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Quality Management in Indian Manufacturing Organizations: Some Observations and Results from a Pilot Survey

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Abstract

The present study aims to explore the current practices adopted by manufacturing organizations in India. The main objective of this paper is to provide empirical evidence on top management's awareness and understanding of the quality management and its role towards business survival and competitiveness. First, several studies about the implementation of the QM in various countries are reviewed, and then a mail survey was sent to 200 manufacturing organizations in India using a questionnaire as the survey instrument. The questionnaire was checked for reliability and validity by experts and practitioners. Only 50 organizations participated in the survey. The survey findings indicate that Indian organizations are well aware of TQM practices. But implementation level is low than the awareness level. The important CSFs of TQM are identified and it is found that overall mean of implementation is lower than the importance perceived by the respondents. The most implemented factors are process management (mean-3.84), customer focus (3.78) and top management commitment (mean3.57).

Keywords: *Quality management, Manufacturing organizations, Survey.*

Introduction

Today achieving customer satisfaction is most important objective of the organizations and quality management (QM) is the most effective approach to achieve this objective. The QM is an embodiment of concepts, methods and applications. It is a philosophy that underlines the organizational transformation that enables manufacturing organizations to reap real benefits from improvement in quality performance and competitiveness. Under competitive pressures, organizations need to learn faster and lead in best practice for business excellence. Indian organizations have come to understand that, in order to stay competitive, an improvement in organizational quality performance is necessary. Thus, a body of organizations started

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to implement quality management (QM) in order to generate a competitive advantage. In the wake of globalization and liberalization of the economy, Indian companies are facing intense competition from the companies all over the world. Indian companies have to compete with multinationals both at domestic as well as International market. So the product quality has emerged as a key issue in most of the Indian manufacturing industry. Indian companies are viewing ISO 9000 as the starting point for total quality management since it requires setting up of and implementing a management system that ensures consistent products and services at a particular level of quality. By the end of the year 2008, 37,958 and 3,281 organizations in India had adopted ISO 9001 and ISO 14001 respectively. However, the vast literature on QM is derived from the experiences in the industrialized world (Gosen *et al.* 2005). Several studies on QM have been conducted, first in developed countries (e.g., United Kingdom, Australia, Japan, and Canada) and later in developing countries (e.g., Taiwan, China, India, Malaysia, Ghana, and Saudi Arabia). Until recently, very few studies examined QM in Indian context. There has been a recent explosion in literature on QM and related issues, particularly in Indian context (Kakkar and Narag, 2007; Khanna, 2009; Kumar *et al.*, 2009; Mahanti and Antony, 2009; Bhat and Jagadeesh, 2009; Prasad and Tata, 2009). As part of a wider study to investigate the TQM implementation in automotive and other manufacturing organizations in India and its relationship with performance, the present study aims to explore the practices adopted by organizations in India under various TQM critical success factors.

Literature Review

Quality management has aroused great interest among academicians and researchers all over the world. Many studies dealing with quality management has been reported in leading management journals. Table 1 represents a non-exhaustive list of such studies.

Table 1 - Studies related to Quality management implementation several countries

Country	References
Australia	Gadenne and Sharma, 2009.
Canada	Kumar *et al.*, 2009.
China	Hua *et al.*, 2000; Li *et al.*,2003
Ghana	Fening *et al.*, 2008.
Hongkong	Antony *et al.*, 2002; Chin *et al.*, 2002; Lau and Tang, 2009.
India	Kakkar and Narag, 2007; Khanna, 2009; Kumar *et al.*, 2009; Mahanti and Antony, 2009; Bhat and Jagadeesh, 2009.
Kuwait	Mady, 2009.
Malaysia	Arumugam *et al.*, 2009; Abdullah *et al.*, 2009.
Taiwan	Chen and Chen, 2009.
Thailand	Tannock *et al.,* 2002.
Singapore	Koh and Low, 2010.

Most of the reported studies provide empirical evidence about the QM implementation and its relation to performance. The Indian studies on QM can be

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categorized into three streams. The first streams relates to TQM relevance, application, models and obstacles in Indian context (Joseph *et al*., 1999; Kakkar and Narag, 2007; Khanna, 2009; Kumar *et al.*, 2009; Bhat and Jagadeesh, 2009). The second stream relates to ISO 9000(Acharya and Ray, 2000; Gyani, 2008). The third stream is about six sigma implementation in Indian industry (Mahanti and Antony, 2009). The table 2 shows the critical success factors of TQM identified by various authors.

Table 2 - Critical Success Factors of TQM

TQM Frameworks	**Critical success factors***												
Author(s)	1	2	3	4	5	6	7	8	9	10	11	12	13
Saraph *et al*. (1989)	X	X	X	X	X	X	X	X			X	X	
Flynn *et al.* (1994)	X	X	X	X	X	X				X			
Tamimi (1995)	X	X	X		X								
Ahire *et al.* (1996)	X	X	X	X	X	X	X	X		X	X		
Black and Porter (1996)		X	X	X	X	X	X	X	X				X
Quazi *et al*. (1998)	X		X					X	X	X			
Rao *et al*. (1999)	X	X	X	X		X		X		X	X		
Zhang (2000)	X		X	X	X	X	X	X		X		X	
Motwani (2001)	X		X	X	X		X				X		
Antony *et al.* (2002)	X	X			X		X			X			
Das *et al*. (2008)	X		X		X	X		X			X		
Gadenne and Sharma (2009)	X				X			X			X		
Koh and Low (2010)	X		X			X		X		X			

*Note: 1 - Top management commitment; 2 – Role of quality department 3 - Process quality management; 4 – Product/service design; 5 - Education and Training; 6 - Supplier quality management; 7 - Customer satisfaction; 8 - Employee empowerment and involvement; 9 – Business/Quality results; 10 - Information and Analysis; 11 - Benchmarking; 12 – Quality citizenship; 13 – Quality Culture.

