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Role of Information Technology in Total Quality Management: A Literature Review

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Abstract— **A survey of literature on role of Information Technology for Total Quality Management to enhance the organizational performance was conducted in this study. Online research sources were searched for scholarly works published in this area. Other available sources such as the journals and magazines were also sifted through. Of the papers surfed 50 were found suitable for conducting a detailed literature review. An in depth classification of literature reveals that there are three types of papers on role of IT in TQM namely – research papers, empirical studies and case studies. Papers were classified on the basis of tools and techniques used, time of publication, region and methodology. Largest numbers of paper were published from Asia followed by Europe. The most popular methodology was found to be Empirical studies using Software Packages for Social Science (SPSS), Structural Equation Modeling (SEM) and Electronic Data Interchange (EDI). Time wise analysis of data suggests an increasing trend in the volume of literature on TQM and IT/IS (Information System) over the past one and a half decade. The present study is deemed to help understand how TQM Literature has evolved over time and indicate the direction of research in this potential area.**

Index Terms— **Total Quality Management, Information Technology, Information System, Literature review – Classification, Tools and Techniques of research.**

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I. INTRODUCTION

Information technology for Total Quality Management has been significantly implemented on most organizations and each has been widely researched. Many organizations are providing better products and services with the help of introducing Information Technology in Total Quality Management. The global competition has enhanced the role of quality in business world whereas competition is adding to pressure to the organization. These challenges and pressures have placed a renewed focus on quality improvement for the long-term survival of the organization. Technology acts as an enabling mechanism, which results in enriched jobs and increased job satisfaction. TQM is a philosophy of management and asset for customer centric practices for delivering quality. The TQM principle, practices and techniques can be applied to all functions within an organization including information system, marketing, finance and research and development [1][2]. The effects of IT on business performance have been frequently studied and reported by [3][4]. Similarly, there have been many studies into the effects of TQM implementation on performance, for example, Judge [5] and Kaynak [6]. Weston [7] claimed that management interventions such as TQM rely heavily on IT, which acts as a feedback mechanism and facilitates communication and the implementation of advanced tools, systems and modeling techniques. Kock and McQueen [8] and Miller [9], have considered how specific IT applications might impact TQM, they suggest that most importantly, IS has to be effective. For instance, in order to satisfy the customers, information on their needs and preference must be collected and to function with a process orientation, IT can be crucial. The IT literature suggests that customer may assess the quality of an organization's system by evaluating the level of the system services preferred. For instance, customers may choose not to accept services from an organization if the systems used in the services are outdated or are unable to satisfy the needs of the customers.

It is anticipated that application of IT in quality management will improve the operational tasks of quality management and hence increase quality output. IT in service industry commented that service industries are investing heavily in technology especially IT, to improve productivity, but with apparently very limited services. The role of IT in quality Improvement is:

- Increasing quality awareness
- Online information about the quality level
- Reducing quality costs

Nine key dimensions are found in the TQM-IT literature [10][11][12], these are:

1. Total employee involvement
2. Continuous improvement
3. Continuous training
4. Teamwork
5. Empowerment
6. Top-management commitment and support
7. Culture change
8. Democratic management style

9. Customer satisfaction

This research paper will explore how organizational management may better preserve the quality of the IS and IT they adopt and how their participation in IS and IT development could impact quality maintenance. This paper provides a review of literature on role of IT and IS in TQM, and covers the following objectives:

- Arranging the publication in an orderly manner to enable easy and quick search
- Focus on the publications
- Classification of literature section.

II. SCOPE OF THE RESEARCH

This literature survey has been conducted to identify articles published in peer referred journals. Reviewing the literature is a well-established academic tradition which is handled down, to new generations of researchers through the experience of postgraduate scholarship. Completing a literature review is usually a significant intellectual achievement in its own right, requiring the analysis and synthesis of previous work in such a manner that new understanding of the work is uncovered and a way is opened for new scholarship or research. In writing literature reviews, however as in any other task, information literacy is being applied to a particular context or genre. TQM-IT philosophy was still new to most researchers and practitioners in the organization

III. RESEARCH METHODOLOGY

Research methodology is very important as it can guide researchers on what steps need to be taken in order to accomplish the objectives of the research [13][14].We assumed that substantial research in this field has not been done and published before 1990. Therefore in this study we provide a review of TQM-IT articles published between 1997-2012.We surveyed 50 referred journals. A significantly higher number of research papers in year 2000 and about 20 percent of the reviewed articles were published in the 1990s.This paper first classifies the articles according to their journals types for making easy search method, provides a comparison of the earlier literature reviews on TQM-IT and highlights the focus on each case. Next we have classified the papers into publication type, publication region and tools & techniques, then categorization of the publication is presented in a graphical form.

