

# Implementation of Quality Management System in Construction Industry

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**Abstract:** Indian construction industry is facing problems to assure the construction quality due to the increasing demand in quality of delivered product. Therefore, Indian construction industry must impose on higher quality product to compete aggressively both at regional or international industry. The concept of quality management system has been introduced to the construction industry to control the product quality and continually improve the effectiveness and efficiency of its performance. The main thrust of a quality management system is to define the processes that will lead to the quality of end result or product. Implementing quality management systems (QMS) based on ISO 9001 are important in helping Indian construction companies become more competitive, for it is acknowledged that quality in construction is a major concern in the global construction industry. However, the possession of ISO 9001 certification does not reflect the presence of a well-operated QMS, which is capable of giving customer and project end-users satisfaction. However, the implementation of quality management system is often treated independently within an organization and this contributes to the limitation of the system. The main aim of this study is to identify current problems within the systems, and examine the performance of companies while implementing their QMSs. The methodologies adopted for this study is questionnaire survey. Hence, the results of study are important for the construction industry that wishes to enhance their end product quality and performance. It is found that there is a strong potential in applying quality management system. Indeed, this study has found that there are few construction companies have implemented this system. The main challenges for applying this system are higher initial cost and lack of understanding of the concept.

**Keywords:** quality management system, construction industry, quality implementing.

## 1. Introduction

### A. General

The construction industry globally is one of the largest contributors to Gross Domestic Product (GDP), as well as playing an important role in determining a country's economic growth. The global forecasts for the construction industry over the decade 2011 to 2020, it was observed that this sector currently accounts for more than 11% of global GDP and it is that by 2020 it will account of 13.2% of the world's GDP. India is categorised as one of the emerging markets in the Asia, and is one of the seven countries (the other being China, USA,

Canada, Russia, Australia, Indonesia), that it is predicted will account for 65% of growth in global construction by 2020 (Debby Willar, 2012). Currently, the construction industry is being viewed as being less quality conscious compared to other sectors. Therefore, many criticisms have been directed to construction industry for the poor workmanship of the end product and not worth the money value. The construction industry is also characterised by its non-standardisation. Besides that, over the decades, the construction industry has had raised serious concerns about the construction activities contribution towards the environmental impacts. The concerns are raised due to the increasing in global environment awareness among the community. It is estimated about 40% of the materials entering in the world's economy each year and 25% of the worlds' usage of wood. Besides, site construction also produces atmospheric pollutants and negligence of construction sites may result in spillage of substances which are washed away into water sources.

Unfortunately, now a day, there are many obstacles faced by construction projects. It is normal for construction projects to experience extensive delays, exceed initial or estimated cost and the most vital is the workmanship quality. These days, clients are more knowledge and conscious on the quality of work and it is very challenging task to deliver the quality that would satisfy the client's standard. Construction industry is also facing problems to assure the construction quality because of the nature of operation is complicated. The Construction industry consists of a multitude of occupations professions and organisations. They are involved in different phases of construction and each one play a different role in delivering a quality project. Failure of any parties will affect the quality of the final project.

For the past decade, the Indian construction sector has been going through a radical change driven by the (ISO) quality policy of the Indian government. Recently, the number of contractors obtaining certification of ISO 9001 Quality Management System (QMS) is ever increasing. However, with insufficient experience on ISO quality implementation within the Indian environment, the construction participants are staggered with several performance related problems. The pressure also comes from the on-going process of economic globalisation. Experiences cultured from other countries such

as United Kingdom, Singapore and Hong Kong revealed that QMS implementation was very encouraging at the initial stage but over a time period became burdensome to all parties involved if the right approaches were not adopted (Abdul Hakim, 2006).

Quality management system (QMS) implementation has been spreading more widely in the Indian construction industry, ever since the quality of civil engineering project work became an issue of high concern to the government, contractors, consultants, project customers and end-users. The effectiveness of the system is one of the most important factors usually considered by internal stakeholders within an Organisation.

In India, QMSs applied by builders developed and implemented based on ISO 9001, are also now becoming very important to customers who have for some time been seeking qualified and professional construction firms capable of meeting their requirements and providing, satisfactory and successful outcomes in the area of project delivery. One of the ways to achieve a better understanding of a QMS is by being able to identify the main factors that drive effective QMS implementation and continuous improvement, and such factors should be taken earnestly and considered by all planes of management.

