Initiatives and outcomes of quality management implementation across industries

Kee-hung Lai*
Department of Shipping and Transport Logistics
The Hong Kong Polytechnic University
Hung Hom, Kowloon, Hong Kong.

and

T.C.E. Cheng
Department of Management
The Hong Kong Polytechnic University
Hung Hom, Kowloon, Hong Kong.

*Corresponding author. Department of Shipping and Transport Logistics, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong. Tel: (852) 2766 7920; Fax: (852) 2330 2704; Email: stlmlai@polyu.edu.hk

Initiatives and outcomes of quality management implementation across industries

Kee-hung Lai[1] and T.C.E. Cheng[2]

Abstract

This paper sets out to explore the quality initiatives of various industries and examine the links between quality management implementation and quality outcomes. We use the scenario in Hong Kong as a first step in addressing these research inquiries. Using Black and Porter's instrument (1996, Decision Sciences, 27, pp. 1-21) and the various perceived performance measures representing quality management implementation and quality outcomes respectively, we conducted a mail survey to collect data from over 1,000 companies with operational quality management systems and received 304 valid responses for data analysis. Analysis of variance (ANOVA) was used to analyze the data and the results are consistent with our prediction that the differences in quality initiatives by industry types affect the levels of quality management implementation and quality outcomes in different industries. In particular, we found that significant contrast exists between public utilities/service industries and manufacturing/construction industries, with the former group having a higher level of quality management implementation and achieving better quality outcomes. The emphases that they placed on their quality management implementation also seem to differ. Implications of the results are discussed and suggestions for further research on quality management and implementation are offered.

Keywords: Quality; Critical factors, Implementation; Industry comparisons; Performance

[1] Department of Shipping and Transport Logistics, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong.
[2] Department of Management, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong.

1. Introduction

One of the important decisions for a firm on the journey to quality concerns the extent to which quality management should be implemented. There are many studies on the impact of quality management on business performance [1]. The benefits of quality management such as improvements to the bottom-line, market share, and productivity are well documented in the literature [2]. Indeed, the improvement of product and service quality is widely discussed in the literature as an appropriate strategy for firms to pursue in order to achieve competitive advantage in the marketplace [3]. Because of the strategic advantages that quality improvement might bring, many firms have embraced the principles of quality management in their operations. The level of quality management implementation seems to reflect the desire of a firm to improve its performance and to prosper [4].

While existing studies tend to investigate the important facets of quality management implementation [5], very little research has been devoted to understanding quality initiatives in different industrial contexts and linking them with implementation efforts and quality outcomes. Furthermore, the limited number of studies considering a comprehensive range of quality management practices invariably concentrate on firms within a particular industry group, rather than comparing different industry groups within the same study [e.g. 6, 7].

There are studies on quality management practices incorporating a contingency framework of contextual variables, including size [8], years since quality management adoption [9], country [10], and strategy adopted [11]. However, these studies are confined to a specific industrial sector, i.e., manufacturing, and their main focus is not on examining the underlying industry initiatives in quality management implementation. To fill this gap in the quality management literature, we set out to examine if there are differences in quality

initiatives of different industries in quality management implementation and if so, whether there are differences in implementation efforts and quality outcomes in major industry types.

With these objectives, we used the situations in Hong Kong as a first step in addressing these research inquiries. First, we examined the quality initiatives of companies in four major types of industries in Hong Kong, namely manufacturing, construction, service and public utilities. The quality initiatives across the industries enabled us to make predictions about variations in their quality management implementation and quality outcomes. Using a mail survey, we collected data on quality management practices and quality outcomes in these different industries. The empirical results were used to verify our predictions and estimate the extent of variations accounted for by the industry type.

Accordingly, this study seeks to contribute to the literature by providing insights into quality initiatives and identifying their association with a wide range of quality management practices and quality outcomes for different industries within a theoretical framework. In particular, this study aims to:

1. Explore the initiatives of quality management implementation in different industries;
2. Determine if there are differences in quality management implementation and quality outcomes across industries and if so, how and why they differ;
3. Examine if different industries have different priorities in their quality management implementation;
4. Provide implications for further research on quality management and implementation.

2. Conceptual framework and hypothesis development

There has been little effort to develop theories in the discipline of quality management [12], particularly those involving identifying the set of situations or circumstances that may cause synergistic variations in quality management and to developing empirical generalizations [11]. Some previous studies, however, have made a few advances in

comparing quality management practices and quality results between the manufacturing and service industries [13]. In this study, we have further advanced the inquiry by examining quality initiatives and comparing quality management practices and outcomes involving additional industry types, i.e., public utilities and construction, in addition to comparing the manufacturing and service industries.

In the following sections, we first briefly describe the movement for quality in Hong Kong. Then, we review the literature and discuss industry differences and their potential effect on quality management implementation in companies across different industries in Hong Kong.

2.1 Quality initiatives in Hong Kong

The heightening of customer expectations and intensified competition in the global market have led many companies in Hong Kong to place greater emphasis on quality as a basis for competition. The awareness of the importance of quality in improving competitiveness among Hong Kong companies, and their eagerness for quality improvement, seem to reflect the global trend [c.f. 14]. Many of them have joined the movement for quality and implemented various quality improvement programs with a view to gaining a competitive position in the market. Among others, the ISO certification process is the most prominent approach they have adopted to achieve such objectives. Some companies even look forward to improving themselves by using the certification process to link quality assurance and process improvement within a total quality management (TQM) framework.

A number of initiatives have triggered the desire of Hong Kong companies to improve quality. They include the move to reduce costs, the pursuit of better business opportunities, and the drive to improve customer satisfaction. The quality initiatives of a company can have an impact on the ways its quality management system is implemented and they vary in different business contexts in Hong Kong. In this study, companies were categorized into

four industry types: manufacturing, construction, services, and public utilities, which are the pillar industries of the domestic economy of Hong Kong [15]. The quality initiatives of companies in these four types of industries in Hong Kong are concisely described below:

Manufacturing – Manufacturers in Hong Kong are generally small to medium in size, with employees numbering less than 500. Many of them function as original equipment manufacturers (OEM) or as parts assemblers for companies in more advanced nations such as the United States and Japan. Generally, product development and quality do not seem to be major issues for many manufacturers in Hong Kong as their products are made to specifications set by their customers. Only a few of them develop products under their own brand names for sale to the world market. However, quality standards requirements are increasingly becoming a trade barrier [16] and a common reference in all commercial negotiations in the international context [17]. In order to overcome the trade barrier and to build market confidence, Hong Kong manufacturers usually pursue quality in the form of ISO certification. Conformance quality, via ISO-certified status, is deemed adequate for survival by most Hong Kong manufacturers, as they consider that quality improvement exceeding this threshold level or the customer-defined manufacturing specifications may not guarantee further profitability. Their profitability-driven quality initiative is reflected in their lack of investment in quality improvement, particularly in the area of computer-based technologies in support of quality [18]. Thus, even though many manufacturers in Hong Kong have embarked on their quality improvement programs in the form of ISO-systems, many of them still lack sophistication in their implementation. They are also not proactive in using quality as a competitive weapon. Chinese manufacturing companies also seem oblivious to some basic quality principles and to modern methods of quality management [19].

