided Design (CAD)	13	43	89	112	62	3.52	1.075	2

Computer Aided Manufacturing (CAM)	16	49	93	115	75	3.42	1.090	4
Enterprise Resource Planning (ERP)	4	37	90	118	70	3.67	0.985	3
Computer Aided Process Planning (CAPP)	13	53	99	113	41	3.36	1.034	5
Computer Aided Engineering	24	68	85	100	42	3.21	1.146	6
Statistical Packages for Social Science (SPSS)	38	89	101	72	13	2.83	1.092	7
Structural Equation Modelling (SEM)	53	95	79	73	19	2.72	1.164	8

Similarly, Table 4.5 shown descriptive statistics of IT resources where three IT resources highest values (>3.35) and five IT resources (3.35 to 3.0) to a moderate value whereas two resources mean score values (<2.5). It indicates that there is no resource having low value (<2.5).

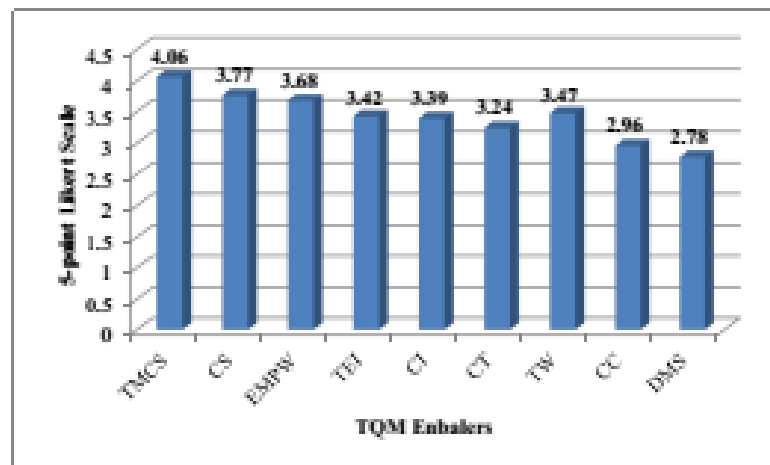


Figure 6. 10. Perceived level of TQM facilitators

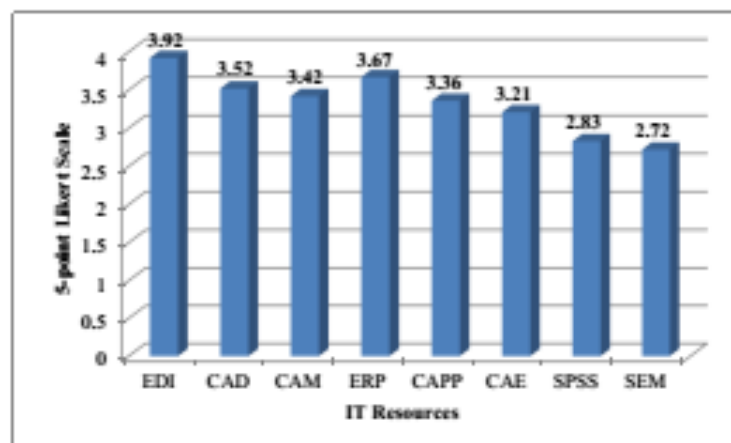


Figure 6.11. Perceived level of IT resources

The Figure 6.11 demonstrates that the mean score for three TQM facilitators for all above (>3.5) named as top management commitment & support, customer satisfaction and empowerment while the mean score for total employee involvement, teamwork, continuous improvement and continuous training are between 3.0 to 3.5. This study suggests that most of the TQM facilitators are most significant for ICT industry. It is found that top three TQM facilitators (TMCS, CS, EMPW) are identified as most significant facilitators and emphasized as largest contributed facilitator in the ICT industry in India. Also, it is reported from the Table 6.4 that is three most important TQM facilitator are TMCS, CS and EMPW with the means score (4.06, 3.77, 3.68), However, TQM facilitators TEI, TW, CT, CI are moderate with the mean score (3.42, 3.36, 3.21). The rest of the two IT resources SPSS and SEM have lowest mean score (2.83, 2.72). Simultaneously, Figure 6.12 shows that the mean score for three IT resources above (>3.5) named as electronic data interchange, computer aided design and enterprise resource planning. Whereas the mean score for computer aided manufacturing, computer aided process planning and computer aided engineering are between 3.0 to 3.5. From the table it is reported that the three most important IT resources are EDI, CAD and ERP with the mean score (3.42, 3.36, 3.21). CC and DMS have a lowest mean score (2.86, 2.79).

This study indicates that these TQM facilitators and IT resources are considered as an important factor for TQM and IT execution in the ICT industry in India. Hence, it is found that the majority of named facilitator and resources in the ICT industry in India is perceived to be significant and are being considered for successfully execute quality programs. The execution of these TQM facilitators and IT resource will improve the business performance and customer satisfaction.

6.5 EXAMINE THE DEGREE TO WHICH TQM FACILITATORS AND IT RESOURCES ARE EXECUTED IN INDIAN INDUSTRY

RQ4: The degree to which TQM facilitator and IT resources executed in the ICT industry of India?

H4: There is no significant difference in the TQM facilitators and IT resources as executed by the ICT industry of India.

This section checks the execution level of named 9 TQM facilitators and 8 IT resources across ICT industry of India. The ANOVA (one way analysis of variance) was used to test differences in the execution between various sectors of ICT industry. Before conducting the ANOVA test there are two assumptions to test first is normality of population and second is the homogeneity of variance assumptions. The normality test tells that taken population from sample size should be normal. The Skewness and kurtosis are performed for assessing the normality of the data. On the other hand, Leven's test used to determine the equality of variance of TQM facilitators and IT resources into four different sectors of ICT. From the Table 6.6 Skewness and kurtosis show that their values are generally very near to zero, it indicates that assumption of normality appears not to be violated [408]. It is also shown from the Table 6.6 Leven's test for homogeneity of variance is not importance ($p < 0.05$) so it is concluded that ANOVA test must be performed.

Table 6.6. Test of Homogeneity of variance (Leven's Test)

TQM Facilitators & IT Resources	Skewness	Kurtosis	Levene Statist	Significance (p-value)
Top-management commitment& Support (TMCS)	-0.068	0.055	0.654	0.581
Customer Satisfaction (CS)	-0.078	-0.072	1.714	0.164
Empowerment (EMPW)	0.067	0.020	0.463	0.708
Total employee involvement (TEI)	-0.092	-0.033	3.331	0.576
Continuous improvement (CI)	0.055	0.079	2.937	0.681
Continuous Training (CT)	0.057	-0.048	3.162	0.506
Teamwork (TW)	0.000	0.000	2.822	0.743
Culture change (CC)	1.010	-0.234	0.472	0.702
Democratic management style (DMS)	-0.098	0.054	5.396	0.060
Electronic data interchange (EDI)	0.047	-0.019	1.885	0.132
Computer aided design (CAD)	-0.067	-0.009	1.525	0.208
Computer aided manufacturing (CAM)	0.041	0.086	2.438	0.065
Enterprise resource planning (ERP)	0.099	0.024	0.353	0.787
Computer aided process planning (CAPP)	-0.006	-0.068	1.303	0.273
Computer aided engineering (CAE)	0.037	0.044	0.289	0.843
Statistical packages for social Sciences (SPSS)	-0.022	0.059	0.673	0.569

Table 6.7. Execution of TQM facilitators and IT Resources in the ICT industry (ANOVA test)

TQM Facilitator & IT Resources	Mean Score					F value	p value
	IT	SD	BPO	Telecom	Total		
Top-management commitment & support	2.43	2.35	2.60	2.58	2.47	1.374	0.251 (NS)
Customer satisfaction	3.83	3.69	3.76	3.73	3.76	1.024	0.382 (NS)
Empowerment	2.67	2.78	2.49	2.69	2.67	1.226	0.300 (NS)
Training employee involvement	3.52	3.43	3.19	3.04	3.34	5.375	0.001**
Continuous improvement	3.61	3.77	3.53	3.71	3.66	1.400	0.245 (NS)
Continuous training	2.94	3.13	3.42	3.16	3.11	4.552	0.004*
Teamwork	3.08	3.33	3.68	3.60	3.35	10.723	0.000**
Culture change	3.20	3.13	3.43	3.40	3.26	3.230	0.020*
Democratic management style	3.05	2.99	3.27	3.24	3.11	2.836	0.038*
Electronic data interchange	2.93	3.45	3.54	3.49	3.28	15.528	0.000**
Computer aided design	3.23	3.14	3.36	3.35	3.26	1.808	0.146 (NS)
Computer aided manufacturing	3.26	3.10	3.36	3.34	3.25	2.159	0.093 (NS)
Enterprise resource planning	3.48	3.33	3.63	3.50	3.47	2.616	0.051 (NS)
Computer aided process planning	3.17	2.91	3.29	3.31	3.15	4.677	0.003*
Computer aided engineering	3.09	2.81	3.12	3.22	3.05	4.277	0.006*
Statistical package for social science	2.73	2.39	2.81	2.84	2.68	5.297	0.001**
Structural equation modeling	2.25	2.20	2.51	2.60	2.05	4.812	0.003*

*p<.050, **p<.001, NS= No Significant difference

The execution of TQM and IT can be checked by an overall mean score in ICT industry as well as into four companies with their mean scores (Table 6.7). It is found from that Table 6.7, four TQM facilitators from the nine TQM facilitator were not significantly different, namely top management commitment and support,

customer satisfaction, empowerment and continuous improvement. Two TQM facilitators total employee involvement and teamwork shows a significant difference at 0.001 level ($p < 0.001$), whereas remaining three facilitators continuous training, culture change and democratic management found significant differences at 0.050 level ($p < 0.050$). Similarly, three IT resources from the eight resources were not significantly different, named as computer aided design, computer aided manufacturing and enterprise resource planning. Two IT resources electronic data interchange, software packages for social science shows a significant difference at 0.001 level ($p < 0.001$). While three IT resources computer aided engineering, computer aided process and planning, and structural equation modeling found significant differences at 0.05 level ($p < 0.05$).