#### *B. Problem statement*

Apparently, the standard of Indian construction industry is still arguable and below the expectation compared to international construction industry. Although the construction industry has been implementing a part of quality management system, still the end product delivered by the construction industry not up to client's expectation. Applying the current management system only could improve a few construction impacts but by integrating the current management system, it will open wide all the vital construction components that needs to be taken into consideration and will gained a long term benefits.

There are many problems and issues that were identified based on the literature review which prevents the QMS to be successfully implemented in the construction project. Some of the related problems and issues that being faced in the QMS implementation especially in project level are, QMS are seen as a marketing tool, issue of knowledge and experience, issue on training, motivation factors and qualification of quality consultant in internal audit. The factors that can influence the effective implementation, operation and continuous improvement of QMSs in Indian construction industries are to be investigated, and identifying which factors can be considered as the most influential in contributing to the success of QMSs in such industries.

#### *C. Aim and objectives study*

The aim of this study is to study the potential of applying quality management systems for construction. The objectives of the study are as follow:

- To investigate the the current status of the quality

management systems (QMSs) being implemented by Indian construction companies

- To find out problems and issues on the implementation of Quality Management System in construction projects.
- To determine the factors impelling effective and continuous improvement of Indian construction industries Quality Management Systems.

## **2. QMS – A REVIEW**

### *A. Introduction to quality management system*

Considering the significance of construction, there are three-fold meaning in construction, which are getting job done on time, ensuring that the basic characteristics of the final product comply with the requirements and getting the job done within budget. It has been a merging dispute over clients' dissatisfaction towards Indian construction industry performance in terms of completing the project within budgeted cost and time frame given and foremost, the quality of the end product. There is an increasing demand towards high quality of construction constructed by Indian Construction Industry. The major indicator to measure and determine the quality of construction is high quality of workmanship where it determines the success of construction. In early 1980's, quality began to emerge as a key management focus in United States. Indian construction industry has realised on the aggressive competition in both regional and international industry. To ensure their position in emerging international market, the construction industry must impose higher quality levels in trying to achieve internationally accepted quality levels (James L. Burati Jr, 1991).

In construction industry, quality should be implemented throughout the life cycle of the project as a preventive action. Quality issues also have to be taken into consideration in the construction project management in order to eliminate any unnecessary problems before it occurs or towards lean construction. Lean construction means to eliminate the unnecessary system or approaches and continually improvement (Kumara Neeraj Jha, 2011).

### *B. Quality management history and gurus*

The concept of quality first emerged out of the Industrial Revolution. Previously, products had been made from start to finish by the same person or team of people with handcrafting and tweaking the product to meet 'quality criteria'. Then, mass production concept was introduced by bringing huge teams of people together to work on specific stages of production where one person would not necessarily complete a product from start to finish. In the late 1800s pioneers such as Frederick Winslow Taylor and Henry Ford recognised the limitations of the methods being used in mass production concept at the time and the subsequent varying quality of output. Therefore, Taylor established a Quality Departments to ensure the quality of production and rectifying of errors, and Ford emphasised a

standardisation of design and component standards to ensure a standard product was produced. The responsibility of Quality Department is to manage the product quality by implementing Inspection of product output to rectify defects.

As a result of World War, application of statistical control was introduced. During the second-half of the 20th century, the quality managements system was the outgrowth of work done by W. Edwards Deming, a statistician, after whom the Deming Prize for quality is named where he defines quality, as a profession and the managerial process associated with the quality function and has evolved since then. Over this period, few other disciplines have seen as many changes as the quality profession and the profession grew from simple control, to engineering, to systems engineering. Quality control activities were predominant in the 1940s, 1950s, and 1960s. The 1970s were an era of quality engineering and the 1990s saw quality systems as an emerging field (Kumara Neeraj Jha, 2011).

