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QUALITY PAPER

Impact of quality management systems on firm performance

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Abstract

Purpose – Within the operations management literature, quality management (QM) has been one of the most popular research areas over the last few decades. The impact of QM systems on firm performance has been the subject of constant interest and challenge among researchers. Last such review was done in 2002 based on QM-related articles published between 1994 and 1999 and these were primarily on Total Quality Management (TQM). In the last 18 years, a large number of empirical studies have been attempted to investigate QM system-performance relationships in different contexts, covering not only TQM but also other QM systems such as ISO 9001, Total Productive Maintenance (TPM), Lean Manufacturing, Theory of Constraints (TOC), and Six Sigma Continuous Improvement projects. The paper aims to discuss these issues.

Design/methodology/approach – Based on an extensive review of 263 papers published in 17 reputed journals during the period 2000 to 2017, this paper shows the reflections of QM systems with respect to study of different QM systems, type of research designs being used, performance categories and metrics being used, and application of tools/techniques.

Findings – The literature review has revealed several gaps in research in the area of QM and calls for research on: empirical longitudinal case studies; implementation of multiple QM systems; identification of leading indicators of firm's performance; standardization of performance measures; safety, environment and health-related performance measures; the differences in the QM systems on firm's performance for manufacturing vs service organizations; application of QM systems in developing countries including Asian countries; and impact of ISO 9001 QM system on firm's performance.

Originality/value – The literature reviews in the past had considered only the TQM-related articles published in reputed journals and did not cover other QM systems such as TPM, TOC, Toyota Production System, Six Sigma, ISO 9001 QMS, etc., which have also been widely used in many organizations, more so in the last 15 years.

Keywords TQM, Quality management, ISO 9001, TPM, Future research, Firm's performance

Paper type Literature review

1. Introduction

Quality management (QM) has been an integral part of the overall organizational movement for the past few decades to achieve world-class product/service quality and market success (Hayes and Pisano, 1996; Ward and Duray, 2000; Voss, 2005; Datta and Roy, 2011). There have been a series of QM principles/practices/approaches/systems in use over the years, including Total Quality Management (TQM), Continuous Improvement (CI), Six Sigma, Total Productive Maintenance (TPM), Toyota Production System (TPS), Lean Manufacturing, Theory of Constraints (TOC), and ISO 9001 QM System standards. Organizations worldwide have also adopted various business/quality excellence assessment models to demonstrate a high level of commitment to quality achievement. Since 1951, Japanese Union of Scientists and Engineers have been giving the Annual Deming Prize/Deming Grand Prize (named after the US quality expert W. Edwards Deming) to companies that have achieved distinctive performance improvements through the application of TQM. In 1987, the US Government started its own annual award program, the Malcolm Baldrige National Quality Award (MBNQA), for excellence in quality achievement for the US-based companies. This was followed by the European Foundation for Quality Management (EFQM), in 1991, launching

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the European Quality Award to recognize companies showing a high level of commitment to quality. Most of the organizations in other countries, worldwide, have also adopted similar or customized business excellence assessment models to demonstrate and achieve quality and business performance achievement.

All these QM systems as well as business assessment models have been evolved by many quality experts at different countries/institutions at different point of time over the last few decades with the fundamental purpose of achieving quality and business performance excellence. However, organizations worldwide have adopted/implemented either a particular QM system or a combination of these QM systems to meet their company objectives including improvement in their business/organizational performance. Further, there are also organizations which have adopted multiple systems, either together or in different sequences, and have reported different levels of performance achievements. Large number of such research have been conducted in last two decades at various organizations showing the impact of adoption of several QM systems on the organization's quality, operating and business performances. In this context, a descriptive literature review was published by Ahire *et al.* (1995) providing a thorough synthesis of 226 TQM-related articles published in 44 management journals from 1970 to 1993 and categorizing the literature among the several components of QM. Alvarez *et al.* (2000) also published a literature review of 201 TQM-related articles from 28 leading journals over the years 1994 to 1999 and categorized them according to a framework for providing an understanding of what constitutes QM research and the direction of research in this area. The authors observed that there is a scarcity of formal models about TQM in the literature as well as there were very few papers on TQM and performance. They further observed that there was a need to identify key variables and define meaningful constructs for the industry. Sousa and Voss (2002) reviewed QM research organized along five main themes including the impact of QM on firm performance based on 17 QM-related articles published from 1994 to 1999. The authors observed that there was a potential to standardize the QM vocabulary, including the need to distinguish between QM principles, systems and techniques. They also recommended that to increase understanding of the means by which QM effects are generated, more research into linkage between several QM systems including the interactions between QM and other best practices is needed. These reviews were a useful stepping-stone in the classification and analysis of research in the QM-related areas and provided future research directions as well as a ready reference to the QM literature. The missing point in the above literature reviews in the past is that they had considered only the TQM-related articles published in reputed journals and did not cover other QM systems such as TPM, TOC, TPS, Six Sigma, ISO 9001 QMS, etc., which have also been widely used in many organizations, more so in the last 18 years.

The objective of this study is therefore to re-visit QM systems adopted by several organizations, worldwide, in the last 18 years (from 2000 to 2017) and provide a reflective and updated review of its contents. The review covers all the research work/articles published on the QM systems (as mentioned above) in 17 reputed journals in the fields of Management Science, Production and Operations Management and Operations Research. This study has attempted to fill the following gaps identified in the previous literature reviews and recommended for future research areas:

(1) review of all QM systems (e.g. TPM, Six sigma, TOC, Lean, and ISO 9001 QMS) in addition to TQM system covered in the past studies;

(2) update the literature review covering last 18 years studies beyond 1999, when the last such review was done;

(3) study and synthesize the findings on the impact of QM systems on firm's performance;

(4) study and recommend key variables/performance measures for studying the impact of QM systems on firm's performance on various dimensions such as quality, financial, operational, marketplace and human resource-related performances;

(5) study and recommend the differences between QM principles, systems and techniques as a guideline; and

(6) provide scope of future research.

Our aim is to synthesize, organize and structure knowledge from an academic/research standpoint and offer suggestions for future research. As such, we mainly reflect on literature with broader QM perspective with an integrated view of managing quality and do not cover specific topics such as technical and analytical quality topics (e.g. statistical techniques, cost reduction models, etc.), functional-specific areas (e.g. service functions, information technology services, etc.) or literature focused on specific individual components of QM (e.g. employee involvement, supplier QM, leadership commitment, etc.).

The remainder of the paper is organized as follows. Based on an extensive review of the literature, the next section briefly describes the evolution of QM systems. Section 3 provides a synthesis of different QM systems, e.g., TQM, TPM, Six Sigma, Lean, TOC, and ISO 9001 QMS. The review methodology used and the review findings on the relationship between QM systems and firm performance are presented in Section 4. Discussion and future perspective and conclusions based on the gaps identified are presented in Section 5 and 6, respectively.

2. Evolution of QM systems

The evolution of QM systems to an all pervasive management philosophy took shape through the works of Shewhart, Deming, Feigenbaum, Ishikawa, Taguchi and Juran and later by Taiichi Ohno and Eliyahu Goldratt. Shewhart is best remembered for his unique invention of the control chart. Deming prescribed 14 points encompassing the organizational requirements for effective QM. Feigenbaum introduced the concept of total quality control (TQC), which was later renamed as total QM. He also supported the integration of statistical techniques and methodology into the processes of firms to implement company-wide TQC. Ishikawa is associated with quality control circles as a way to achieve CI and the usage of cause-effect diagrams for problem solving. Taguchi made three principal contributions to statistics with a specific loss function, the philosophy of off-line quality control, and innovations in the design of experiment. Juran identified three basic functions of the QM process: quality planning, quality control and quality improvement. Taiichi Ohno, one of the founding engineers of Toyota Motor company, developed TPS which integrates the people of Toyota with its technical system. This concept was later made popular in western world by Wommack and Jones in the name of Lean thinking. Goldratt was the originator of the optimized production techniques such as the TOC, Critical Chain Project Management and other TOC derived tools.

Based on the extensive literature survey, a generic evolution of various QM systems over past 100 years has been depicted in Figure 1. It is seen that in the early part of the QM evolution (Era 1), large number of QM concepts and principles were developed in different parts of the world. In the later part of the twentieth century (Era 2), various business and quality excellence assessment systems and models such as USA's Malcolm Baldrige quality model, European EFQM model, ISO 9001 QM system standard, etc. had evolved primarily to understand the level of deployment of the concepts in the organizations. With more and more organizations maturing through the deployment of various QM concepts, the focus now (Era 3) is on integration and consolidation with the development of many integrated approaches to implement various QM systems such as Lean Six Sigma or Lean TPM, etc.

