

Role of Information Technology and Information System as an Antecedent to Successful Implementation of TQM



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Abstract: Many organisations have used Information Technology (IT) and Information System (IS) for successfully implementing Total Quality Management (TQM). With the aid of IT many firms have been able to provide higher quality goods and services. Competition at the international level has expanded the importance of quality in the area of business. The world of business now faces more competition than ever with challenges and pressure growing day by day. Therefore, the focus on quality of product and services is now more paving the way for TQM practices on a large scale. As we are aware, Technology drive the world so how can the business world remain unaffected by it. Hence it is widely used for achieving the desired result. TQM is a management philosophy and IT is best explained as the telecommunication, hardware and software that helps in processing, collecting, storing and transmitting multimedia information.

One of the many reasons for the expanding TQM practices is also the cost ratio, which has been possible because of computer processing. This has made the procedure economical in firms. Information System is an integral part of a firm because information is one of the main assets of a firm. Many firms depend on technology based information system for the organisation's day-to-day activities such as decision making at a managerial level and for getting strategic advantages. It aids in decreasing wasteful spending helps in excellent and error free documentation, analysis and measuring all activities of an organization.

The combination IT and TQM plays a vital role in ensuring a bug free and easy to maintain procedures and applications of the changing needs of a firm. The technologies that are used are Database management system (DBMS); Distributed data processing; Object Oriented Programs; Parallel processing; Data Warehousing; Replication; Networks; Neural Networks and Information Communication System Programs..

Basic objectives of Information Systems are to enhance the production, quality development, enhanced service delivery, reduced costs, and increasing the competitiveness of the organization's.

An organization's development expansion and growth require a combination of IT and IS and TQM go hand in hand. This study

aims to present the role of Information Technology and Information System on TQM. The present study comprises of a thorough conceptual analysis of 29 review papers in order to compare the standard of literature taken from different papers like TQM practices, approach, Role of IT in TQM, Role of IS in TQM etc.

Keywords: Information Technology, Information System, Total Quality Management, Networking, Data Warehousing.

I. INTRODUCTION

In the recent era quality is a major concern to attract the customers and retain them for a longer period of time to gain the competitive advantages. We can consider Total Quality as a business tactic and idea in which all elements of the organisation procedure are integrated in order to fulfil the requirements and prospects of clients which is possible with the help of Information Technology and Information system. Total Quality Management is an integrated approach; it is the totality of people, product, process, policy and procedure. TQM is the most favoured and long lasting managerial idea that focuses on the quality founded on involvement of all concerned in the firm. The basic objective of this integration at all levels is to achieve long term success by providing consumer gratification and profit to shareholders of the organization with the application of IT and IS.

Walter E.Deming is credited with the discovery of TQM concept.TQM in its true sense meant how it is perceived as quality in the mind of the consumers, how it impacts the change in design, a forerunner and the commercial use of a product. It generates the perception of quality in all aspects. The role played by the Japanese in initiating TQM for customer oriented electronic gadgets paved the way for its foray into the whole world.

To quote the British Standard Institution- TQM comprises of 'management philosophy and company practices' with the objective of making use of both the resources of men and materials of the company in the most efficacious manner to accomplish the organisational goal.

Total Quality Management (TQM) was introduced in 1920s, with the advent of the Statistical approach used for the quality control in the American factories. Later it was also used by the corporate managers of Japan in the 1950s when the country was preparing for their Industrial Development. In the 1980s era the concept got its global exposure in order to assist the companies in achieving excellence and to survive in world-class competition. Siam et al.(2012)[1]explore that

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TQM accomplishment receipts rewards of Information Technology in addition with ‘information and investigation, production of quality assurance, significant invention, client gratification, headship and the tactical planning process. The major paybacks of TQMIS are satisfied consumers, enhanced worker throughput and sophisticated product and services

Total Quality Management tries to attain and sustain long term organizational victory by cheering employee participation, filling client needs and expectations, regarding societal values and beliefs, and obeying legislative laws and guidelines .Organization can achieve its competitive advantages by several ways, such as by refining the quality and productivity of the business firm. The basic aim of the organisation now a day to produce more in less time period as well as to reduce cost which is called optimization. Information technology plays a significant role to help an organization to achieve its objective.