A. Search methods

The following online databases were searched to identify the articles published in different journals relevant to the objectives of this paper.

1. Emerald Database: The search in this database covered the operations and production management journals, quality and reliability management journals, industrial management and data system journals.

2. Elsevier Science: All databases were searched from information and management journals and production economics journals.

3. Taylor and Francis: Database covered from total quality management journal, quality and reliability management journals.

4. ABI Inform Global: Databases were searched from quality management journals.

5. J STOR: Searched database cover from the management information system journals.

All the journals in the above selected database are of International repute and highly peer reviewed as well as the journals are highly relevant to this research topic.

All the database searches yielded from hundred publications that include journals and magazines. Each of the articles were examined to ensure that their content was relevant to TQM-IT. Searched database has not been on a journal-by-journal basis but has rather been limited only to the search of the whole database using 25 keywords. These keywords are used in the literature survey to describe TQM-IT related practices and were therefore deemed to be the most relevant search keywords:

- Total quality management
- Technology led strategy
- Total quality
- Total quality management theory
- Quality Management
- Quality assurance
- Quality control information system
- Quality control
- Quality learning
- Logistic data processing
- Performance measurement
- Information technology
- Information system
- Information system management
- ISO 9001:2000
- Benchmarking
- Structural equation
- Business performance
- Company performance
- Communication technologies
- Customer focus
- Continuous improvement
- Software quality
- System development
- Statistical process control

IV. OVERVIEW ON REVIEWS

A. Review of Total Quality Management

TQM took ground in the early 1980's when Hewlett Packard criticized US chip manufacturers for product quality when compared with their Japanese competitors. It is ironic that when W. Edward Deming first introduced TQM, the

Japanese adopted the philosophy while the USA rejected its principle. Higher quality leads to higher productivity through reduced rework, rejects and wastes, leading to lower costs and customer complaints, and ultimately increased market share [15].

According to Deming [15] TQM is a management philosophy that makes use of a particular set of principles, practices and techniques to expand business and profits that provide a bypass to enhance productivity by avoiding rework, rejects, waste, customer complaints and high cost. According to Witcher [16] TQM is composed of three terms; Total: meaning that every person is involved including customer and suppliers. Quality: implying that customer requirements are met exactly. Management: indicating that senior executives are committed. According to Sashkin and Kiser [17], TQM means an organization's culture is defined by, and supports, the constant attainment of customer satisfaction through an integrated system of tools, techniques and training. According to Dean and Bowen [18], TQM is a philosophy or an approach to management, characterized by principles, practices, and techniques that emphasize an organizations total commitment to the customer and to continuous improvement of every process through the use of data driven, problem solving approaches based on top management commitment and empowerment of employee groups.

Gaither [19] says that TQM is the process of changing the fundamental culture of an organization and redirecting it towards superior product or service quality. According to Michael *et al.* [20] TQM can be defined as general management philosophy and a set of tools which allow an institution to pursue a definition of quality and a means for attaining quality, with quality being a continuous 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 help improve each business activity of the organization [21].