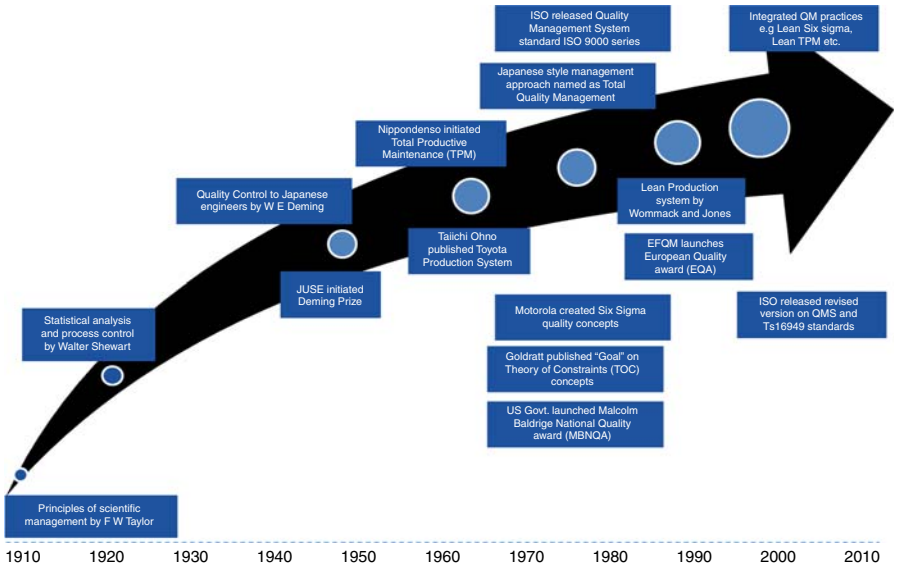

Figure 1.
Evolution of quality management systems

3. QM systems and the need for a review

The ultimate objective of any organization is to achieve a condition of "Sustenance, Improvement and Innovation" in all of its systems and processes so as to achieve the end goals. To accomplish these objectives, organizations, world-wide, adopt a particular QM system, which can be defined as "a set of interrelated or interacting elements of an organization to establish policies and objectives, and processes to achieve these objectives with regard to quality" (as per ISO 9000:2015 standard on QM systems – Fundamentals and vocabulary). A QM system, therefore, comprises activities by which the organization identifies its objectives and determines the processes and resources required to achieve desired goals. Based on this definition of the QM system, while doing the extensive literature review on this subject, we could identify the following six most popular QM systems being followed world-wide by various industries:

(1) TQM;

(2) TPM;

(3) Six Sigma quality;

(4) ISO 9001 quality management system;

(5) Lean manufacturing (also known as TPS); and

(6) TOC.

Table I shows a brief synthesis of all these QM systems including some of the distinguishing and value-adding contributions made by these systems.

While these QM systems have evolved at different part of the world at different point of time, each one of them has the common intent of accomplishment of the overall objectives of the organization. Each of these systems, however, has few distinguishing and value-adding contributions as its focus area. While TQM system is more focused on process and customer orientation through the use of statistical quality control, TPM is more inclined toward autonomous and planned maintenance activities with the involvement of shop-floor work

Table I.
Synthesis of quality management systems

Description	Total quality management	Total productive maintenance	Theory of constraints	Toyota production system (lean/just in time)	Six Sigma	ISO 9001 QMS
First mentioned	1951	1971	1984	1988	Late 1980s	1987
Origin (Gurus)	Shewart, Juran, Deming. Crosby	Nippondenso, Japan	Eliyahu M Goldratt	Toyota (Toyoda Ohno and Shingo)	Motorola, general electric	International organization for standardization
Primary objective	Customer Satisfaction/Delight	Overall Plant Effectiveness	Profit Maximization	Value creation	Cost reduction	Quality management system development
Focus on	Quality of products and processes new product development	Loss/Waste reduction availability production rate quality rate	Bottlenecks (constraints)	Inventory, pull, material and information flow, speed	Variation reduction	Quality of products and processes
Methodology	Four vehicles: Policy management daily management cross-functional management employee involvement initiatives	Eight Pillars: Autonomous Maintenance Planned Maintenance Focused Improvement Quality Maintenance Education and Training Development Management Safety Health and Environment TPM in Offices	5 Focusing Steps: Identify the constraint Exploit the constraint Subordinate to the constraint Elevate the constraint Go back to Step 1	Three Foundations: Just in Time (JIT) Heinjunka (Production Levelling) Jidoka (Autonomation)	Five step Process: Define Measure Analyze Improve (Design) Control (Verify)	Seven Clauses: Context of the organization Leadership Planning Support Operation Performance evaluation Improvement
Effectiveness measures	Customer complaints/ warranty internal rejections/rework no. of new products/ services delivery performance cost reduction	Overall equipment effectiveness equipment availability equipment utilization quality rate employee involvement	Throughput improvement due date performance project time compliance	Inventory, work in progress takt time (lead time) first time right yield	Process capability variation (sigma level) cost savings	Customer complaints internal rejections/ rework no. of nonconformities
Typical Tools/ techniques used	Seven basic QC tools seven new QC tools advanced statistical tools	5S and visual management phenomenon observation physical mechanism analysis why-why analysis 4-M analysis	Buffer management bottleneck analysis inventory visualization	Value stream mapping visual management 7 types of waste identification Kanban cell manufacturing	Basic statistical tools advanced statistical tools Shainin techniques	Corrective and preventive actions statistical tools data collection

(*continued*)

Description	Total quality management	Total productive maintenance	Theory of constraints	Toyota production system (lean/just in time)	Six Sigma	ISO 9001 QMS
Applicability	All types of industries	Primarily manufacturing industries	Primarily manufacturing industries	Primarily manufacturing/ assembly industries	All types of industries	All types of industries
Timelines for implementation	3-4 years	3-4 years	1-2 years	1-2 years	1-2 years	1-2 years
Distinguishing and value adding contribution	Statistical quality control, cross-functional involvement, process orientation	Autonomous maintenance shop floor team involvement, preventive maintenance	Focus mechanisms on constraints	Pull, Takt time, Heinjuka, one-piece flow, value stream mapping, respect for people	Organizational structure with improvement experts (BB GB), project orientation, quantification of cost savings	Standard operating procedures internal audits management reviews

Table I.

force (Ahuja and Khamba, 2008). TOC concepts, on the other hand, enable management to remain focused on what is really important in an organization – the system's constraint(s). TPS/Lean systems prescribe a pull-based system with a human touch. Six Sigma concepts added value through building an improvement structure (black belts/green belts) with statistical experts along with project orientation. ISO 9001 QMS contributed immensely in the development of a standardized system of governance through standard operating procedures, internal audits and management reviews to achieve customer's needs and expectations in a pro-active manner.

These QM systems are being used by many organizations world-wide, sometimes one system at a time or few systems together. It is hypothecated that synthesis of past studies on QM systems will provide guidelines to move forward both from methodological development and implementation points of view. Literature reviews in the past (Ahire *et al.*, 1995; Alvarez *et al.*, 2000; Sousa and Voss, 2002) have studied the impact of these QM systems on the firm's performances and have observed that there was a potential to standardize the QM vocabulary, including the need to distinguish between QM principles, systems and techniques. Last such literature review was done in 2002 covering articles published till 1999. Most of the above literature reviews in the past were also done considering only the TQM-related articles published in reputed journals and did not cover other QM systems, which have also been widely used in many organizations, more so in the last 18 years. Therefore, there is a need to re-visit QM systems adopted by several organizations, worldwide, in the last 18 years and provide a reflective and updated review of its literature.

4. The review

In the following sub-sections, the review methodology used with respect to selection of journals and identification of relevant articles, classification and analysis of review findings and the final outcome in terms of impact of QM systems on the firm's performance have been explained.

4.1 Selection of journals and identification of articles

The online databases were searched extensively to identify relevant papers published in different journals on the identified research topic. The Intellectual Property and Science Business of Thomson Reuters, the world's leading source of intelligent information for businesses and professionals, and the world's most influential resource for evaluating peer-reviewed publications, were used for our research of relevant journals. For doing the literature survey on QM systems in our research, we searched the details of journals amongst this list with the keywords "Quality," "Management," "Production," "Operations," "Business," and "Excellence," etc. in the journal titles and found 340 such journals using these words in their title. Out of these journals, there were 23 journals which were found related with our topic of "Quality Management Systems" and these are shown in Table II with their rank based on the Thomson Reuter's five year impact factor as per Journal Citation Report (JCR) for 2013.

Out of these 23 journals, we did not find any papers published on our topic of research in 12 journals and these were therefore removed from the list. In addition, we found that few journals such as *TQM & Business Excellence*, *Journal of Quality Management*, *International Journal of Operations & Production Management*, *International Journal of Quality and Reliability Management* (*IJQRM*), The *TQM Journal* and *Decision Sciences*, which are although having large number of articles published on the selected topic but their impact factor was not included in the JCR list. We therefore decided to include these journals in the scope of our study. Accordingly, altogether we used 17 journals (as shown in Table II) for our literature review.