Methodology

To make the study more specific, extensive and feasible, investigations and analysis were limited within the defined boundary. The scope of study is limited

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to the automotive and other manufacturing industry in Northern Indian states. The organizations which are certified with ISO 9001 were chosen for the study. We believe that this group of companies is able to provide information about Quality management. 200 organizations were chosen for the study. The names and addresses of the organizations were taken from the directory of Industries published by CII and local survey of the enterprises. All of these companies were contacted through email. Random sampling method was applied to select the sample. In deciding on the most suitable method for research purpose, it is important to note that based on the literature survey it was clear that the majority of research about QM has been conducted through survey, predominantly through questionnaires. Survey research has been accepted as a legitimate methodology for understanding the core issues and problems in operations management. So in this study, this technique was used. The survey instrument was questionnaire. It was designed to help achieve the objectives of the research. The questionnaire was developed to collect three types of information: (1) general information about the firm, including its characteristics and the industry it belongs to; (2) information that would allow an assessment of the extent to which the responding firm is using QM; (3) information that would allow an assessment of the extent to which the respondent is familiar with the QM techniques. Before using the questionnaire as an instrument to achieve various objectives the research, it had to be tested for its reliability because if the mean of measuring a concept is purposed, the measurement mean must be reliable. The internal consistency will be measured using the Cronbach's α reliability coefficient. The Cronbach's α was calculated for the questionnaire. The alpha value was found to more than 0.7. To ensure content validity, extensive literature survey and consultations with academicians and practitioners were carried out to adopt measurement items from past research. After which, the pilot survey was carried out to check and refine the items. The questionnaire, accompanied by a covering letter in which detail of the objectives was given was mailed to 200 organizations in India. Fifty questionnaires were returned yielding a response rate of 25%.

Findings and Discussion

Profile of the Sample

The organizations that responded to the study varied in industry, turnover and size. The demographic profile of the responding organizations is not very much different from the distribution offered by the population of firms targeted in this research.

The manufacturing industry in India consists of number of sectors automobile, textile, light engineering industry etc. The profile of the sample with respect to nature of industry is shown in the figure. It is interesting to note that most of the industries are from automotive sector (52%). This may be due to the fact that among other manufacturing sectors, the automotive manufacturing sector in India is understood to be the most dynamic. It is one of the world's fastest growing

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automotive industries. It is exposed to a highly competitive market and is adopting the latest management techniques, therefore, is more willing to participate in this type of research in order to gain knowledge about systems to improve quality and operational performance. The other industries which participated in the study are from Electrical (6%), Electronics (12%), and textile (12%). Other industries include primary metals(6%), consumer products (6%), cement(2%) and pharmaceutical(4%) organizations.

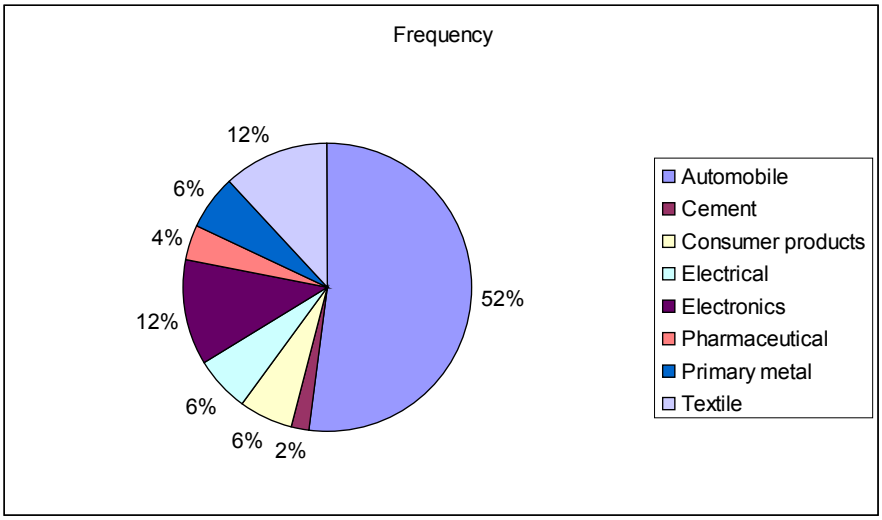

Figure 1 - Distribution of respondents on basis of Nature of industry

Turnover of the Companies

The responding organizations are classified on the basis of turnover of the company. It has been observed that most of the companies (26%) are in 500-1000 million group and 22 % companies are from above 4000 million group. This is due to the reason that most of the responding organization are from automotive industry. The automotive industries are either multinationals or part of large groups.

No of Employees

The table 3 shows the profile of the companies on the basis of number of employees. Twenty four percent of the organizations belong to third group of 501-1000 employees. The distribution shows that all the four groups have adequate frequency of number of employees which shows that sample is representative. All the four categories are represented in the study.

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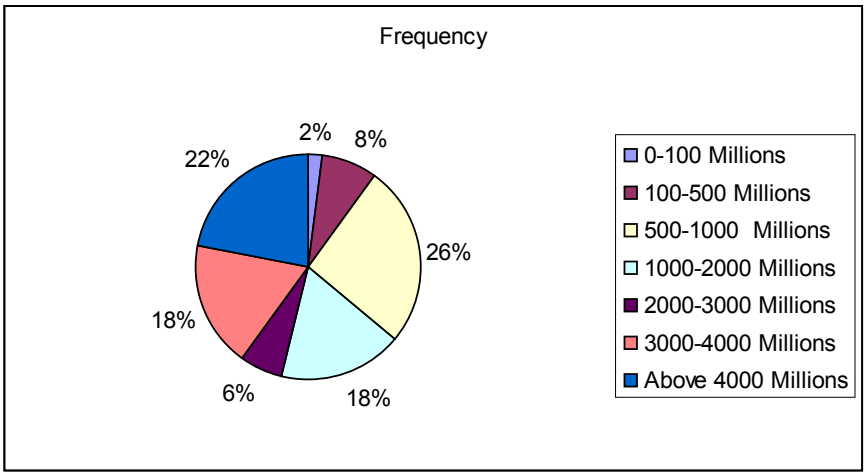

Figure 2 - Distribution of organizations based on annual Turnover

Table 3 - Sample distribution on basis of no. of employees

S. No	No of employees	Frequency	%age
1	51-250	7	14.0
2	251-500	15	30.0
3	501-1000	16	32.0
4	More than 1000	12	24.0
	Total	50	100.0

Integration of Management Systems

Table 4 shows that, in terms of integration of management systems, 70% of the respondents have integrated ISO 9001 and ISO 14000. This is followed by 58 % ISO 9001, ISO 14000 and OHSAS; 50% having ISO 9001, TS 16949 and ISO 14000. Some companies are in the process of certifying to MS ISO 14001 and TS 16949. This indicates that Indian companies emphasize in integration of their MS to compete in the global market.

Table 4 - Distribution of combinations of management systems

S. No	Management Systems	Respondents	%age
1	ISO 9001, ISO 14000	35	70%
1	ISO 9001,TS 16949, ISO 14000	25	50%
2	ISO 9001, ISO 14000, OHSAS	29	58%
3	ISO 9001, ISO 14000, HACCP	3	6%
4	ISO 9001, ISO 14000, SA 8000	10	20%

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Competitive Priorities

Competitive priorities are a set of consistent goals for manufacturing. These are foundations of customer satisfaction. Firstly they were asked about their competitive priorities. The companies indicated that the quality is number one priority of all the companies (mean-4.40). The table shows the mean and standard deviation of the competitive priorities of the companies.