It is concluded that four TQM facilitators top management commitment and support, customer satisfaction, empowerment and continuous improvement and three IT resources computer aided design, computer aided manufacturing are effectively executed in the ICT industry, while three TQM facilitators continuous training, culture change, democratic management style and two IT resources electronic data interchange and statistical packages for social science are partially executed across ICT industry of India. The remaining facilitator total employee involvement, teamwork and IT resource computer aided engineering, computer aided process and planning, and structural equation modeling are effort executed across the ICT industry.

6.6. EXAMINE THE RELATIONSHIP AMONG NAMED TQM FACILITATOR AND IT RESOURCE ON CUSTOMER SATISFACTION IN INDIAN INDUSTRY

This section deals with the relationship between TQM facilitator, IT resources and customer satisfaction. To achieve this objective, research question (RQ5) and hypothesis (H5) is proposed. Responses were received based on 5-point Likert scale where 1 representing “strongly disagree” and 5 “strongly agree”. The research question and hypothesis were:

RQ5: Do the named TQM facilitators and IT resources have relationship with customer satisfaction in ICT industry of India.

- H5: There are significant positive relationships between TQM facilitators and IT resources and customer satisfaction.
- H51: Top management commitment and support for TQM facilitators have positive relationship with the customer satisfaction.
- H52: Empowerment for TQM facilitators have positive relationship with the customer satisfaction.
- H53: Total employee involvement for TQM facilitators have positive relationship with the customer satisfaction.
- H54: Continuous improvement for TQM facilitators have positive relationship with the customer satisfaction.
- H55: Continuous training for TQM facilitators have positive relationship with the customer satisfaction.
- H56: Teamwork for TQM facilitators have positive relationship with the customer satisfaction.
- H57: Culture change for TQM facilitators have positive relationship with the customer satisfaction.
- H58: Democratic management style for TQM facilitators have positive relationship with the customer satisfaction.
- H59: Electronic data interchange for IT resource have positive relationship with the customer satisfaction.
- H5 10: Computer aided design for IT resource have positive relationship with the customer satisfaction.
- H511: Computer aided manufacturing for IT resource have positive relationship with the customer satisfaction.
- H5 12: Enterprise resource planning for IT resource have positive relationship with the customer satisfaction.
- H5 13: Computer aided process planning for IT resource have positive relationship

with the customer satisfaction.

H514: Computer aided engineering for IT resource have positive relationship with the customer satisfaction.

H5 15: Statistical package for social science for IT resource have positive relationship with the customer satisfaction.

H5 16: Structural equation modeling for IT resource have positive relationship with the customer satisfaction.

6.6.1. VARIABLE MEASUREMENT

Independent Variable

A total no. of 152 items captured for the TQM facilitator and IT resources under investigation. These items have been taken from different studies by various authors [51; 211; 205; 409; 410]. These studies were selected because scales have good reliability and validity in all respective and these studies have been done specifically in the ICT industry. In the present research, customer satisfaction is dependent variable and remaining 16 variables are an independent variable.

Dependent Variable

It is a type of variable which is dependent on the other factors. The variable which is affected by the force of measure of changes in independent variables. All the variables deal with product and service quality, employee satisfaction, quality performance and customer fulfillment. In the present study CS chosen as dependent variable which was derived and adapted from numerous existing studies [246; 411; 133]. The research instrument followed a 5-point Likert scale with the choice of responses as strongly disagree to strongly agree to measure customer satisfaction.

6.6.2. RELIABILITY AND VALIDITY

There are basic two requirements to measure the variables. First, measures the variable should be accurate or valid and second measurement process check the outcome variables must be consistent or repeatable

Reliability

Reliability test can be expressed in terms of stability, equivalence and consistency. Reliability test measures internal consistency which is commonly expressed in the form of Cronbach alpha [413]. According to Black [414] reliability test measure how well the various items measure the same thing. The reliability of the different factors should be examined to support any measures of validity. Although there is four methods suggested by Nunnally to measure reliability. But present research considered only Cronbach alpha's is the all possible spilt half coefficient resulting from different ways of splitting the scale items [397].

Table 6.8. Scale Reliability of TQM facilitators & IT resources

Items	Original Number of Items	Original Alpha (Reliability)	Items Deleted	Final Number of Items	Final Alpha (Reliability)
Top Management commitment (TMCS)	8	0.872	1	7	0.890
Empowerment (EMPW)	8	0.841	1	7	0.852
Total Employee Involvement (TEI)	8	0.792	None	8	0.792
Continuous Improvement (CI)	9	0.793	None	9	0.793
Continuous Training (CT)	8	0.764	None	8	0.764
Teamwork (TW)	9	0.792	None	9	0.792
Culture Change (CC)	8	0.804	None	8	0.804
Democratic Management Style (DMS)	9	0.835	None	9	0.835
Electronic Data Interchange (EDI)	10	0.798	None	10	0.798
Computer Aided Design (CAD)	9	0.858	None	9	0.858
Computer Aided Manufacturing (CAM)	9	0.872	None	9	0.872
Enterprise Resource Planning (ERP)	9	0.824	None	9	0.824
Computer Aided Process Planning (CAPP)	7	0.861	None	7	0.861
Computer Aided Engineering (CAE)	7	0.854	None	7	0.854
Statistical Packages for Social Science (SPSS)	9	0.805	None	9	0.805

Structural Equation Modeling (SEM)	7	0.799	None	7	0.799
Customer Satisfaction (CS)	9	0.770	4	5	0.789
Total	143		6	135	

In other words, Cronbach alpha is used to measure of the reliability of a psychometric test. It measures internal consistency among a group of different items combined to form a single scale. Cronbach alpha tends to be high if the scale items are highly correlated [403]. The value of Cronbach alpha coefficient 'a' ranges lies between 0 to 1. Generally, Cronbach alpha should be at least 0.70 are considered as good and reliable [415; 416; 403]. However, there is no particular opinion on the value of Cronbach alpha for internal consistency of items. The Cronbach alpha in each category of different items was computed which comes out in the form of data reduction. By using SPSS 22, An reliability test was performed for the items of independent TQM facilitator and IT resource and on one dependent variable customer satisfaction. In the above Table 6.3, there are 16 independent variables (TQM facilitator & IT resource) and one dependent variable (Customer Satisfaction). Goble and Wolf [417] considered that 0.80 alpha value is good whereas (Cortina [418]) suggests that alpha coefficient is above 0.85 is quite good. Nunnally [416] suggests that minimum reliability coefficient < 0.70 is acceptable. The summary of internal reliability test for all the items is presented in the Table. It is seen reliability test value lies between 0.764 to 0.892. After applying reliability test six items were deleted to increase the reliability of the scale. The total item was 152 after performing reliability test reduced to 137 items.

Validity

The validity of an instrument is the degree to which measure what it is supposed to measure. Validity measurement gives very consistent results as compared to reliability tests. Validity is often defined as the extent to which an instrument measure, what it is support to measure [419]. Also, validity requires that an instrument reliable without being valid. It is an evaluation of the extent to which theory and empirical evidence support the inference and explanation of the research data. There are various types of validity test that will be discussed in the below section.

- **Face validity**

A scale is said to have face validity if it ‘looks like’ it is going to measure what is supposed to measure [420]. It is the subjective judgment of the individual’s items which is rated by expert judges (Hair *et al.*, [403]). TQM facilitators & IT resources identified from an extensive literature review, selection of items was justified and ensures by face validity instruments. Face validity was established by different experts for e.g. academicians, industrialists and quality performance.

- **Content validity**

Content validity is a general agreement among the subjects and researchers that the instrument has measurement items that cover all aspects of the variable being measured [26]. According to Robinson *et al.*, [421] content validity is to ensure that the selection of construct items extends past empirical issue also to include theoretical and practical consideration. An exhaustive literature review and dialogue with experts helped in ensuring content validity. The 17 constructs for measuring TQM and IT execution had content validity as the measurement items were developed from the extensive literature review as well as by detailed evaluation from the academicians and managers. It avoids repetition of similar statements and adding a more suitable term for the better understanding of the respondents. Hence, it is strongly built a methodologically rigorous assessment of survey instrument's content validity.