Hendricks and Singhal [22] and Flynn *et al.* [23] agree that TQM, with its emphasis on the organizational and socio behavioral aspects of quality improvement, can add to existing research on systems quality management. TQM is an integrated management philosophy that has been found to strongly influence organizational performance. Terziovski *et al.* [24] says that TQM is an information intensive management practices. Information plays a vital role as all quality improvement activities are based on informed decision-making. Wiele *et al.* [25] analyzed the concept of TQM using the "fad, fashion, and fit theory" to examine 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 also can be defined as fulfillment of customer needs and continuous improvement of quality, making it the responsibility of every employees etc. (Talib *et al.* [26]) concluded that TQM has 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 that managers hold a positive view of TQM. Kanji and Wallace [27] go on to identify ten TQM practices: top-management commitment, customer focus and satisfaction, quality information and performance measurement, human resource management, employee involvement, teamwork, process management, quality assurance, zero defects, and communication. In Brah's *et al.* [28] study, the following 11 constructs of TQM were identified: top management support, customer focus, employee involvement, employee training, employee empowerment, supplier quality management, process improvement, service design, quality improvement rewards, benchmarking, and cleanliness and organization. Talib *et al.* [29] conducted a comprehensive review of TQM literature and identified 17 TQM practices which are: top management commitment (TMC), customer focus (CF), training and education (TE), continuous improvement and innovation(CII), supplier management (SM), employee involvement (EI), information and analysis (IA), process management (PM), quality systems (QS), benchmarking (BM), quality culture (QC), human resource management (HRM), strategic planning (SP), employee encouragement (EE), teamwork (TW), communication (COM), and product and service design (PSD).

B. Review of Total Quality Management and Information Technology

IT can be defined as computer and telecommunications hardware and software that aid in processing, collection, and transmission of text, voice, and pictorial information [30]. Application of IT in various areas including quality management is growing and continually expands. One of the reasons for this growth rate is the dramatic increase in the cost ratio of all types of computer technology [31].They argue that, this decrease in cost has made computer processing economical for more and more firms.

The value of IT to support quality management capabilities finds a basis in the resources based view of the firm, which argues that to confer competitive advantage, an organization should acquire or develop resources and capabilities that contribute to positive performance, are not possessed by all competing firms, and are difficult to imitate or duplicate [31][32][33]. Rogers *et al.* [34] examined the relationship between the utilization of IT and firm performance in the warehouse industry. Their work provided empirical evidence of the importance of IT in quality performance. Saraph et al. [35] elaborated the key practices that are important to know whether an organization has explicit quality policies or not. The key practices include specific quality goals, comprehensiveness of the goal setting processes, importance attached to the quality in relation to other goals and the extent to which quality goals are reviewed and their attachment emphasized. All of the elaborated key practices need information and analysis therefore, it is obvious that IT is required, in all those aspects to be able to implement the key practices. The founder of TQM philosophy Deming [15] shows the importance of extracting the information inherent to quality process variations. Taguchi [36] emphasizes on the role of information acquisition in quality management by suggesting that experiment must be designed to measure and determine the causes of quality problems. Therefore, the data analysis will involve the identification of deviations from

expected norms, revealing the cause for these deviations. It is obvious that IT has an important role to play in the area of quality management. According to Pearson *et al.* [37] and Matta *et al.* [38], IT responsiveness to the needs of TQM is a critical success factor in the implementation of such an information-intensive management system. Ang *et al.* [39] developed an instrument to measure the impact of IT on quality management, with the purpose of understanding how IT supports quality management. The proposed measures were empirically tested to be reliable and valid. This method was adopted and was used to test those quality dimensions in a processing industry in Tanzania. Mjema *et al.* [40] showed that the introduction of IT on quality management has contributed greatly to the enhancement of quality awareness in the improvement of product quality and in the reduction of quality costs. Brah and Lim [41] found that TQM and technology play important and complementing roles in improving performance. Their analysis showed that both high technology firms and high technology TQM firms perform significantly better than their low technology peers.

C. Review of Total Quality Management and Information System

The objective of Total Quality Management in the information system design is to assure the quality of information. This is done by ensuring, verifying and maintaining software integrity through an appropriate methodology. It institutes appropriate procedures with checks and controls in all the processes of information systems development. It ensures the scope and the objective of the system, choice of the design architecture and development methodology. Further quality ensuring processes and planned implementation 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. Many organizations rely on computer based information system for their day-to-day operation, managerial decision making and strategic advantage [42] .Because of this increased demand for information within the organization, IS professional should expect a greater focus on the quality and business value of products and services provided by the IS function.
According to Ayers [43] application of the TQM principles applied to IS helps in decelerating wasteful expenditure in technology for the sake of technology. With efficient documenting, analyzing and measuring all activities 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 [44] [45]. According to Reese [46] top management initiatives can innovates ways of using IS, abandoning the stereotype mind-set that it is just a tool for performing several tasks faster and cheaper. Information Systems have become an integral part of most organizations. Not only has TQM fundamentally altered and reshaped the work practices and management thinking of many organizations it has also made new and profound demands on many organizations. TQM addresses all these requirements of the information systems development [47]. It ensures that the information system design is flexible, bug free and easy to maintain with the changing needs. In the TQM application with information systems, the technologies play a vital role. These are classified as current and emerging technologies. The current technologies are database management, distributed data processing, object orientation, parallel processing, data warehousing and replication, networks and communication.
Table 1 summarizes the various studies of TQM/IT perspectives on the basis of the main premise and findings. In this study 50 papers have been surveyed.