S. No.	Journal title	Publisher	ISSN	Impact factor	5-Year impact factor	Selected
1	*Journal of Operations Management* (*JOM*)	Elsevier	0272-6963	4.382	6.012	Yes
2	*Management Science* (*MS*)	INFORMS	0025-1909	1.733	3.304	Yes
3	*International Journal of Production Economics* (*JIPE*)	Elsevier	0925-5273	1.760	2.384	Yes
4	*Operations Research* (*OR*)	INFORMS	0030-364X	1.665	2.285	No
5	*European Journal of Operations Research* (*EJOR*)	Elsevier	0377-2217	1.815	2.277	Yes
6	*Production & Operations Management* (*POM*)	Wiley	1059-1478	1.301	2.259	No
7	*Computer & Operations Research* (*COR*)	Elsevier	0305-0548	1.720	1.984	No
8	*Computer & Industrial Engineering* (*CIE*)	Elsevier	0360-8352	1.589	1.872	Yes
9	*Journal of Quality Technology* (*JQT*)	ASQ	0022-4065	1.564	1.860	No
10	*IEEE Transactions Engineering Management* (*IEEE Tr*)	TASE	0018-9391	0.958	1.768	Yes
11	*Industrial Management & Data Systems* (*IMDS*)	Emerald	0263-5577	1.472	1.717	Yes
12	*IIE Transactions* (*IIE Tr*)	Taylor & Francis	0740-817X	0.856	1.469	No
13	*International Journal of Production Research* (*IJPR*)	Taylor & Francis	0020-7543	1.115	1.367	Yes
14	*Quality and Quantity* (*Q&Q*)	Springer	0033-5177	0.768	1.101	Yes
15	*International Journal of Plant Production* (*IJPP*)	Gorgan University	1735-6814	1.100	1.057	No
16	*Quality and Reliability Engineering International* (*QREI*)	Wiley	0748-8017	0.700	0.842	Yes
17	*Production Planning & Control* (*PPC*)	Taylor & Francis	0953-7287	0.725	0.841	Yes
18	*Accreditation and Quality Assurance* (*AQA*)	Springer	0949-1775	1.036	0.781	No
19	*SPE Production & Operations* (*SPE PO*)	SPE	1930-1855	0.331	0.338	No
20	*Quality Engineering* (*QE*)	Taylor & Francis	0898-2112	0.745	NA	No
21	*Central European Journal of Operations Research* (*CEJOR*)	Springer	1435-246X	0.484	NA	No
22	*4OR-Quality Journal of Operations Research* (*QJOR*)	Springer	1619-4500	0.323	NA	No
23	*Quality Technology & Quantitative Management* (*QTQM*)	NCTU Publications	1684-3703	0.276	NA	No
24	*TQM & Business Excellence* (*TQM & BE*)	Routledge	1478-3363	NA	NA	Yes
25	*Journal of Quality Management* (*JQM*)	Pergamon	NA	NA	NA	Yes
26	*International Journal of Operations & Production Management* (*IJOPM*)	Emerald	0144-3577	NA	NA	Yes
27	*International Journal of Quality & Reliability Management* (*IJQRM*)	Emerald	0265-671X	NA	NA	Yes
28	*The TQM Journal* (*TQM*)	Emerald	1754-2731	NA	NA	Yes
29	*Decision Sciences* (*DS*)	Wiley	1540-5915	NA	NA	Yes

Table II.
Rank of journals as per 5-year impact factor and selected journals

A total of 263 papers could be identified in the selected journals, which have published articles on QM systems during the period 1993 to 2017; a summary of the same has been shown in Figure 2, showing that more than two-third of the total number of papers on this topic have been published in the top six journals, namely, *Journal of Operations*

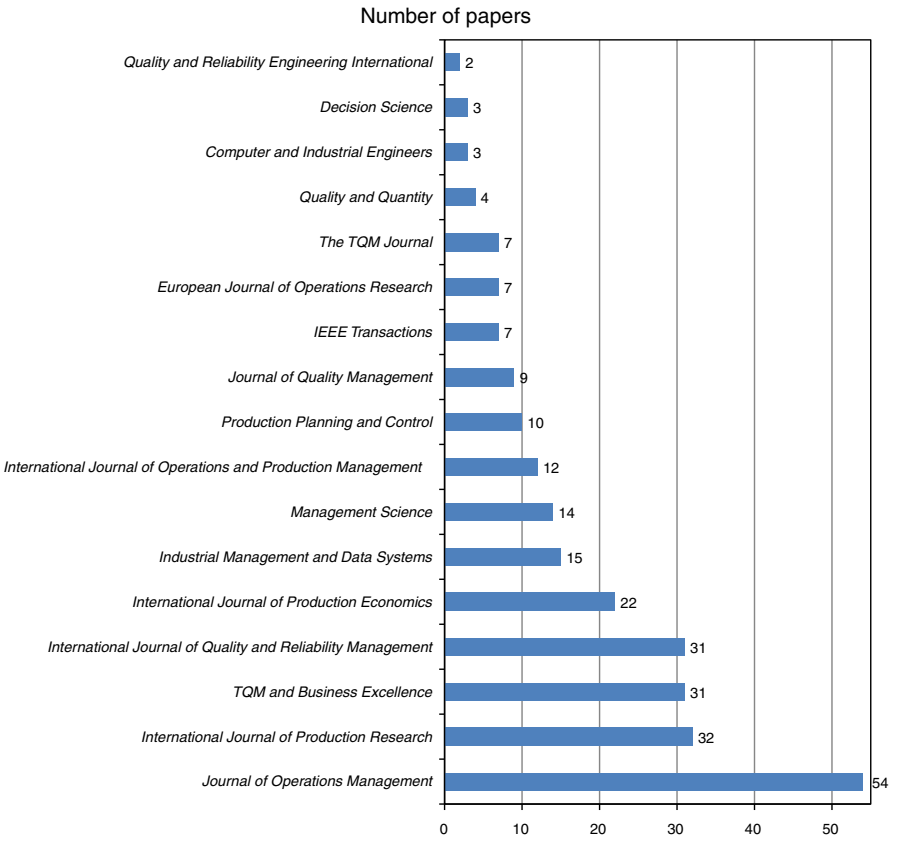

Figure 2.
Distribution of papers published in selected journals

Management (*JOM*), *International Journal of Production Research* (*IJPR*), *Total Quality Management & Business Excellence* (*TQM & BE*), *International Journal of Quality and Reliability Management* (*IJQRM*), *International Journal of Production Economics* (*IJPE*) and *Industrial Management and Data Systems* (*IMDS*).

4.2 Analysis of review findings

We have developed a framework for classifying the review findings into the following dimensions giving the distribution of the published articles in the reviewed journals with our observations under each of these dimensions:

- year-wise publication of articles;
- continent-wise publication of articles;
- QM system-wise publication of articles;
- type of research study used;
- broad firm's performance measurement categories;
- performance measures used under each performance measurement categories; and
- use of statistical tools and techniques.

4.2.1 Year-wise publication of articles. The last such literature review was done on the QM systems by Alvarez *et al.* (2000) and Sousa and Voss (2002) for the publications during the period 1994 to 1999. The year-wise analysis of the publications, in Figure 3, shows that more than 80 percent (217 out of 263 papers) of the studies have been published in the years 2000 and afterwards. It confirms that there is a need to do a further literature review with the articles published during this period to identify future directions for research on QM systems.

4.2.2 Continent-wise publication of articles. Most of the research on QM systems – performance relationships has been conducted in developed countries, while few studies have been conducted in developing countries. Figure 4 shows that around 60 percent of the studies during this period were been done in the western countries (America + Europe) with the Asian countries contributing only around one-fourth of the studies done. Studies done during this period also showed that there were only 16 such studies (about 6 percent of the studies) done in India on the adoption of QM systems and its impact on firm performance.