Ramey (2012)[2], in order to compete with the global market and to sustain in this competitive marketplace organisations need to achieve the faster growth that's the reason Information technology has become an essential for all organization. The organisational information can be managed with the help of Information technology. It requires knowledge and knowledge is the processed form of information. So to fulfil the organisational goal one approach or methodology is not sufficient it need integration. The researchers in this paper are trying to explore the relationship between IT, IS and TQM to achieve organisational development and growth.

In a constantly evolving world in every sector, there is immense scope of “Application of Information Technology, Information System and Total Quality Management” that can renovate the entire scenario of customer satisfaction, employee satisfaction, better performance, better quality, reduction in cost and proper utilization of available resources like Information System, Information technology, capital and infrastructure. A proper practice of TQM and the application of IT can give a turn around to any organisation which seeks to take advantage over their competitors in a long run.

II. REVIEW OF LITERATURE

A. Total Quality Management

In a research finding Reed, Lemark& Mero (2000) [3] analyse the study of five TQM experts (Crosby, Deming, Feigenbaum, Ishikawa, Juran) and establish the sameness of the below mentioned TQM features although there were dissimilarities in their approaches to (1) Consumer Gratification (2) Responsible Leadership (3) Culture of the firm (4) Team spirit (5) Coaching and Education, and (6) Bringing down price.

Mare fat &Faridfathi (2015) [4], explained that TQM is a way of handling an organization’s resources and capabilities to improve its quality and productivity. TQM is customer oriented viewpoint where all resources, commercial activities, ethos of an organisation, people, behaviour are interlinked to guarantee customer satisfaction.

(A.Martínez, F.Dewhurst, and B.Dale, 2004) [5]. TQM is a management philosophy defined by many researchers basically based on the following dimensions such as:

(i)Support from higher level Management, (ii)management of workforce, (iii)attitude and behaviour of the organisational workforce, (iv) well defined customer relationship management,(v) healthy relationship with supplier, (vi)Appropriate product design and methods and (vii) management Flow.

Crosby (1979) [6] opines that doing certain things right or perfectly doesn’t add to the price of an object. As a matter of fact he says that price of the product is the cost of not performing the right thing. Crosby gives importance “On the four Absolutes of Quality Management” – 1. Standard Means correspondence to necessities, with top administration setting up needs and supplying the workforce the resources top fulfil them; 2. Standard emerges from precautions or safeguarding instead of scrutiny; 3. Zero error or error free is the calibre for standard execution. 4. Price of quality or measurement of quality is the cost of no correspondence.

Deming (1986) [7] explains that quality is whatever the consumers look forward to. Furthermore Deming’s cycle “Plan – Do – Check – Act (PDCA)” and Deming’s “14-Points” gives necessary guidelines and instructions to the managers of American organization who were required to understand how to be successful by emphasizing on manufacturing high standards of objects and facilities that the consumers desire.

Juran (1989) [8] constructs the theories of quality based on implementation of quality scheme, quality benchmarking and quality enhancement. His plans are focused on top level administration participation, strategizing quality enhancement enterprise by enterprise, and evolve a coaching programme for the workforce.

Ishikawa (1991) [9] propositions to standard is constructed on Feigenbaum’s idea of total standard check. He describes Total Standard Check as a structure for manufacturing procedures which manufactures standard objects and facilities that measure up to the expectations of consumers. He describes standard as the involvement of all employees from high to low, the front line employees, so that every employee has an important function to perform. He maintains that standard starts with the consumers and that the employees must be authorized to shoulder the developmental endeavour that fulfils the wants of the consumers, trust, confirms to the governments, laws, rules and regulations.

