Significance of Quality Certification Towards Business Excellence: Case of Indian software Industry

Ankur Jain and S. L. Gupta.

Abstract—**Total quality management (TQM), ISO 9000, the Capability Maturity Model standards, and the -performance indicators of organizations leads to business excellence. An empirical study addressing these issues is presented in this study. Results of the study indicate that quality certifications help the implementation of quality management programs based on TQM principles, and that the quality certifications have an impact on performance and helps to the organizations to achieve business excellence.**

Index Terms—**Business excellence, critical factors, quality certification, software industry, TQM.**

I. Introduction

In the competitive and global economy, long-term success depends upon the organization's ability to reorganize proactively and to improve its operations to match the new challenges in the external environment. (Hitt, Hoskisson,and Harrison 1991). To remain competitive, organizations introduce quality management programs one after another. TQM is the main quality management programme in the manufacturing and service sectors. TQM impact on business performance and attracted the attention of researchers and the business community all over the world (Sun 2000).

In the software industry also quality is the key factor that provides organizations to achieve success and a competitive edge in the global market. In the software industry, ISO 9000 and the Software Engineering Institute's (SEI) standards, i.e. Capability Maturity Model (CMM), CMMI and PCMM are main quality certifications to achieving TQM and business excellence. Though the research on quality management has increased dramatically over the past 2 decades, many questions about quality management still remain unanswered— for example, the relationship between TQM and quality certificates and the impact of quality management practices on business excellence. This reveals a major gap in research literature.

The present research aims to investigate such relationships in the software industry. The study is based on a survey conducted among the software developers and managers in the Indian software industry. The research questions in this study are the following:

- Do quality certifications such as ISO 9000 and CMM influence the implementation of quality management programs in the software industry?
- Do quality certifications such as ISO 9000 and CMM contribute towards the business excellence of organizations in the case of the software industry?
- Is there a difference between ISO 9000 certified firms and CMM certified firms with respect to the business excellence?

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II. Research Gap and Conceptual Model

A. Research Gap

It appears in the literature survey that many studies that explore the relationships between quality certification and quality management practices, and quality certification and financial performance and business excellence, have not yet been conducted in the software industry. This finding indicates a gap in studies on quality management in the software industry. Considering the growth of the software industry and the increased application of quality certification by the management of software organizations, there is a need to explore the relationship between quality certification(s) and business excellence in the software industry. A critical analysis of the clauses of ISO 9000.3, CMM, and PCMM standards brings out the fact that the implementation of quality standards is expected to lead to many of the quality practices mandated by TQM. In the literature, the link between quality certification, TQM and business excellence is not well established, especially in the case of the software industry. To fill this gap in literature, the link between quality certification, quality management and business excellence in the software industry in India will be explored in this study.

Indian software companies, being leading software exporters to Europe and United States, and also being the leaders in acquiring quality certification, would be an ideal choice to conduct such a study.

The results of the present study would be of great relevance to software organizations all over the world.

B. Conceptual Model

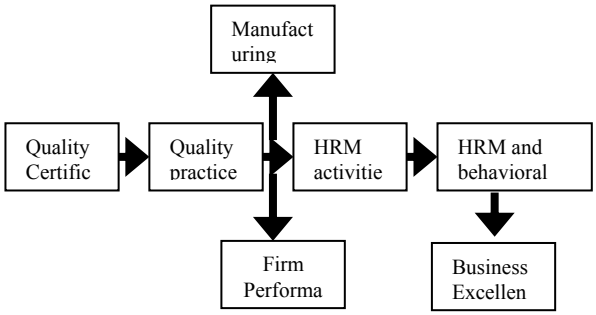

Fig. 1. Conceptual Model

The conceptual schema of this study focuses on the development of a theoretical business excellence model as a systematic way in explaining the relationship of quality certification, TQM practices and business excellence within software industry in India. Examining the relationship between quality certificates and business excellence should contribute to our knowledge of the complexity of the relationship that exists between them.

The link between quality certificates and business excellence is illustrated in Figure 1. In this conceptual framework, quality certificates, TQM practices are independent variables and business excellence is dependent variable, which includes HRM and operative outcomes. The present study thus attempts to bridge the gap by providing a basis for a thorough and insightful discernment of quality certificates and business excellence.