V.CLASSIFICATION OF LITERATURE

The papers surveyed in this study are classified according to their publication, tools& techniques and their regions (Fig 1). Simultaneously this paper includes the growth of literature on IT & TQM time to time. The literature has also been classified according to the genre.

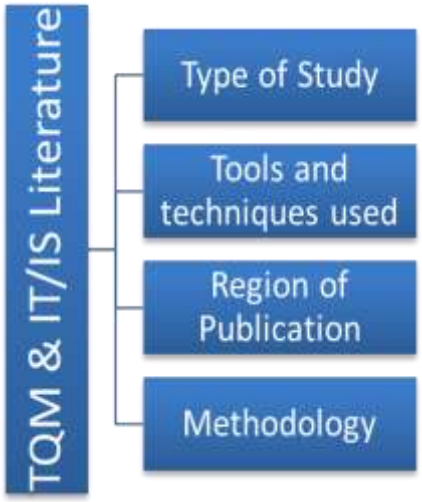

Fig 1: classification of Literature

IT and TQM (research study): Under this category a publication deals with the general and fundamental concepts of this topic. Fundamentals are usually covered when the discipline is in the introduction and growth stage.
IT and TQM (case study): In this category, a publication presents detailed study of one or more organizations.
IT and TQM (empirical study): The category includes that publication which is based on field studies of large number of organizations.

In this literature review, a total no. of 50 publications are analyzed for the purpose of providing insight to the growth and development of TQM-IT concept. These publications include specific papers in international journals, and conferences. Further 30 of these publications are research papers on TQM-IT, 12 publications pertain to empirical studies in TQM-IT and 8 publications fall under the category

of case study. For showing the chronological appearance of all publications, a Pareto diagram is presented (Fig 2).

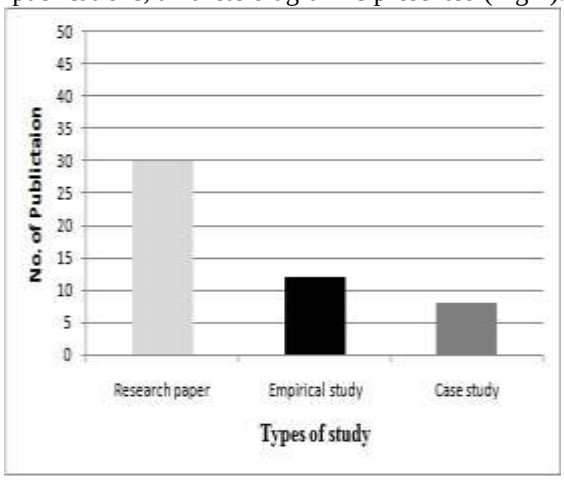

Fig 2: Number of Publications on IT & TQM under various genre.

Almost 60percent of the publications are research paper and the rest 40 percent are empirical and case studies.
From the table authors examined tools and techniques used, for example SPSS, SEM, EDI, Questionnaire survey etc. These tools and techniques can be used in conjunction with system analysis work to assist the organization in properly defining customer requirements. Some authors recommended that using EDI increases the possibility of error. Recently many researchers have used SPSS in their papers for conducting statistical analysis, manipulating data and generating tables and graphs that summarized data.