### *C. Basic concept of quality, quality dimensions and parameters*

Quality has a broad definition under different aspect. Crosby has defined quality as conformance to requirements and specifications and suggests that to measure quality in order to manage quality effectively. Juran (1998) stated that quality is fitness for use. He emphasised that requirements and specifications translate fitness for use as a quality measurement and he relegated design responsibility to inspection department. According to Hoyle in ISO 9000 Quality System Handbook 3rd edition, quality means a degree of excellence, conformance with requirements, the totality of characteristic of an entity that bears its ability to satisfy stated or implied needs, fitness for use. Clients' demand should be prioritised and contractors have to build the structure within the cost and time frame given by the clients'. The quality of works also must be freed from any defects, imperfections and satisfy clients' needs and expectations.

Agreeing to other researchers it is defined as five different perspectives of quality. The first perspective is from transcendental perspective where the quality cannot be defined, one knows what it is. From this perspective, quality is synonym to excellence, universally renowned, resistance to fashion and taste. Most often quality cannot be defined but we learn to recognise it through experience. Secondly, from the product's perspective, stated the qualitative differences reported to quantitative differences of some desired components or attributes. In this context, the qualitative differences are given by the quantitative differences between the characteristic of a product. Thirdly, from the user's perspective where quality consists of the capacity to fulfil demands. Juran (1998) stated that the quality represents the capacity of the product to be used (fitness for use) and the quality of the product depends on the manner it satisfies the requests of the user. Fourthly, from the producer's perspective is the quality means conformity to request. In this case, quality represents the extent to which a certain product is conformant to a project or stipulation or

demand. Lastly, from the value perspective is the quality represents the level of excellence at an affordable cost together with the control of variability at an affordable cost. Further explain, a product can be considered high quality if the product provides performance or conformity at an affordable or acceptable price or cost. The conclusion is by integrating all the perspectives, the aims still to satisfy the client's demands.

In the construction field, the word quality has a different meaning than it has in general usage. According to Design & Construction Quality Institute (DCQI), there are four definitions of quality depending on the roles. For an owner, quality means fitness for an intended purpose; for a designer, conformance to standard requirements; for a contractor, reliance and strict adherence to tender documents and design plan and lastly from the operational and facilities management point of view, ability to have acceptable and predictable performance. In general usage, quality means better quality and better quality means richer, finer, expensive materials and better methods or better appearance. Besides that, quality is not strictly an aesthetic issue. It is also an economic or financial issue. Statistic based on DCQI, approximately 30% of the total construction cost can be attributed to quality. The remaining 70% can be attributed to poor quality including the cost of repairing and rectifying the substandard work. The conclusion is doing the job right the first time can saves approximately 24% of the total cost of construction. The poor quality also can be minimised with the implementation of quality management system in the construction project.

## **3. Research methodology**

### *A. Introduction*

This chapter shall describe the methodologies adopted for this study. The methodologies are described from how the data is collected till how it is analysed to achieve the aim and objectives of the study. This chapter aim is to elaborate the methodological process to carry out the study which includes literature review, interview with expert panels, case study and questionnaire survey.

### *B. Selection of research methods*

The careful selection of appropriate research methods is an important component of the strategy in the overall design of any study. The understanding, of which research methodologies and methods are appropriate, is important in development for successful data collection in the construction industry. The methods employed in undertaking this research were chosen specifically to support each of the research objectives, the type and availability of the information required the expertise of the researcher, and the time and financial support available for data collection. This research adopted both rigorous and comprehensive methods that were able to be employed in the whole research process, from the early phase of the literature review and data collection, to complete data analysis, seeking to satisfy the research aims and objectives.

A “Questionnaire survey” method was adopted for this research. Collecting data using a questionnaire survey method from multiple sources lends rigor to research and can potentially reduce potential bias associated with other data collection methods. The questionnaire generated gives quantitative data.

The choice of the questionnaire survey approach for the conduct of the research was based on the requirements of the different research strategies. A survey was regarded as appropriate to answer the ‘what?’ type research questions. The parts of the questionnaire were quantitative in nature for measuring the numerical itemised rating scale. The quantitative method was the mainstay of the methodology used to generate the research findings in this study. Therefore, quantitative method for data collection and analysis in this study was considered as the best strategy in order to get robust valid answers to the research questions

### C. Case study

Case study has to be conducted in order to investigate the current practice of quality management system and the issues involving in the implementation and to find the factors impelling continuous improvement of Indian construction management systems. Questionnaire survey will be used in the case study as a tool to collect additional data on the quality management system. The detail on the questionnaire is described below.