Table 5 shows that quality receives highest attention (mean is 4.40) which can be interpreted in terms of stress on quality management. The mean value for cost is 4.08, which is the second highest; the mean value for delivery and flexibility is 3.96 and 3.14 respectively, which is relatively low. It can be observed that quality is receiving enough attention in manufacturing industries in India.

Table 5 - Competitive Priorities of Indian Organizations

S. No	Manufacturing Priority	Subject	Mean	Standard deviation
1	Quality	Producing products with high quality performance standards	4.40	.700
2	Cost	Producing and distributing products at low cost	4.08	.886
3	Delivery	Improvement in delivery rate and reliability	3.96	.807
4	Flexibility	Improving ability to change product mix and variety	3.14	1.050

Awareness of Quality Management

Due to the importance of quality practices in organizations, this question was used to determine the number of organizations which are aware of these practices. Awareness is the state or ability to perceive, to feel, or to be conscious of events, objects or sensory patterns. The answers to this question were invariably yes, and it is probably safe to assume that if the answer had been no then the respondent would not be in a position to answer the rest of the questions. However, it is generally true that TQM and its implications for marketing are well known among the manufacturers in India and a unanimous positive reply was expected. Most of the Indian companies have adopted ISO 9000 as a starting point in their quality journey. India is at number eights position in the survey of 2005. Most of the companies which are ISO 9000 certified are from manufacturing sector. The companies were asked to indicate their awareness about Quality management. The table 6 shows that 100% of the companies are aware of Total quality management along with ISO 9000.

Table 6 - Comprehension level of TQM

Comprehension Level		Frequency	%age
Heard of Total Quality Management	Yes	50	100
	No	0	0

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Figure 3 shows that an overwhelming 55% of the respondents said that the importance of Quality management has increased significantly over the last 10 years. And 40% felt that quality today has become critical to their operations. Only 4% felt that the importance of quality management has increased only marginally and 1% felt that its importance has remained the same. This can be supported by Raghunathan *et al.* (1997) that the demand for quality practices is emerging as one of the most critical factors for organizations to survive in the expanding and competitive marketplace.

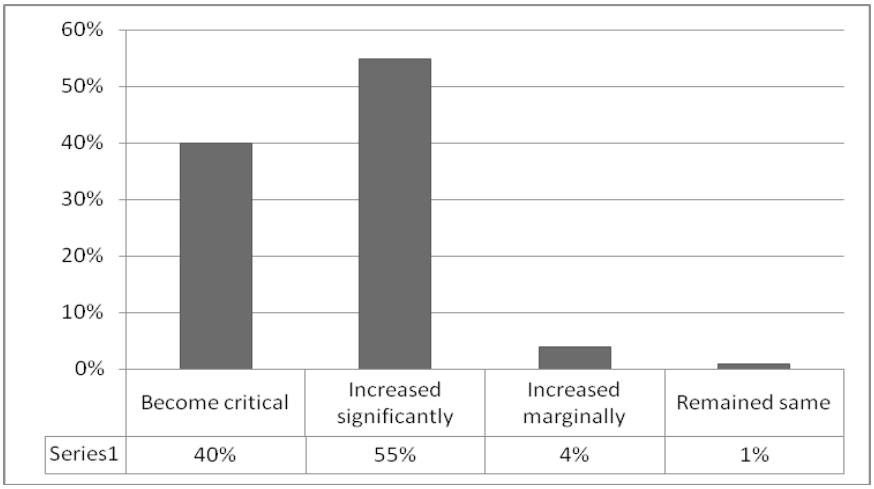

Figure 3 - The quality management issue importance

In total in all the 50 organization which responded, have heard of TQM. However level of awareness varies with 46% saying that their familiarity with TQM is very much and 2% a little (Figure 4). This indicates that a large portion of the group has a fair idea about quality management concepts.

The next question attempted to ascertain how long the company has been using or been involved in the implementation of TQM. The responses indicate that 46 % the companies are practicing TQM for more than 4 years in which 14 % are practicing TQM for more than even 7 years (Figure 5).

However when asked about the age of ISO 9000 program in their companies most of the organizations (66%) have implemented ISO 9000 beyond 7 years (Figure 6)

The companies first got the idea of ISO 9000, adopted it and then they moved to TQM. The ISO 2000 version of ISO 9000 series of standards is inline with TQM. So the companies started transforming into ISO 9000:2000 version after year 2000. However these companies started TQM program after 1-2 years after ISO 9000 adoption.

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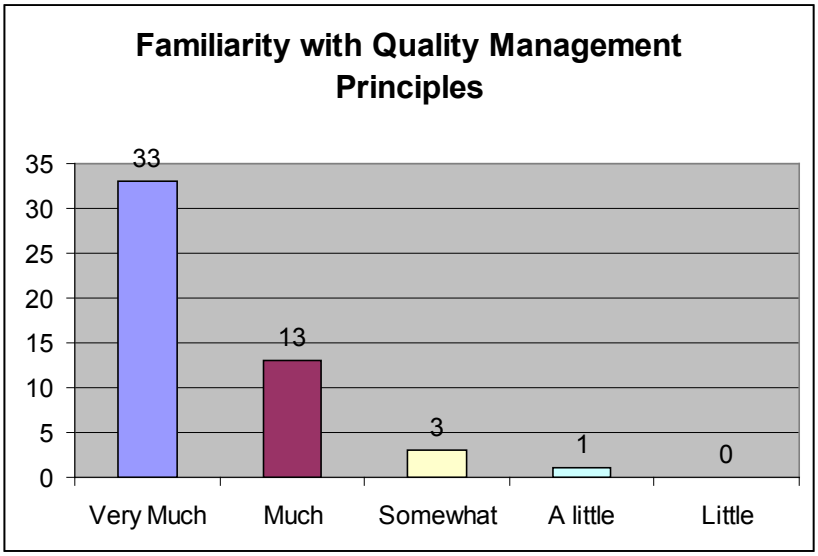