- **Construct validity**

Construct validity was designed to measure the theoretical constructs [422]. Construct validity is performed to check whether there exist any subscales within the same construct. Factor analysis can be used for construct validity. Factor analysis helps to find out the closeness of data and data interpretation in which items are compressed into common interrelated and meaningful dimension [423]. It is a multivariate data reduction technique, consisting of the method of extraction the components and the method of rotation for interpretation of the factors [220]. It helps in reducing a large correlated variable to a set of independent underlying factors. Coakes *et al.*, [424] found that factor analysis employed as associate preliminary technique once the researcher needs to summarize the structure of a

group of variables.

There are two types of factor analysis, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) both have been used for defining the underlying dimension in a data matrix. On the basis of nature of the study, both EFA and CFA were used to measure the construct validity.

6.7 EXPLORATORY FACTOR ANALYSIS (EFA)

EFA can be used to find out the underlying structure of a moderately large set of variables set up links when the observed (items) and latent (independent) variables are unknown or uncertain [26]. EFA helps to identify whether or not selected things cluster on one or even more than one construct and therefore unidimensional of the construct is evaluated. EFA defines how and what extent the observed variables are related to their underlying constructs [428]. There are seven different types of extraction method named as, Principle component analysis (PCA), Unweighted least squares, Generalized least squares, Maximum likelihood analysis (MLA), Alpha factoring and Image factoring. In the present study researcher used PCA extraction method. PCA is the most often type of factor analysis, which is used to summarize almost all of the original information in a minimum number of factors for assessment purpose. PCA obtains a linear combination of variables such as the most variance is taken from the variables. Furthermore, eliminate this variance and obtain a second linear combination that indicates the whole relationship of the remaining variance etc. PCA achieves the set of factors which address for all the common and certain variance in a set of variables. Multiple criteria for identifying the number of factors to retain were used such as Kaiser's criterion, where only factors with eigenvalues greater than 1 are retained (Kaiser's [429]); cumulative % of variance explained; and the scree plot of factor eigenvalues. Among the three techniques eigenvalue is the most commonly used factor extraction method. Factor having greater than one are considered significant and remaining factors with eigenvalue less than one are considered insignificant and are ignored. Another two techniques, percentage of variance and scree test are considered to subjective (Zhang *et al.*, [246]) and it is most frequent in social sciences to consider a solution that accounts for 60 percent of the total variance as a suitable solution [429]. For a psychometric purpose, factor loading greater than 0.30 is considered to meet the minimal level, loading are 0.40

are considered more important and loading is 0.50 or greater than are considered highly significant. In the current study factor loading 0.50 is the cutoff point [403; 431]. Another important concern is the type of rotation to be employed. The rotation of factor is done to improve the meaningful, reliability and reproducibility of factors. The goal of rotation is to simply and classify the data structure. There are two kinds of rotation oblique rotation that allow for factor correlation and another one is orthogonal rotation that assumes the factor are not correlated. When the primary goal is to reduce the data researcher usually go for orthogonal rotation. Oblique rotation is used when the objective is to obtain different theoretically meaningful factors [431]. Mostly used rotation is orthogonal rotation having different methods Varimax, Quartimax, Equamax, Promax and Direct Oblimin. In the current study researcher iterated with PCA method followed by Varimax orthogonal rotation.

Table 6.9 Rotated factor loading related to TQM facilitators and IT resources

Factor loading																			
TQM Facilitators & IT Resources	Measure Item	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	No. of Items deleted
TMCS	TMCS 1	0.75	0.06	0.13	-0.03	0.41	0.13	0.22	0.03	0.05	-0.02	0.02	-0.06	-0.09	-0.12	0.08	0.09	0.08	3
	TMCS 2	0.73	0.08	0.09	-0.08	0.33	-0.10	0.11	0.03	0.02	0.12	0.07	0.06	0.10	-0.00	0.03	0.03	0.23	
	TMCS 3	0.70	0.12	0.11	0.08	0.46	0.08	-0.01	0.15	0.00	0.15	0.12	0.05	-0.12	-0.12	0.13	0.04	0.07	
	TMCS 4	0.71	0.10	-0.01	0.23	0.21	0.23	0.09	0.16	-0.10	0.12	0.22	0.03	-0.13	0.09	0.07	0.16	0.06	
	TMCS 6	0.62	0.16	-0.02	0.07	0.05	0.07	0.11	0.22	-0.02	0.17	0.21	-0.02	-0.10	0.11	0.03	0.21	0.09	
EMPW	EMPW 2	-0.02	0.61	0.09	0.06	-0.12	0.06	0.23	0.31	-0.12	0.20	-0.01	0.06	-0.07	0.00	0.13	0.23	0.23	3
	EMPW 3	0.10	0.53	0.04	0.09	-0.05	0.09	0.23	0.33	0.09	-0.01	-0.05	0.09	0.10	-0.02	0.12	0.07	0.33	
	EMPW 4	0.08	0.51	0.12	-0.11	0.06	0.22	0.07	0.35	0.11	-0.03	-0.04	0.23	0.23	-0.12	0.17	0.06	0.22	
	EMPW 6	0.22	0.50	0.23	0.35	0.09	0.27	0.01	0.23	0.00	-0.05	-0.03	0.33	0.06	0.09	0.20	0.09	0.20	
	EMPW 7	0.33	0.58	0.06	0.23	0.23	0.30	-0.02	0.23	-0.02	0.22	0.11	0.22	0.23	0.11	-0.01	0.22	0.11	
TEI	TEI 1	0.08	-0.01	0.50	0.23	0.33	-0.12	0.16	0.07	0.22	0.19	0.22	0.20	-0.02	0.00	-0.03	0.27	0.11	3
	TEI 2	0.23	0.11	0.53	0.07	0.22	-0.01	0.05	0.35	0.21	0.16	0.21	0.11	0.16	-0.02	-0.05	0.30	0.23	
	TEI 3	0.07	0.07	0.51	0.01	0.20	-0.05	0.21	0.46	0.07	0.24	0.07	-0.12	0.05	0.22	0.05	-0.12	0.23	
	TEI 5	0.06	0.24	0.52	-0.05	0.11	0.10	0.26	0.21	0.24	0.29	0.24	-0.13	0.33	0.21	0.02	-0.01	0.07	
	TEI 6	0.09	0.33	0.51	0.09	-0.02	0.23	0.23	0.05	0.33	-0.12	0.33	-0.10	0.11	-0.12	0.00	-0.05	0.01	
CI	CI 1	0.23	0.10	-0.03	0.50	0.16	0.06	0.17	-0.12	0.10	-0.11	0.10	-0.01	0.00	0.13	-0.10	-0.01	-0.02	5
	CI 2	0.33	0.23	0.14	0.52	0.05	0.23	0.20	0.10	0.23	0.33	-0.12	0.04	-0.02	-0.10	-0.02	-0.05	0.16	
	CI 4	0.22	0.06	0.11	0.58	0.06	-0.02	-0.05	0.23	0.10	0.22	0.09	0.05	0.22	0.08	-0.12	-0.04	0.05	
	CI 7	0.20	0.23	0.27	0.54	0.09	0.16	0.10	0.06	0.29	0.27	0.11	0.15	0.21	0.23	0.21	-0.03	0.21	