### D. Questionnaire survey

The purpose of questionnaire survey is to evaluate the respondent’s perception towards the concept of quality management system, the benefits and challenges faced by the company when implementing the system. It is one of the effective ways to gather data needed. However, the limitation of questionnaire is subjected to the respondents’ willingness and cooperation. Thus, all questions should be straight to the point, understandable and no ambiguity. A series of set of questionnaire survey form is preparing to the respondent’s in the project for this case study. To ensure that meaningful data was collected, the research instrument (i.e. questionnaire) in this study was carefully developing and will be tested in the pilot study, followed by minor revisions in order to have a well-validated survey instrument. All statements were primarily based on information derived from the literature review and preliminary studies.

Questions in the survey were classified as either “closed-ended” or “open-ended”. Since most of the questions sought opinions or a subjective measurement, the formats of such questions were based on an unbalanced itemised rating scale. For example, 4 = fully implemented, 3 = not so fully implemented, 2 = minimally implemented, 1 = yet to be implemented. The itemised rating scale provides flexibility in the number of points in the scale as appropriate (e.g. 4, 5, etc.); it is also allows for the possible use of different anchors (e.g. very important to very unimportant)

It is best to start with general questions and keep key questions in the last part of the questionnaire. However, revision of the original questionnaire design resulted in the main questions being in the middle part of the questionnaire which commenced by providing general information to respondents on the objectives of the survey, with the middle sections requiring them to think deeply; the questions in the last section allowed respondents to be more relaxed in expressing their thoughts and opinions.

### E. Methods of analysis

As noted above, data collected from the questionnaires was quantitative data, which was the output, required from the survey. This data was then processed, analysed and interpreted by using statistical techniques, to provide the information needed. Quantitative data analysis involves both looking at the general trends in the data and fitting statistical models to the data.

A descriptive statistical analysis of frequency distribution (numbers and percentages) was first undertaken to provide an overview of the development phase of contractors’ QMSs. In particular, measurement of central tendency (mean, median and mode), and the measurement of variation (standard deviation), were utilised to depict initial motives driving the development of QMS under ISO 9001. Continuing the descriptive analysis, the results depicted the current status of the QMSs implementation including the levels of the existing QMS implementation, the levels of barriers that affect QMSs implementation, and the levels of company’s key performance during QMSs implementation.

The second category of analyses undertaken was the conduct of parametric test using:

- Analysis of Variance (ANOVA) was conducted to statistically test whether different profiles of organisational culture variables have different influence on the QMS variable.

The parametric test used in this study fulfilled the three main conditions 1) the scale of measurement be treated as interval scale 2) the distribution of the data is normal; and 3) the assumption of homogeneity of variance is not violated.

## 4. QMS in Indian construction industry

### A. Introduction

This chapter describes the analysis and results of the questionnaire survey which was performed, and contains the following components: (1) the investigation of the current status of quality management systems (QMSs) implementation in Indian construction companies; (2) the chapter examines in detail, the main components of the establishment of a QMS; (3) the motives which underlie the development of QMSs; (4) the implementation of ISO 9001 principles and elements, together with problems influencing effective QMS implementation; (5) company performance in terms of major achievements during the implementation of QMS. Following an analysis of the

results, the discussion section provides insights to the above, based on a comparison with existing theory as covered in the literature review. This Chapter is focused on meeting the first and second research objectives.

This chapter is divided into four main sections: Section 4.2 discusses the details of respondents and companies; Section 4.3 concentrates on the analyses and the presentation of results of current QMS implementation; Section 4.4 discusses the results of QMS implementation from the analysis; Section 4.5 presents a brief summary of the chapter.

**B. Profiles of respondents**

The respondents for the questionnaires were drawn from ISO 9001 certified construction companies and some consultancies which work for them. The companies are mainly engaged in the construction of buildings and/or civil engineering works including roads and bridges, construction of highways and irrigation systems. There were three groups representing typical construction companies – Quality Management Representatives (QMRs), Managers (MRs) and Project/Site Engineers (Ses). These groups of respondents also represented the high level (QMRs), middle level (MRs), and low level (Ses), in the Organisational structure.