III. Hypothesis Development

Based on the extensive study of previous research, the following hypotheses are proposed:

- **H0.1:** There is no difference between non-certified firms and certified firms (ISO9000/CMM/PCMM) with respect to each factor (construct) of TQM and business excellence.
- **H0.2:** There is no difference between non-certified firms and ISO 9000 certified firms with respect to each factor (construct) of TQM and business excellence.
- **H0.3:** There is no difference between non-certified firms and CMM (levels 4 or 5) firms with respect to each factor (construct) of TQM and business excellence.
- **H0.4:** There is no difference between ISO 9000 certified firms and firms having CMM (levels 4 or 5) with respect to each factor/construct of TQM and business excellence.

IV. Methodology

In this section we discuss sample and data collection procedures and operational measures of variables used in the study as well as the statistical tests used to evaluate the hypothesis.

A. Sample and Procedures

A list of constructs was prepared through literature survey and sent to the software quality experts and academicians to verify it. They evaluate the list and also assess the relevance, understandability, clarity, and un-ambiguity of the questions. This ensures the validity of the questionnaire.

Data were collected from employees of various software organizations in India. The Companies were selected from the member list of NASSCOM.

The questionnaire survey used for data collection. The questionnaires were sent to software developers to 100 development centers of different software firms. They were sent through email or distributed through HR manager. Out of the 500 questionnaires sent, 424 questionnaires were returned, yielding a response rate of 84.8 percent, which is considered acceptable.

B. Variable Measurements

1) Independent variables

TQM practices. A total of 45 questions include the 12 TQM variables. The questionnaires on TQM dimensions were grouped into 12 elements; namely, Top management leadership, Organizational culture, Customer focus, Process Quality Management, Quality of work life, Continuous Improvement, Human resource management, Employee Empowerment, Benchmarking, Communication, risk management and quality matrices. The importance of the 12 constructs of TQM practices is described below:

a) Top-Management Leadership (TML)

The leadership of top management is very important and in central to the implementation of a TQM practices in any organization. Literature survey states that the quality improvement efforts in any organization should start from the top and flows down to the lower level.

b) Organizational Culture (OC)

Quality cannot be achieved without the cooperation and coordination of everyone in the organization. A proper atmosphere should be created in the organization to imbibe and cultivate an organizational culture, which builds up the commitment of everyone to quality (Tenner 1991).

c) Customer Focus (CF)

Many researchers agree on that quality means, satisfaction of customer requirements. Customer focus leads to improved quality irrespective of anything. So, understanding of the client's requirements and maximizing his satisfaction are critical in the software industry also.

d) Process Quality Management (PQM)

Quality performance depends on process management, measurement and analysis of data, and leadership. So, the quality of processes needs to be improved continuously for improving the quality of the product. "Process" is a key factor in software development. Improvement of processes helps to reduce the effort, development time, and defects in software (Jalote 2000).

e) Human Resource Management (HRM)

Based on an empirical study, Paul and Anantharaman (2002) said that there is a positive relationship between human resources practices and organizational performance. The authors further states that there is a significant difference in human resources practices across multinational and Indian software companies. Thus, it is evident that human resources practices are critical in software firms.

f) Quality of Work life (QWL)

An essential factor that decides the effectiveness of software employees is "conducive work environment." Quality of work life is the general atmosphere and human relations at the workplace.

g) Employee Empowerment (EE)

Empowerment means the assigning of responsibility with authority to the employees. High performance and high commitment require high levels of employee empowerment can be successfully used to transform organizations.

h) Continuous Improvement (CI)

According to the TQM philosophy, the key to quality is satisfying the needs and expectations of the customer through a system wide continuous improvement strategy (Goyal and

Islam 2001; Ahmed 2001). Therefore, superior quality demands the propagation of a culture of continuous improvement, driven by measurement and improvement (Lewis 1999).

i) Benchmarking (BM)

Benchmarking is a term used to describe activities that are aimed to make comparisons against the best practices. Benchmarking is a common element of TQM implementation, irrespective of the nature of the organization (Zinovy et al. 1996). In the IT industry, the common benchmark themes are expenditures, operations, helpdesk activities, programming effectiveness, and efficiency (Cortada 1995).

j) Infrastructure and Facilities (IF)

Infrastructure becomes very critical in the case of software companies, where technological advancement is rapid and its adaptation is compulsory for survival. The term "facilities" also includes sufficient conference rooms; training areas; physical resources such as furniture, computers, and application software; and communication technologies such as telephone, fax, and e-mail (Bahrami and Evans 1997).

k) Communication (COM)

Communication helps to provide better control of processes, which in turn helps to improve quality. Communication helps to provide clarity of roles and responsibilities of each employee. Communication helps to improve quality through customer satisfaction by providing better service and quicker response to queries (Cortada 1995).

l) Quality Measures (or Metrics) (QMET)

Metrics are used to quantify the schedule, effort, size, defect density, and other measures of quality performance. They help to track the effectiveness of process implementation practices.

m) Risk Management (RM)

Risk management aims at minimizing the chances of failure caused by unforeseen events. It is a key process area (KPA) at CMM level 3, and it is given top priority among the best practices for managing large software projects (Jalote 2000). The benefits of effective risk management policy are increased programmer productivity, minimization of losses, fewer surprises, and better customer satisfaction (Ravichandran and Shareef 2001).