Figure 4 - Familiarity with TQM principles

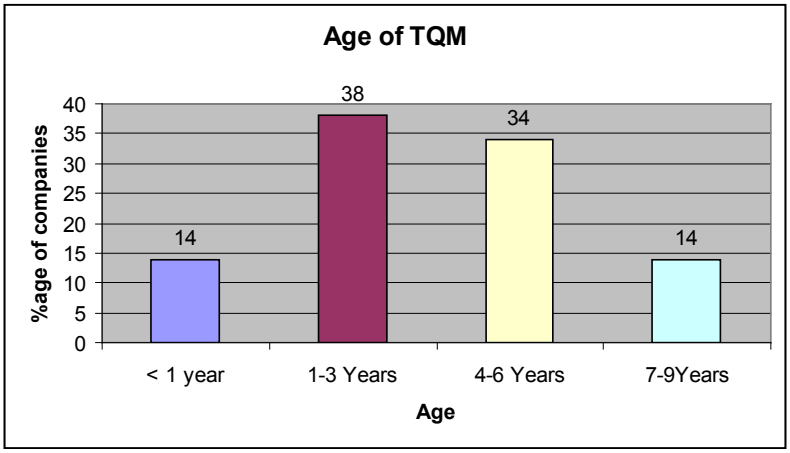

Figure 5 - Age of TQM programme

The plants are "quality mature" in terms of having had a formal program of quality improvement in place for an extended period of time and having successfully implemented QM practices. The duration of the formal QM programs specifically ISO 9000 ranged from 4 to 9 (a 3-year period is generally considered to be the cut-off point between young and mature organizations in QM (e.g. Ahire *et al.*, 1996) and there

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were external indicators of successful QM implementation for the plants, including the winning of Deming application prize, Rajiv Gandhi National Quality Award & other quality awards illustrating best practice in QM.

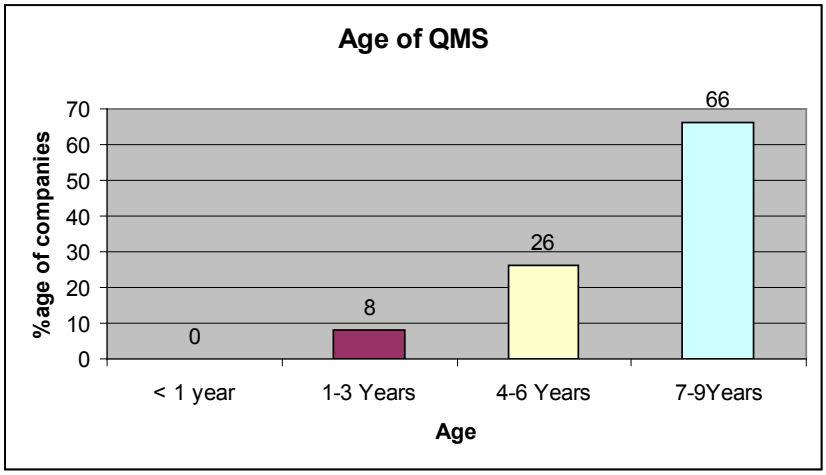

Figure 6 - Age of QMS (ISO9000) programme

From the survey it is quite clear that 100% of the Indian organizations are aware of TQM concept. The main reason behind this phenomenon is that most of the Indian industry is ISO 9001:2000 certified. India is ranked 8th in ISO 9001:2000 certified companies in the world (Khanna *et al.*, 2007), so they are also aware of TQM through QMS. However some the small and medium scale organizations are companies are implementing TQM partially. The table 7 shows the level of TQM implementation by these industries.

From the above it can be concluded that Indian organizations are aware of total quality management and appreciate it in the big way. These results point out that QM is a widely adopted management approach in Indian manufacturing organizations. Majority (55%) of the respondents said that the importance of Quality management has increased significantly over the last 10 years. Data show that QM implementation in most of these companies has already entered a well structured and experienced phase.

Relevance of Quality Methodologies

Prompted awareness of established quality models is shown in Figure 7. The TQM awareness in 100% with 5 as a mean on 5 point scale whereas its perceived relevance is 4.5. The quality awards awareness is 3.66 with perceived relevance is 3.4. The companies are aware of these awards and consider it to be relevant. The

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awareness of ISO 9000 is also 100% whereas its perceived relevance is 4. This means that only 80 % of the companies thought these ISO 9000 standards to be relevant but 100% implementing these due to some external reasons. Six Sigma awareness is 3.5 with perceived relevance 3. Six sigma is a new concept for Indian manufacturing industry. So its awareness and perceived relevance is low as compared to other quality programs. ISO 9000 and TQM are two models, of which the respondents are most aware of. In addition, these two models which respondents felt were most relevant for manufacturing industry. The Figure 7 also indicates that perceived relevance of the named quality models was lower than awareness.

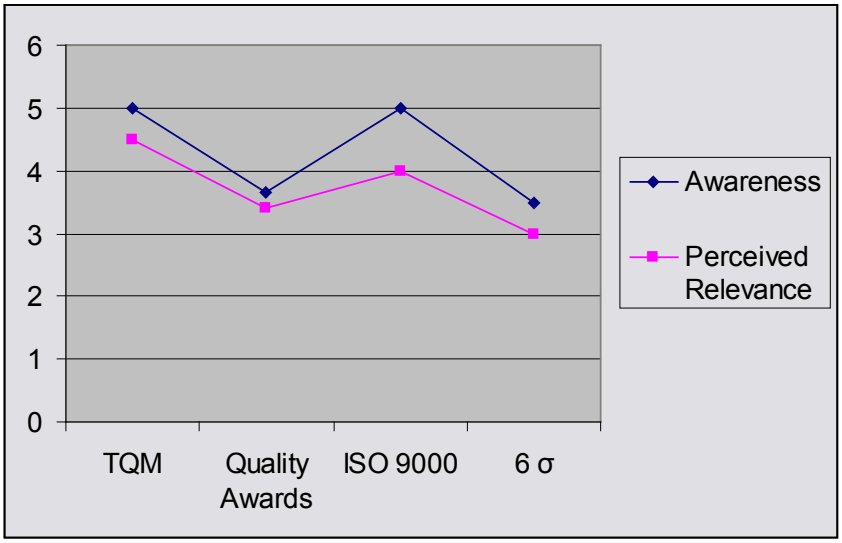

Figure 7 - Awareness and relevance of Quality methodologies

Use of Techniques and Tools for Quality Management

A single quality management tool may be described as a method which has a clear role and defined application; it is often limited in its focus and can be and usually is used on its own (e.g., a cause-and-effect diagram). A quality management technique, on the other hand, has a wider application than a tool. There is also a need for more intellectual thought, skill, knowledge, understanding, and training to use a technique in an effective and efficient manner. A technique may even be viewed as a collection of tools. If the companies are implementing total quality management, next issue was to how much extent the companies are aware of tools and techniques (T&T) of TQM. For this the two things were asked to organization. First was awareness of T&T and second was implementation of T&T. The list of tools and techniques of was provided in the questionnaire. The finding revealed that most of T&T are known to these organization but the implementation of only few tools are there .The table below shows the list of T&T and there awareness and implementation by these