CT	CT 1	0.11	0.27	-0.12	0.43	0.50	0.05	0.23	0.23	0.25	0.30	0.00	0.16	0.07	0.07	0.05	0.11	0.26	5
	CT 3	-0.02	-0.02	0.34	0.40	0.57	0.33	0.06	0.27	0.28	-0.12	-0.02	0.19	0.24	0.06	-0.12	0.22	-0.12	
	CT 6	0.16	0.08	0.15	0.39	0.58	0.24	0.23	0.09	0.37	-0.01	0.22	-0.11	0.33	0.09	0.10	0.21	-0.00	
TW	TW 1	0.05	0.22	0.12	0.22	0.49	0.58	0.27	0.10	0.35	0.33	0.21	-0.07	0.10	0.16	0.23	0.07	-0.12	
	TW 2	0.04	0.33	0.10	-0.11	0.41	0.51	-0.02	-0.03	-0.12	0.34	-0.12	-0.08	0.23	0.18	0.06	0.24	0.09	
	TW 5	0.21	0.08	0.16	0.21	0.39	0.51	0.08	-0.02	0.00	0.17	0.16	-0.03	0.10	0.07	0.23	0.33	0.11	5
	TW 8	0.11	0.07	0.01	-0.08	0.33	0.50	0.22	-0.07	0.11	0.15	0.19	-0.08	0.29	0.01	0.07	-0.02	0.12	
CC	CC 3	0.09	-0.01	0.20	-0.09	0.03	0.16	0.51	0.24	0.17	0.12	-0.09	0.08	0.25	-0.02	0.24	0.22	0.15	5
	CC 5	0.11	-0.05	-0.01	0.10	0.15	0.05	0.52	0.28	-0.12	0.39	-0.08	0.23	0.28	0.16	0.33	0.21	0.12	
	CC 6	0.00	0.04	-0.03	-0.12	0.16	0.21	0.53	0.33	0.21	0.35	0.19	0.07	0.10	0.05	0.10	-0.12	0.17	
DMS	DMS 1	-0.02	0.03	-0.05	-0.13	0.22	0.26	0.11	0.55	0.34	0.30	0.12	0.06	0.08	0.21	-0.12	0.16	0.20	5
	DMS 2	0.22	0.11	0.22	-0.10	0.31	0.23	0.00	0.54	0.40	0.11	0.15	0.09	0.22	0.26	0.09	0.19	-0.01	
	DMS 7	0.21	0.10	0.19	0.07	0.33	0.17	-0.02	0.51	0.41	0.19	0.22	-0.11	0.33	0.23	0.11	-0.09	-0.03	
	DMS 8	0.07	0.16	0.16	0.06	0.35	0.20	0.22	0.51	0.39	0.39	0.21	-0.05	0.08	0.17	0.00	-0.08	-0.05	
EDI	EDI 2	0.24	0.05	0.24	0.09	0.23	-0.01	0.21	0.10	0.67	0.35	0.34	0.06	0.23	0.20	-0.02	0.19	0.22	7
	EDI 8	0.33	0.21	0.29	-0.11	0.23	-0.03	0.07	0.08	0.51	0.30	0.22	0.09	0.07	-0.01	0.22	0.12	0.19	
	EDI 10	0.10	0.26	-0.12	-0.05	0.07	-0.05	0.24	0.22	0.53	0.33	0.36	0.23	0.06	-0.03	0.22	0.07	-0.01	
CAD	CAD 2	-0.00	0.23	-0.01	0.06	0.35	0.23	0.33	0.33	-0.08	0.56	0.25	0.33	0.21	-0.05	0.33	0.06	-0.05	6
	CAD 6	-0.00	0.17	-0.03	0.09	0.46	0.17	0.10	0.08	0.08	0.53	0.33	0.22	0.25	0.22	0.08	0.09	-0.04	
	CAD 7	-0.02	0.20	-0.05	0.23	0.11	0.20	0.23	0.23	0.23	0.56	0.30	0.20	0.25	0.19	0.23	0.22	-0.03	
CAM	CAM 5	-0.05	-0.01	0.22	0.33	0.22	-0.01	0.10	0.07	0.07	0.03	0.53	0.11	0.27	0.16	0.07	0.27	0.11	5
	CAM 6	0.08	0.16	0.19	0.19	0.21	-0.03	0.29	0.06	0.06	-0.02	0.52	0.22	0.31	0.24	0.06	0.30	0.22	
	CAM 7	0.23	0.19	0.16	-0.12	0.07	-0.05	0.09	0.16	0.09	0.06	0.56	0.25	0.30	0.29	0.09	-0.12	0.21	
	CAM 8	0.07	-0.09	0.10	-0.13	0.24	0.22	0.23	0.05	-0.11	0.09	0.50	0.26	0.35	0.21	0.23	-0.01	0.07	

ERP	ERP 1	0.06	-0.08	-0.12	-0.10	0.33	0.19	0.33	0.21	-0.05	0.23	0.23	0.52	0.33	0.20	0.33	-0.05	0.24	5
	ERP 3	0.09	0.19	0.09	-0.01	0.10	0.16	0.22	0.26	0.06	0.33	-0.07	0.53	0.41	0.28	0.22	0.10	0.33	
	ERP 4	0.22	0.12	0.11	0.04	-0.12	0.24	0.20	0.23	-0.05	0.22	-0.01	0.51	0.44	0.29	0.20	0.21	0.20	
	ERP 8	0.31	0.15	0.00	0.05	0.09	0.29	0.11	0.17	-0.04	0.20	0.12	0.51	0.37	0.31	0.11	0.05	-0.01	
CAPP	CAPP 4	0.33	0.22	-0.02	0.15	0.11	0.21	-0.12	0.20	-0.03	0.11	0.15	0.06	0.56	0.35	0.23	-0.12	-0.03	4
	CAPP 6	0.35	-0.01	0.22	0.16	0.00	0.00	-0.13	-0.01	0.11	0.00	0.12	0.09	0.55	0.41	0.33	-0.05	-0.05	
	CAPP 7	0.23	-0.03	0.22	0.19	-0.02	-0.02	-0.10	0.16	0.07	-0.02	0.17	0.23	0.62	0.39	0.22	0.06	0.22	
CAE	CAE 4	0.23	-0.05	0.33	-0.11	-0.12	-0.12	0.23	0.19	0.01	0.22	0.20	0.10	0.20	0.66	0.20	0.09	0.19	3
	CAE 5	0.19	0.22	0.08	-0.00	-0.05	0.09	0.07	0.10	-0.02	0.21	-0.01	-0.12	-0.01	0.62	0.39	0.21	0.16	
	CAE 6	0.17	0.19	-0.01	-0.01	0.06	0.11	0.06	-0.12	0.16	0.07	-0.00	0.09	-0.03	0.53	0.41	-0.11	0.24	
	CAE 7	0.18	0.16	0.09	-0.03	-0.03	0.00	0.09	-0.13	0.05	0.24	-0.02	0.08	-0.05	0.55	0.49	-0.00	0.29	
SPSS	SPSS 1	0.21	0.10	0.11	-0.05	0.11	-0.02	0.23	-0.10	0.21	0.33	-0.01	0.08	0.07	-0.12	0.52	0.26	-0.12	6
	SPSS 6	0.00	0.23	0.23	0.04	0.22	0.22	0.29	0.07	-0.04	0.29	-0.03	0.23	0.24	0.09	0.55	0.12	-0.14	
	SPSS 7	0.00	0.06	0.23	0.03	0.21	0.21	-0.12	0.15	-0.03	-0.12	-0.05	0.07	0.33	0.11	0.64	0.17	0.09	
SEM	SEM 3	0.02	0.23	-0.07	0.11	0.19	-0.12	-0.01	0.16	0.11	-0.01	-0.00	0.06	0.10	0.00	0.07	0.60	0.23	4
	SEM 5	0.05	-0.02	-0.01	0.10	0.11	0.06	-0.03	0.19	0.22	-0.03	-0.00	0.16	-0.12	-0.02	0.06	0.63	0.33	
	SEM 7	0.09	0.16	-0.02	0.16	0.10	0.23	-0.05	-0.11	0.10	-0.05	-0.01	0.05	0.09	-0.12	0.09	0.61	0.21	
CS	CS 3	0.09	-0.01	0.16	-0.09	0.12	-0.02	0.23	-0.00	0.22	-0.09	-0.02	0.21	0.11	-0.05	0.22	0.22	0.76	5
	CS 4	0.23	-0.00	0.05	-0.07	0.06	0.16	-0.02	-0.01	0.19	-0.08	-0.05	0.11	0.00	0.06	0.27	0.21	0.62	
	CS 8	0.20	-0.02	0.01	0.15	0.09	-0.01	0.16	-0.03	0.17	0.19	0.16	0.22	-0.02	-0.04	0.30	0.07	0.74	
	CS 9	0.19	0.03	0.12	0.01	0.21	0.00	0.17	0.01	0.21	0.12	0.19	0.10	0.22	-0.03	-0.12	0.24	0.71	
Eigen value		37.07	10.06	4.53	3.96	3.52	3.22	3.14	2.94	2.69	2.62	2.54	2.28	2.19	2.06	2.00	1.92	1.82	
% Variance Explained (64.04)		25.96	7.03	3.17	2.77	2.46	2.25	2.19	2.06	1.88	1.83	1.78	1.59	1.53	1.44	1.40	1.34	1.27	

Table 6.10 Sample Adequacy test

KMO and Bartlett's test		
Kaiser- Meyer-Olkin Measure of Sampling Adequacy		0.777
Bartlett's Test of Sphericity	Approx. Chi- Square	49264.57
	df	10153
	Sig.	0.000

The factor analysis results are shown below in the Table 6.9, it is found that all the 151 items in 17 factors. According to Hair et al., [403] if the sample size is more than 100 means acceptable. The sample size of this study is 319 which is acceptable and could achieve good results. Factor loading obtained for each item, higher the loading better representation of an item and overall factors. The EFA extracted for 17 factors with the eigen value higher than 1, and total variance explained 64.04%. There are 78 items deleted due to low loading such as top management commitment and support- 3 items; empowerment-3 items; total employee involvement-3 items; continuous improvement-5 items; continuous training- 5 items; teamwork-5 items; culture change- 5 items; democratic management style- 5 items; electronic data interchange-7 items; computer aided design- 6 items; computer aided manufacturing- 5 items; enterprise planning - 5 items; computer aided process planning- 4 items; computer aided engineering- 3 items; statistical packages for social science-6 items; structural equation modelling- 4 items and customer satisfaction- 5 items.

The KMO measure of sampling adequacy was 0.777 (Table 6.10) which is greater than 0.60 indicates sufficient correlations while the Barlett's test of sphericity was significant (Chi square= .49264, df=10153, sign=.000). Finally, a total no. of 72 items loaded in the construct were retained for further analysis.