2) Dependent variables

Business excellence includes two elements, namely HRM outcomes and operative outcomes.

a) HRM outcomes:

This includes the HR performance of the system. This can be divided in two:

1. Perception HRM outcomes; e.g. employee satisfaction, employee motivation, employee trust, employee commitment, and employee loyalty.

2. Objective HRM outcomes; e.g. employee turnover rate and absenteeism rate.

b) Operative Outcomes

This includes:

Return on Quality (ROQ): The returns (benefits) of quality implementation are measured by performance indicators such as the reduction of errors, better process management, and decrease in production costs, decrease in rejects and wastage, reduction in rework, and decrease in customer complaints (Radovilsky and Gotcher 1996).

V. Factor Analysis and Scale Reliabilities

TABLE I. Factor Analysis and Scale Reliabilities

Measure	Items	Factor loading	KMO	Eigenvalue	Variance explained (%)	Reliability
Independent variables			0.838	44.269	87.915	0.869
TMCL	3	0.681-0.845				0.776
OC	6	0.591-0.892				0.781
CF	4	0.594-0.710				0.778
PQM	4	0.517-0.914				0.897
HRM	7	0.600-0.882				0.800
CI	3	0.578-0.665				0.854
EE	6	0.604-0.829				0.865
BM	2	0.743-0.770				0.786
IF	2	0.551-0.891				0.789
COM	3	0.609-0.744				0.867
RM	3	0.767-0.844				0.876
QMET	5	0.557-0.789				0.843
Dependent variable			0.734	2.107	75.270	0.986
Operative outcome	3	0.641-0.889				0.886
HRM outcome	4	0.757-0.901				0.889

A principal component factor analysis with varimax rotation was conducted to validate the TQM constructs. (Table I). Only a loading of 0.5 or greater on the factor and 0.35 or lower on the other factors is considered. Varimax rotated analysis showed the existence of 12 significant factors with eigenvalues (i.e. 44.69) greater than one that explained 87.9 percent of the variance. The KMO sampling adequacy test has 0.84 value for each item with sufficient intercorrelations with the Bartlett's test of spehericity was also found significant. Thus, the factors are considered adequate because they are less than 60 percent of the variance recommended in social sciences (Hair et al., 1998). The results of the factor analysis represented in Table I.

Similarly, another factor analysis performed to check the dimensionality of the dependent variables. The two factor analysis with eigenvalue of 2.34 showing 46.45 percent of variance in the data. The KMO measure of sampling adequacy was 0.84 indicating sufficient intercorrelations, while the Bartlett's test of sphericity was also significant.

The reliability of the questionnaire was tested by Cronbach alpha. The reliability coefficient (alpha) of each element of TQM/HRM practices was as follows: top management leadership (77 percent), employee empowerment (86 percent), organization culture (78 percent), communication (86 percent), process quality management (89 percent),

human resource management (80 percent), infrastructure and facilities (78 percent), benchmarking (78 percent), and for continuous improvement (85 percent). The reliability for dependent variables i.e. HRM outcome is (88 percent) and for operative outcome is (88 percent). The reliability coefficients of all the elements of TQM were above 0.70, which concurs with the suggestion made by Nunnally (1978).

VI. Analysis of Data

The statistical computer program used for the questionnaires data analysis was SPSS 11.0. One way ANOVA used to determine the relationship between the dependent and independent variables.

A. Certified and Non-certified Firms

The relationship between TQM, quality certification and business excellence is studied by testing the null hypothesis H0.1.

- *H0.1:* There is no difference between non-certified firms and certified firms (ISO9000/CMM/PCMM) with respect to each factor (construct) of TQM and business excellence.