TalibFaisal, RahmanZillur (2014) [10], identified and rank the TQM barriers in Indian ICT industry and as well as in Indian banking industries. The study exposed that from 12 TQM barriers, six barriers namely "insufficient use of authorization and teamwork"; "lack of continuous improvement culture"; "inadequate skill development"; " No benchmarking"; "Improper planning"; and "lack of top-management commitment" exposed significant difference in their presence across Indian ICT and investment businesses while rest six barriers have no significant difference in their presence.

ManjunathS.J., Arunkumar G. (2013) [11], in their paper tried to regulate the influence of TQM implementation on high productivity and quality.



The result exposed that there is a substantial relationship between TQM implementation and high productivity and quality.

WuSarahJinhui, JhangDongli (2013) [12], have identified Quality Management Practices are organized by two orientation, that is Examination vs Manipulation. The results provide an insight and a full guidance for quality managers to allocate scarce resources to make quality practices more effective in operations sites in China.

Elsiddig, Elhaj. (2011) [13] The study indicates that the TQM practices have positive impact on poultry processing plants, efficiency and effectiveness with a partial mediating effect of efficiency on TQM and effectiveness linkage.

AgusArawati, HassanZa'faran (2011)[14] the objectives were to examine the status of incorporating TQM in the Malaysian Business Industry. The outcome directs that manufacturing firm should highlight greater consideration to both TQM processes and a superior degree of management provision for TQM improvement initiatives.

There are many definition of TQM by many researchers, but the fundamental finding is to develop the organization continuously to improve its value of product or service and to enhance customer and other stake holders' satisfaction.

TQM implementation is possible only when the higher management of the firms impose planned as well as substantial study. Integrity, training, Ethics, belief, leadership, collaboration, acknowledgment, as well as communication among the stakeholders are the aspects of TQM. The below figure explains the process through which TQM characteristics are related to each other.

The features like ethics, integrity, trust and training represents that how well an organization's top management is involvement in the organisation process. The other side represents the characteristics so as to show the process in which the organization's workforce and management deliver the services efficiently. The two characteristics recognition and communication explain the way business firm's workforce and management achieve the objective of the organization. The management can apply TQM for the communication between the two sides effectively.

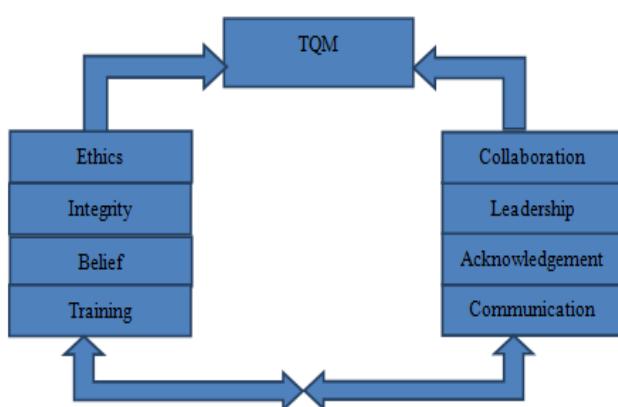


Fig 1: Conceptual Framework of TQM

B. TQM and Information Technology

Khanam, Siddiqui, and Talib (2013) [15] specified that TQM & IT are interdependent, they also identified that IS has to be effective so that the customer can access the organisation's information easily. The major role of

Information Technology is to increase quality awareness and online information about the organisation with less cost. The key dimensions identified are: Participation of Top Level Management, Constant improvement, adequate training, Collaboration, Employee Empowerment, Assurance and support from Top level management, Cultural changes and satisfied customer. The organisational development can achieved by reducing redundant work, discards, left-over, customer dissatisfaction and high implementation and maintenance cost. TQM is an approach and the characteristics are philosophies, practices, and technical knowhow that stress an organizations promise towards its customer and to improve the processes continuously towards data driven, problem solving methods, which is dependent on higher management involvement and support and empowerment of workforces. TQM is encompassed of three terms; Total: represents involvement of stakeholders, Quality means to meet the customer need accurately; Management implies the top management involvement and support.