6.8 CONFIRMATORY FACTOR ANALYSIS (CFA)

CFA was used to determine construct validity of the survey Items. It means how well is the construct explained the variables under the constructs [431]. CFA is used to examine the variables that define a construct that cannot be measured directly [433]. Analysis of the indicators that are used to give the meaning of the label was given to the latent variables or construct that being confirmed. The interpretation of the result by EFA is limited by the subjectivity in which factor loading, cross loadings and

factor independence are assessed. CFA is recommended to overcome the EFA limitations [434]. CFA is a theory driven confirmatory technique, which implies that theory guides the relationship between observed and unobserved variables. It is a way to either confirm or reject a theory. In essence, a CFA measurement model is used to examine the extent of interrelationships and co-variations among latent constructs.

CFA model was applied for each construct to eliminate items with weak loading coefficient (>0.5) and to validate measurement model [435]. There are no set rules for assessing how the model fit per se. To validate the constructs CFA output includes fit indices, the construct must meet the Good-of-fit (GOF) indices acceptable values. Assessing the fitness of the construct fit the data or not [436; 437]. There are many indices show the GOF like Goodness of-fit index (GFI), normal fit index (NFI), comparative fit index (CFI), nonnormed fit index (NNFI), also named Tucker Lewis index (TLI) [438;436]). The most common GOF indices used are Chi- Square Statistics, root mean square error of approximation (RMESA), GFI, TLI, NFI [439].

CFA Measurement Model

To apply CFA under structural equation modelling (SEM) approach most of indices are categorized into three parts, absolute GOF indices, Parsimonious GOF indices and incremental GOF indices. The first category is absolute GOF indices evaluate the overall incongruity between observed and implied covariance matrices [440]. GFI (Goodness of Fit Index) and SRMR (Standardized Root Mean Square Residual) are reported as absolute indices. Parsimonious indices appraise the discrepancy between observed and expected covariance matrices while taking into account the model's complexity. The RMESA (root mean square error of approximation) and AGFI (Adjusted Goodness of Fit Index) are parsimonious index. NFI (Normed Fit Index) and CFI (Comparative Fit Index) are incremental indices compares the performance of the proposed model with the model.

The selected indices like Chi square, degree of freedom, GFI, AGFI, RMESA, and NFI were used by Hair et al., [402]. It is mandatory that Chi-square test and its degrees of freedom is associated with p-value Hooper et al., [441]. Many researchers

suggest that Chi- square/df value between 1 to 5 are more appropriate (Chin et al., [442]; Salisbury et al., [443]) however less than 3 value considered as good [444]. The value of GFI and AGFI above are 0.9 considered a good fit [445]. According to Hair et al., [403] GFI greater than 0.85 and AGFI greater than 0.80 are also acceptable, whereas for NFI and CFI also greater than 0.9 value recommended [432; 443]. According to Hair et al., [43] indices NFI values greater than 0.80 are also acceptable. While the acceptable value of RMSEA below 1.00 shown a good fit [431]. Table 6.11 shows that CFA measurement model is fit on the basis of model fit indices value which is acceptable means model (Figure 6.13) can go for further analysis.

Table 6.11. Model fit Indices of CFA model

Model Fit Index	Calculated Value	Acceptable Value
Chi-square/df	1.734	1 to 5
GFI (Goodness Fit Index)	0.778	<0.9
AGFI (Adjusted Goodness Fit Index)	0.746	<0.9
Root Mean Squared Error	0.048	<1.00
Normative Fit Index (NFI)	0.553	<0.9
Confirmative Fit Index (CFI)	0.735	<0.9

Validity and Reliability Test:

As an overall model accepted, now each of the factor was evaluated separately for composite reliability (CR) and average variance extracted (AVE). According to Hair et al., [403] value of composite reliability (CR) should be <0.7 and average variance extraction (AVE) <0.5 . The below Table demonstrated that CR ranges from 0.718 to 0.877 and AVE value lies between 0.522 to 0.668.

Table 6.12. Validity test

Latent Construct	Composite Reliability (CR)	Average Variance Extracted (AVE)
TMCS	0.872	0.668
EMPW	0.814	0.558
TEI	0.758	0.573
CI	0.718	0.568
CT	0.839	0.550
TW	0.850	0.575
CC	0.816	0.645
DMS	0.789	0.633
EDI	0.802	0.583
CAD	0.745	0.561
CAM	0.748	0.522
ERP	0.756	0.573
CAPP	0.808	0.561
CAE	0.755	0.545
SPSS	0.745	0.562
SEM	0.761	0.552
CS	0.877	0.670

Common Method Bias:

It implies that some external factor which is not related to the variables, was able to influence the dataset. There are different ways to measure CMB, but in the present study, we have gone for Harman's single factor analysis [447]. In this analysis, extraction method constrained no. of factor is 1 and unrotated solution. If it is observed from a dataset that maximum variance explained by single factor, hence it is concluded that dataset is not suffered from the common method bias. In the present study maximum variance explained by variance is 27.09%, which is $>50\%$ variance it means present dataset is not suffered from common method bias.

Invariance Test: Invariance testing confirmatory factor analysis is carried out to assess the measurement model across different groups. The researcher divided the

sample into specific groups based on demographics. The division of the demographic on the basis of gender, one group is divided into male and another one is into female.

6.9 PATH ANALYSIS AND HYPOTHESIS TESTING (STRUCTURAL EQUATION MODELING)

SEM is a general purpose, powerful tool for statistical analysis and modeling of interactions between observed and unobserved variable [448]. It gives the statistical approach for understanding the nature of fundamental constructs as well as the influence of the constructs upon one another [449;450]).

After the validity of measure used has been attained and an acceptable model goodness-of-fit achieved, only then the structural can be constructed and tested [436; 452;453]). In the present research, the measurement model was found to be a good fit and the validity of measure was confirmed. Then the structural model of industrial effectiveness was tested. Maximum Likelihood Estimation (MLE) was employed in AMOS for calculating path analysis. It is robust and logically tolerant violations which are common in psycho-behavioral studies. Path analysis to describe the directed dependencies among of variables. It is assumed that all variables are measured without error.

Table 6.13. Model Indices of Path model (SEM)

Model Fit Index	Model 1	Model 2	Expected values
GFI (Goodness Fit Index)	0.771	0.749	<0.9
AGFI (Adjusted Goodness Fit Index)	0.742	0.702	<0.9
Root Mean Squared Error (RMSE)	0.766	0.764	<1.00
Normative Fit Index (NFI)	0.381	0.373	<0.9
Confirmative Fit Index (CFI)	0.378	0.36	<0.9