The firms are classified into two groups, quality certified and non-certified firms. A one way ANOVA test is used for analysis. The results of the ANOVA test are presented in Table 2. The quality certified group includes ISO 9000 certified, CMM certified, and PCMM certified organizations. It is found that there is a significant difference in TQM practices and business excellence between the two groups with respect to all the factors. Therefore, the null hypothesis H0.1 is rejected. All factors are significantly different at the 0.01 level. Thus, it can be concluded that in certified companies, there is a significant and prominent presence of TQM and business excellence factors such as TMCL, OC, CF,

PQM, QMET, HRM, CI, BM, IF, COM, and RM, when compared to non-certified firms. A comparison of the mean values of each construct indicates that quality certified firms have better management practices. The results shows that quality certification leads to better management practices, which is expected to lead to better quality, thereby resulting in better performance and better business excellence. Therefore, it can be concluded that software firms can be justified in going for quality certification.

In continuation, a detailed analysis on quality certification is carried out to get an idea of the pros and cons of different quality certifications that are popular in software industry. Therefore the following hypotheses are tested.

- *H0.2:* There is no difference between non-certified firms and ISO 9000 certified firms with respect to each factor (construct) of TQM and business excellence.
- *H0.3:* There is no difference between non-certified firms and CMM (levels 4 or 5) firms with respect to each factor (construct) of TQM and business excellence.

The results are presented respectively in Table 3 and Table Non-certified and ISO-9000 certified Firms

From the results of ANOVA presented in Table 3, it is clear that there is no significant difference between ISO certified firms and non-certified firms with respect TMCL, OC, POM, HRM, CI, QMET, EE, IF, COM, EA, OT, and JS (the significance value is > 0.05). While in the case of CF, BM, RM, O_Comt, and EM the difference is significant (the significance value is < 0.05). From these results it can be concluded that ISO certified firms are not significantly different from non-certified firms with respect to a majority of the factors. However, ISO certified firms have better performance indicators i.e. HR outcome and operative outcome, as indicated by the mean scores.

TABLE: II A COMPARISON OF NON-CERTIFIED VS. QUALITY CERTIFIED FIRMS

Constructs	Mean		'f' value	'p' value
	Certified	Non-certified		
TMCL	2.90	2.42	22.684	.000
OC	3.15	2.16	61.810	.000
CF	2.88	2.16	17.993	.307
PQM	2.97	2.43	24.422	.001
HRM	3.25	2.76	68.457	.000
CI	2.92	2.44	51.154	.000
EE	3.39	2.13	26.511	.000
BM	3.89	2.32	25.546	.000
IF	2.82	2.24	41.238	.000
COM	2.96	2.41	88.488	.000
RM	2.85	2.13	13.229	.000
QMET	3.29	2.01	23.344	.003
HR outcome	3.51	2.13	66.920	.000
Operative Outcome	3.52	2.10	95.550	.000

TABLE: III A COMPARISON OF NON-CERTIFIED VS. ISO 9000 CERTIFIED FIRMS

Constructs	Mean		'f' value	'p' value
	ISO Certified	Non-certified		
TMCL	2.96	2.42	8.898	.070
OC	2.17	2.16	14.057	.880
CF	2.61	2.16	4.159	.007
PQM	2.54	2.43	13.795	.080
HRM	2.89	2.76	11.792	.070
CI	2.39	2.44	8.011	.055
EE	2.20	2.13	13.034	.062
BM	2.35	2.32	11.715	.071
IF	2.36	2.24	15.426	.000
COM	2.47	2.41	6.321	.092
RM	2.41	2.13	13.224	.076
QMET	2.16	2.01	6.359	.000
HR outcome	2.35	2.13	17.580	.086
Operative outcome	2.18	2.10	18.457	.938

It can be concluded that ISO certification thus helps the organization to have improved customer focus, superior HR practices, and better infrastructure and facilities, thereby helping the organizations to start implementing a new quality culture in the organization.

This, in turn, will help the firms to achieve better quality and business excellence over time.

B. Non-certified and CMM certified Firms

There is a significant difference between these two types of organizations with respect to all critical factors of quality management and business excellence. All factors showed a significant difference at the 0.01 level. The business excellence indicators, namely HR outcome and operative outcome, are also found to be significantly different at the 0.01 level. The mean scores indicate that these TQM and

business excellence constructs are better in the CMM certified firms, and such organizations demonstrate better performance leads to business excellence, than non-certified organizations. It can be inferred that CMM certification helps organizations in achieving better quality of products and better productivity, which leads to business excellence. Thus, CMM certification helps organizations to take a competitive advantage over non-certified firms. This finding also supports the growing interest of Indian software organizations in CMM standards. An interesting point is that the CMM certification is found to be more effective when compared to ISO firms, with respect to most of the TQM and business excellence factors.