4.2.3 QM system-wise publication of articles. Figure 5 shows the number of studies done on various QM systems and their impact on the firm's performance. It can be seen from the

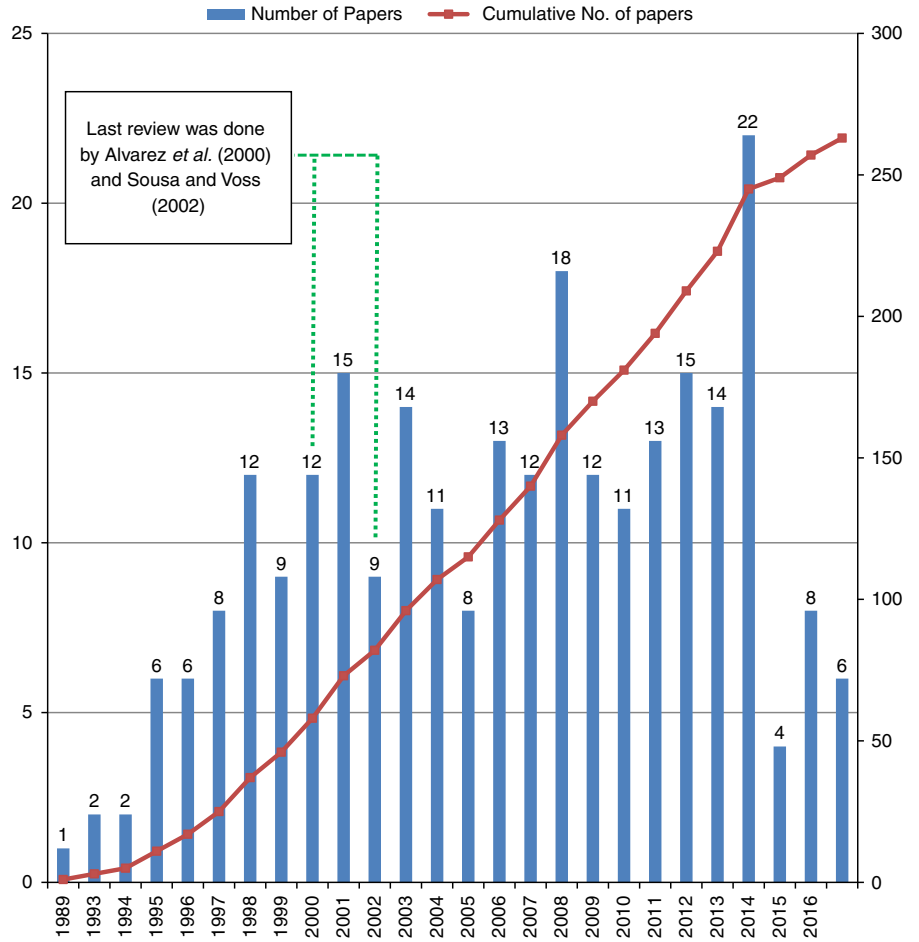

Figure 3.
Number of papers published in selected journal in last 20+ years

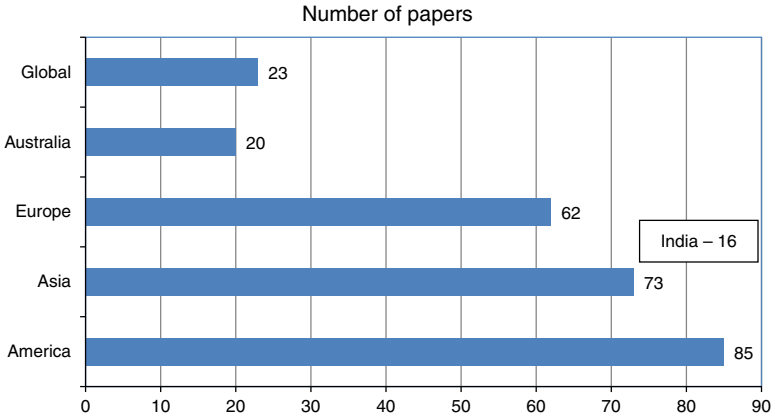

Figure 4.
Distribution of papers published in different continents

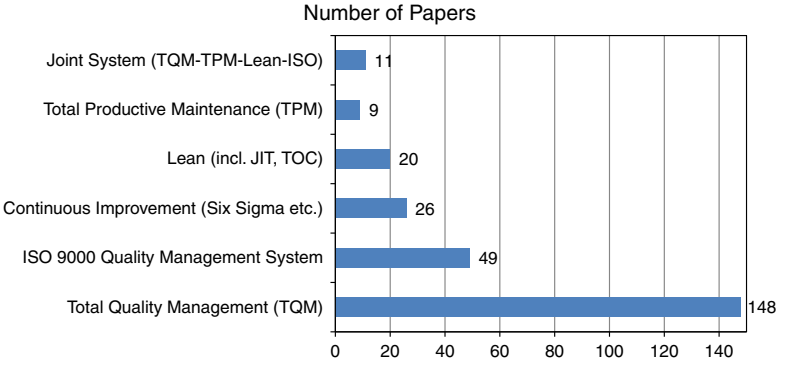

Figure 5.
Distribution of papers published on various QM systems

graph that while the adoption of TQM system and its impact on firm's performance have been studied the most (more than half of the total studies), almost all the studies have analyzed adoption of a particular QM system only at a time. Only 11 such studies (around 4 percent) have been published in which a firm has adopted multiple QM systems, either simultaneously or in any particular sequence. This shows a large gap in the existing literature on the joint studies and has scope for further research.

A joint distribution of QM systems across continents has been shown in Table III (frequency with the joint probabilities as percentage shown in the brackets). It can be seen

Table III.
Joint distribution of QM practices across continents

	Quality management practices						
Continent-wise	TQM	TPM	CI	Lean	QMS	Joint	Total
America	46 (18%)	–	17 (6%)	8 (3%)	11 (4%)	3 (1%)	85 (32%)
Asia	45 (17%)	7 (2%)	4 (2%)	1 (0.5%)	12 (5%)	4 (2%)	73 (28%)
Europe	32 (12%)	1 (0.5%)	5 (2%)	5 (2%)	16 (6%)	3 (1%)	62 (23%)
Australia	13 (5%)	–	–	2 (0.5%)	5 (2%)	–	20 (8%)
Global	12 (5%)	1 (0.5%)	–	4 (2%)	5 (2%)	1 (0%)	23 (9%)
Total	148 (56%)	9 (3%)	26 (10%)	20 (8%)	49 (19%)	11 (4%)	263

that TQM system and its impact on firm's performance has mostly been studied in American, Asian and the European countries, showing its popularity in these countries. It is primarily due to the fact that TQM concepts were first developed in the USA, deployed and improvised in Japan and later also widely used in other countries. TPM concepts have been more popular in Asian countries compared to rest of the world mainly due to its inception in Japan and deployed at other Asian countries, e.g., India, Thailand, etc. While ISO 9001 QMS has been studied world-wide, CI concepts such as Six Sigma and Lean systems have been studied more in America and Europe as compared to remaining part of the world.

4.2.4 Types of research study used. Wacker (1998) examined the published articles during the period 1991-1995 with respect to different theory-building research methods in operations management and classified these into two major categories: analytical (use of deductive methods – logical, mathematical and/or mathematical-statistical) and empirical (use of data from external organizations or businesses). Each of these two major categories was further classified into three sub-categories: analytical conceptual research, analytical mathematical research, analytical statistical research, empirical experimental research, empirical statistical research and empirical case studies.

We have also classified the 263 articles as per the research categories and the result has been presented in Figure 6, which shows that most of the studies done are empirical statistical research type (using survey-data based on questionnaire) with very few empirical case studies (around 2 percent studies). Even within the empirical statistical research, most of the studies use cross-sectional design, which involves administering the survey once to a sample and yielding data on the measured characteristics as they exist at the time of the survey. This type of research study had been adopted predominantly for almost all the QM systems as can be seen from Table IV, except for the studies on TPM system, in which empirical historical data analysis is predominant.

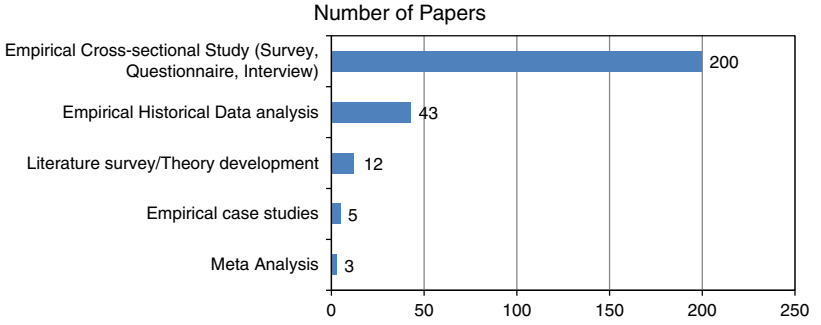

Figure 6.
Distribution of papers published based on type of research study

Type of research study	Quality management practices TQM	TPM	CI	Lean	QMS	Joint	Total
Empirical cross-sectional study	121 (46%)	3 (1%)	13 (5%)	17 (7%)	38 (15%)	8 (3%)	200 (76%)
Empirical data analysis	15 (6%)	5 (2%)	8 (3%)	2 (1%)	11 (4%)	2 (1%)	43 (16%)
Literature survey	9 (3%)	–	2 (1%)	–	–	1 (0%)	12 (5%)
Empirical case studies	1 (0%)	1 (0%)	3 (1%)	–	–	–	5 (2%)
Meta analysis	2 (1%)	–	–	1 (0%)	–	–	3 (1%)
Total	148 (56%)	9 (3%)	26 (10%)	20 (8%)	49 (19%)	11 (4%)	263

Table IV.
Joint distribution of QM practices across type of research study

It has been seen from the literature review that most of the researchers have used a design framework as depicted in Figure 7 (either fully or in part) and can be classified into following categories:

- QM system implementation → impact of firm's performance.
- QM system implementation → QM principles → impact on firm's performance.
- QM system implementation → mediating/moderating factors → impact on firm's performance.
- QM system → QM principles → mediating/moderating factors → impact on firm's performance.