From a complete review of TQM literature it is recognized the major TQM implications are commitment from higher management, consumer alignment, training and development, Constant upgrading and invention, supplier relationship administration, participation of employee, acquisition and analysis of information and all the above management of process so to implement these practices we need to manage and to analyse the information it is only possible with the help of Information Management system and to manage the information system we need take the help of Information Technology. It is because Data analysis will help to recognise the nonconformities from anticipated expectations and the cause for these irregularities. That's the reason IT acts as a key factor towards successful implementation of TQM through the organisational Information System.

Rais Nasir al Din Srour (2014) [16], explained that the application of information technology towards TQM drives towards the improvement of the relationship between customers and suppliers. The application of IT helps to improves the business firm's activity and procedures, such activities are increasing the process control, enhanced team activities, easy communication among different units, sophisticated design process, quick decision making with the quality assurance unit. The link of IT and IS with TQM leads the organizational development by increasing its productivity.

Lewis, Goodman, and Fandt (2002) [17] explained that TQM is to meet the customer requirement by managing the entire organization such a way that it will enhance the delivery of the product or the services. ". Stoner, Freeman, and Gilbert (1999) [18] perceive TQM as "the culture of the organization is to satisfy the clients requirements through the use of an integrated system, tools, techniques, and training". TQM involves the constant improvement of organizational processes, ensuing in superior quality products and services.

Nickeland Mchugh, (1999) [19] explained TQM as "the exercise of striving the customer satisfaction by guaranteeing quality from all the departments in a business firm. Many researchers ponder that IT is an enabler of TQM.

Zadrozny and Ferrazzi (1992) [20] explained that, IS plays an important part in the application. Murray (1991) [21] stated that IT is used to evaluate, comprehend, and advance an organisation's level of sustainable and quality enhancement. IT supports TQM through the application of statistical process control (SPC), Design of Experiments, FMEA, QFD and self-assessment to achieve its Competitive advantages. By utilising Information technology the organisation can collect real-time data in regards to customer satisfaction, in-house process control, critical corporate structures, and other dimension.

Konstadt (1990)[22] claims that classy communications and computational tools and advance data base management systems are the major element of successful TQM implementation. IT helps in incessant development, even though the procedure and relationships among workers are not a sophisticated one.

Ayers (1993) [23], explained that TQM and IT promises to slow down extravagant investments in technology for the sake of technology know-how. It is predicted that application of Information Technology in TQM will definitely enhance the operative responsibilities of quality organization and will lead to excellence output. Most of the service sector organisation is capitalizing profoundly in Information Technology to enhance the productivity of their organisation, nonetheless up to very restricted services. The fundamental role of IT in quality Improvement is: to Increase quality consciousness among the stake holders, the quality level information available online and plummeting quality costs.

Ramachandran, K. K (2019) [24].They suggest that the organizations have to be systematic, integrated in nature .As well as they have to follow proactive approaches to deal organisations practices and principles. Only by adopting quality principle the objective may not be fulfil. So the organisation may require the restructure , managerial roles needs to be redefined, organizational structures has to be reframed, training of new skills to the employees and the organizational goals need to be communicated properly so that the objective of quality management will be fulfil.

The Information Technology provides the required tools to TQM and with the application the purpose of TQM is achieved efficiently.

From the different reviews the link between IT and TQM has been shown in the below figure