A total of 43 questionnaire booklets were filled by 37 companies located across India. These Companies include L&T, AFCONS, Gammon India, NCC, Shapoorji Pallonji, SEW, Aarvee Associates, Bharathi reality etc. These were considered satisfactory for the required purposes, since the sample represents approximate number of building and civil engineering certified companies in India. Out of 43 Respondents 5 Quality Manager Representatives (QMRs), 17 Managers (e.g., Project Managers, Purchasing Managers, Logistic Managers, Maintenance Managers, Finance Managers), and 21 Project and Site Engineers. Fig. 1. summarizes the levels of respondents for specific categories.

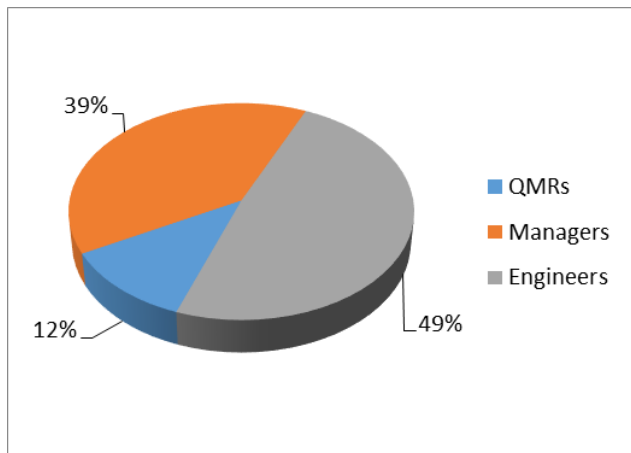


Fig. 1. Individual Respondents Levels by Percentage

Table 1 shows that about 48% of respondents in the low level group, and 68% of the respondents in the other two groups, had more than five years of professional experience in the

construction industry, making them well-qualified to respond to the questionnaires.

Table 1  
Individual Respondents Work Experience

Years with Organisation	High level (n=5)		Middle level (n=17)		Low level (n=21)	
	Total	%	Total	%	Total	%
< 5 years	1	20	6	35.29	11	52.38
5-10 years	2	40	8	47.06	8	38.1
10-15 years	-	-	2	11.77	2	9.52
15-20 years	2	40	-	-	-	-
> 20 years	-	-	1	5.88	-	-

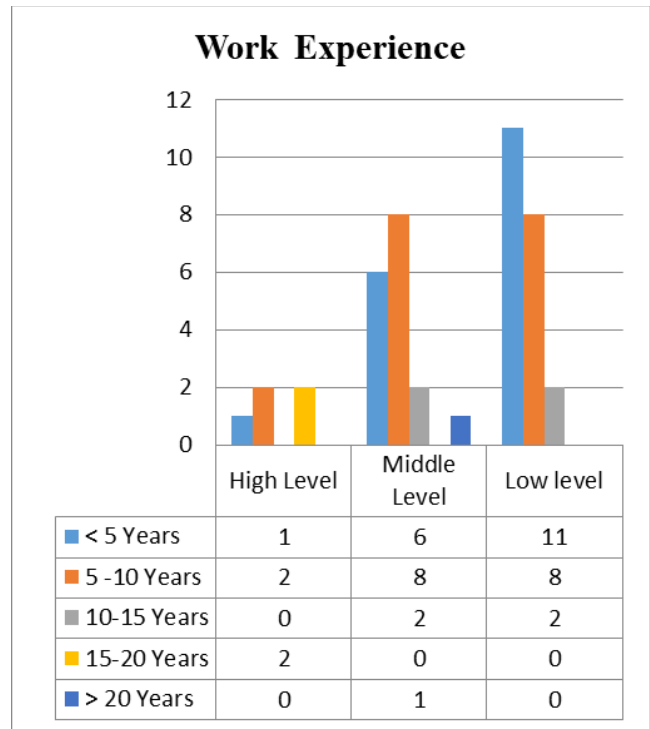


Fig. 2. Individual Respondents Work Experience

Fig. 3 shows that out of 37 companies, 21 companies (56.76%) have been involved in the construction business for over 10 years, while 9 companies (24.32%) have more than 20 years construction experience. This data clearly indicates that majority of the company respondents (81.1%) have extensive experience in the Indian construction industry.