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organizations. The tools and techniques can contribute to improving the level of QM if a climate of managerial commitment is created. This means that techniques and tools are a reliable indicator of a superior level of QM and therefore, of a superior performing company in terms of quality, cost, etc. Another issue that was included in the study was to determine the breadth of use of the different methods of quality improvement in the manufacturing sector. Mean use values were calculated for each and are presented in Figure 8. It should be noted that the opinion of both users and occasional users was taken into consideration to calculate the average ratings i.e. participants who rated a particular method as 1, were included in the calculations. This is because the author felt it appropriate to analyze not only the 'voice of users' but also the 'voice of occasional users' to gain a general view within the sector. The responding companies seem to have adopted a wide variety of initiatives to improve quality, as shown in Figure 8. Indian manufacturing organizations most frequently adopt a ``Continuous Improvement'' program (mean-3.92), followed by ``Zero Defects'' (mean-3) and ``World Class Manufacturing'' (mean-3). The other techniques used by the organizations are Lean (mean-2.84), 5S(mean-2.74), BPR(mean-2.72). Six Sigma(mean-2.12), CEL(mean-1.62) and TOC(mean-1.76) are the lowest used techniques for quality improvement. Although Just in Time, Lean, TOC etc are aimed at improving the productivity of operations. These also result in improving quality and customer satisfaction (Brown *et al.,* 2008).

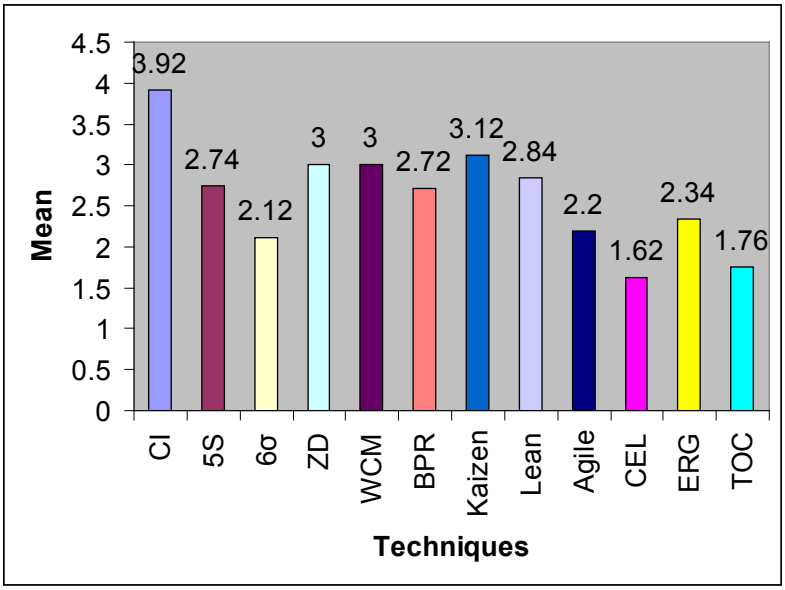

Figure 8 - Use of techniques

To implement QM into practice better, an organization should adopt the right methods and tools in problem-solving for quality improvement to meet customer requirements. These methods and tools should be able to identify possible root causes

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as well as provide potential solutions. Researchers have identified a number of tools and techniques for quality improvement. This section examines the awareness of tools and techniques that are applied in support of quality management programmes. This was a simple likert scale 1-5 response to the range of tools offered. This list is by no means exhaustive given the huge range of approaches that have been proposed. An attempt was made to focus on relatively broad areas, and those that represent a range of levels of sophistication and incorporate aspects of both the ``hard'' and the ``soft'' aspects of QM. One of the objectives of the survey was to determine the level of awareness and level of implementation of the different tools used in automobile and other manufacturing industries. Mean implementation and mean awareness values were calculated for each and are presented in Table 8 shows the difference between awareness and implementation of tools. Quality improvement projects(QIP), Internal Audit(IA), Cause and Effect Diagram(CAED), Control Charts(CC), Flow Charts(FC) and Brain Storming(BS) are the most the techniques of which the responding companies are aware of. However the most widely implemented techniques are Internal Audit(IA), Quality Improvement projects(QIP), Quality Awards(QA), Flow Charts(FC), Competitive Benchmarking(BEN) are the most widely implemented tools and techniques of quality management. The mean of implementation in all the cases is less than the awareness. As stated earlier, generally the respondent companies rated the awareness of the methods higher than the extent to which they were implemented. Statistical tests were performed, however, to ascertain whether these differences were significant or not. Two further tests were conducted to see if there were differences between the automobile and other manufacturers. The following hypotheses were formulated and a 5% level of significance used throughout.

1) To test for a significant difference between the awareness and the implementation for all the manufacturing organizations:

   H0: $\mu a - \mu i = 0$, i.e. there is no difference between the two means;

   H1: $\mu a - \mu i \neq 0$, i.e. there is a significant difference between the two means.

2) To test for a significant difference in the extent of use between respondent companies in the automobile and other manufacturing sectors:

   H0: $\mu man - \mu auto = 0$, i.e. there is no difference between the level of implementation of each of the methods in automobile companies and other respondent companies;

   H1: $\mu man - \mu auto \neq 0$, i.e. there is a significant difference between the implementation in methods in automobile companies and other respondent companies.

The t-test between awareness and implementation shows that except in case of Quality Awards (QA), Internal Audit (IA), Poka Yoke (PY) and Process Mapping (PM) the difference between awarenss and implementation of techniques is significant.