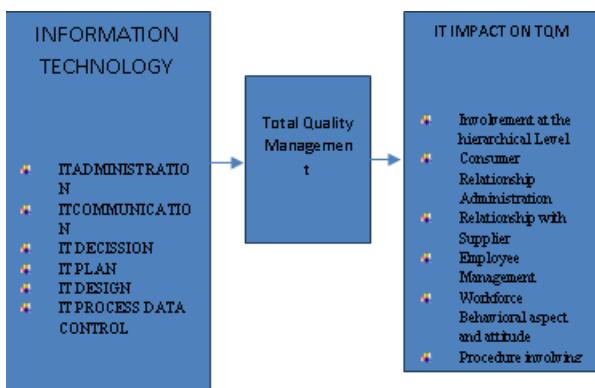


Fig-2: Conceptual Framework of IT and its Impact on TQM

C. TQM and Information System

The total quality management information system (TQMIS) is a combination of Information System and Total Quality Management System. The basic objective of TQMIS is to manage the critical information of an organisation. Management of information means acquiring, storing and manipulation of information. TQMIS include several databases. Therefore, TQMIS directs to enhancing purchaser contentment, growth in the employee productivity and recuperating the quality of products or services provided. TQMIS increases the organization and considers a CA over other competitors.

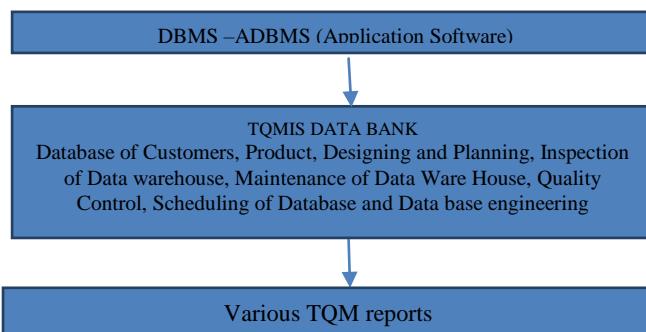
Information system is an integration of man and machine which helps the organisation in its decision making process. Different organisation uses different Technology- based information system for their decision making process. These Information Systems are the customized Technology-Based which fulfil the requirements of the organization. The Information system is a combination of Hardware, Software, Networking, Database, Graphical User Interfaces and users. It helps the organisation to Obtaining, expanding and controlling business activities through technology and as well as it provides the required information to government and other agencies associated with the organisation in an uninterrupted manner. The other way it helps the organisation to Design their product and to improve their whole system. Siam et al (2012) [1], IS acts as a link between the organisation's existing system and TQM practices.

Wang, Xiaoh (2008)[25],explained that TQMIS increase customer satisfaction by providing them the information in time and in a proper format , increase the productivity of employees by reducing rework and recuperating the quality of goods or services with less cost. The basic purpose of TQMIS is to monitor and manage the quality in the long term by fulfilling the organisational objective and strategies. TQMIS helps to manage the critical information of an organisation; it also provides the security to the organisational information by restricting unauthorised updating, retrieving and processing of the information. It also helps in the management of the databases such as: database of the management, customer, design and engineering, database for

inspection and control as well as the databases for maintenance, production planning & scheduling.

Maheshprabhu, R (2018) [26].In his work develop a software tool for mechanizing the process of documentation and report preparation in quality management system. The researchers have suggested that by utilising this model small and medium scale industries can enhance their performances.

TQMIS requires a DBMS an application Software to manage the above mentioned databases. The fig-3 shows explained that how the application package helps to maintain the databases and help to generate the TQM report. Bandyopadhyay, J. (2003)[27]TQMIS serves as a basic element towards the success of TQM in the organization.

**Fig.3 The relationship between DBMS,TQMIS and TQM**

TQM needs information and that information required to be available immediately in an appropriate format so that the report can be generated. The foremost cause of failure of TQM practice is the non-availability of information which basically happens due to lack of connection between Database IS and TQM. To bridge the gap there is a requirement to connect IS and TQM. IS and TQM have common goals, fundamental ideas, and management of organization. Proper framing and purpose of each critical features leads to accomplishments organisational goal..

III. RESEARCH METHODOLOGY

This paper tries to evaluate the performance of IT and IS on making TQM successful by identifying the chinks present in the field of study and by considering opinion of stakeholders in this procedure (Sylvester, Tate, & Johnstone, (2013) [28]. The present methodology attempts to support a theoretical foundation for advanced studies by evaluating the chinks and constraints and therefore contribute to the huge storehouse of information and procedures for further research. (Hart, 1998) [29]

The researchers have used content analysis to compare the standard of literature taken from different papers like TQM practices, approach, Role of IT in TQM, Role of IS in TQM etc.