Construction – The need for quality improvement in Hong Kong's construction industry began to receive wide recognition in 1993 when the Housing Authority stipulated

that building contractors must be certified to the ISO series before being eligible to submit tenders for public housing construction work. Since then, many construction companies in Hong Kong have sought and obtained ISO certification to demonstrate their commitment to high quality construction work. However, they implement quality management systems mainly in order to meet the Housing Authority's ISO quality standards requirement for tendering public construction work [20]. Conformance quality and profitability for each project represent the most valued objectives of many construction companies in Hong Kong. They invest in quality improvement generally up to the minimal acceptable level, i.e., obtaining and maintaining the ISO-certified status. They consider the cost of pursuing quality beyond this level unwarranted, given the nature of construction work (e.g., standards and procedures), which varies from one project to another, and the risk level (e.g., delayed completion, profit-and-loss) involved for individual construction projects. Sommerville and Robertson [21] also share the view that many construction companies are predominately quality assurance-oriented due to pressure from their clients. Many of them have in-depth knowledge about ISO quality management systems and have attained certified status. However, few have embraced the principles of quality management and implemented quality management to such a high level as TQM.

On the other hand, construction work involves several parties with different professional backgrounds such as contractors, subcontractors, and construction workers, and these parties have to deal with different phases of a construction project including concept development, feasibility studies, cost estimates, engineering, procurement, and construction [22]. Because of the complicated nature of the operations in the construction industry, and the fact that different parties have different roles and objectives (e.g., cost, safety and speed) in a construction project, construction companies in Hong Kong generally take conformance

quality as the path to ensuring the successful and profitable completion of a construction project, particularly for the ISO requirements mandated by the Housing Authority [23].

Similar to their counterparts in the manufacturing industry, the tangible nature of quality standards and specifications for conformance, which are generally measurable, are taken as the target quality improvement level sufficient to satisfy their customer's requirements. Profitability and better business opportunities derived from conformance quality drive quality improvement initiatives for most construction companies in Hong Kong. Generally, they consider that quality improvement exceeding the target level does not contribute much to profitability [24].

Services – After the launch of the open door policy in the People's Republic of China (PRC) in 1979, many Hong Kong manufacturers moved their production lines to the PRC to take advantage of low labor costs across the border, retaining only non-production functions such as distribution and marketing in Hong Kong. Since then, the service sector has assumed an increasingly important role in the economy, employing over 80 per cent of the 3.4 million workers in Hong Kong by 2002 [25]. Being aware of the importance of quality for the survival of a company, as well as of quality's contribution to competitiveness in the service industry, many service firms in Hong Kong have adopted different measures to improve the quality of their services.

Delivering a service is different from delivering a product because of many factors, including intangibility, simultaneous production and consumption, heterogeneity, and perishability [26]. Unlike the manufacturing and construction industries, which produce tangible goods, services are intangible and no standards exist to determine the level of quality adequate for conforming to customer specifications and requirements [27]. Furthermore, service companies in Hong Kong are facing increased competition, both domestic and international, as a result of economic growth. To stay ahead of the competition, whether

domestic or foreign, service companies in Hong Kong generally aim for the highest level of quality improvement they can afford.

As services are intangible and it can be difficult to convey the message of quality to customers, quality management tends to be more important and prevalent in the service industry than in the manufacturing and construction industries. It is natural that service businesses invest more on quality management than their counterparts in the manufacturing and construction sectors. This is reflected in the fact that the quality of service offered in Hong Kong, notably in the hotel industry, is regarded as world class and that Hong Kong has evolved to be one of the leading financial and import/export trade centers in the world [28]. All of this demonstrates the desire and effort of companies in Hong Kong's service sector to pursue the highest possible level of quality improvement.

Public utilities - Public utilities in Hong Kong are generally monopolistic in nature. Many of them, such as railway transportation and electricity, are the sole providers of the services/products they offer. They are highly profitable because their monopoly status guarantees high profit margins. To foster competition for the benefit of customers and other investors, the Hong Kong Government has recently deregulated such markets as telecommunications and public transportation, and accelerated the pace of introducing competition to other markets of the public utilities sector. On the other hand, the heightening of customer expectations and the comparisons which are often made between the quality levels of the private and public sectors have prompted many public utilities in Hong Kong to improve the quality of their offerings. In response to rising customer expectations and potential competition resulting from market deregulation by the Government, public utilities companies are known to employ quality improvement as a weapon to deter new entrants into the market. Importantly, many of them have embarked on quality improvement efforts with a focus on value-for-money, continuously improving their operations through elimination of

waste and delivery of better customer service. Many of them seek to achieve the highest possible level of quality, in the hope that they can consolidate their competitive advantages before the gradual loss of their monopolistic status. As a consequence, the management of quality has emerged as a cornerstone of the overall strategic effort in many public utilities in Hong Kong. Indeed, many past winners of the Hong Kong Management Association's (HKMA) quality management award, the local version of the Malcolm Baldrige National Quality Award (MBNQA) in the United States, are in the public utilities sector, for example, the Kowloon-Canton Railway, the Mass Transit Railway, and Town Gas.

2.2 Hypotheses

The above discussions highlight the quality initiatives of companies in different types of industries in Hong Kong. Manufacturing and construction companies tend to be oriented towards conformance quality as compared to service companies and public utilities, which strive for the highest possible levels of quality improvement as a means to yield competitiveness. The differences in their initiatives for quality improvement lead us to hypothesize that:

Hypothesis 1. Levels of quality management implementation are higher in public utilities and service companies than in manufacturing and construction companies.

As the literature generally supports the link between quality management implementation and company performance [29], it is natural to hypothesize that:

Hypothesis 2. Companies in an industry type with a higher level of quality management implementation achieve higher quality outcomes.

Results from the test of these hypotheses not only shed light on how sophistication levels in quality management implementation differ among companies in different industry types, but also give insights into the strengths and weaknesses of quality management efforts in different industrial contexts. The following section discusses the methodology adopted for addressing these issues.