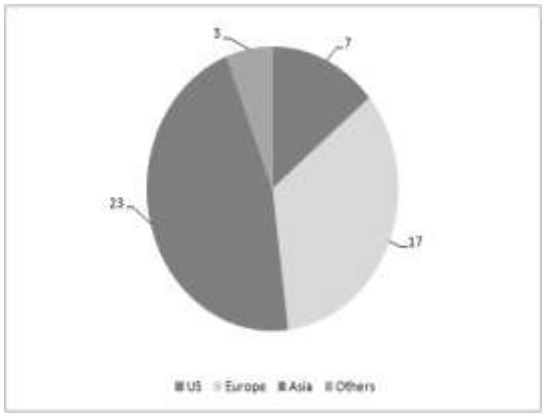

Fig 3: Region wise classification of literature

The classification of literature based on the region of its publication suggests that the largest volume of intensive research on IT/IS for TQM is being produced from Asia i.e. 46% whereas from Europe 34% papers were produced (Fig 3).
Similarly analysis of literature on TQM and IT/IS on the basis of time of publication reveals that the volume of literature on this topic is increasing. The number of publications has increased from less than 10 in the pre 2000 period to more than 20 in the time slots of 2000 to 2007 and 2008 to 2012 (Fig 4).
Literature has also been analyzed on the basis of methodology used in conducting the study. It was found that 40% papers were using questionnaire based survey techniques and around 20% each used the descriptive statistics method and literature review to conduct research on TQM. However, very few studies < 10% used theoretical framework and hypothesis, qualitative case studies and comparative case studies (Fig 5).

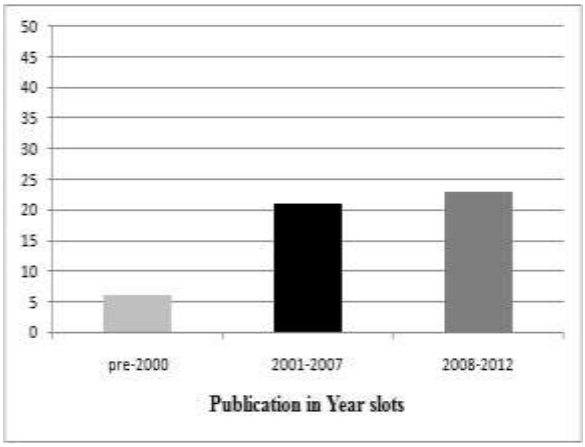

Fig 4: Temporal Classification of literature

Table1. Earlier Review of Total Quality Management, Information Technology & Information System. Publications according to journal title, type, tools & techniques and regions

Authors	Journal Title	Methodology	Focus	Tools & Techniques	Paper type	Region
Freund *et al*. (1997)	Journal of Technology Management	Questionnaire survey	Control of work process can be enhanced by the use of IT.	Simulation Tools	Case study	Germany
Matta *et al*. (1998)	Total Quality Management	Questionnaire survey	The major contribution of the paper is developing a model for the information requirements in TQM.	Not Available	Case study	US
Dewhurst et al. (1999)	Quality and Reliability Management	Literature review	This paper presents a complete and comprehensive review of the literature concerning the relationship between IT and TQM and examines the key issue.	Ten dimensions of TQM	Research paper	UK
Au and Choi (1999)	Information and Management	Descriptive statistical study	The authors have provided empirical evidence of the application of TQM theory to improve the IT implementation process.	Entity diagram, data flow diagram, Pareto chart, control chart, paper type	Case study	Hong Kong
Ang *et al*. (2000)	Quality and Reliability Management	Questionnaire survey	This paper reports on successfully coined construct that can be used to evaluate the QM-IT relationship. This paper offers a set of nine dimension of TQM that have been synthesised from various practitioners.	QMIT eight dimension, test re-test method, parallel form, spilt half method, inter half method.	Research paper	Malaysia
Ravicahandran and Rai (2000)	Journal of Management Information System	Descriptive statistical analysis	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
Fok et al.(2001)	Information and Management	Questionnaire survey	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
Palvia *et al.* (2001)	Industrial Management and Data System	Literature review, data collection and analysis	This article recommends a sociotechnical approach to determining the quality of computer information system.	SDLC, ANOVA, retest, pilot test	Research paper	North America
Cheon and Stylianou (2001)	Global Information Technology Management	Questionnaire survey	This paper 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.* (2001)	Quality in Maintenance Engineering	Qualitative comparative analysis	This paper discussed the application of TQM philosophy applied in maintenance engineering and increase in 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 *et al.* (2002)	Measuring Business Excellence	Descriptive study	This paper examines how quality management practices are implemented in Taiwan's Telecommunication industry.	Dimension QM, correlational analysis statistical control chart, QFD, Taguchi method, five point Likert scale	Research paper	Taiwan
Lari (2002)	Business Process Management	Literature review	This paper provides the conceptual structure for a quality assurance with IS within organization. This paper presents the results of survey determining the information needs for implementing total quality	Conceptual framework 300 Michigan auto parts	Research paper	US