The researchers have developed few constructs (either directly or using some of the QM principles) and prepared research questions linking the implementation of these constructs with the firm's performance (critical outcomes on various performance measurement categories). While in some of the research designs, this linking has been made directly with the performance measures, rest of them used it through some mediating/moderating factors, which might also have impacted the level of implementation of the QM systems, and which in turn has effect on the firm's performance. The development of these constructs, the mediating/moderating factors and the performance measurement categories varied widely across various research studies done for the QM systems. While this type of research designs have merits of considering country or company-specific constructs and/or mediating/moderating factors, it also poses a major demerit as there is no consistency/standardization of the factors considered and therefore the conclusions may not be comparable amongst continents and for various QM systems.

Since these empirical statistical research designs primarily adopted perceptions of the respondents (self-reported data from CEO and top QM executives), these might have introduced bias into the data, due to vested interest that these executives might experience successes in their initiative. This results into potential concerns regarding generalizability, reliability, and validity of the studies. Second, these survey

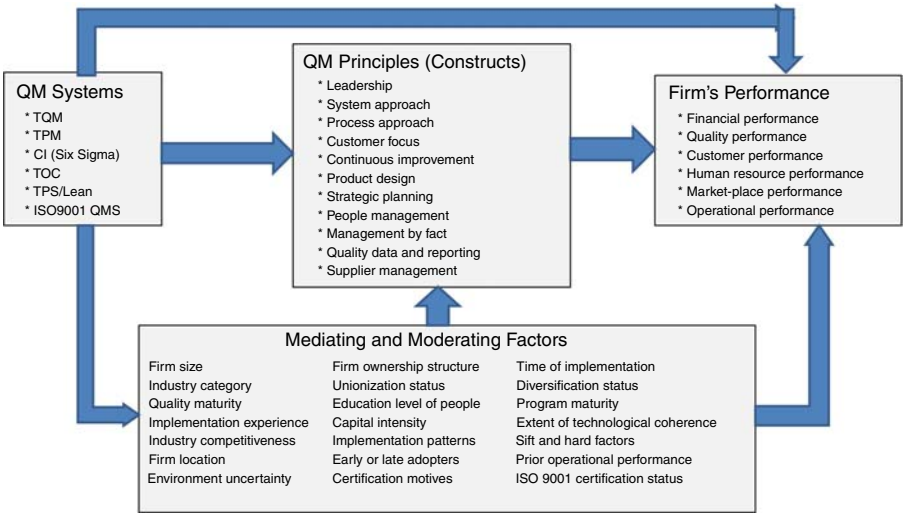

Figure 7.
Typical research study design on impact of QM systems on firm's performance

respondents were in no position to assess any causal linkage between the QM systems and the subsequent firm's performance because such studies fail to isolate effects of other causes, if any. Further, most of the data on performance measures were also based on the respondents' perceptions (self-reported perceptions of performance) and not on hard data (Samson and Terziovski, 1999; Kaynak 2003; Prajogo and Sohal, 2006). Objective measures of performance such as actual performance could provide a better test of the proposed hypotheses.

Several studies have also assumed winning of a quality award or a certification as a proxy for the establishment of an effective QM program. Although many of these awards and certifications were given to a division or a functional unit of large organizations, the firm's performance (mainly financial performance) was taken at the corporate level as the division-wise performance was not available publically (Hendricks and Singhal, 1997). Therefore, the link between an award or certification for a QM program given to a division/unit of the large organizations and their subsequent performance may not be valid.

Furthermore, the independent and dependent constructs were measured using the same survey instrument, which may result in common method variance and potential common method bias. Therefore, in order to have a more objective and reliable findings, it is better to conduct a research which is based on empirical case study using longitudinal design to understand the true relationship between implementation of QM systems and the firm's performance (Jayaram *et al.*, 2010).

4.2.5 Broad firm's performance measurement categories. Past empirical studies have attempted to investigate the relationship between QM systems and firm performance using both factual and perceptual data, at manufacturing as well as service enterprises of all sizes (large, medium and small). Figure 8 shows the frequency of broad performance measurement categories used by these studies. It indicates that, among the collection of all possible performance measurement categories, quality and customer satisfaction performance, financial performance and operational performance measures are most widely cited. Operational performance is a primary performance measure as it follows directly from the actions taken during QM implementation. Quality performance, financial and market performance and customer satisfaction are secondary measures as they are a consequence of QM implementation systems (Brah *et al.*, 2002; Ebrahimi and Sadeghi, 2013).

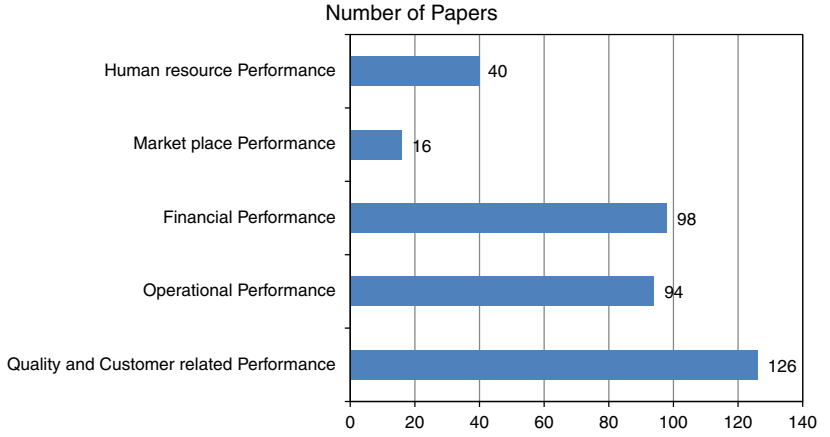

Figure 8.
Frequency of broad firm's performance measurement categories

Table V shows the joint distribution of the QM systems with performance measurement categories. It can be seen from this analysis that TQM studies predominantly consider quality and customer-related performance and financial performance of the organization to confirm its impact on firm's performance. Further, while TPM and Lean systems use operational performance as the predominant measures to study its impact, studies on CI systems such as Six Sigma use quality and customer-related performance as the predominant measure for this study.

4.2.6 Performance measures used under performance measurement categories. Each of the above broad performance measurement categories was further broken down to show the performance measures most frequently used by the researchers under these categories and have been presented in Figures 9 (financial performance), Figures 10 (human resource performance), Figures 11 (quality and customer performance), and Figures 12 (operational performance). Under the market-related performance measures, the metrics used are market share (45 times), market competitiveness (15 times) and brand image/performance (3 times).

We could not find any published article that has studied the impact of the implementation of any QM systems solely based on the safety, health and environmental performance of the company. While few of the published papers have included some of the safety and environmental-related performance measures such as injury rate/injury cost (8 times) and environmental pollution and hygienic condition (3 times), as a part of

Table V.
Joint distribution of QM practices with performance measurement categories

Performance measurement categories	Quality management practices						
	TQM	TPM	CI	Lean	QMS	Joint	Total
Quality and customer related	76 (20%)	2 (1%)	11 (3%)	6 (2%)	25 (7%)	6 (2%)	126 (34%)
Financial performance	61 (16%)	2 (0%)	7 (2%)	7 (2%)	17 (5%)	4 (1%)	98 (26%)
Operational performance	39 (11%)	9 (3%)	8 (2%)	14 (4%)	20 (5%)	4 (1%)	94 (25%)
Human resource performance	29 (8%)	–	1 (0%)	2 (0%)	5 (1%)	3 (1%)	40 (11%)
Marketplace performance	11 (3%)	–	–	1 (0%)	4 (1%)	–	16 (4%)
Total	216 (59%)	13 (4%)	27 (7%)	30 (8%)	71 (19%)	17 (5%)	374