3. Research methodology

3.1 Samples

To evaluate quality management implementation and quality outcomes, it is important that the target sample companies demonstrate a certain level of quality management implementation. This is essential simply because companies without any operational quality management practices do not have the necessary knowledge and experience to meaningfully respond to the research questions. In line with previous studies on establishing the links between quality management and performance [30], we sampled firms that practised quality management. The population sampled in this study consisted of all the companies in Hong Kong practising quality management. We acknowledge that the sampling frame may result in positively biased return because of the respondent companies' experience in quality management implementation. However, such a sampling frame with companies employing quality management at a certain level of sophistication and maturity helps ensure validity in sample selection.

A sampling frame that covered all the business units/ organizations in Hong Kong known to have a quality management system was used as the sampling population. This sampling frame includes the HKMA's quality award winners and finalists (N = 10), and companies/business units certified to ISO 9000 series in Hong Kong (N = 1,082). The HKMA's quality award is modeled on the MBNQA, whose criteria are widely accepted as

the blueprint of excellence in quality management implementation. We also consider that companies having an ISO-certified status are likely to have implemented quality management systems in the workplace [31].

3.2 Measures

To evaluate a company's efforts in quality management implementation, it is important that the measures reflect the theory and concept that underlie quality management and cover all the domains of its implementation. In this regard, we employed the instrument developed by Black and Porter [32], which measures the critical criteria of quality management implementation. They developed this instrument using the criteria of the MBNQA, which are the assessment frameworks for identifying leaders in quality management in the United States. They extracted a series of items from the MBNQA criteria, excluding the business results categories, and combined them with the items identified in the literature that are considered critical components of quality management, but which were not adequately covered in the MBNQA criteria, to evaluate organizational efforts in quality management implementation on a five-point Likert type scale. They then tested the instrument with over 200 managers and found that the instrument is reliable and valid for measuring the critical components of quality management. The empirical analysis conducted by Black and Porter [32] resulted in a 10-factor, 32-item instrument. The ten critical factors of quality management generated by their study include:

1) people and customer management (QM1),
2) supplier partnerships (QM2),
3) communication of improvement information (QM3),
4) customer satisfaction orientation (QM4),
5) external interface management (QM5),
6) strategic quality management (QM6),

7) teamwork structures for improvement (QM7),
8) operational quality planning (QM8),
9) quality improvement measurement systems (QM9), and
10) corporate quality culture (QM10).

As the instrument of Black and Porter [32] represents literature-based, empirically tested elements of quality management, it was used with some refinements to measure quality management implementation in our study. In our refinements, seven potentially confusing items in their instrument, each asking two questions, were split into two. This resulted in a 10-factor, 39-item instrument to measure quality management implementation in this study. To facilitate the respondents' understanding, most of the questionnaire items measuring different aspects of quality management implementation were provided with illustrative examples.

The implementation of quality management emphasizes the importance of satisfying multiple stakeholders [33]. In order to extend beyond finance-based measures and to consider the interests of multiple stakeholder groups, the 15-item multi-model performance framework (MMPF) of Weerakoon [34] was adopted in this study to operationalize quality outcomes. The MMPF model consists of four dimensions, including:

1. employee motivation (QO1),
2. market performance (QO2),
3. productivity (QO3), and
4. impact on society (QO4).

The multi-dimensional nature of these outcome measures covers the satisfaction of various stakeholders such as customers, investors, employees, suppliers, and society. Considering that the influence of a firm's strategy (e.g., quality management implementation) usually only becomes apparent over a period of years, these quality outcomes were measured

over a three-year period with an anchor on the degree to which they improved with respect to motivation performance, market performance, productivity performance and societal impact.

Perceptual measures on a five-point interval scale were used to capture information about quality management implementation and quality outcomes in this study. The perceptual measures are in the form of attitude statements with 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. Respondents were invited to indicate the extent to which they agreed or disagreed with each statement. They were also asked to indicate the type of industry they belonged to, their length of quality management implementation, and to provide other relevant company information. The measurement items, the codings of quality management implementation and quality outcomes used, and the items for collecting general information are presented at Appendix A.

3.3 Data collection and demographics

A sample of 1,092 companies was drawn from the buyer's guide of the Hong Kong Quality Assurance Agency (HKQAA), the ISO 9000 directory published by the Hong Kong Trade Development Council (HKTDC), and the list of winners and finalists of the HKMA's quality management award. This sample represented companies in Hong Kong known to have implemented a quality management system. The sample companies were cross-checked to avoid double mailing. The survey questionnaire was sent out twice.

We chose the study respondents based on a key-informant methodology [35]. We acknowledge that bias in data collection may stem from the use of a single respondent in this study. However, a key-informant may be a more reliable source of information and help to ensure that the respondent has the necessary knowledge to respond [36]. In line with other quality management researchers [e.g. 30], we targeted a single well-informed respondent from each sampled company.

For each sample company, we solicited only one response. The respondent included the quality manager or the personnel responsible for quality management in the company. Because a quality management system requires a company-wide focus, we assume that these informants had a good understanding of the quality management implementation and quality outcomes in their companies.

The two mailings of the survey questionnaire yielded 342 returns; 304 of which were valid for data analysis, representing a usable response rate of 28.6%. Of these, 69 were manufacturing companies, 107 service companies, 114 construction companies, and 14 public utilities companies. We evaluated non-response bias using the t-test, with the respondents in the first and the second mailings as the proxy 'respondents' and 'non-respondents' respectively to determine if there were significant differences in the mean values of quality management implementation and quality outcomes (see Section 4 for calculation of the mean values) between the two groups [37]. The results showed that no differences between the groups at the $p > 0.05$ level (quality management implementation, $t = -0.32$; quality outcomes, $t = -0.36$), suggesting that non-response was not a problem in this study. The profiles of the respondent companies embraced in this study and their characteristics are displayed in Table 1.

<< Insert Table 1 about here >>

4. Results

Descriptive statistics, alpha coefficients, item-total correlation were used to initially analyze the survey data. A high percentage of the respondents were "service" and "construction" companies. Confirmatory factor analysis (CFA) was used to further evaluate the measurement properties of the quality management implementation and quality outcomes

constructs. To analyze the differences in quality management implementation and quality outcomes according to industry types, analysis of variance (ANOVA) was used.