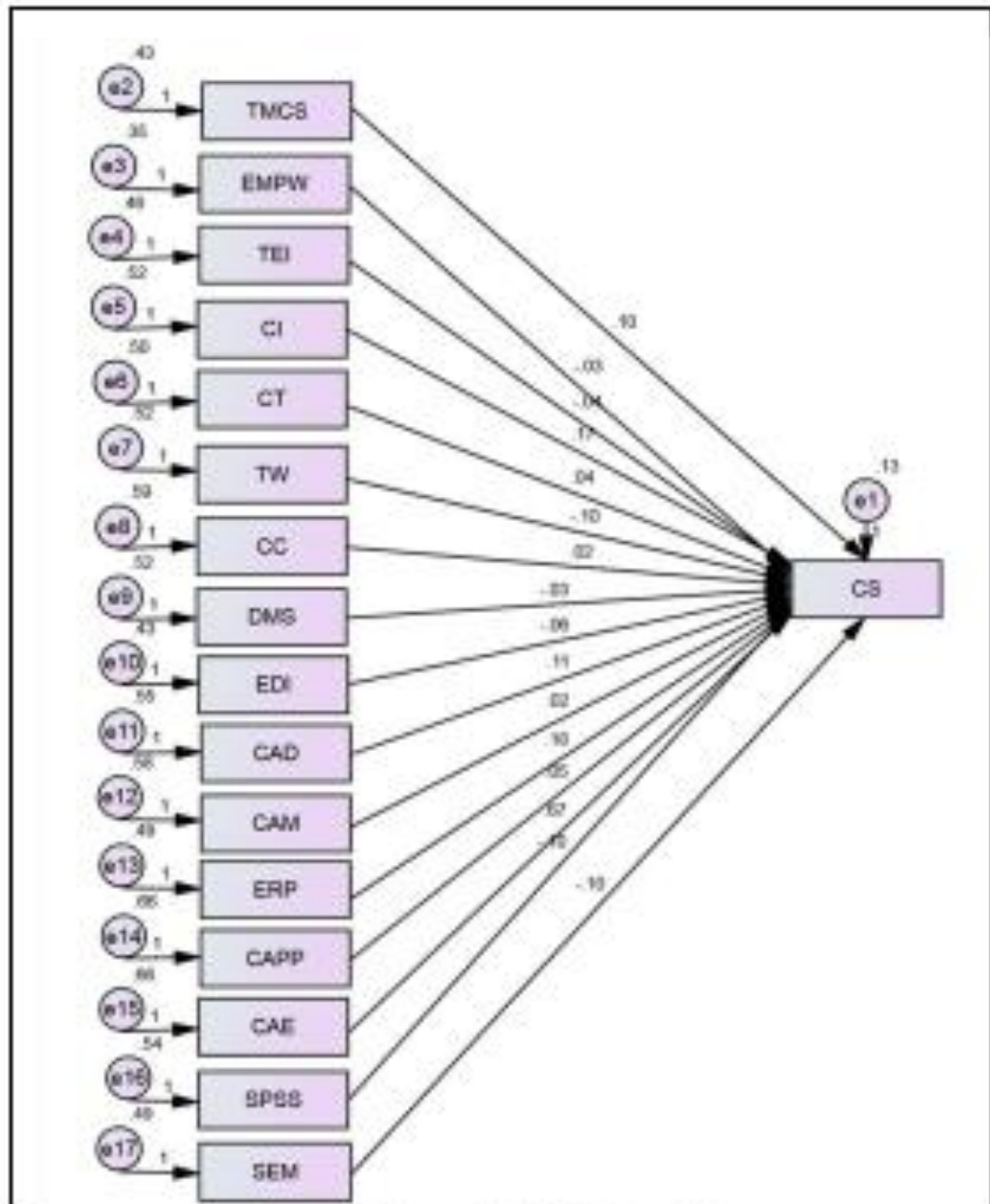


Figure 6.13 : Structural model of factors on CS

Table 6.14. Summary of SEM results and Hypothesis testing

Hypotheses	Path	Estimate	C.R	P value	Result
H61	TMCS → CS	.098	3.25	0.001***	Significant
H62	EMPW → CS	-.029	-0.85	0.395	Insignificant
H63	TEI → CS	-.036	-1.20	0.227	Insignificant
H64	CI → CS	.028	6.27	0.000***	Significant
H65	CT → CS	.028	1.26	0.206	Insignificant
H66	TW → CS	.028	-3.69	0.000***	Significant
H67	CC → CS	.026	0.65	0.511	Insignificant
H68	DMS → CS	.028	-1.15	0.249	Insignificant
H69	EDI → CS	.030	-2.11	0.034*	Significant
H610	CAD → CS	.027	4.13	0.000***	Significant
H611	CAM -----> CS	.026	0.83	0.404	Insignificant
H612	ERP → CS	.028	6.32	0.000**	Significant
H613	CAPP → CS	.025	1.86	0.062	Insignificant
H614	CAE → CS	.024	27.3	0.000***	Significant
H615	SPSS → CS	.027	-3.64	0.000***	Significant
H616	SEM → CS	.028	-3.51	0.000**	Significant

Significant at $p < 0.05^*$, $p < 0.01^{**}$, $p < 0.001^{***}$

To the overall model (Figure 6.14), we could claim that there is nine direct relationships between hypothesis means path are important, whereas eight hypothesis have indirect relationship means path are insignificant (Table 6.14). H61 proposed that top management commitment & support (TMCS) importantly correlated with the customer satisfaction. The relationship between TQM facilitator TMCS and CS was significant with $p = .001 (< .05)$ and well supported. The estimated value 0.098 shown that TMCS gives better execution positive effect on customer satisfaction. In supporting this result, Javed [454] found that top management is an industry is positively related to the success of quality management. Kaynak [60] state that management leadership is positively related to the training which will directly affect the customer satisfaction. Effective leadership has a critical impact on industrial changes especially in purchasing that improve interactions with the customers.

H62 proposed that empowerment (EMPW) has not positively related to the customer satisfaction. The relationship of EMPW and CS was not significant ($C.R = -0.85$) and not supported. The finding support previous studies suggests that there is no

significant relationship between empowerment and customer satisfaction [453; 456]. The next hypotheses H63 shows that total employee involvement (TEI) has not positively related to customer satisfaction. The relationship of TEI on CS was not significant with $p = 0.227$ ($p < 0.50$) and not supported.

H64 presents that continuous improvement (CI) have significantly related to the customer satisfaction, it means that the relationship between CI and CS was significant with $p = .000$ (< 0.001) value and well supported. The estimate value 0.028 which gives the positive effects on customer satisfaction. Regarding to the evidence of this hypothesis were found in the Jung and Wang [289] and showed the relationship between continuous improvement and performance of the industry. It is used as a method to identify opportunities for organizing work and reducing the time, which is by default affecting the relationship between continuous development and customer satisfaction.

H65 proposed that continuous training (CT) not importantly correlated with the customer satisfaction i.e. the relationship between CT and CS was not significant with $p = 0.206$ and not supported. However, this result is consistent with the findings of [245; 431]. Although training is important and management should understand that these activities tend to the long time commitment to the customers.

The upcoming hypotheses H66 offer that teamwork (TW) has positively related to customer satisfaction. The relationship between TW and CS was significant with $p = 0.000$ and well supported. Teamwork found as dominant TQM facilitators & they have a strong association with the customer satisfaction with previous findings [258; 353]. This result reveals that teamwork facilitates ability to work as a team with their full support [457; 257].

It was also discovered from the H67 hypotheses that TQM facilitators culture change (CC) is not positively related to customer satisfaction. The relationship between CC and CS was not significant with the $p = 0.511$ (< 0.050) and not well supported. This finding supported by the [458; 311]. This finding highlighted the culture change is not conducive to the execution of TQM which is not positively related to the customer satisfaction.

H68 proposed that DMS is not positively related to the customer satisfaction. The

relationship between DMS and CS is not significant with $p = 0.249$ ($p < 0.50$) and not well supported. Democratic management style focuses on people by empowering and involving them in decision making process, but sometimes decision making process takes a lot of time due to many employee's views which is badly effecting the productivity. The lesser employee productivity negatively affects the customer satisfaction (Puni et al., [459]) and organizational performances [460].

Regarding to IT resources hypotheses, H69 proposed that electronic data interchange (EDI) has positively related to the customer satisfaction. The relationship between EDI and CS is significant with $p = 0.034$ (< 0.5) and well supported. This result is consistent with the Sanchez-Rodriguez et al., [53] and Amine [461] also found EDI is directly supported to the customer relationship. EDI has been a most common technology used in managing the information flow with their customers and organizations. According to Scala and McGrath [462] and Canright [463] proposed the following advantages over customer satisfaction: decreasing necessary time to complete an order, improving the accuracy in the processing of the orders, satisfying customer demands.

H610 suggests that CAD has positively related to the customer satisfaction. The relationship between CAD and CS is significant with $p = 0.00$ (< 0.001) and well supported. This finding is assits by [53; 51]. CAD is the use of a wide range of computer based tools that assist engineers in their design activities and fulfills the customer demands [325].

H611 proposed that CAM is not positively related to the customer satisfaction. The relationship between CAM and CS in not significant with $p = 4.04$ (< 0.05) and not supported. CAM are widely used technologies in manufacturing therefore one of the most appropriate technologies to understand the relationship between IT and Product Process Management (PPM). Basically, it deals with engineers rather than customers.

H612 suggests that ERP has positively related to the customer satisfaction. The relationship between ERP and CS is significant with $p = 0.00$ (< 0.001) and well supported. ERP system investment are strategic in nature, with the key goal often being to help an organization sales, reduce production time and customer services

and satisfy the customers [464]. This results are supported by [53; 51]. The hypotheses, H613 offer that CAPP has negatively related to the customer satisfaction. The relationship between CAPP and CS is insignificant with the $p=0.062$ ($p<0.050$) and not supported.

Moreover, hypotheses H613 proposed that CAE has positively related to the customer satisfaction. The relationship between CAE and CS is significant with the $p=0.00$ ($p<0.001$) and well supported. Hypotheses H614 derivate that SPSS has positively related to the customer satisfaction and the relationship between SPSS and CS is significant with the $p=0.00$ ($p<0.001$) and well supported. Finally, hypotheses H617 offers that SEM is positively related to the customer satisfaction. The relationship between SEM and CS is significant with the $p=0.00$ ($p<0.001$) and well supported.