Bandyopadhaya (2003)	Journal of Management	Descriptive study	management by auto parts manufacturer in US.	manufacture, DBASE, ISO 9000/QS 9000.	Research paper	US
Wali *et al.* (2003)	Production Planning and Control	Descriptive and Case study	Few key factors of information are identified which should be given special attention for ensuring successful implementation of TQM programme.	Combination of LR, Questionnaire survey	Research paper	India
Yong and Wilkinson (2003)	TQM and Business Excellence	Qualitative descriptive analysis	This paper utilise aspects of the Baldrige criteria in order to determine the progress of QM practising companies in Singapore towards the objective of TQM-IT.	Statistical analysis	Case study	Singapore
Dewhurst *et al.* (2003)	Operation and Production Management	Multiple case study	The paper has employed multiple case study methodology to investigate whether there is an underline framework linking the extent of use of IT and TQM dimensions.	Sampling approach, EDI, CAD, JIT, Customer survey, SPC, FEMA, QFCD.	Case study	Spain
Chow and Lui (2003)	Journal of Computer Information System	Questionnaire survey	This paper examines the significance of a set of the original measurement items of TQM factors in information system function.	SEM, five point Likert, MANOVA test, SMC.	Research paper	Hong Kong
Issac *et al.* (2004)	The Quality Management	Questionnaire, confirm factor analysis, correlational analysis	The objective of the study is to identify the critical factors of quality management perspective based on an empirically analysis and to provide holistic framework.	Framework, test- retest, equivalent form, halves method internal consistency method.	Empirical study	India
Jabnoun and Sofiane (2004)	Global Competitiveness	Literature review	Introduction of TQM and organizational structure and the relationship between TQM and IT. It also deals with TQM structure and how they are enabled by IT.	Characteristics of a TQM	General review	UAE
Martinez-Lorente *et al.* (2004)	Production Economics Operations	Questionnaire and Statistical study	This paper has 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
Philip and Mckewon (2004)	European Management Journal	Descriptive and Case study	The aim of this paper to examine the relationship between culture and business transformation by using the IS and TQM.	Grid model, hierarchical typologies, G/G model	Case study	Africa
Mjema *et al.* (2005)	TQM Magazine	Questionnaire survey	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 organization objective including production quality.	ANOVA, four indicator of company performances	Case study	Tanzania
Brah and Lim (2006)	Physical Distribution and Logistics Management	Questionnaire survey	This paper discussed that usage of IT is a crucial component in improving the operations, quality and business performances. The information and management technology strongly correlate to TQM and serve as an enabler to quality performances.	EDI,SEM, five point Likert scale, correlation	Research paper	Singapore
Rahman and Siddiqui (2006)	Information, Knowledge and Management	Questionnaire survey	This paper discussed that TQM for 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. Customer satisfaction followed by increased productivity of IS personnel and enhanced quality of services and products are common	Simple regression analysis, mail &questionnaire survey, five basic concept of TQM	Research paper	India