Both the quality management implementation and the quality outcomes constructs are measured on a five-point interval scale with multiple items. The mean value of all the items measuring a particular factor of the respective constructs (e.g., QM1 in quality management implementation) is taken as the value of that factor. The values (levels) of quality management implementation and quality outcomes are determined by the average of all the factors concerned (e.g., QM1-QM10 in quality management implementation). Tables 2 and 3 show the factors in the quality management implementation construct and the quality outcomes construct, the number of items which measure them, the means, standard deviations, reliability values based on Cronbach's alpha, and item-total correlation coefficients. Except for two factors in the quality management implementation construct, all of the factors in quality management implementation and quality outcomes have a reliability (alpha) value above 0.70, the threshold value recommended by Nunnally and Bernstein [38]. However, the reliability values of the other two factors, namely QM7 and QM10 in quality management implementation, are marginally below the benchmark value of 0.70. In addition, all the factors of quality management implementation and quality outcomes have high item-total correlation values, i.e., > 0.60.

<< Insert Tables 2 & 3 about here >>

The key premises of the testable hypotheses in this study rest on the validity of the measurement properties of the two constructs. CFA using LISREL 8 was conduced, with the composite scores of the factors as the measures, to further assess the structure and measurement properties of the two constructs. CFA was performed separately for the two

constructs. All factors were forced to load onto and were allowed to correlate with other factors in their corresponding construct. The results of the CFA are presented in Table 4.

<< Insert Table 4 about here >>

All factors had a reasonably high and significant loading, i.e., $t > 2$, on their respective higher-level constructs. For the quality management implementation construct, all ten first-order factors had reasonably high loadings (0.84, 0.65, 0.85, 0.84, 0.83, 0.91, 0.75, 0.69, 0.86, 0.85). For the quality outcomes construct, all four factors loaded reasonably highly in their corresponding higher level construct (0.58, 0.59, 0.60, 0.59). The results provided evidence of the convergent validity and unidimensionality of the underlying factors of the two constructs. Furthermore, the goodness-of-fit indices for the ten-factor quality management implementation construct ($\chi^2 = 69.8$, df = 35, p = .01, CFI = 0.99, GFI = 0.96, NFI = 0.97) and the four-factor quality outcomes construct ($\chi^2 = 0.01$, df = 2, p = 1.0, CFI = 1.0, GFI = 1.0, NFI = 1.0) demonstrated the fitness of the measurement models to the data collected. Thus, the CFA results substantiated the measurement properties of the two constructs.

One-way analysis of variance (ANOVA) was used to determine whether differences exist between the mean values of quality management implementation, quality outcomes, and their underlying factors in each of the industry types being studied. The ANOVA results reported in Table 5 indicate that statistically significant differences, i.e., $p < 0.05$, existed among the four industry types in quality management implementation and all the underlying factors. The post hoc test results using Tukey, Scheffe and Bonferroni procedures for all ANOVA results generated were similar. In sum, the public utilities appeared to have the highest level of quality management implementation (mean = 3.93), followed by the service industry (mean = 3.64), and then the manufacturing industry (mean = 3.52). The construction

industry was found to have the lowest level of quality management implementation (mean = 3.28). The findings lent support to Hypothesis 1.

<< Insert Table 5 about here >>

As shown in Table 6, except for market performance, the four industry types differ significantly, i.e., $p < 0.05$, in quality outcomes and all the underlying factors. The differences in their quality outcomes are consistent with their level of quality management implementation, where the public utilities have the highest level of quality outcomes (mean = 3.90), followed by the service industry (mean = 3.67) and the manufacturing industry (mean = 3.63). The construction industry was found to have the lowest level of quality outcomes. Therefore, the results provided support for Hypothesis 2.

<< Insert Table 6 about here >>

5. Discussions and implications

5.1 Initiatives and implementation

This study argues that the initiatives of quality management implementation for companies differ with their industrial contexts, and that the differences cause variations in their implementation efforts and hence their quality outcomes. The study results were congruent with our postulation that the desire for profitability drove the initiatives of companies for quality improvement. In the manufacturing and construction industries, companies tended to be oriented towards conformance where quality improvement exceeding the contractual specifications might not generate additional financial benefits for them. In the service and public utilities contexts, on the other hand, because of a lack of tangible customer requirements to which to conform, companies tended to pursue the highest possible quality

improvement to retain existing customers and to recruit new customers in the hope that their quality management efforts would bring increased business and hence profitability for them. Although the literature is rich in discussing the quality/ profitability link [39], there do not seem to have any studies examining the initiatives behind companies' pursuit of quality in different industrial contexts. Using the scenario and the data collected from companies in Hong Kong, this preliminary study provides empirical evidence for this important, but under-explored research topic in quality management.

The results show that companies in the public utilities and service industries outperformed companies in the manufacturing and construction industries in both quality management implementation and quality outcomes. The differences were especially apparent in such quality management factors as people and customer management, external interface management, quality improvement measurement systems, and corporate quality culture. The consistently higher mean scores of quality management implementation in the public utilities and service companies over those of the manufacturing and construction companies were in line with our earlier discussion. The results have implications for companies implementing, or intending to implement, quality management within those industry types.

The findings of this study are useful for both researchers and managers. From a research perspective, understanding the quality initiatives and how they would affect the implementation of quality management and quality outcomes across industries opens new avenues for theory development in quality management. For instance, under what circumstances would companies in different industries take quality management implementation as a way to pursue quality improvements, to satisfy contractual or market requirements, or to defend against the competition? How do the industry-based contingencies vary companies' efforts in their quality management implementation and hence their performance outcomes? Will certain aspects of quality management implementation be more

(or less) important in some industries than in others? What are the boundaries of the influence of the quality initiatives on the patterns of quality management implementation in different industries? Answers to these questions are crucial to the further development of quality management theories.

These questions also raise important issues concerning the differences in varying industrial contexts, particularly between the manufacturing and the service sectors in business operations and performance assessment [40]. Results from this study provide insights into the differences in quality management implementation in different industrial settings and point to ways to improve quality from one setting to the other. In particular, the study provides a step for further study to specify and to test 1) the conditions under which companies in different industries should be considered part of the same contingency set, and 2) the conditions under which findings from one setting should not be generalized to the other.

From a managerial point of view, this study argues that differences exist between industries in their initiatives for quality management implementation and that their implementation efforts affect their quality outcomes. To this end, we have identified the degree to which quality management is being implemented in different industries, and have shed light on the various areas where improvements can be made.

5.2 Implementation priorities

Regarding the priorities of different industries in quality management implementation, all of the four industry types assigned the highest value to the factor of quality improvement and measurement systems (QM9). This means that, regardless of industry type, they all stressed the importance of “fact-based” management and of “charting” progress in quality improvement, and were making remarkable efforts to measure improvements in their products/services and processes. This is, perhaps, due to the ease of finding evidence for

control and measurement than for some of the other intangible aspects (e.g., social responsibility in QM5) of quality management implementation. The second highest prioritized quality management factor was external interface management (QM5) for the public utilities and service industries, people and customer management (QM1) for the manufacturing industry, and supplier partnerships (QM2) for the construction industry. These results indicate that both the public utilities and service industries greatly emphasized the satisfaction of various stakeholders in their quality management implementation process. The manufacturing industry placed a high importance on employee development and proactive customer relations in support of overall quality and performance objectives, while the construction industry viewed supplier partnerships as a highly prioritized area for quality improvement.