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Table 8 - The t-test Between Awareness and Implementation of Tools and Techniques for Quality Improvement

Quality Improvement Tools and Techniques	Awareness Mean*	Implementation Mean*	T	df	Sig. (2-tailed)	Results
Quality Improvement projects	4.30(1.015)	3.58(.971)	-3.624	98	.000	Sig
Quality Awards	3.66(1.303)	3.38(1.244)	-1.099	98	.274	Non Sig
Quality circles	3.64(1.321)	3.02(1.204)	-2.453	98	.016	Sig
Competitive benchmarking	3.82(.962)	3.44(1.110)	-1.829	98	.070	Sig
Statistical process control	4.02(1.000)	2.98(1.116)	-4.909	98	.000	Sig
Just in Time	3.74(1.259)	2.96(1.228)	-3.136	98	.002	Sig
Cause and effect Diagram	4.16(.792)	3.30(1.035)	-4.666	98	.000	Sig
Control charts	4.16(.934)	3.34(1.287)	-3.646	98	.000	Sig
Histogram	4.06(.978)	3.18(.983)	-4.488	98	.000	Sig
Flow charts	4.22(.864)	3.34(1.118)	-4.404	98	.000	Sig
Check sheets	3.92(1.066)	3.24(1.349)	-2.797	98	.006	Sig
Brainstorming	4.30(.839)	2.969(1.106)	-6.826	98	.000	Sig
Pareto analysis	4.06(1.038)	2.74(1.103)	-6.162	98	.000	Sig
Internal Audit	4.42(.785)	4.36(.827)	-.372	98	.711	Non Sig
Failure Mode and Effect Analysis	3.76(1.098)	3.22(1.200)	-2.347	98	.021	Sig
Scatter Diagram	3.54(1.249)	2.52(1.035)	-4.447	98	.000	Sig
Total Productive Maintenance	3.68(.819)	3.10(1.129)	-2.940	98	.004	Sig
Poka Yoke	3.16(1.361)	2.76(1.098)	-1.617	98	.109	Not Sig
Design of Experiments	3.08(1.209)	2.12(.961)	-4.394	98	.000	Sig
Quality Function Deployment	3.02(1.253)	2.08(.944)	-4.236	98	.000	Sig
Graphs	3.96(.968)	3.00(1.143)	-4.532	98	.000	Sig
Process mapping	3.28(1.144)	2.92(1.192)	-1.541	98	.127	Non Sig
Gantt Charts	3.08(1.353)	2.28(1.070)	-3.280	98	.001	Sig
Cost benefit analysis	3.82(.983)	3.16(.976)	-3.368	98	.001	Sig
Fault Tree Analysis	2.58(1.162)	1.96(.856)	-3.037	98	.003	Sig
Value-Stream Mapping	2.60(1.229)	1.92(.944)	-3.103	98	.003	Sig
Affinity Diagrams	2.28(1.011)	1.58(.642)	-4.134	98	.000	Sig
Arrow diagrams	2.60(1.107)	1.84(.817)	-3.907	98	.000	Sig
Matrix diagrams	2.68(1.203)	1.88(.961)	-3.674	98	.000	Sig
Force Field Analysis	2.56(1.296)	1.729(.927)	-3.728	98	.000	Sig
Jidoka	2.42(1.197)	1.749(.777)	-3.369	98	.001	Sig
Andon Lights	2.56(1.296)	1.689(.913)	-3.924	98	.000	Sig
Hoshin Kanri	2.56(1.162)	1.689(.913)	-3.728	98	.000	Sig

*the values in parentheses indicate standard deviation

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This implies that although the Indian organizations are aware of tools and techniques of quality management, their implementation is less. Then a t-test was performed to find out any significant difference between awareness and implementation of tools and techniques for quality management usage by the Indian manufacturing industry. Following table shows the t-values for different tools and techniques

It is no surprise that the Internal Audit is the technique that is known to most of the organization (awareness mean-4.42) and implemented (implementation mean-4.36) in most of the organizations. The reason of this may due the Internal Audit is one of the main requirements of QMS certifications and all the organizations are QMS certified. This finding of the study is the same as that of other international research (Tarí, 2005).Then a t-test was performed to check that whether there is any significant difference between implementation of these tools and techniques between automobile and other industry. Table 9 shows that there is no significant difference in implementation of tools and techniques by manufacturing and other organizations.

The table 10 shows the importance and implementation of various TQM critical success factors in the surveyed organizations. The mean values range from 4.38 to 4.76, which is at the 'important' level. The two highest critical success factors are Process management (mean-4.76), Customer Focus (4.68). On the other hand, Suppliers quality management (4.41) and Human Resources Management (4.38), are the two least important critical success factors perceived by respondents. In case of implementation, overall mean values on extent of implementation for the 12 CSFs, the mean values ranges from 3.11 to 3.85. It can be seen that the two highly implemented critical factors practiced by the respondents were Process Control (3.85), Customer Focus (3.78) were the two least implemented factors are suppliers management (3.11) and training (3.14).

From the above results, it can be seen that overall mean of implementation is lower than that of importance. This is probably due to the companies' failure to translate what they perceived to be important into practice. All of the CSFs indicate they might show significant difference between perception of importance and practice. The statistical comparison to test whether there was significant difference between the perception of importance and practice will be discussed in following section. So the results indicate that respondents perception of importance and implementation in case of majority of the critical success factors of TQM were consistent. The respondents have 'important' level of perception of CSFs. However in terms of implementation the level is 'moderate' to 'high'. This demands for more efforts to be focused on implementing the practices especially suppliers management and training so as to reap full benefits of TQM.

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Table 9 - The t-test Between Implementation of Tools and Techniques for Quality Improvement in automobile and other manufacturing organizations

Quality Improvement Tools and Techniques	Automobile companies	Other companies	t	df	Sig. (2-tailed)	Results
Quality Improvement projects	3.73(.724)	3.42(1.176)	1.147	48	.257	Non Sig
Quality Awards	3.42(1.301)	3.33(1.204)	.252	48	.802	Non Sig
Quality circles	3.12(1.243)	2.92(1.176)	.579	48	.565	Non Sig
Competitive benchmarking	3.27(1.218)	3.63(.970)	-1.136	48	.262	Non Sig
Statistical process control	3.00(1.233)	2.96(.999)	.131	48	.897	Non Sig
Just in Time	3.04(1.371)	2.88(1.076)	.466	48	.643	Non Sig
Cause and effect Diagram	3.35(1.093)	3.25(.989)	.325	48	.746	Non Sig
Control charts	3.04(1.399)	3.67(1.090)	-1.760	48	.085	Non Sig
Histogram	3.35(1.129)	3.00(.780)	1.251	48	.217	Non Sig
Flow charts	3.27(1.282)	3.42(.929)	-.462	48	.646	Non Sig
Check sheets	3.27(1.430)	3.21(1.285)	.158	48	.875	Non Sig
Brainstorming	3.08(1.197)	2.83(1.007)	.775	48	.442	Non Sig
Pareto analysis	2.92(1.197)	2.54(.977)	1.228	48	.225	Non Sig
Internal Audit	4.58(.578)	4.13(.992)	1.988	48	.053	Non Sig
Failure Mode and Effect Analysis	3.31(1.225)	3.13(1.191)	.534	48	.596	Non Sig
Scatter Diagram	2.46(1.029)	2.58(1.060)	-.412	48	.682	Non Sig
Total Productive Maintenance	2.85(1.223)	3.38(.970)	-1.685	48	.098	Non Sig
Poka Yoke	3.08(1.055)	2.42(1.060)	2.206	48	.032	Non Sig
Design of Experiments	2.19(1.059)	2.04(.859)	.550	48	.585	Non Sig
Quality Function Deployment	2.19(1.096)	1.96(.751)	.873	48	.387	Non Sig
Graphs	3.19(1.266)	2.79(.977)	1.245	48	.219	Non Sig
Process mapping	3.00(1.058)	2.83(1.341)	.490	48	.626	Non Sig
Gantt Charts	2.50(1.105)	2.04(.999)	1.534	48	.132	Non Sig
Cost benefit analysis	3.23(.863)	3.08(1.100)	.529	48	.599	Non Sig
Fault Tree Analysis	1.96(.871)	1.96(.859)	.013	48	.990	Non Sig
Value-Stream Mapping	2.04(1.038)	1.79(.833)	.922	48	.361	Non Sig
Affinity Diagrams	1.58(.703)	1.58(.584)	-.035	48	.972	Non Sig
Arrow diagrams	1.88(.909)	1.79(.721)	.398	48	.692	Non Sig
Matrix diagrams	1.92(.796)	1.83(1.129)	.327	48	.745	Non Sig
Force Field Analysis	1.69(.838)	1.75(1.032)	-.218	48	.829	Non Sig
Jidoka	1.92(.845)	1.54(.658)	1.770	48	.083	Non Sig
Andon Lights	1.73(.827)	1.63(1.013)	.406	48	.687	Non Sig
Hoshin Kanri	1.82(.771)	1.79(.720)	.331	48	.731	Non Sig