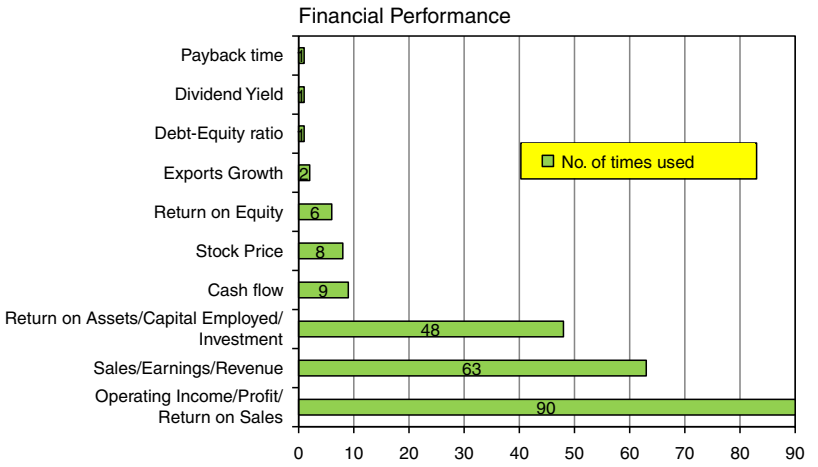

Figure 9.
Mostly used performance measures on financial performance

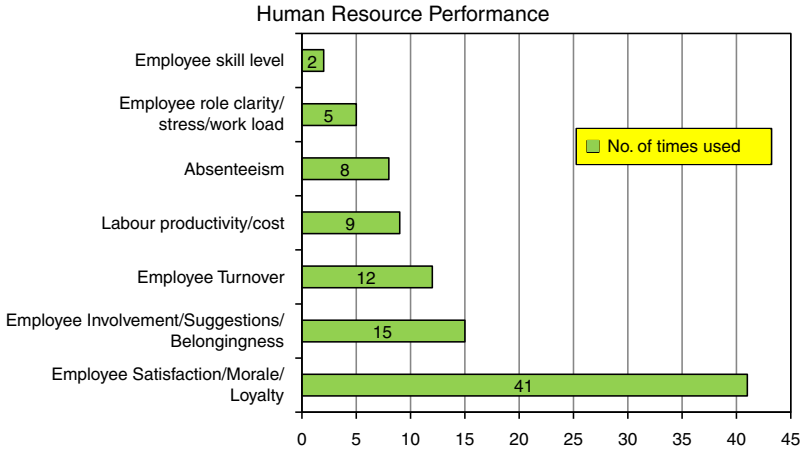

Figure 10. Mostly used performance measures on human resource performance

Figure 11. Mostly used performance measures on quality and customer performance

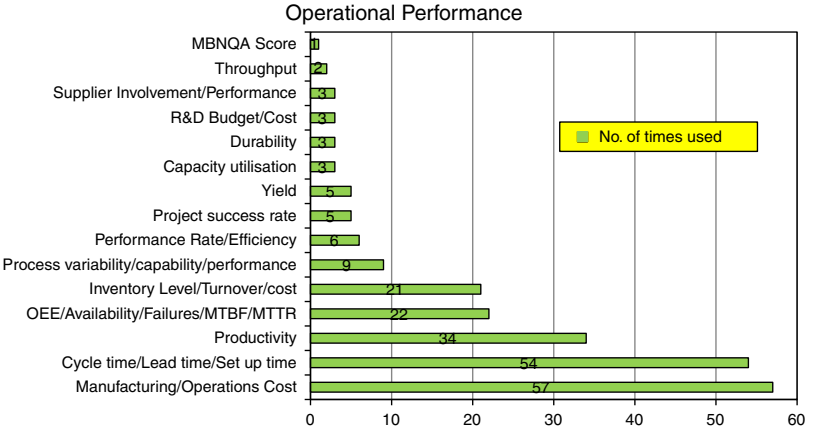

Figure 12. Mostly used performance measures on operational performance

operational performance of the company, a full-fledged study on how the QM systems of a company impacts the safety, health and environmental performance of the company is yet to be reported.

It can be seen from the Figures 9-12 that different measures have been used under each of the performance measurement categories, by different researchers to study the impact of implementation of QM systems on firm's performance. Within a performance measurement category (e.g. financial performance), some of the measures considered are the outcome measures whereas other are in-process measures and there is no uniformity in the consideration of these for the analyses. It may be worthwhile to standardize sets of measures under each of the performance measurement categories (may be top 3-5 measures under each categories as shown in Figures 9-12) so that these studies are comparable world-wide over a time-period with the consideration of these standardized performance measures to draw conclusions.

4.2.7 Use of statistical tools and techniques. Researchers have collected data (either through questionnaire survey or historical real data) from organizations on the implementation of QM systems and their impact on the organizational performance measures and analyzed these data using various statistical tools and techniques to confirm the hypotheses developed. The frequency of the use of various tools and techniques used to analyze QM system-performance relationships is presented in Figure 13. It can be seen from the figure that more than two-third of the papers used multivariate statistical models (e.g. structural equation modeling, correlation and regression, etc.) to confirm the hypotheses developed.

Table VI also shows that use of multivariate statistical modeling has been employed predominantly across all the QM systems and account for around 70 percent of these studies. Since the outcomes of these studies are based on the sample data gathered from organizations for a particular period, these therefore give only a snapshot at one specific point of time and do not account for changes over time. All studies of such nature suffer from this limitation and a longitudinal study would be necessary to overcome such a limitation. These types of studies and the outcomes depend upon the sample size and the factors/constructs developed. Further, using these statistical analyses, the existence of a significant correlation between quality constructs and firm's performance does not establish that the QM system causes an improvement in the performance.

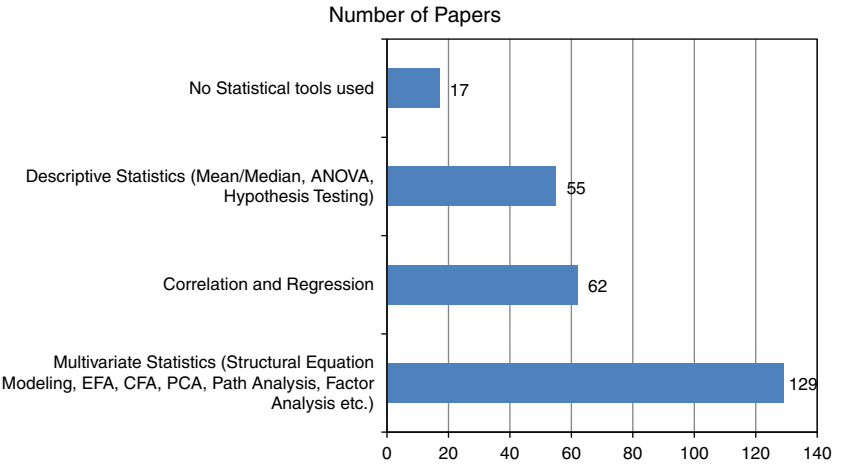

Figure 13.
Distribution of papers using various statistical tools and techniques

High performance may trigger implementation of a QM system or both QM system and performance may be the result of a third factor. Therefore, a set of structured longitudinal studies, using statistical credible samples and multivariate methods, may measure changes in the firm's performance before and after the implementation of a QM system in a company across a three-to-five year period.

4.3 Impact of QM systems on firm's performance

The numerous empirical studies that examined the impact of QM systems on firm performance have produced mixed results. Many studies suggested that successful QM implementation can bring many benefits to an organization. On the other hand, some studies also found that firms that implemented QM system(s) did not outperform the firms which did not implement any QM systems (Prajogo and Sohal, 2003; Yunis *et al.*, 2013). It was also reported that some organizations had difficulties with implementation and had mixed success (Samson and Terziovski, 1999; Terziovski and Samson, 1999). Managers, researchers and QM practitioners are continuously interested in and concerned about the exact nature of QM system-performance relationships and which QM system to adopt to achieve successful implementation.

In most of the reviewed papers, hypotheses were developed to confirm the relationship between the implementation of QM system(s) and the firm's performance with respect to financial, marketplace, quality and customer, human resource and/or operational performance. These relationships have been tested to confirm whether there exists a positive relationship, no relationship or a negative relationship between implementation of QM systems and its impact on performance. Figure 14 shows the summary of QM system-wise status of these studies.

It can be seen that on an overall basis about 90 percent of these studies have confirmed that QM systems have a positive impact on the firm's performance, with the remaining 10 percent studies reporting either there is no relationship or a negative relationship. While this is true for firms implementing QM systems such as TQM, TPM and Lean, either individually or jointly, the same is not true for ISO 9001 QM system. More than 30 percent (around one-third) of these studies on firms implementing ISO 9001 QM system have reported that the implementation of this QM system did not have a positive impact on the organizational performance. It may therefore be worthwhile to study further why some of the implementation of QM systems, especially ISO 9001 QM system, in a firm did not yield positive impact on its performance to identify implementations issues and/or critical success factors necessary for an effective implementation.