The least valued quality management factors among the four industry types were teamwork structures for improvement (QM7) for the service and construction industries, communication of improvement information (QM3) for the manufacturing industry, and customer satisfaction orientation (QM4) for the public utilities. This points to the weaknesses of individual industry types in their quality management implementation. The industry concerned had to catch up with their own weak factors in order to maintain a “balanced” and “integrated” quality management implementation.

However, it is important to note that all of these less emphasized factors had “positive” mean values, i.e., > 3.0, in all four industries, where 5.0 represents the maximum positive evaluation and 1.0 means the maximum negative evaluation. Teamwork structures for improvement had a lower value in the service and construction industries (as seen from the scores for QM7 – teamwork structures for improvement in Table 5). This implies that, among other quality management factors, these two industries were less disposed to non-hierarchical organizational structures and a “process improvement” view of quality

management. Communication of improvement information, the sharing of knowledge and experience of quality improvement both within and outside the company, was rather weak in the manufacturing industry. Customer satisfaction orientation in the public utilities sector received the lowest score, i.e., 3.71, among the quality management implementation factors. However, it is interesting to note that when compared across industries, this was the highest value. This seems to suggest that public utilities were in fact leading the other industries in Hong Kong in the area of customer satisfaction orientation. Perhaps other industries can use the public utilities sector as a benchmark.

We have found that the public utilities and service industries were performing better than the manufacturing and construction industries in terms of the level of quality management implementation and quality outcomes. The results were expected as the two industry types had a higher level of daily contact with customers and were more customer-responsive than the manufacturing and construction industries, which were oriented more towards product/contract specifications. Furthermore, because of their monopolistic nature, the public utilities could not gauge what level of quality improvement was adequate in their field for long-term survival. The consistent high scores of the public utilities in all aspects of quality management implementation over other industries reflected the desire of the public utilities to maintain their “monopolistic” status in the market.

As for the service industry, it needs to pay more attention to teamwork structures in its quality management implementation, to ensure “coordinated” and “concerted” efforts in serving customers. On the other hand, the manufacturing and construction industries need to put more effort into the communication of improvement information and teamwork structures for quality improvement. To do this, adopting a flat organizational structure and establishing cross-functional working teams might help facilitate information flows and create an environment for teamwork. We suggest that they learn from the experience of the top

performers in the service and public utilities sectors, and benchmark the quality management practices of the high performing companies in their industries.

6. Directions for further research

There are some limitations to the interpretation of the study results and we leave them as topics for future research. First, we used cross-sectional data to test our hypotheses. While the data were useful in capturing the perceptions of managers at a point in time, the ways that firms implemented their quality management system and their quality outcomes could not be determined on a temporal dimension. There might also be delayed effects of quality management implementation on quality outcomes. It might be useful to conduct a longitudinal study to document the quality initiatives, quality management practices, and the quality outcomes of companies in different industrial contexts and to triangulate with different evidence sources to augment the survey findings.

This study assessed information only from the perspectives of the quality related personnel. However, it might offer a self-reported, one-dimensional focus. As the success of quality management implementation demands an organization-wide focus, it is desirable to generate information from different parties within an organization.

Lastly, this study represents the first step in understanding quality initiatives and quality management practices across industries. We collected data only from companies in one culture, i.e., Hong Kong. This may limit the generalizability of the results to other cultures. Studies of the quality initiatives, quality management implementation, and quality outcomes in different cultural and social contexts will not only help to generalize the findings, but also contribute to determining how differences in cultural and social contexts influence quality management implementation and quality outcomes.

Acknowledgements

This study was partially funded by The Hong Kong Polytechnic University under grant number A-PC99. The authors are grateful to Thilaka S. Weerakoon and three anonymous reviewers for their constructive comments on previous versions of this paper.

Appendix A - List of Major Items in the Questionnaire

Quality Management Implementation

QM1 People and Customer Management

1 Strategic human resources management (e.g. education, training, and employee involvement schemes) is a key performance objective of our company.

2 Our company monitors the effectiveness of the quality education and training which support the company's quality and performance objectives.

3 Our company uses employee recognition and performance measurement schemes (e.g. frequent evaluation of employee participation in quality improvement) which support the company's quality and performance objectives.

4 Our company employs proactive customer relations (e.g. market research, follow-up with customers, and use of customer service standards) i.e., frequent use of customer information to improve customer satisfaction.

QM2 Supplier Partnerships

1 Our company audits suppliers' quality (e.g. by first party audits, management reviews, inspection, and accreditation to ISO series).

2 Our company takes action (e.g. providing rapid information and data exchange) to assist and improve the quality and responsiveness of our suppliers.

3 Our company considers suppliers as associates rather than as adversaries (e.g. by reliance on a few dependable suppliers, development of long-term relations, involvement in the design/development process).

QM3 Communication of Improvement Information

1 Our company employs quality costs (e.g. appraisal, prevention, and failure) to facilitate the continuous improvement processes.

2 Our company assesses the need for quality education and training (e.g. on-the-job performance improvement, employee growth) and its subsequent delivery and review.

3 Benchmarking of processes in non-competing organizations for process improvement is practiced in our company (e.g. learn best practice outside the company's industry).

4 Our company interacts with outside groups (e.g. education, business, trade, professional groups) for the mutual benefits of quality improvement.

QM4 Customer Satisfaction Orientation

1 Our company promotes trust and confidence in our products/services (e.g. by quality policy, third party assurance, guarantees, and warranties).

2 Our company evaluates competitors with respect to the level of customer satisfaction (e.g. by company-based competitive studies, evaluations made by independent organizations including customers).

3 Our company evaluates customer satisfaction with internal performance objectives (e.g. by comparisons with past customer satisfaction index or standard set).

4 Our company determines and improves customer satisfaction (e.g. by identifying market segments, benefits sought by customer groups, and the target quality requirements of each segment or group).

5 Benchmarking of direct competitors' products/services for improvement of own products/services is practiced in our company (e.g. learn best practice within the company's industry).

6 Benchmarking of direct competitors' processes for improvement of own processes is practiced in our company (e.g. learn best practice within the company's industry).