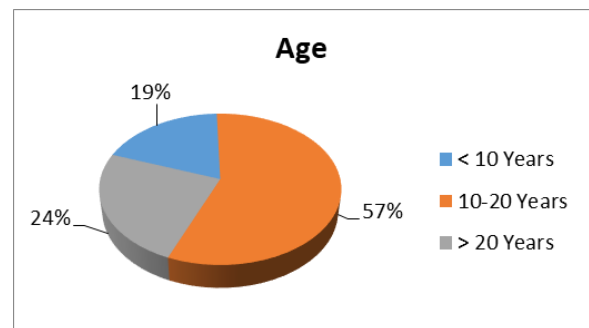


Fig. 3. Age of the Company

Table 2  
Opinions of Consultant Roles

Respondents	VH	%	H	%	FH	%	NH	%
	7	21.88	19	59.38	5	15.62	1	3.12

(Notes: NH=not helpful, FH=fairly helpful, H=helpful, VH=very helpful)

Table 3  
Level of Consultant Roles

Respondents	<25%	%	25-50%	%	51-75%	%	76-100%	%
	5	15.62	17	53.13	8	25	2	6.25

### C. Current Quality Management System Implementation

This section summarises the data obtained from the quality management systems (QMSs) survey. It outlines and analyses the perception of the construction practitioners in relation to the development and level of implementation of QMS-ISO 9001 in their companies, along with the identification of barriers affecting the effectiveness of the QMS implementation. The contractors' performances, particularly during the implementation of the QMS, are also examined.

#### 1) Development of quality management systems

This section examines experiences of the construction companies in relation to the development of quality management systems.

#### Consultant services during the ISO 9001 registration process

For a construction company to develop a QMS based on ISO 9001, is not an easy task. The process usually requires the assistance an ISO 9001 consultant to help the company set up the program of activities that would allow the company to achieve ISO 9001 certification. However, for those companies that already have a consistent internal quality system, usually only adjustments to their existing quality system or documentation is needed, to comply with the requirements of ISO 9001. Such companies are therefore not usually dependent on ISO 9001 consultant input.

As shown in Fig. 4, there were 37 contractor respondents, of which 26 (70.3%) responded "Yes" in reference to the question relating to the need to employ consultants to assists them in setting up their QMS.



Fig. 4. Use of Consultants Assistance for QMS Development

For companies that answered "Yes" to the need for consultant assistance, the respondents were further asked to give opinions regarding the consultants' role, categorising the

assistance in terms of being - (1) not helpful, (2) fairly helpful, (3) helpful, (4) very helpful. The companies were then asked to rate the involvement (role) of the consultants in relation to the establishment of the company's QMS documentation (Quality Manual, Quality Procedures, Project Quality Plan) in one of the following categories: (1) less than 25%, (2) 25 – 50%, (3) 51 – 75%, (4) 76 – 100%.

Table 2 summarises the results received from 43 respondents regarding opinions of the consultant's roles, while Table 4.3 summarises the level of the assistance provided by the consultants. The majority of the respondents (59.38%) admitted that the involvement of the consultants was helpful, while about (21.88%) respondents categorised the consultant's role was very helpful. In reference to the level of assistance by the consultants in the development of the QMS manual and procedures, most respondents categorised the consultant's assistance in the range 25-50% (17 of 32).

#### Development of quality management systems documentation

In the questionnaire survey, companies were asked about their varying approaches in developing QMS documentation. The development of QMS documentation is one of the important steps in the establishment of QMS-ISO 9001. A company with consultant assistance normally has templates of the QMS documents that the company Quality Assurance (QA) team and/or, together with the consultant, refer to in order to develop a quality manual and quality procedures. However, it is noted that sometimes the consultant may themselves prepare all the required QMS documentation. Another approach is that of the QA team being trained to develop the manual and procedures of ISO 9001 standard, in order to independently develop the QMS documentation. As the ISO 9001 standards are implemented by all company divisions, all the divisions are required to prepare drafts of the procedures of their operational processes which, in turn, are redesigned by QA team and or the consultant.