TABLE: IV A COMPARISON OF NON-CERTIFIED VS. CMM CERTIFIED FIRMS

Constructs	Mean		'f' value	'p' value
	CMM Certified	Non-certified		
TMCL	3.91	2.42	522.726	.000
OC	3.51	2.16	179.374	.000
CF	4.07	2.16	766.610	.000
PQM	3.79	2.43	266.431	.000
HRM	3.54	2.76	120.185	.000
CI	3.81	2.44	367.743	.000
EE	3.98	2.13	110.175	.000
BM	4.04	2.32	107.519	.000
IF	3.74	2.24	292.984	.000
COM	3.62	2.41	245.541	.000
RM	3.68	2.13	203.222	.000
QMET	3.93	2.01	208.261	.000
HR outcome	3.85	2.13	447.155	.000
Operative outcome	3.79	2.10	856.632	.000

A comparison of the results indicates that attaining quality certification also helps to improve performance or business excellence through better HR and operative outcomes. A comparison of Table 3 and Table 4 indicates that CMM standards appear to be more effective than ISO standards. These observations underscore the opinion that ISO standards are only a set of practices that could lead to improved processes and procedures, but they do not assure quality (Reedy 1994; Avery 1995).

C. *ISO-9000 certified and CMM certified Firms*

From the previous discussions on quality certified organizations vs. non-certified organizations, it is indirectly observed that CMM standards appear to be better than ISO standards.

However, empirical investigation is necessary for making such conclusions. Therefore, the following hypothesis is tested to find the differences between ISO 9000 certified organizations and CMM certified organizations.

- *H0.4:* There is no difference between ISO 9000 certified firms and firms having CMM (levels 4 or 5) with respect to each factor/construct of TQM and business excellence.

One-way ANOVA is used for testing the difference between these groups, and the results are presented in Table 5.

From Table 5, it can be seen that the CMM certified firms are significantly different from ISO 9000 certified firms with respect to all TQM factors at the 0.01 level. All of these factors are significantly better for CMM certified firms.

Discussions with software industry experts lead to the following conclusions. Software development is a creative process, so, individual competence and experience have great influence on the development process. Most of the software organizations realize this, so they applaud that employee empowerment is essential in software development organizations irrespective of their quality practices and also necessary for the business excellence. According to experts in software development organizations, risk management is one of the most important and fundamental factors for surviving in business, irrespective of the quality certification status. Hence, these factors are universal in nature, irrespective of quality certification status.

TABLE: V A COMPARISON OF ISO 9000-CERTIFIED VS. CMM CERTIFIED FIRMS

Constructs	Mean		'f' value	'p' value
	ISO Certified	CMM Certified		
TMCL	2.96	3.91	59.511	.000
OC	2.17	3.51	70.839	.000
CF	2.61	4.07	50.958	.000
PQM	2.54	3.79	36.042	.000
HRM	2.89	3.54	35.871	.000
CI	2.39	3.81	47.110	.000
EE	2.20	3.98	82.897	.000
BM	2.35	4.04	9.774	.003
IF	2.36	3.74	68.368	.000
COM	2.47	3.62	49.674	.000
RM	2.41	3.68	52.754	.000
QMET	2.16	3.93	54.585	.000
HR outcome	2.35	3.85	88.196	.000
Operative outcome	2.18	3.79	59.979	.000

VII. CONCLUSION

Main findings from the current study are as follows.

- Quality certification helps to improve the business excellence of software organizations.
- Quality certification helps software organizations to develop better software and provide better returns (productivity).
- Quality certified software organizations have better TQM practices as compared to non-certified firms.
- Among the quality certified organizations, CMM certified software organizations have better TQM practices and business excellence as compared to ISO certified organizations. Because ISO 9000 provides general guidelines for all the organizations, which can be used for TQM purposes, whereas CMM stresses on process improvement and provides guidance for stable, capable, and mature processes by identifying the KPAs in software development.
- Thus, CMM guides software organizations in selecting process improvement strategies by judging the current maturity of the processes and identifying the most critical issues for improvement.
- ISO certification stresses documentation over process improvement, while CMM focuses on continuous process improvement.

Therefore, based on the above study, it is clear that quality

certification helps software organizations to achieve business excellence in the form of better HR and operative performance.

Further, CMM certification provide a competitive edge over ISO 9000 certification, since CMM certified firms have been found to have better TQM practices and higher business excellence. The findings of this study provide support to the software organizations to decide upon certification type to gain a competitive advantage in the global market.

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