QM5 External Interface Management

1 Our company recognizes its social responsibilities, such as public health and safety, environmental

protection, and waste management (e.g. by including its public responsibilities in its quality policy and practice).

2 Our company determines customers' future requirements and the relative importance of product/service features (e.g. by survey, focus group, dialogue with customers).

3 Our company's new product/service development process is designed to ensure satisfaction of customer needs (e.g. by tools such as quality function deployment, venture team, new product development committee).

QM6 Strategic Quality Management

1 Our company uses process capability studies to ensure that product/service design requirements are delivered by the processes.

2 Our managers take active leadership in coaching, encouraging, communicating and promoting quality issues (e.g. frequent reinforcement of the company's quality value).

3 Satisfaction of intrinsic rewards (e.g. employee job satisfaction, sense of achievement) for employees is considered as a critical factor for attaining our company's quality objectives.

4 Satisfaction of extrinsic rewards (e.g. pleasant working conditions, job security, fair salary and promotion) for employees is considered as critical factor for attaining our company's quality objectives.

5 Our top management commits to quality improvement through involvement and visibility in quality activities and communication of quality values (e.g. frequent involvement and reinforcement of quality values within and outside the company).

6 Our company implements long-term plans (3 years or more) which are based on customer needs.

7 Our company implements long-term plans (3 years or more) which are based on company capabilities.

8 A continuous improvement program of processes based on objective analysis of operational performance (e.g. improved cycle time, productivity, and waste reduction) is carried out in our company.

QM7 Teamwork Structures for Improvement

1 Our company uses non-hierarchical organizational structures (e.g. councils, quality circles, steering committees, and quality improvement teams) to support quality improvement.

2 Work is organized in our company according to key business processes which reflect customer needs, rather than on traditional specialization of functions.

QM8 Operational Quality Planning

1 Our company implements short-term plans (1 to 2 years) which are based on customer needs.

2 Our company implements short-term plans (1 to 2 years) which are based on company capabilities.

3 Quality goals, measurable and time-based (e.g. reduction of failure costs by 10% within the next six months) are included in the development of our short-term plans (1 to 2 years).

QM9 Quality Improvement Measurement Systems

1 Our company evaluates and improves its products/services.

2 Our company evaluates and improves its business processes.

3 Our company manages data/information (e.g. data/information on quality improvement, customer and employee relations, supplier relations) to support quality improvement efforts.

4 Our company employs procedures (e.g. regular reviews and time updates) to ensure reliability, consistency, and rapid access to data and information throughout the company.

QM10 Corporate Quality Culture

1 Quality goals, measurable and time-based (e.g. increase in customer satisfaction by 20% within the next three years) are included in the development of our long-term plans (3 years or more).

2 The quality culture (e.g. common value, belief, and behaviors) in our company is company wide.

Quality Outcomes

QO1 Motivation Performance

1 The equity of our company (e.g. wage, promotions, fringe benefits) to employees has been continuously improving in the past three years.
2 The training function provided to employees for the acquisition of necessary job skills and knowledge has been continuously improving in the past three years.
3 The extent of employee job satisfaction has been continuously improving in the past three years.
4 The extent of employee job security has been continuously improving in the past three years.
5 The environmental factors affecting the job (e.g. safety of the job environment) have been continuously improving in the past three years.

QO2 Market Performance

1 The success rate of our company in introducing new or modified products/ services to satisfy customer needs has been continuously improving in the past three years.
2 The price of the products/services of our company has remained relatively competitive to the price trend of the competitors in the past three years.
3 The ability of our company to satisfy customer needs has been continuously improving in the past three years (e.g. decrease in customer complaints, product returns).

QO3 Productivity Performance

1 The efficiency of materials usage of our company (e.g. ratio of total output to material input) has been continuously improving in the past three years.
2 The efficiency of labor of our company (e.g. ratio of total output to labor input) has been continuously improving in the past three years.
3 The efficiency of capital utilization of our company (e.g. ratio of total output to capital input) has been continuously improving in the past three years.

QO4 Societal Performance

1 The level of consumer rights of our company has been continuously increasing in the past three years.
2 The level of recognition of the need to protect the environment in our company has been continuously increasing in the past three years.
3 The expansion of the product/market of our company has been continuously increasing in the past three years.
4 The provision of employment opportunities by our company has been continuously increasing in the past three years.

General Information

1 How do you describe the nature of your business unit/ organization

a. manufacturing
b. services
c. construction
d. public/ utilities
e. others

2 What is the number of employees in your business unit/ organization

a. below 100
b. 100-999
c. 1,000-4,999
d. 5,000 or above

3. In which year did your business unit/ organization start to have a quality management program

References

[1] Terziovski, M., Samson, D. and Dow, D. The business value of quality management system certification: evidence from Australia and New Zealand. Journal of Operations Management 1997; 15 (1): 1-18.

[2] Hendricks, K.B. and Singhal, V.R. Firm characteristics, total quality management and financial performance. Journal of Operations Management 2001; 19(3); 269-285.

[3] Devaraj, S., Matta, K.F. and Conlon, E. Product and service quality: the antecedents of customer loyalty in the automotive industry. Production and Operations Management 2001; 10(4): 424-439.

[4] Lai, K.H. Market Orientation in quality-oriented organizations and its impact on their performance. International Journal of Production Economics 2002 (forthcoming).

[5] Douglas, T. and Judge, W.Q. Jr. Total quality management implementation and competitive advantage: the role of structural control and exploration, Academy of Management Journal 2001; 44(1): 158-169.

[6] Fynes, B. and Voss, C. A path analytic model of quality practices, quality performance and business performance, Production and Operations Management 2001; 10(4): 494-510.

[7] Sousa, R. and Voss, C. Quality management: universal or context-dependent? Production and Operations Management 2001; 10(4): 383-404.

[8] Price, M. and Chen, E. Total quality management in a small, high-technology company. California Management Review 1993; 96-117.

[9] Ahire, S. TQM age versus quality: an empirical investigation. Production and Inventory Management Journal 1996; 18-23.

[10] Madu, C., Kuei, C. and Lin, C. A comparative analysis of quality practice in manufacturing firms in the US and Taiwan. Decision Science 1995; 26(5): 621-636.

[11] Sousa, R. and Voss, C. Quality management re-visited: a reflective review and agenda for future research. Journal of Operations Management 2002; 20 (1): 91-109.

[12] Dean, J.W. Jr. and Bowen, D.E. Management theory and total quality: improving research and practice through theory development. Academy of Management Review 1994; 19: 392-419.

[13] Solis, L.E., Rao, S.S., Raghu-Nathan, T.S., Chen, C.Y. and Pan, S.C. Quality management practices and quality results: a comparison of manufacturing and service sectors in Taiwan. Managing Service Quality 1998; 8(1): 46-54.