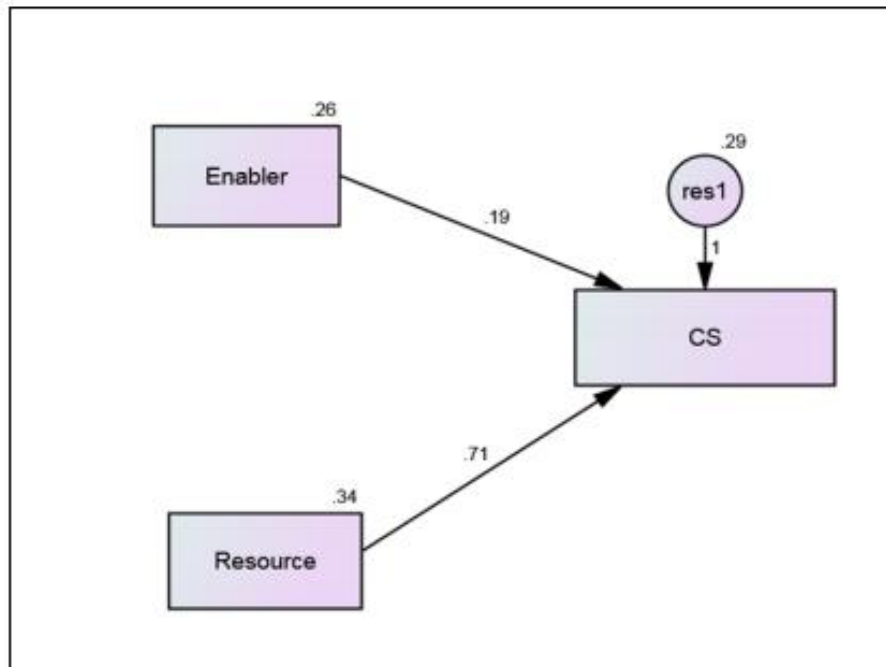


Figure 6.14 : Structural model of overall TQM facilitators and IT resources on CS

Table 6.15. Summary of SEM results and Hypothesis testing

Hypotheses	Path	Estimate	C.R	P value	Result
H617	Facilitator --- ► CS	4.61	8.67	.000***	Significant
H618	Resource ----- ► CS	1.85	4.08	.000***	Significant

H617 proposed that TQM facilitators have positively related to the customer satisfaction. The relationship between TQM facilitator and CS is significant with $p=0.000$ ($p<0.001$) and well supported (Table 6.15). This finding, reported by Sadikoglu and Olcay [237] that overall TQM facilitators improving the organizational performance, enhancing customer satisfaction, also increasing market and financial performance which are the primary reason of TQM facilitators.

H618 offers that IT resources have positively related to the customer satisfaction. The relationship between IT resources and CS is significant with $p=0.000$ ($p<0.001$) and well supported (Table 6.15). This result is consistent with earlier anecdotal evidence by [53; 51; 465].

6.10. SUMMARY

This chapter sought to achieve five research objectives. It began with a descriptive of a sample demographic profiles shown the characteristics of the respondents. The initial descriptive results provide the background of the respondents' profile and their knowledge toward the TQM and IT. The overall result shows that respondents who participated in this study were male and female, they were properly qualified and working in the ICT industry of India. The result of the variable measure based on the five-point Likert scale, these measurement scale for each variable satisfies at least the minimum acceptable level.

The next objective analyzes the awareness of TQM and IT in the ICT industry of India. This result extracted the majority of the variables mean values are greater than 3 which is more than mid-point scale employed. Also, most of the standard deviation values implies that the data are distributed consistently.

The third objective is name and grade the TQM facilitator and IT resource in the ICT industry of India. The result reveals that the most important facilitators named top management commitment and support, customer satisfaction, empowerment, teamwork, total employee involvement, continuous improvement, continuous training and least important facilitator are culture change and democratic management style. Similarly, results obtain the most significant resource namely, electronic data interchange, computer aided design, enterprise resource planning and least important such as, computer aided process planning, computer aided

engineering, statistical packages for social science and structural equation modelling.

The fourth objective was to examine the degree to which TQM facilitator and IT resources are executed in the ICT industry of India. Accordingly, it is used ANOVA test, having two assumptions first is used to test the normality of population and second is the homogeneity of variance assumptions means population is taken normal. Also, name 4 TQM facilitators, top management commitment & support, customer satisfaction, empowerment, continuous improvement and three IT resources computer aided design, computer aided manufacturing are effectively executed in the ICT industry, while continuous training, culture change, democratic management style, computer aided engineering, computer aided process planning and structural equation modeling are partially across ICT industry of India. The remaining facilitator total employee involvement, teamwork and IT resource electronic data interchange and software packages for social science effort can execute the TQM and IT across ICT industry.

The last objective evaluates the relationship among the name the TQM facilitators and IT resources on customer satisfaction in the ICT industry of India. Accordingly, the assessment of reliability and validity of each measurement scale is presented. The study observed the procedure by using exploratory factor analysis, confirmatory factor analysis. CFA validates the latent and observed variable. Finally, the hypothesized relationship between the variables were tested by using structural equation modelling.

CHAPTER – VII

IMPLICATION, CONCLUSION, LIMITATION AND FURTHER SCOPE

7.1.INTRODUCTION

In the wake of growing attempts to make changes into opportunities in the new industrial environment, there is extensive research on total quality management. The vital role played by information technology also for TQM. The purpose of this study to execute TQM and IT together in the ICT industry of India to satisfy the customer regarding to quality aspects. The present literature suggests that there is a lot of research have been done on TQM in a different industry, whereas there is no study on execution of TQM and IT together in a specific industry. There is an important effort in aiding and smoothing the adoption of IT by TQM in the late 1980's. But ICT industry easily and successfully aids the TQM and IT together in result of increased competition among industries. In different words IT support TQM which resulting increasing industrial performance because top management shows strongest points IT with business strategy. Due to this researcher try to combine TQM and IT. In the present model nine TQM facilitator and IT eight resources were considered from various academic and practitioner's perspective. They included top management commitment & support, customer satisfaction, empowerment, total employee involvement, teamwork, continuous improvement, continuous training, culture change, democratic management style, electronic data interchange, computer aided design, computer aided manufacturing, enterprise resource planning, computer aided process planning, computer aided engineering, statistical package for software and structural equation modelling. The execution of TQM and IT were formed by combining these facilitator and resources with the support of several previous researches.

In doing so a theoretical model was developed and tested using primary data obtained from questionnaire survey which is drawn from the ICT industry of India. By using different descriptive statistical analysis and SEM techniques were used to validate the model and the relationship between hypotheses.

7.2 SUMMARY OF CURRENT RESEARCH

This research was carried out to naming and execute the TQM facilitators and IT resources in the ICT industry of India. It means models were developed for the categorizing and grading the relations of TQM facilitators and IT resources. A literature review related to TQM execution in Indian industry was studied, whereas there is no specific study on TQM and IT together in the industry of India to satisfy the customer to fulfill the aspects of quality program. The present research covers the following objectives:

- To naming the TQM facilitators and IT resources in ICT industry of India.
- To categorize and grade the TQM facilitators and IT resources for ICT industry Of India and develop contextual relationships between them.
- To understand the awareness of TQM program & IT resources in ICT industry
- To examine the degree to which TQM facilitators & IT resources are executed in the ICT industry of India.
- To examine the relationship among the named TQM facilitators and IT resources in the ICT industry of India.

The present research encompasses the following tasks to fulfill the above objectives:

- An extensive literature review was carried out TQM and IT. The review of literature mainly focused on research approach, different tools & techniques, research type and region which place research was done. This study was done in different four sectors, namely information technology, software development, business process outsourcing, telecommunication and specifically study of TQM & IT in Indian context was elaborated and finally identify the gap related to TQM and IT.

- A detailed literature review found out TQM facilitators and IT resources from different databases.
- An ISM-MICMAC model was developed to categorize, grade and establish the relationship between named TQM facilitators and IT resources. The model was named significant TQM facilitator and IT resource that would be importantly helps managers and practitioners of the ICT industry.
- Five hypotheses were formulated to test the present research. These hypotheses were formulated after consulting literature and discussion with academicians, practitioners and quality experts.
- An instrument was developed to conduct a survey to capture the awareness, naming and grading of TQM and IT. The instrument that could be used in the survey based empirical study.
- The final instrument was organized survey across 301 ICT industry from those 119 information technology sector respondents, 71 software development respondents, 52 business process outsourcing sector respondents and finally 77 telecommunication sector respondents’.
- Primarily instruments were tested for reliability and internal consistency. A descriptive statistics were calculated for different test and responses were used to test the hypothesis formulation. At the end EFA and CFA were used to validate the model.

7.3. IMPLICATION OF CURRENT RESEARCH

This study has a consider implication for the development of a framework to assist with execution of TQM and IT in the ICT industry of India. The proposed theoretical framework developed with the support of the literature review and framework was empirically examined by using a suitable methodology. There are some implications for the academicians as well as practitioners found in the present study.

Implication for Academicians

This research work found the integration of TQM and IT with better customer satisfaction which is ultimately increase the quality performance of product and

services

- The present research contributed to the literature review on TQM and IT which will be helpful for identifying research gaps for further study.
- This study also contributed to formulate hypotheses in the ICT industry of India.
- The developed questionnaire can be used for different studies in another industry.
- The ISM-MICMAC is a relatively new modeling techniques for TQM and IT which gives the direction to academicians to use the same techniques in other studies.
- The different facilitators and resources were found the present study will be helpful for academicians to derive new facilitators and resources for further study.
- This study identifies the strength and weakness in the present scenario of quality management and support the ICT industry by adopting TQM and IT both.

Implication for Managers

This study tells managers that information technology can be one of the effective approaches to improve quality management for better customer satisfaction. It means they need to know how to mobilize and deploy IT in combination with quality performance in the industry. There are many insights can be obtained from a managerial viewpoint. This study demonstrates that how TQM and IT increase the performance of industries. Thus, this study presents some managerial recommendation are following:

- This study provides the practical understanding of TQM facilitators and IT resources and their advantages in the ICT industry of India. Managers could use appropriate facilitators and resources to measure the effectiveness of specific TQM facilitator and IT resources.
- The finding of this suggests that the execution of TQM and IT together can be a step towards as customer satisfaction.
- The result suggests that TQM facilitator and IT resources are the two most

important factors relating to customer satisfaction. Managerial implication is that each facilitator and resource must recognize their role in executing TQM and IT which affects the ICT industry performance.