			benefits.			
Sanchez- Rodriguez *et al.* (2006)	Operation and Production Management	Descriptive statistical analysis	This study has examined the use of IT to support TQM initiatives and their contribution to operational quality performances in the manufacturing sectors of Spain & provides a step towards understanding how TQM jointly adds value to manufacturing firms.	SEM, SPC FEMA, QFD, ANOVA,CFA, Sample of 234 manufacturing companies	Research paper	Spain
Gunderson *et al.* (2006)	TQM Magazine	Hypothetical case study	This paper proposed the TSIT model which integrates the TQM foundation with software & information technologies.	Six case study, QFD, FIS. Qualitek 4,dbase 4, Matlab PDM	Research paper	India
Siddiqui and Rahman (2007)	TQM Magazine	Questionnaire survey	Study conducted in Indian companies to evaluate the role of TQM of IS in pragmatically realizing organizational benefits.	Seven point Likert scale, PCA,ANOVA, HSD, Regression analysis	Research paper	India
Hemsworth *et al.* (2008)	Total Quality Management and Business Excellence	Questionnaire survey	The purpose of the paper is to advance the literature by providing an empirically evaluated comprehensive model that relates QMPP with IS and purchasing performance.	Not Available	Empirical study	Canada
Daghfous and Barkhi (2009)	Technovation	Questionnaire survey	This paper focus on a recent survey of IT application and challenges in few hotels in UAE. This study presents the finding of an exploratory empirical investigation and the data collected on the interrelated practices of TQM enterprises initiatives.	Drop off method, DELPHI, FIDELIO,OPERA, Six sigma, MS windows	Empirical study	UAE
Kumar *et al.* (2009)	Quality and Reliability Management	Questionnaire survey	The purpose of this paper is to investigate the impact of TQM implementation on different dimension of company performances by using IT. The purpose of this paper is to identify the barriers of TQM implemented in order to make them known to the managers of Indian industries.	Statistical method	Research paper	Canada
Bhat and Rajashekhar (2009)	TQM Magazine	Extensive literature review	The aim of this paper is to develop model of TQM & HRM practices on KM activities supported by IT.	Data collection by mail survey, factor analysis	Research paper	India
Ooi *et al.* (2009)	Management Research News	Literature review and Hypothetical study	This paper compares the implementation of quality management practices in the industries.	Dimensions of TQM, evaluation method	Research paper	Malaysia
Costa *et al.* (2009)	Journal of Operation Management	Descriptive analytical analysis	This paper investigates the role of TQM as a knowledge enabler in the creation and exploitation of organizational knowledge.	MACS analysis, ANOVA	Empirical study	Spain
Colurcio (2009)	TQM Magazine	Qualitative and Case analysis	This paper investigates the effectiveness of quality management training by reviewing crucial success factors.	21 prominent firms, SECI model	Research paper	Italy
Clegg *et al.* (2010)	TQM Journal	Questionnaire survey	This paper determines the relationship between TQM, organizational learning and innovation performances in high tech industry.	Web based questionnaire, Pareto charts, Six sigma, Lean, ISO 9001, QS9000	Research paper	UK
Hung *et al*. (2010)	Business Review		This paper discusses whether the adoption of TQM can	SEM, AMOS		

		Descriptive and Correlation analysis	improve firms organizational performance. The current work examines how firm can increase the benefits traditionally by linking this approach to management.		Empirical study	Taiwan
Bernal and Aleson (2010)	TQM and Business Excellence	Literature review	This articles presents the finding of a study which examined the relationship between people related elements of TQM practices and employees job satisfaction.	ANOVA, Statistical method	Empirical study	Spain
Prajogo and Cooper (2010)	Production Planning and Control	Theoretical framework and Hypothesis	This study integrates TQM practices by introducing employee training, employee empowerment, teamwork, employee compensation and management leadership into theoretical model for studying employee satisfaction and loyalty within the context of government.	Dimension of TQM , 23 organization, SEM	Empirical study	Australia
Chang *et al*. (2010)	Total Quality Management	Theoretical framework and Hypothesis	This paper presents a study on the relationship between implementing TQM and organizational characteristics in a industrialized country.	Statistical analysis, confirmatory factor analysis	Research paper	Taiwan
Hoang *et al*. (2010)	TQM and Business Excellence	Descriptive model and Case study	The framework of the total customer relationship management (TCRM) has been constructed in this research. Industries, companies, leadership, time, geography and so forth could vary elements lodged in this CRUT model.	SEM, t-test, ANOVA, 222 manufacturing companies	Empirical study	Vietnam
Su and Hsu (2010)	TQM and Business Excellence	Literature review	The aim of this paper is to provide evidence on the degree of reliability tests for HR related CSFs in TQM implementation.	ISO 9000, quality management system model, CRM core system	Research paper	Taiwan
Ali *et al*. (2010)	Total Quality Management	Literature review	This research paper finding relates to factors analysis of the eight TQM dimensions.	SPSS, SERVQUAL model	Research paper	Malaysia
Mane *et al.* (2011)	European Business Review	Questionnaire survey	This paper develops a framework to be used on how information technology can support the TQM practices in the Iranian manufacturing organization.	Painstaking approach, SPSS feedback people, pilot test	Research paper	Mauritius
Valmohammadi (2011)	Journal of Academic Research	Questionnaire survey	The main objective of this study to deepen the understanding of the relationship between quality management capabilities and quality performances.	Seven basic quality tools, QFD, COQ,FEMA, 5S, BPR, TPM, DOE	Empirical study	Iran
Sanchez- Rodriguez *et al.* (2011)	Industrial Management and Data System	Hypothetical, sample and data collection, survey method	This paper discussed that TQM is a systematic management approach and technological challenges which has been accepted by both service and manufacturing organizations globally.	EDI, CAD/CAM, ERP, Sample of 229 manufacturing companies	Research paper	Spain
Kumar *et al.* (2011)	The TQM Journal	Literature review	The purpose of this paper is to analyze 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.	SPSS, 30 manufacturing companies	Research paper	India
Perez-Arostegui *et al.* (2012)	Industrial Management and Data System	Hypothetical, sample and	The extent to which information technology has been used to support TQM in order to identify the role in	ERP, CATI, Multiple Regression analysis, SPSS Packages	Research paper	Spain