*the values in parentheses indicate standard deviation

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Table 10 - The importance and implementation of TQM factors

S. No	CSF	Importance	Implementation	Difference
1	Top Management Commitment	4.43(.41)	3.57(.55)	0.86
2	Human Resources Management	4.38(.43)	3.36(.60)	1.02
3	Suppliers Management	4.41(.39)	3.11(.68)	1.30
4	Process Management	4.76(.45)	3.85(.57)	0.91
5	Product Design	4.51(.44)	3.51(.81)	1.00
6	Role of quality department	4.60(.24)	3.38(.62)	1.22
7	Quality Information System	4.51(.35)	3.17(.73)	1.34
8	TQM culture	4.69(.35)	3.27(.77)	1.42
9	Training	4.66(.35)	3.14(.65)	1.52
10	Use of IT	4.45(.42)	3.54(.69)	0.91
11	Quality citizenship	4.45(.48)	3.51(.72)	0.94
12	Customer Focus	4.68(.32)	3.78(.60)	0.90
	Overall Mean	4.55	3.43	1.12

Moreover, all of the TQM critical success factors have mean above 3 which could be preliminary indication of the Indian manufacturer's awareness of major role quality management practices can play in achieving sustainable competitiveness for their plants. The most implemented critical success factors are Process management (mean-3.84), Customer focus (3.78) and Top Management commitment (mean3.57), which indicates that quality management implementation according to ISO 9000 has resulted in more stress of process management. Moreover the management is also committed when we compare this CSF with other CSFs.

Then the t-test was conducted to find out the difference between importance and implementation of critical success factors of TQM. The following hypothesis were formed.

H0: $\mu 1-\mu 2 = 0$, i.e. there is no significant difference between importance and implementation of CSFs of TQM.

H1: $\mu 1-\mu 2 \neq 0$, i.e. there is significant difference between importance and implementation of CSFs of TQM.

The results of t-test are shown in table 10.

The paired comparison t-test by using SPSS – Compare Means Procedure was employed for analyzing the test. The results in Table 11 shows that the p-value of the eight CSFs are lower than 0.05 (i.e. significant level); hence the null hypothesis was rejected. In short, it can be concluded that there was a significant difference between perceived importance and the extent of implementation.

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Table 11 - Paired Sample Statistics for Mean Importance and Practice

S.No	CSF	T	df	Sig. (2-tailed)
1	Top Management Commitment	8.78	98	.000
2	Human Resources Management	9.65	98	.000
3	Suppliers Management	11.64	98	.000
4	Process Management	8.80	98	.000
5	Product Design	7.64	98	.000
6	Role of Quality Department	12.98	98	.000
7	Quality Information system	11.65	98	.000
8	TQM culture	11.89	98	.000
9	Training	11.96	98	.000
10	Use of IT	7.95	98	.000
11	Quality Citizenship	7.63	98	.000
12	Customer Focus	8.30	98	.000

Conclusion

Indian manufacturing industry is aware of and appreciates QM. Tools and techniques are vital to support and develop the quality improvement process. The organizations are aware of all the tools and techniques. But when it comes to implementation, it is less. There is significant difference between awareness and implementation when these are measured on five point scale. The use of latest quality tools and techniques is somewhat less in all the industries. The findings also indicate the weakness of Indian manufacturing organizations in lack of implementation of tools and techniques for quality improvement, mainly regarding the advanced. The use of Six Sigma is very less than the other quality improvement approaches; this finding corroborates the work of Khanna (2009). This paper has also presented the results of survey conducted on the Indian manufacturing companies with the main purpose of finding the awareness and implementation of tools and techniques of QM. This study has also identified crucial issues for organization to consider especially on areas found lacking in implementation. There is no significant difference between quality practices being followed by followed by automotive and other manufacturing organizations. The findings seem to indicate that there is no difference in use of quality tools and techniques in automobile and other manufacturing industries. So it can be inferred that the quality management is not industry context dependent. This finding of the study is in tandem with a recently conducted study in another developing country (Mady, 2009)

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References

Abdullah M. M. B.; Uli J. and Tarí J. J. (2009), "The relationship of performance with soft factors and quality improvement", Total Quality Management, Vol. 20, No. 7, pp. 735–748.

Acharya, U. H. and Ray, S. (2000), "'ISO 9000 certification in Indian industries: a survey", Total Quality Management & Business Excellence, Vol. 11 No. 3, pp 261 – 266.

Ahire, S. L.; Golhar, D. Y. and Waller, M. A. (1996), "Development and validation of TQM implementation constructs", Decision Sciences, Vol. 27 No. 1, pp. 23-56.

Antony, J.; Leung, K.; Knowles, G. and Gosh, S. (2002),"Critical success factors of TQM implementation in Hong Kong industries", International Journal of Quality and Reliability Management, Vol. 19, No. 5, pp. 551–566.

Arumugam, V.; Chang, H. W.; Ooi, K. and Teh, P. (2009), "Self-assessment of TQM practices: a case analysis", The TQM Journal, Vol. 21, No. 1, pp. 46-58.