- This study confirms that top management commitment and electronic data interchange have a major role towards the successful execution of TQM and IT.
- Similarly, remaining TQM facilitators and IT resources also indirectly expand the performance of industry by executing the TQM and IT. They are very significant to continuous improvement and they should not neglect.
- The present research provides the functional experiences for the use of TQM facilitator and IT resource in several ways. This will enable to them to update their professional knowledge regularly and learn different quality improvement techniques so that they increase the performance of industries.
- This finding has valuable implications for ICT industry of India to motivate to work of TQM and IT program together, which is improve the Indian economy by satisfying the quality of product and services.
- This study will allow that managers can integrate the execution of TQM and IT at the same time as well as can access the quality performance and customer satisfaction.
- With the help of this study manager will be better able to evaluates benefit and problem from which facilitator and resources have more realistic experience of effort to move forward ICT industry.

7.4 CONCLUSION

This study has several limitations which in turn offer opportunities for future researchers. This research contributes to a better understanding of how customer satisfy with the quality program. In terms of aiding and smoothing the TQM and IT, there is some agenda which must be consider for future research.

- This study was conducted in one country only, it can be expanded into different countries to achieve higher generalization.

- Customer satisfaction data were obtained from industry managers rather than customers. In other words, questionnaire respondents were taken only from managers and engineers not from other lower level of employees.
- This study focusses only ICT industry's four sectors, namely information technology, software development, business process outsourcing and telecommunication. This study can be extended into different areas like education, banking, transportation, real estate, hospital extra.
- In the present research ICT industry was selected from NASSCOM database further collect databases from other sources in an exhaustive manner.
- For the ICT industry the concept of TQM may be relatively new and this may cause a bias in the data gathering and in the data interpretation.
- The developed instrument would be used in subsequent academic studies as well as in industrial context.
- This study was conducted only in the business industry but it would be extended into academic as well as.
- There are 21 experts from different sectors were participated in the judgment process for ISM-MICAM model development. In further studies number of experts can be increases and from different sectors.
- In the present study only ISM-MICMAC model techniques were used besides it QFD, Fuzzy QFD, AHP, Fuzzy AHP, ANP, Fuzzy ANP and TOPSIS method can be used for developing models.
- DEA (Data Envelopment Analysis) can be used with TQM because DEA includes many variables that could help managers identify the inefficient areas in their TQM-IT system and make the system efficient.
- DOE (Design of Experiments) and Taguchi method can also use for quality control and tries to eliminate in production before they can occur. IT would act like nectar for DOE and Taguchi method, and they could easily control the quality which will enhance the effectiveness of quality of industry.
- Meta analysis approach can be used for TQM and IT to enhance the

understanding, generalizability and applicability of comparative research.

- In a fuzzy system decision maker use fuzzy set theory in hierarchical and network structure analysis and found that interval judgment is more confident than fixed value judgment. Fuzzy AHP and Fuzzy ANP could identify and emphasize the important criteria and attribute for TQM-IT in the ICT industry.
- QFD (Quality Function Deployment) provides a systematic process for integrating TQM into the product design process. QFD and IT together will facilitate TQM in new product development.
- FEMA can combine with the IT which helps people to identify the foreseen failures in a product or process and plans to eliminate the failure. Combining FEMA and IT together will enhance the TQM program in the industry.
- The JIT (Just In Time) and IT would be applied together in the ICT industry for customer service involved in applying information system and mobile hardware to deliver customer information as needed, and reducing waste by video conferencing to cut travel time.
- SPC (Static Process Control) methods are useful to enhance profitability by improving process and product quality. SPC techniques were used in manufacturing but it would be used in an ICT industry with the help of IT.
- This study can be extended to discover the effect of execution of TQM and IT together with increasing business growth and assists in adopting new management techniques.

7.5. LIMITATIONS AND FURTHER STUDY

This chapter finds the significant research contributions, findings, implication of the study, limitations and future scope are discussed. This study has enlightened many important contributions and implications which may be carried forward for the growth of the ICT industry in developing ICT economy. The finding of this thesis revealed that the concept of execution of TQM and IT by various phases and planning. It is investigated and brought to the forward that TQM and IT together gives bright potential to the ICT industry of India. In order to effective execution of

TQM and IT there are nine TQM facilitator were taken from among seven facilitators namely top management commitment and support, customer satisfaction, empowerment, total employee involvement, teamwork, continuous training, continuous improvement and three IT resource namely electronic data interchange, computer aided design and enterprise resource planning have special attention to execute TQM and IT. While boosting industrial performance by integrating TQM and IT has vital importance and managers are ready to bring this type of research in their industry. The present research will helpful for managers, academicians, practitioner related to TQM and IT area.

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ANNEXURE – A

Section (A): Demographic Profile

- 1. Gender:** ☐ Male ☐ Female
- 2. Age group:** ☐ 25- 30 ☐ 31 – 35
☐ 36 – 40 ☐ More than 40
- 3. Qualification:** ☐ Undergraduate ☐ Graduate
☐ Post Graduate ☐ Others
- 4. Job Designation:** ☐ Managers ☐ General managers
☐ Senior managers ☐ Engineers ☐ Others
- 5. Length of Service:** ☐ Less than a year ☐ 1-5 years
☐ 5-10 years ☐ More than 10 years
- 6. Organization Scope:** ☐ Information Technology ☐ Software Development
☐ Business Process ☐ Telecommunication
- 7. Total number of employees:** ☐ Less than 50 ☐ 50-200
☐ 200-500 ☐ More than 500
- 8. Annual Turnover Less than a crore:** ☐ 1-100 crore ☐ 100-500 crore
☐ More than 500

9. Does your organization apply TQM and IT programs? ☐ Yes ☐ No

Section B: Descriptive statistics of awareness

Statement	Strongly Disagree (SDA)	Disagree (DA)	Neither agree nor disagree (N)	Agree (A)	Strongly Agree (SA)
1. TQM is a management philosophy to ensure effective and efficient use of available resource.					
2. IT is act as feedback mechanism & facilitate communication tools & techniques in the organization.					
3. Awareness of TQM & IT in your organization is high.					
4. TQM & IT program are successful in the ICT organization.					
5. TQM & IT makes CS as the focus of an organization.					
6. IT investment with TQM facilitators raise the productivity and reduce the cost.					
7. TQM & IT together has the potential to help an organization attain new levels of competitive strength.					
8. IT provides suitable resource to execute QM program.					
9. TQM & IT together can help to solve managerial problems in the organization.					
10. There are strong relationship between TQM & IT concept & hence success to the organization.					

Section C (A): Naming And Grading the TQM Facilitators

TQM Practice	Strongly Disagree (SDA)	Disagree (DA)	Neither agree nor disagree (N)	Agree (A)	Strongly Agree (SA)
Top-management commitment & Support					
Customer Satisfaction (CS)					
Empowerment (EMPW)					
Total Employee Involvement (TEI)					
Continuous Improvement (CI)					
Continuous Training (CT)					
Teamwork (TW)					
Culture Change (CC)					
Democratic Management Style (DMS)					

Section C (B) : Naming And Grading the IT Resources

IT Resource	Strongly Disagree (SDA)	Disagree (DA)	Neither agree nor disagree (N)	Agree (A)	Strongly Agree (SA)]
Electronic Data Interchange (EDI)					
Computer Aided Design (CAD)					
Computer Aided Manufacturing (CAM)					
Enterprise Resource Planning (ERP)					
Computer Aided Process Planning (CAPP)					

Computer Aided Engineering (CAE)					
Statistical Packages for Social Science (SPSS)					
Structural Equation Modelling (SEM)					

Section D: Relationship Among TQM Facilitator and IT Resource

Statement	Strongly Disagree (SDA)	Disagree (DA)	Neither agree nor disagree (N)	Agree (A)	Strongly Agree (SA)
Top management commitment and support for TQM facilitators have relationship with the customer satisfaction.					
Empowerment for TQM facilitators have relationship with the customer satisfaction.					
Total employee involvement for TQM facilitators have relationship with the customer satisfaction.					
Continuous improvement for TQM facilitators have relationship with the customer satisfaction.					
Continuous training for TQM facilitators have relationship with the customer satisfaction.					
Teamwork for TQM facilitators have relationship with the customer satisfaction.					
Culture change for TQM facilitators have relationship with the customer satisfaction.					
Democratic management style for TQM facilitators have relationship with the customer satisfaction.					
Electronic data interchange for IT resource have relationship with the customer satisfaction.					

Computer aided design for IT resource have relationship with the customer satisfaction.					
Computer aided manufacturing for IT resource have relationship with the customer satisfaction.					
Enterprise resource planning for IT resource have relationship with the customer satisfaction.					
Computer aided process planning for IT resource have relationship with the customer satisfaction.					
Computer aided engineering for IT resource have relationship with the customer satisfaction.					
Statistical package for social science for IT resource have relationship with the customer satisfaction.					
Structural equation modeling for IT resource have relationship with the customer satisfaction.					