A. Paper Selection Criteria

A lot of literature is available on TQM, Information Technology and TQM, Information System and TQM. Certain criteria were set to select the article. Select articles were sourced from online database like Elsevier's Science Direct, Scopus, Taylor& Francis, IJRTE etc. Since, reading all the articles was next to impossible, certain conditions were set for adding articles meant for studying the article is as follows:

To understand the concept, implementation and application

Relationship With Suppliers	For selecting suppliers, its quality that should be given priority over price. Firm's should develop long term relationships with their suppliers and aid in enhancing the standards of products/services.	Electronic Data Interchange (EDI). Automatic Reordering System. Integrated Management System.	Enhance the Communication links between the suppliers and business organisation electronically. Instant Communication facility. Automatic order placing. Information regarding product specifications and Design. Confirmation of invoices and paying for suppliers. Business firms can access the supplier's inventory. Helps in accessing the production Scheduling System. IT supports Just in Time schedules and with the help of integrated Management System links that reduce the level of shipment discrepancies.
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of TQM, papers from 1990-2019 were included. The articles studied for the literature have been enumerated as follows: (i) Critical Dimensions of TQM (ii) Importance of TQM Implementation (iii) The influence of TQM on Administrative performance (iv) TQM Framework development (v) Relationship between TQM and other aspect of Organisation.

The outcome of the study has been categorized as: (i) Basic Dimension & Description of TQM (ii) Tools of IT and IS used and (iii) Output.

Once finalization of article selection criteria were done, the articles were searched from the above mentioned database .As many as 60 write ups were reviewed and 33 out of them were included in the study. The link between IT with TQM and that of IS with TQM is also present .Although the combined effect of IT and IS in the implementation of TQM is not profound, it has been found that consideration of IT, IS and TQM is visible in many sectors. Research proves that the combination of these three is more profound in the manufacturing sector than in the other areas.

IV. RESULT AND DISCUSSION

Basic Dimensions of TQM	DESCRIPTION	TOOLS of IT and IS used to achieve the dimension	Output
Involvement At The Hierarchical Level(Top Level)	Proper TQM Practices depends on the level of involvement of the high level management. The high level management has to practice it first and then encourage others to follow suit. It depends upon them to take the first step. Not only that but also encourage the workforce and provide them with good leadership as well.	Automated Information system. Information System is a combination of Hardware, Software, Networking, Database, User Interface and User.	Improve the Business communication without any error, with less cost and in a less time. Helps in Market Analysis. Strategic Decision Making
Consumer Relationship Administration	The requirement of consumers must be borne in mind of the workforce, not only their needs but also their gratification. Prior to that their requirement and gratification need to be identified first	Bar-coding, Product recognition systems, Electronic point of sale, Electronic Database, CRM Application Software	Intensify the accuracy and enhance the delivery speed. Online display regarding Product and Services. Feedback from the Customer. Global Access. Reaching to new customer, Unlimited Business Hours. Increase the communication among the customer and customer support team.