Table 4  
Approaches in Developing QMS Documentation

Development of QMS documentation	No of Respondents	%
QA team and the consultant developed the document	7	16.28
The consultant developed the document	4	9.30
QA team developed the Document	17	39.53
Every division prepared a draft of the document	15	34.88
Total	43	100

Table 4 summarises the results of the survey showing that 15 (34.88%) contractors' QMS documents were drafted by every division, while 17 (39.53%) contractors' QMS documents were developed by their QA team, and seven (16.28%) contractors required their QA team and the consultant to develop the quality documents. It is apparent from this data, that contractors' QMS documentation were mainly developed by the QA team in accordance with the requirements of ISO 9001, or alternatively, all divisions were required to make draft descriptions of their operation processes.

*Length of time for ISO 9001 certification*

As part of the examination of the development of QMS-ISO 9001, the company respondents were asked how long it took for the company to be registered after officially starting the preparations for ISO 9001 certification. The ISO9000Council.org (2009) states that the duration required for obtaining certification depends on the size of a company and the motivation of the company and its staff to get certification. Usually the fastest certification takes between three and four months following the completion of the ISO 9001 documentation; however, it can often take up to two years if a company has to write their ISO 9001 quality manual and procedures from scratch, rather than base them on a template or proven sample of the QMS documentation.

Table 5  
Length of Time for ISO 9001

Period	No. of Respondents	%
< 6 Months	18	41.86
6 – 12 Months	15	34.88
13 – 18 Months	6	13.95
19 – 24 Months	4	9.30
Total	43	100

Table 5 summarises the company responses in the survey, regarding length of time for ISO 9001 certification. Overall, 44.74% (17) of companies surveyed stated that it took the company less than six months to be registered from the start of preparations to the achievement of ISO 9001 certification; 36.84% (14) of the surveyed companies reported taking between six and 12 months; 10.53% (4) of the surveyed companies took between 13 and 18 months, while 7.89% (3) of companies took between 19 and 24 months.

**5. Summary, conclusions and recommendations**

*A. General*

This section summarizes the conclusions of the research study. First, it summarizes the significance of the major findings in relation to the research aim and objectives. It then presents the contributions of the study in terms of theory, practice, and policy. Finally, this chapter reviews the limitations of the study, and provides recommendations for further research.

*B. Summary*

The main aim of this study is to identify current problems within the systems, and examine the performance of companies

while implementing their QMSs. The results of study are important for the construction industry that wishes to enhance their end product quality and performance. It is found that there is a strong potential in applying quality management system. Indeed, this study has found that there are few construction companies have implemented this system. The main challenges for applying this system are higher initial cost and lack of understanding of the concept.

*C. Conclusions*

The aim of the study was to suggest Effective and Continuous Improvement of Construction Industries Quality Management Systems for Indian contractors and builders, suitable for integration into their own company and project quality management practices, to help them achieve better project quality delivery. This aim was achieved through the collection and analysis of data, combined with the incorporation of extant literature to address issues relating to the effectiveness and continual improvement of the implementation of quality management systems, within the context of the Indian construction Organisations. The study fills the gaps between the espoused values of ISO 9001 in ensuring the ultimate delivery of a well-operated QMS being capable of giving customer satisfaction, and presence practical evidence of the QMS within the Indian construction industrial context. The following conclusions are made from the study:

- This study provides empirical evidence in support of the notion that problematic issues associated with the implementation of QMS-ISO 9001 can have an impact on the effective implementation of the QMS, and contribute to the lower level of business performance of the ISO 9001 certified construction companies. The 'typical QMS barriers' contained in the Quality Management System Improvement Implementation are meant to raise 'the interest' of constructions companies to these barriers, which are the chief inhibitors to successful QMS-ISO 9001 implementation, as well as being barriers to companies wanting to achieve higher levels of business performance.
- Within Indian context, the study provides empirical evidence to conclude that the status of having high business performance of the ISO 9001 certified construction companies cannot be directly attributed to the possession of ISO 9001 certification. In practice, obtaining ISO 9001 certification is regarded as a matter to fulfilling tender administration requirements for domestic infrastructure projects, results in Indian contractors being confined to their 'safe zone', and they do not see any real value-adding from the possession of the certification. However, this status will no longer exist for much longer into the future, with Indian contractors facing reforms in the national construction industry and global competitiveness challenges. If the Improvement in Implementation

Quality Management System can be made to work, it suggests that the frameworks can help the ISO 9001 certified contractors in utilising the adoption of QMS-ISO 9001 in assisting them with better project quality delivery, while also making them become more competitive.