		data collection, survey method	implementing TQM.			
Siam *et al.* (2012)	American Journal of Applied Science	Questionnaire survey	This paper discussed the information system maintainability in terms of CRUT model and reviews the application of total quality management construct to suit organizational IS.	Nine dimensions of TQM data statistical analysis, SPSS	Case study	Oman
Chandan *et al.* (2012)	Journal of Business Studies Quarterly	Qualitative and Exploratory study	IT and TQM have significant impact on most organization and each has been widely researched.	CRUT model, ITEC, Qualitative study	Research paper	US
Tiwari and Chaudhari (2012)	World Journal of Science and Technology	Questionnaire and multiple case study		Eight TQM dimensions, ANOVA	Empirical study	India

VI. DISCUSSION AND CONCLUSION

Several papers were reviewed in this study and it was found that the body of literature is growing albeit with a lack of case studies. In this paper we examined the TQM –IT survey by analyzing the articles published between 1997 and 2012 in various types of journals. Considering the publications it can be said that the TQM-IT techniques has seen a steady growth and appears to be heading towards maturity level. A scrutiny of the publication shows that TQM-IT along with many interesting and diversified applications has been covered in sufficient detail. These publications can serve a great deal towards quality improvements. Thus academicians and researchers have a good number of sources in the form of more than 50 articles.

• Authors examined 50 survey studies and collected keywords from those articles relevant to the objective of the papers. These keywords are used as term to describe literature of TQM-IT related articles.
• Authors categorised the publication in the type of research which may suggest that TQM-IT survey research may be at a junction where new direction need to be taken by researchers.
• An examination of the publication on the types of paper and as well as growth of the paper has been done.
• Scrutiny of articles in different regions of the world including India, North America, Malaysia, US, Spain, Tanzania, Iran, Oman etc. helps examine interest of regions for today's global companies to have more information about the nature of TQM-IT activities and whether TQM-IT activities differ from those in their home country. Such potential differences may have important decision making implication for companies operating in different parts of the world.

Results suggests that a large numbers of research papers dealing with the general and fundamental concept of TQM-IT exist but more case studies on various fields and empirical studies including multiple case studies are required to yield better results for better organizational improvement. Literature survey has been done on the basis of tools and techniques of the paper, and we suggest tools and techniques mostly used by the researchers. This study will help improve the efficiency and growth of literature on TQM-IT. This study will help the researchers to understand the existing body of knowledge including where excess research exists and where new research is needed. The finding of this review may assist researchers to anticipate potential of TQM-IT during the past several years. Through extensive effort, leading firms have
come to realize that there is a better way to focus on TQM-IT literature for their improvement. A review of tools and techniques used gives an account of the suitable approaches to treating an empirical study in this area of research.

We investigate how TQM survey research evolved over the last 15 year period from 1997-2012. The increase in the number of survey studies found in the literature in recent years and the lack of compiled information about them stimulated us to look how TQM-IT research survey design has evolved over time.

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