5. Discussion and future perspective

As mentioned in the introduction, since its formal beginning in 1950s in Japan, QM systems have been widely used world-wide and have entered a matured phase now. While it was initiated in the name of TQM, several other QM systems (namely TPM, Six Sigma, Lean manufacturing, TOC, ISO 9001 QMS, etc.) have also been adopted by various

	Quality management practices						
Use of tools and techniques	TQM	TPM	CI	Lean	QMS	Joint	Total
Multivariate statistics	109 (42%)	6 (2%)	16 (6%)	19 (7%)	35 (13%)	6 (2%)	191 (73%)
Descriptive statistics	30 (11%)	3 (1%)	5 (2%)	1 (0%)	12 (5%)	4 (2%)	55 (21%)
No statistical tools used	9 (4%)	–	5 (2%)	–	2 (1%)	1 (0%)	17 (6%)
Total	148 (57%)	9 (3%)	26 (10%)	20 (7%)	49 (19%)	11 (4%)	263

Table VI. Joint distribution of QM systems with tools/techniques employed

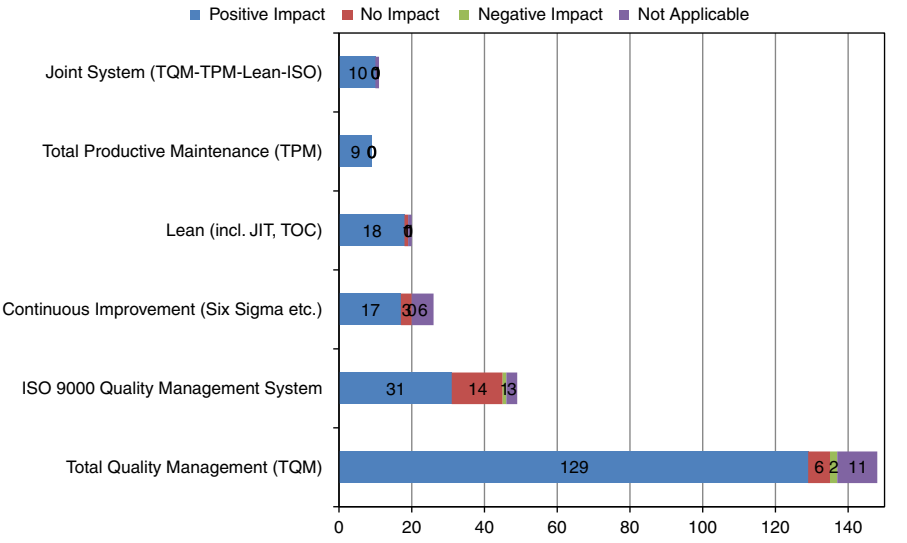

Figure 14.
Impact of quality management systems on firm's performance

organizations worldwide in the last few decades. All the past studies done on this subject were primarily focused on TQM only. The present study is the first of its kind which has considered all these QM systems together while studying their impact on firm's performance. Further, the latest literature review on this subject was done in 2000 (studies completed till 1999) and in the last 18 years, large number of articles have been published in the reputed journals on this subject. This study was therefore undertaken to include all the QM systems being implemented by the firms and have considered the studies done till May 2017. Accordingly 263 articles were studied to conduct a comprehensive literature review and the review findings have been described in detail under Section 4. Several future perspectives have been identified and detailed below.

5.1 Use of empirical longitudinal case studies

Our literature review finds that more than 75 percent of the studies on this QM system-performance relationship evaluation are empirical statistical research type using survey-data with cross-sectional design, in which the conclusions are based on the responses on the survey questions. This research methodology has its own limitations. Since these studies primarily adopted perceptions of the respondents (self-reported data), these might have introduced bias into the data. Further, the respondents might not have assessed the causal linkage between the QM systems and the subsequent firm's performance (Samson and Terziovski, 1999; Heras *et al.*, 2002; Kaynak, 2003).

In order to have a more objective and reliable findings, future research must concentrate on empirical longitudinal case studies to understand the true relationship between implementation of QM systems and firm's performance, which are very few in the present literature. This, however, will require a closer tie of industry and academia to get real-time data from industries. Researchers should select few organizations in any particular industry (say Steel, Petro-chemicals, Automobiles, etc.), which have been practicing QM systems for few years, identify appropriate parameters for measuring the implementation of QM systems as well as their performance, collect real-time data over time on these parameters to capture any change in the performance and do an empirical longitudinal case study design

for their research to confirm the relationships between the implementation of QM systems and firm's performance. In this context, readers may consult different empirical methods as described by Wacker (1998). While many statistical methods are available for the analysis of longitudinal data, some modern methods such as general linear mixed model and generalized estimating equations may be used to analyze these data and get insights.

5.2 Implementation of multiple QM systems

Organizations world-wide have adopted various QM systems (TQM, TPM, Six Sigma, ISO 9001 QMS, etc.). While all these systems have a common intent, the principles, methodologies and tools/techniques prescribed by them are somehow different (as discussed in Section 3). The missing point in the past literature reviews (Ahire *et al.*, 1995; Sousa and Voss, 2002) is that they have considered only the TQM-related articles published in reputed journals and did not cover other QM systems, which have also been widely used in many organizations, more so in the last 18 years. Our literature review finds that out of the 263 studies during the period 2000-2017, while 57 percent of studies were for the organizations which adopted TQM systems, rest of the studies were for the organizations which adopted other QM systems such as TPM, Six Sigma, etc. (Figure 5). Further, our literature review also finds that most (around 96 percent) of the studies are concentrated in finding out the impact of a single QM system (TQM or TPM or Six Sigma or Lean, etc.) implemented on the firm's performance. There have been only 11 studies in which a combination of these QM systems has been adopted by the organizations.

Many organization world-wide (especially in developing countries like India) have been adopting multiple QM systems over time to improve their systems and processes and be competitive in line with their business needs. There are many organizations in India, which started with the adoption of ISO 9001 QMS in early 1990s, later initiated implementation of TPM, followed by Six Sigma and finally TQM system over a period of 20 years. There are also organizations which started with adoption of ISO 9001 QMS, followed by TQM and later TPM and Six Sigma systems. However, there are also few organizations where only one of the QM systems is being adopted since its inception. Therefore, there are organizations in different countries, in which either a particular QM system or a combination of these systems (either simultaneously or in series over time) has been adopted. There are no such researches in the existing literature, which has studied this aspect of the QM system adoption-performance relationships. Further, in the existing literature, there are no such studies available wherein the sequence of implementation of these multiple QM systems on companies over time and their impact on the organizational performance have been examined.

It is recommended that future research should identify a particular industry, select organizations within this industry which have adopted multiple QM systems over time, study the pattern/sequence of adoption of these systems, collect data based on the appropriate research design and study the impact of the implementation of QM systems on firm's performance over time. This type of research may provide deep insights on the applicability/validity of different QM systems for different industries as well as also prescribe the sequence of adoption of different QM systems for different industries based on past research findings. This is an area on which the researchers can focus on in the future.

5.3 Selection of lead performance measures for impact evaluation

Business excellence assessment models followed world-wide (e.g. MBNQA criteria, EFQM model, etc.) evaluate organizational performance (outcomes) primarily on five broad performance categories such as quality and customer-focused results, operational performance results, human resource results, marketplace performance results and financial performance results. These models generally consider the financial and marketplace performance measures as lag (outcome) measures and the quality, customer, human-resource

and operational performance measures as lead (process) measures. Under each of these broad performance categories, many performance metrics can be used to evaluate firm's performance. While some of the performance metrics may be relevant for most of the industries (such as operating profit, customer complaints, defects, human resource satisfaction, etc.), some of these metrics may not be relevant to few industries (such as labor productivity for automated industries, equipment availability for service industries, etc.). Therefore, while evaluating the impact of implementation of QM systems on firm's performance, it is necessary that the broad performance categories as well as the performance metrics being used for this evaluation should be relevant and applicable for different industries for meaningful assessment.

Our literature review finds that while most of the studies have considered a particular performance category (such as financial performance or operational performance) to evaluate the impact of QM systems on firm's performance, some of the studies have also considered a combination of these performance categories (financial, operational, human-resource related performance measures, etc. together). Around one-third of the studies have only considered financial performance as the indicator of firm's performance. The financial and/or marketplace performance are primarily the outcome (or a lag) measures and may get impacted due to factors/practices other than the intervention of a QM system. The process (or a lead) measures, which are directly impacted by the adoption of a particular QM system, are normally the operational and/or quality performance measures (e.g. internal rejections/defects, production/delivery cycle times, delivery adherences, plant/equipment availability and utilization rates, and other in-process measures). These leading measures are further impacted by human resource-related measures (e.g. work force involvement and empowerment, team work and communication, work force learning and development, etc.).

We recommend that future research to evaluate the impact of QM systems on firm's performance should focus more on these process/lead measures (operational, human-resource related, quality-related performance metrics) to study the impact of the adoption of a QM system rather than only studying their impact on the lag measures such as financial and marketplace performances.

5.4 Selection of standardized performance metrics

While the different business excellence assessment models evaluates organizational performance based on different lag (financial, marketplace, etc.) and lead performance (operational, quality, human-resource related) categories with different weightages, the real performance metrics to be used under each of these broad performance categories have not been prescribed by these models and this has been left on the judgment of the assessment teams based on their relevance/applicability of different organizations/industries. As such, there are no standardized performance measures under each of the performance categories which can be used by researchers to evaluate firm's performance.

Our literature review finds that in the past studies on this subject, different performance measures, even within a particular performance category, have been used for examining the impact of implementation of QM systems on firm's performance with no consistency and standardization. For example, while within financial performance category, few studies have used "operating profit" (Enrique *et al.*, 2008) as a metric, few others have used "return on capital/asset" (Benner and Veloso, 2008) as the metric to examine financial performance. Similarly, for evaluating quality and customer-related performance, while few studies have used "Defect/rejections" (Samson and Terziovski, 1999) as the metric, few others have used "warranty cost/customer complaints" (Baird *et al.*, 2011) as the metric. Same are the cases for the consideration of metrics of other performance categories (refer Figures 9-12).