[14] Lai, K.H., Weerakoon, T.S. and Cheng, T.C.E. The state of quality management implementation: a cross-sectional study of quality-oriented companies in Hong Kong. Total Quality Management 2002; 13(1): 29-38.

[15] Government of HKSAR, Half-yearly economic report 2002. Economic Analysis Division, Financial Services and the Treasury Bureau, Government of the Hong Kong Special Administrative Region, August 2002.

[16] Spizizen, G. The ISO 9000 standards: creating a level playing field for international playing. National Productivity Review 1992: 331-346.

[17] Chauvel, A.M. Quality in Europe: towards the year 2000. Total Quality Management 1994; 5(5): 309-319.

[18] Cheng, T.C.E. and Ngai, E.W.T. Computer-based technologies to support operations management in Hong Kong. International Journal of Operations and Production Management 1998; 18(7): 654-660.

[19] Zhao, X.D., Young, S. and Zhang, J.C. A survey of quality issues among Chinese executives and workers. Production and Inventory Management 1995; 36 (1): 44-48.

[20] Doug, C. and Bannister, B. The role of ISO 9000 in improving the quality of service delivery of Hong Kong's public housing programs. International Journal of Public Administration 1996; 19 (11/12): 2167 - 2194.
[21] Sommerville, J. and Robertson, H.W. A scorecard approach to benchmarking for total quality construction. International Journal of Quality and Reliability Management 2000; 17 (4/5): 453-466.
[22] Schultzel, H.J. and Unruh, V.P. Successful Partnering – Fundamentals for Project Owners and Contractors, New York, John Wiley and Sons, 1996.
[23] Lee, T.Y. Total quality management in Hong Kong Industry and its subsidiaries in China. Quality and Reliability Engineering Journal 1993; 9: 179-183.
[24] Chan, K.W. and Chan, H.C. Meeting quality assurance standards in the construction industry: experience from Hong Kong. International Journal of Management 1997; 14 (1): 87-91.
[25] Government of HKSAR, Hong Kong economic trends. Census and Statistics Department, Government of the Hong Kong Special Administrative Region, People's Republic of China, 30 September 2002.
[26] Zeithaml, V.A. and Bitner, M.J. Services Marketing, McGraw-Hill Companies, Inc, 1996.
[27] Morris, B. and Johnston, R. Dealing with inherent variability: the differences between manufacturing and services. International Journal of Operations & Production Management 1987; 7 (4): 13-23.
[28] Sowinski, L.L. 30 top markets for trade & expansion. World Trade 2000; 13 (6): 38-50.
[29] Hendricks, K.B. and Singhal, V.R. Does implementing an effective TQM program actually improve operating performance? Empirical evidence from firms that have won quality awards. Management Science 1997; 43(9): 1258-1274.
[30] Adam, E.E. Jr. Alternative quality management practices and organization performance. Journal of Operations Management 1994; 12 (1): 27-44.
[31] Frehr, H.U. From ISO 9000 to total quality management: a rough road. Human Systems Management 1997; 16: 185-193.
[32] Black, S.A. and Porter, L.J. Identification of the critical factors of TQM. Decision Sciences 1996; 27(1): 1-21.
[33] Mohr-Jackson, I. Conceptualizing total quality orientation. European Journal of Marketing 1998; 32(1/2): 13-22.
[34] Weerakoon, T.S. Organizational performance - A stakeholder concept. International Research Conference on Quality Management Proceeding 1996: 80-90.
[35] Phillips, L.W. and Bagozzi, R.P. On measuring the organizational properties of distribution channels: methodological issues in the use of key informants. In J. Sheth (eds.), Research in Marketing 1986; 8: 313-369.
[36] Phillips, L.W. Assessing measurement error in key information reports. Journal of Marketing Research 1981; 18: 395-415.
[37] Armstrong, J. and Overton, T.S. Estimating nonresponse bias in mail surveys. Journal of Marketing Research 1977; 14 (3): 396-402.
[38] Nunnally, J.C. and Bernstein, I.H. Psychometric Theory. Third Edition, McGraw-Hill, New York, 1994.
[39] Powell, T.C. Total quality management as competitive advantage: a review and empirical study. Strategic Management Journal 1995; 16(1): 15-37.
[40] Schneider, B. and Bowen, D.E. Winning the Service Game, Boston, MA, Harvard Business School Press, 1995.

Table 1. Profile of the respondent companies

Frequencies (Percentage)	**Manufacturing**	**Service**	**Construction**	**Public utilities**	**Total**
No. of employees					
Below 100	10 (14.5%)	52 (48.6%)	38 (33.3%)	1 (7.1%)	101 (33.2%)
100 – 999	28 (40.6%)	35 (32.7%)	54 (47.4%)	3 (21.4%)	120 (39.5%)
1,000 - 4,999	24 (34.8%)	8 (7.5%)	18 (15.8%)	7 (50%)	57 (18.8%)
5,000 or above	6 (8.7%)	10 (9.3%)	3 (2.6%)	3 (21.4%)	22 (7.2%)
Unknown	1 (1.4%)	2 (1.9%)	1 (0.9%)	--	4 (1.3%)
Level of turnover (HKD)					
Below 1 million	1 (1.4%)	6 (5.6%)	--	--	7 (2.3%)
1-10 million	10 (14.5%)	20 (18.7%)	13 (11.4%)	--	43 (14.1%)
10-100 million	19 (27.5%)	27 (25.2%)	35 (30.7%)	3 (21.4%)	84 (27.6%)
Over 100 million	33 (47.8%)	34 (31.8%)	58 (50.9%)	9 (64.3%)	134 (44.1%)
Unknown	6 (8.7%)	20 (18.7%)	8 (7%)	2 (14.3%)	36 (11.8%)
Length of quality management program					
1 - 2 years	7 (10.1%)	38 (35.4%)	33 (29%)	2 (14.3%)	80 (26.3%)
3 - 4 years	22 (31.9%)	35 (32.7%)	41 (35.9%)	3 (21.4%)	101 (33.2%)
5 - 6 years	17 (24.6%)	17 (15.9%)	21 (18.4%)	6 (42.9%)	61 (20.1%)
7 - 8 years	11 (15.9%)	7 (6.5%)	14 (12.3%)	2 (14.3%)	34 (11.2%)
9 years or above	7 (10%)	6 (5.5%)	2 (1.8%)	1 (7.1%)	16 (5.3%)
Unknown	5 (7.2%)	4 (3.7%)	3 (2.6%)	--	12 (3.9%)
Total no. of firms	69 (22.7%)	107 (35.2%)	114 (37.5%)	14 (4.6%)	304 (100%)