- One-Way Analysis of Variance (ANOVA) analysis in this study provided a valuable understanding of the influence of different profiles on QMS-ISO 9001 standard implementation by Indian construction companies. This empirical evidence supports the development of a Quality Management System Implementation to provide guidance for Indian construction companies to effectively and continuously implement their QMS, and enable the companies to experience benefits from their QMS implementation.

#### *D. Research contributions*

The research contributions can be viewed from three different perspectives: (i) a contribution to the body of knowledge; (2) a contribution to the construction industry; and (3) a contribution for policy.

Due to the lack of the research in this area, there is a scarcity of literature on the Competing Values and QMS-ISO 9001 implementation, in construction Organisations. For the body of knowledge, by empirically examining the Implementation of QMS for this study, the results reported contribute to and enrich the literature in this area. Specifically, past studies on QMS practices in construction Organisations, coupled with the findings of this research, have enhanced the body of literature and imparted new insights relating to our knowledge of QMS implementation, in construction Organisations context. The past and current studies have also contributed to the knowledge in the area of Indian construction's quality management system development. The findings from this study have also provided additional recommendations for more effective QMS-ISO 9001 implementation.

In addition to the contribution to the body of knowledge, this study has also demonstrated the methods for analysis of QMS practices (dependent variable). The research found that there is an increased awareness among the construction organisations and project practitioners, of the importance of pursuing quality. Generally, they accept the fact that quality is the basis for moving companies forward, both in relation to satisfying clients and in the attainment of a sustainable competitive advantage. The result potentially fit all grades in the large-scale Indian construction industry, enabling them to develop strong motives in order to successfully achieve effective quality management practices and quality deliverables in infrastructure project delivery.

In the context of the contribution to policy, the research findings will provide a future reference for facilitating consultation and communication among the construction services providers, construction companies associations and the

Government, in defining and determining policy for more widespread promotion and implementation of QMSs, in the Indian construction industry. As found in this study, with the exception of the adoption of the QMS-ISO 9001 standard to assist construction companies in measuring their performance of services and products delivery, and whether they comply with customer requirements, there is a lack of measurement tools for assessing a contractors' performance for services and projects results, as well as achievements on defined key performance indicators (KPIs) in an Indian construction context. The research will therefore provide a stepping stone for the development standards for performance measurement for Indian construction companies to assess their companies' performance outcomes against defined standards, as well as for the evaluation of their performance relative to other similar service providers.

#### *E. Limitations and recommendations for future research*

Although this study provides insights into the Quality Management System Implementation in driving to the construction industry, it has some limitations.

First, given that the measurement of the QMS within the construction companies was conducted under 'current' conditions. Future research should therefore cover the measurement of the preferred future implementation within large-scale construction companies, to meet their perceived needs relating to internal developments and the future business environment, including challenges and opportunities to be faced by the companies.

Second limitation relates to the empirical study of the implementation of the research findings in this study. Due to the time constraint relating to the process of data collection, this study was not able to explore the implementation within construction companies, which is about the performance outcomes of companies during the time of implementing. Therefore, future research could focus on sampled construction organisations, which are willing to be pilot-projects for the implementation. A Case Study could be utilised to collect data for an in-depth investigation of the QMS's implementation.

The third limitation relates to the lack of involvement of certain external respondents in the questionnaire surveys (e.g., project owners, professional associations, academics, and end-user customers). In this study, a limited number of Indian construction companies are participated, based on this small volume responses evaluating whole country is regarded as being inappropriate. Large number of respondents including the external respondents' involvement might be utilised to obtain a complete and comparative picture of the implementation of ISO 9001 by contractors, as well as company performance, from the perspective of external stakeholders.

Finally, given the fact that the participating respondents were all from India are specifically applicable to Indian construction organisations rather than countries more broadly. Different countries have different and specific national cultures, different legal guidelines, and different political and business



environments, which might influence an QMSs. However, this study might have potential value for the examination of quality management system implementation in construction organizations in other emerging and developing countries and on a wider global basis. In addition, the lessons from this study might potentially provide a good source of reference material related to construction organizations elsewhere around the world.

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