Bhat, K. S. and Jagadeesh, R. (2009), "An empirical study of barriers to TQM implementation in Indian industries", The TQM Magazine, Vol. 21, No. 3, pp. 261-272.

Black, S. A. and Porter, L. J. (1996), "Identification of the critical factors of TQM", Decision Sciences, Vol. 27, No.1, pp. 1-21.

Brown, A.; Eatock, J.; Dixon, D.; Meenan, B. J. and Anderson, J. (2008), "Quality and continuous improvement in medical device manufacturing", The TQM Magazine, Vol. 20, No. 6, pp. 541-555.

Chen, J. and Chen, I. (2009), "TQM measurement model for the biotechnology industry in Taiwan", Expert Systems with Applications, Vol. 36, No. 5, pp. 8789–8798.

Chin, K. S.; Rao Tummala, V. M. and Chan, K. M. (2002), "Quality management practices based on seven core elements in Hong Kong manufacturing industries", Technovation, Vol. 22, No. 4, pp. 213-230.

Das, A.; Paul, H. and Swierczek, F. W. (2008), "Developing and validating total quality management (TQM) constructs in the context of Thailand's manufacturing industry", Benchmarking: An International Journal, Vol. 15, No. 1, pp. 52-72.

Gadenne, D. and Sharma, B. (2009), "An investigation of the hard and soft quality management factors of Australian SMEs and their association with firm performance", International Journal of Quality & Reliability Management, Vol. 26 No. 9, pp. 865-880.

Gosen J.; Babbar S. and Prasad S. (2005), "Quality and developing countries: the role of international and organizational factors", International Journal

BJ Brazilian Journal of Operations & Production Management
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of Quality & Reliability Management , Vol. 22, No. 5, pp. 452-464.

Fening, F.; Pesakovic, G. and Amaria, P. (2008), "Relationship between quality management practices and the performance of small and medium size enterprises (SMEs) in Ghana", International Journal of Quality & Reliability management, Vol. 25, No. 7, pp. 694-708.

Flynn, B. B.; Schroeder, R. G. and Sakabara, S. (1994), "A framework for Quality Management research and associated measurement instruments", Journal of Operations Management, Vol.11, No. 4, pp. 339-366.

Gyani G. J. (2008), "Effectiveness of QMS Certification Process", Total Quality Management, Vol. 19, No. 3, pp. 263-279.

Hua, H.; Chin, K. S.; Sun, H. and Xu, Y. (2000), "An empirical study on quality management practices in Shangai manufacturing industries", Total Quality Management, Vol. 11, No. 8, pp. 1111-1122.

Joseph, N.; I., Rajedran C. and Kamalanabhan T. J. (1999), "An instrument for measuring total quality management implementation in manufacturing-based units in India", International Journal of Production Research; Vol. 37, No. 10, pp. 2201-15.

Kakkar, S. and Narag A. S. (2007), "Recommending a TQM model for Indian organizations", The TQM Magazine, Vol.19, No.4, pp 328-353.

Khanna H.; Sharma D. D. and Sharma R. (2007), "Critical success factors for implementation of TQM in Indian Manufacturing industry", Icfai Journal of Operations Management , Vol. 6 , No. 3.

Khanna, V. K. (2009), "5 "S" and TQM status in Indian Organizations", The TQM Journal, Vol. 21, No. 5, pp. 486-501.

Koh, T. W. and Low S. P. (2010), "An empiricist framework for TQM implementation in construction companies", Journal of Management in Engineering. doi:10.1061/(ASCE)ME.1943-5479.0000014.

Kumar, R.; Garg, D. and Garg, T. K. (2009), "Total quality management in Indian industries: relevance, analysis alnd directions", The TQM Journal, Vol. 21 No. 6, pp. 607-622.

Lau, A. W. T. and Tang, S. L. (2009), "A survey on the advancement of QA (quality assurance) to TQM (total quality management) for construction contractors in Hong Kong", International Journal of Quality & Reliability Management, Vol. 26, No. 5, pp. 410-425.

Li, J.; Anderson, A. R. and Harrison, R. T. (2003), "Total quality management principles and practices in China", International Journal of Quality & Reliability Management; Vol. 20, No. 9, pp.1026 – 1050.

Mady, T. M. (2009), "Quality management practices- An empirical investigation of associated constructs in two Kuwaiti industries", International Journal

Brazilian Journal of Operations & Production Management
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of Quality & Reliability Management, Vol. 26, No. 3, pp. 214-233.

Mahanti, R. and Antony, J. (2009), "Six Sigma in the Indian software industry: some observations and results from a pilot survey", The TQM Journal, Vol. 21, No. 6, pp. 549-564.

Motwani, J. (2001), "Measuring critical factors of TQM", Measuring Business Excellence, Vol. 5, No. 2, pp. 27-30,

Prasad, S. and Tata, J. (2009), "Micro-enterprise quality", International Journal of Quality & Reliability Management, Vol. 26, No. 3, pp. 234-246.

Quazi, H. A.; Jemangin, J.; Kit, L. W. and Kian, C. L. (1998), "Critical factors in quality management and guidelines for self-assessment, the case of Singapore", Total Quality Management, Vol. 9, No. 1, pp. 35-55.

Raghunathan, T. S.; Rao, S. S. and Solis, L. E. (1997), "A comparative study of quality practices: USA, China and India", Industrial Management & Data Systems, Vol. 97, No. 5, pp. 192–200.

Rao, S.; Solis, L. and Raghunathan, T. (1999), "A framework for international quality management research: development and validation of a measurement instrument", Total Quality Management, Vol 10, No. 7, pp 1047-75.

Saraph, J. V.; Benson, P. G. and Schroeder, R. G. (1989), "An instrument for measuring the critical factors of quality management", Decision Sciences, Vol. 20, No. 4, pp. 810-829.

Tamimi N. (1995), "An empirical investigation of critical TQM factors using exploratory factor analysis", International Journal of Production Research, Vol. 33, No. 11, pp. 3041 – 3051.

Tannock, J.; Karasachol, L. and Ruangpermpool, S. (2002), "The development of total quality management in Thai manufacturing SMEs: a case study approach", International Journal of Quality & Reliability Management, Vol. 19, No. 4, pp. 380-395.

Tarí, J. J. (2005), "Components of successful total quality management", The TQM Magazine, Vol.17, No.2, pp.182-194.

Zhang, Z. (2000), "Developing a model of quality management methods and evidence their effects on business performance", Total Quality Management, Vol. 11, No. 1, pp. 129-37.

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