Employee Management		There should be certain principles based on which the management of employees should be conducted. For this we require proper teamwork, employee empowerment and training. Necessary steps should be taken for recruitment of personnel, teamwork, empowerment of employees and training skill needed should be imparted for proper involvement in the enhancement process.	Information System. Application Software Packages like Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), and Business Process Reengineering (BPR). E_training Modules, Program Instructions, Online Recruitment	Reduce the number of organizational hierarchy level. Reduction in the numbers of middle management in Organizations with centralized decision experts. Automate the routine task without human interaction in an efficient manner. Increase Work Autonomy, Job enrichment and job satisfaction that leads to higher Productivity. Employee empowerment, Produce self-managing groups
Workforce Behavioral Aspect And Attitude		Organizations should encourage a set of values. Such as: a positive approach towards work, Allegiance to the firm, Dignity of work. To remain focused on the firm's goals and have the capability to perform cross functionally.	Information System and Integrated Management system	IT to eliminate tedious, muted and risky jobs. Increase job satisfaction. IT help to share information among different functional and cross functional departments.
Basic Dimensions of TQM	DESCRIPTION	TOOLS OF IT AND IS USED TO ACHIEVE THE DIMENSION	OUTPUT	
Procedure Involving Design Of Product	Coordination and involvement of all departments is required. The idea is to attain a design, a procedure to work unitedly and achieve gratification of the consumer, even within the technical, technological and financial limitations of the organisation.	Computer Aided Design(CAD), Computer Aided Manufacturing, Enterprise Collaboration System(ECS), Process Control System(PCS) and Groupware System	CAD helps to design the products as per the customer's requirement. It provides faster innovation. IT helps in New product Design. Failure Mode and Effects Analysis (FMEA) helps to identify the causes of failure. Quality Function Deployment used for New Product Development.	
Administration Of Process Flow	Management of household affairs as per 5S ideas. Analytical and non analytical enhancement instruments should be put in as required. Procedures should be error free. Scrutiny should be done as per instructions. The procedure should be done as per tactical power.	Automated systems, Electronic detection and signaling devices, Statistical Process Control(SPC)	Helps to detect apparatus maintenance requirements and analyze what needs to be done from the remote machine with the help of Automation system, reduce process variance Enhance the production processes speed, Enhance the quality of Product. SPC is used to control and monitor a process; it helps to reduce rework and scrap.	
Reporting Of Quality Data	Right information should made available on time and particulars or details should be a part of the administration. One can maintain documentation of quality index, comprising scrap, value of quality and reprocess.	Newsgroups and Listserv., List server, Internet, Database, Data Ware house, Cloud Computing	IT can help in different tasks, To determine costs of production, Provide relevant information to the workforces and executives for problem solving, Deliver appropriate quality measurements of organizational cost.	
Involvement Of Quality Department	The quality selection should gain access to top administration as well as independence. And has to amalgamate the work of the division.	Information System Integrated Management System	Provide assistance to collect and analysis of data as well as it also helps to transfer relevant information to other departments. The employees of the quality department alongside senior management provide answers meant for the queries which come up from the completion of IT in a TQM setting.	
Benchmarking	A point of reference should be there as a guide.	Information Technology and Information System policies and manuals.	Easier communication with business partners. Help in identifying best in class companies' through simulation of performance measures and gap analysis. Internal communication is easier. Resulting action plans is made faster.	

V. CONCLUSION

Information Technology plays a vital role to implement TQM in an organization which can help to fulfil all the dimension of TQM .Information Technology, Information system and TQM have a positive impact on the organisational growth.From the different review of literature it has been found that there is appositive correlation between IT and TQM.It is suggested that to meet the customer satisfaction and to increase the productivity of the organization the TQM practices can be adopted. Though the concept was started in Japan but most of the countries are applying the TQM practices in their country's business. It is concluded that there is a relationship between TQM implementation and high productivity. TQMIS serves the purpose of managing the organisational information in a long run with a secure manner so that the quality can be achieved. The combination of IS and TQM lead to accomplish the organizational growth and productivity that provides the means to increase its competitive status. From the various study it has been found that there is an impact of IT and IS over TQM. By adopting TQM practices the organizations can improve their productivity and performance, as well as it can enhance the customer satisfaction levels, and overall attractiveness that leads to organisational growth. Information Technology plays a vital role to implement TQM in an organization which can help to fulfil all the dimension of TQM .Information Technology, Information system and TQM have a positive impact on the organisational growth. From the different

review of literature it has been found that there is appositive correlation between IT and TQM. It is suggested that to meet the customer satisfaction and to increase the productivity of the organization the TQM practices can be adopted. Though the concept was started in Japan but most of the countries are applying the TQM practices in their country's business. It is concluded that there is a relationship between TQM.

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