Table 2. Descriptive statistics, alpha values, and item-total correlation coefficients in quality management implementation

Construct/ factors	No. of items	Mean	S.D.	Alpha	Item-total correlation
Quality management implementation	**--**	**3.49**	**0.71**	**0.95**	**--**
QM1 – People and customer management	4	3.61	0.80	0.80	0.82
QM2 – Supplier Partnerships	3	3.64	0.82	0.73	0.63
QM3 – Communication of improvement information	4	3.30	0.83	0.77	0.82
QM4 – Customer satisfaction orientation	6	3.41	0.82	0.86	0.82
QM5 – External interface management	3	3.64	0.89	0.78	0.81
QM6 – Strategic quality management	8	3.46	0.80	0.89	0.88
QM7 – Teamwork structures for improvement	2	3.30	0.97	0.67	0.73
QM8 – Operational quality planning	3	3.40	0.87	0.77	0.68
QM9 – Quality improvement measurement systems	4	3.82	0.80	0.88	0.84
QM10 – Corporate quality culture	2	3.30	0.98	0.69	0.82

Table 3. Descriptive statistics, alpha values, and item-total correlation coefficients in quality outcomes

Construct/ factors	No. of items	Mean	S.D.	Alpha	Item-total correlation
Quality outcomes	**--**	**3.56**	**0.63**	**0.89**	--
QO1 – Motivation performance	5	3.44	0.72	0.87	0.75
QO2 – Market performance	3	3.71	0.69	0.74	0.79
QO3 – Productivity performance	3	3.52	0.77	0.89	0.72
QO4 – Societal performance	4	3.56	0.70	0.78	0.78

Table 4. Results of confirmatory factor analysis for quality management implementation and quality outcomes

Parameter	**Completely Standardized Loading (λ)**	**Standard Error**	**t-value**	**Error Variance**	**Completely Standardized Estimate (δ)**
Quality Management Implementation					
QM1 (λ1,1)*	0.84	--	--	QM1 (δ1)	0.29
QM2 (λ2,1)	0.65	0.06	12.7	QM2 (δ2)	0.58
QM3 (λ3,1)	0.85	0.05	19.1	QM3 (δ3)	0.27
QM4 (λ4,1)	0.84	0.05	18.5	QM4 (δ4)	0.30
QM5 (λ5,1)	0.83	0.06	18.3	QM5 (δ5)	0.31
QM6 (λ6,1)	0.91	0.05	21.5	QM6 (δ6)	0.17
QM7 (λ7,1)	0.75	0.07	15.6	QM7 (δ7)	0.44
QM8 (λ8,1)	0.69	0.06	14.0	QM8 (δ8)	0.52
QM9 (λ9,1)	0.86	0.05	19.5	QM9 (δ9)	0.26
QM10 (λ10,1)	0.85	0.07	19.0	QM10 (δ10)	0.28
Quality Outcomes					
QO1 (λ1,1)*	0.58	--	--	QO1 (δ1)	0.35
QO2 (λ2,1)	0.59	0.06	16.5	QO2 (δ2)	0.26
QO3 (λ3,1)	0.60	0.07	14.4	QO3 (δ3)	0.41
QO4 (λ4,1)	0.59	0.06	16.1	QO4 (δ4)	0.29

** The corresponding parameter was set to 1.00 (unstandardized) to fix the scale of measurement*

Table 5. ANOVA results for quality management implementation by industry

Construct/ factors	Manufacturing (N=69)	Service (N=107)	Construction (N=114)	Public utilities (N=14)	F	Sig.
Quality management implementation	**3.52 (0.75)**	**3.64 (0.66)**	**3.28 (0.67)**	**3.93 (0.78)**	**7.17**	**.000***
QM1 - People and customer management	3.66 (0.81)	3.78 (0.77)	3.36 (0.77)	3.99 (0.76)	6.60	.000*
QM2 – Supplier partnerships	3.64 (0.87)	3.80 (0.79)	3.46 (0.79)	3.86 (0.79)	3.50	.016*
QM3 – Communication of improvement information	3.17 (0.96)	3.43 (0.81)	3.18 (0.71)	3.92 (0.76)	4.88	.003*
QM4 – Customer satisfaction orientation	3.38 (0.78)	3.59 (0.82)	3.22 (0.76)	3.71 (1.18)	4.46	.004*
QM5 – External interface management	3.62 (0.92)	3.87 (0.81)	3.38 (0.86)	4.19 (1.01)	8.00	.000*
QM6 – Strategic quality management	3.48 (0.85)	3.61 (0.77)	3.26 (0.77)	3.84 (0.81)	4.85	.003*
QM7 – Teamwork structures for improvement	3.29 (1.13)	3.41 (0.94)	3.15 (0.88)	3.82 (0.85)	2.77	.042*
QM8 – Operational quality planning	3.51 (0.94)	3.50 (0.89)	3.20 (0.78)	3.87 (0.69)	4.41	.005*
QM9 – Quality improvement measurement systems	3.92 (0.76)	3.96 (0.82)	3.57 (0.76)	4.32 (0.74)	7.51	.000*
QM10 – Corporate quality culture	3.49 (0.95)	3.46 (0.97)	3.0 (0.94)	3.75 (1.01)	6.86	.000*

Note: Entries in the table are mean values on a 5-point interval scale and entries in parentheses are standard deviations with * indicating significance at $p < 0.05$ level.

Table 6. ANOVA results for quality outcomes by industry

Construct/ factors	**Manufacturing (N=69)**	**Service (N=107)**	**Construction (N=114)**	**Public utilities (N=14)**	**F**	**Sig.**
Quality outcomes	**3.63 (0.61)**	**3.67 (0.63)**	**3.37 (0.59)**	**3.90 (0.60)**	**6.57**	**.000***
QO1 – Motivation performance	3.50 (0.69)	3.53 (0.75)	3.30 (0.69)	3.56 (0.71)	2.28	.080
QO2 – Market performance	3.77 (0.66)	3.84 (0.71)	3.50 (0.66)	4.09 (0.61)	6.66	.000*
QO3 – Productivity performance	3.66 (0.76)	3.60 (0.77)	3.30 (0.72)	4.08 (0.82)	7.03	.000*
QO4 – Societal performance	3.60 (0.69)	3.70 (0.71)	3.38 (0.67)	3.89 (0.62)	5.21	.002*

Note: Entries in the table are mean values on a 5-point interval scale and entries in parentheses are standard deviations with * indicating significance at $p < 0.05$ level.