We recommend that in order to get findings which are comparable with past studies as well as over a time-period to draw valid and meaningful conclusions, future research should use a set of standardized performance measures under each of the broad performance

measurement categories. These performance metrics can be standardized for a particular industry as per their relevance and applicability and the same set of measures should be used by the researchers to derive valid conclusions.

5.5 Studies on safety, environment and occupational health-related performance

While operational and other business-related performance measures are important parameters for the evaluation of organizational performance, the consideration of safety, environment and occupational health-related performance of the organizations in this evaluation is also critical for their long term sustainability. It is becoming increasingly important now with the present focus on sustainable development which requires meeting human development while maintaining the ability of natural systems to continue to provide the natural resources and ecosystem services upon which economy and society depend. The adoption of a QM system by an organization focuses on all-round development and improvement of its systems and processes to facilitate improvement in its overall performance including the performance on safety, environment and occupational health. More and more organizations are therefore adopting the ISO 14001 Environmental Management System and BS:OHSAS 18001 Occupational health and Safety Management System standards in addition to ISO 9001 QM System world-wide to focus on developing a system to manage (plan, execute, monitor, review and improve) the environmental, safety and occupational health performance of the organization. TPM, the other QM system, also provides great emphasis on the management of these aspects in any organization through one of its pillars (named Safety Health and Environment pillar) including some prescriptions on how to manage these. TQM system too focuses on safety, health and environmental performance of an organization through its daily management and cross-functional management vehicles to manage these in an pro-active manner.

Our literature review, however, finds that while there are few studies which have considered some safety and environmental performance-related performance measures as a part of the operational performance, there have been no reported studies describing the impact of implementing any QM systems solely on the safety, occupational health and environmental management-related performance of the firm. With most QM systems also providing impetus on managing these aspects in an organization, this area appears to have been neglected in the literature and there may be a need to initiate some research work on this subject too.

5.6 Coverage of service industries

Most of the QM systems were originated and adopted first in the manufacturing industries (TPM was first initiated in M/s Nippondenso, a Toyota group manufacturing company, Six Sigma concepts were first used by M/s Motorola and TPS was invented in M/s Toyota). After their initiation, these systems were also replicated in other manufacturing industries world-wide. Since the concepts behind all these QM systems are very generic and are applicable to any industries – manufacturing or service, over the years, service industries have also initiated adoption of these systems.

Our literature review indicates that most of the past studies are based on data analyses from the manufacturing industries. This is primarily due to the fact that in comparison to service, more manufacturing firms have adopted QM systems earlier. Since large number of service firms has also implemented these QM systems now, more so in the developing countries, future research should concentrate now on service industries (Evangelos and Jaca, 2016). This may also help to understand whether the impact of implementing QM systems on the firm's performance has a similar pattern between manufacturing and service industries or different and give more insights on the validity and applicability of these systems.

5.7 Coverage of all QM systems in developing countries including Asian countries

While different QM systems have originated from different part of the world (TQM, TPM, TPS from Japan and Six Sigma, Lean, TOC from western countries), our literature review finds that the pattern of this study on impact of QM systems on firm's performance is not uniform world-wide. Around 60 percent of the studies on the QM system-performance relationship have been done in developed countries and there are proportionally (based on population) fewer studies from developing countries specifically in Asian companies (only 6 percent studies in India). Therefore, future research on this subject may concentrate on this part of the world as this region has become/is going to become the manufacturing hub globally.

Further, the literature review finds that while TPM, as a QM system, has been studied more in Asian countries compared to rest of the world, CI concepts such as Six Sigma and Lean systems have been studied more in America and Europe. More studies on impact of implementing TPM at organizations in American/European countries as well as impact of implementing CI and lean systems at the organization in Asian countries should also therefore be taken up by the future researchers to confirm the applicability and validity of all QM systems at all parts of the globe for getting further insights (Muhammad *et al.*, 2017).

5.8 Impact of ISO 9001 QMS on firm's performance

Our literature review finds that around 90 percent of the studies (on an overall basis) have confirmed that there is a positive relationship between the implementation of a QM system and its impact on firm's performance. However, the finding is not consistent amongst various QM systems. While this percentage varies from 85 to 100 percent for other QM systems, it is only 67 percent for the ISO 9001 QM system, meaning that one-fourth of the studies on ISO 9000 QM system standard implementation by organizations show either no relationship or a negative relationship on its performance (Maurizio *et al.*, 2017; Jacqueline *et al.*, 2015).

The ISO 9001 QM system standard focuses on sustenance and improvement in an organization's operating processes as the means to improve quality and efficiency. Organizations receive ISO 9001 certifications after demonstrating to a third-party registrar that they have mapped their operating processes associated with the quality of their products and that they conform and adhere to these repeatable, documented processes. In the initial period after the release of ISO 9001 standard in 1987, many firms did not have this framework of mapping, documenting, adhering, monitoring and reviewing of their processes, and therefore developing and following this framework prescribed by the standard itself resulted into improvement in the performance of the firm during this period. However, with the increased awareness and realization of the need to have these systems in place for the sustenance of an organization, these systems were already in place in most organizations, in a formal and/or informal way, and became a minimum requirement to run an organization. Many of the times, the certification of the organization to the ISO 9001 QM system standard by a third-party registrar became a mandatory requirement by the customer(s) to become eligible to supply products and services to them. Under these situations, just by having a formal system in place with certification and demonstration to a third-party registrar for conformance did not result into any performance improvement of the organizations. It may also be argued that while the ISO 9001 QM system standard requires both the sustenance and the improvement of the processes, it has been observed that more firms these days are primarily using this system for the sustenance of its processes and this may also be a reason behind the above research finding that contribution of ISO 9001 QM system on firm's performance is the lowest as compared to other QM systems. This was also confirmed by Benner and Veloso (2008) in his study of the auto supplier industry where the authors concluded that as the majority of firms within an industry adopt ISO 9001 system, late adopters no longer gain financial benefits from these practices. Further since ISO 9001 QM system is a generic standard applicable to all

industries and can be implemented by any organization, a mere adoption and implementation of the system is not likely to give lasting benefits (Ahire *et al.*, 1996; Chow-Chua *et al.*, 2003; Gotzamani and Tsiotras, 2002; Lieberman and Montgomery, 1988). We however recommend that future research should concentrate on the process of implementation of ISO 9001 QMS including its focus on sustenance and improvement of the processes and its impact of firm's performance to get more insights whether these are due to faulty implementation or there are other critical success factors for an effective implementation of this system. The research findings may also provide more insights on applicability and validity of this QM system across industries, continents, etc.

6. Conclusions

In this paper, we have mapped different QM systems, principles, methodologies, tools/techniques and assessment models to clarify differences amongst these words widely used by the managers and engineers world-wide. Clarity on the same would certainly help the practitioners in adopting and implementing these with clear understanding and purpose of doing it with effectiveness assessment. It can be concluded that while different QM systems have evolved in the different parts of the world at different periods, successful implementation of any of these QM systems will help an organization in achieving its operational and business performance. It is therefore recommended that organizations should adopt any of these QM systems with a clear objective (on what to achieve with its measures) and follow the principles and methodologies prescribed by the said QM system in a consistent manner till its end objectives are accomplished. This, in authors' opinion, is a better and proven strategy, rather than using multiple systems at the same time as it not only confuses the implementers on different methodologies prescribed by these systems but also create duplication of efforts.

The future research needs discussed in Section 5 point to the overarching need to conduct studies on the following:

- While past research on the relationship between QM systems and performance points to an overall positive impact, we identified the need for a more detailed and solid understanding of QM's performance effects by using refined research study designs (including the relevant variables). It has been recommended that in order to have a more reliable and objective findings, it is better to conduct a research which is based on empirical case study using longitudinal design to understand the true relationship between implementation of QM systems and the firm's performance.
- The generation of richer and deeper knowledge on QM system-performance relationship should not only be backed up by rigorous research designs but also the identification of right performance parameters. In addition to relevant financial and customer-related performance (lag measures), the studies should also include operational and quality-related performance parameters (lead measures). There is also a need to standardize the measures to be used for all these performance categories so that these studies are comparable world-wide over a time-period.
- Further, the future research studies should adequately cover all continents including both developed as well as developing countries, types of organizations (manufacturing as well as service) and with all the QM systems being followed by the organizations (either individually or together) so that the research findings are more holistic in nature and more insights can be derived whether these dimensions have any impact on the study outcomes.

We hope that the present study will bring some clarity to the subject and provides helpful guidelines and contributions to the literature for managers and researchers. It contributes

to the development and understanding of QM implementation and the effects of its systems on firm performance. It will also help to reinforce the importance of QM as a field of study and will help it affirm as a major best practice tool kit that should be in place in most if not all organizations.

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