

The Requirements of Developing a Framework for Successful Adoption of Quality Management Systems in the Construction Industry

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I. INTRODUCTION

Abstract—Quality management systems (QMSs) in the construction industry are often implemented to ensure that sufficient effort is made by companies to achieve the required levels of quality for clients. Attainment of these quality levels can result in greater customer satisfaction, which is fundamental to ensure long-term competitiveness for construction companies. However, the construction sector is still lagging behind other industries in terms of its successful adoption of QMSs, due to the relative lack of acceptance of the benefits of these systems among industry stakeholders, as well as from other barriers related to implementing them. Thus, there is a critical need to undertake a detailed and comprehensive exploration of adoption of QMSs in the construction sector. This paper comprehensively investigates in the construction sector setting, the impacts of all the salient factors surrounding successful implementation of QMSs in building organizations, especially those of external factors. This study is part of an ongoing PhD project, which aims to develop a new framework that integrates both internal and external factors affecting QMS implementation. To achieve the paper aim and objectives, interviews will be conducted to define the external factors influencing the adoption of QMSs, and to obtain holistic critical success factors (CSFs) for implementing these systems. In the next stage of data collection, a questionnaire survey will be developed to investigate the prime barriers facing the adoption of QMSs, the CSFs for their implementation, and the external factors affecting the adoption of these systems. Following the survey, case studies will be undertaken to validate and explain in greater detail the real effects of these factors on QMSs adoption. Specifically, this paper evaluates the effects of the external factors in terms of their impact on implementation success within the selected case studies. Using findings drawn from analyzing the data obtained from these various approaches, specific recommendations for the successful implementation of QMSs will be presented, and an operational framework will be developed. Finally, through a focus group, the findings of the study and the new developed framework will be validated. Ultimately, this framework will be made available to the construction industry to facilitate the greater adoption and implementation of QMSs. In addition, deployment of the applicable recommendations suggested by the study will be shared with the construction industry to more effectively help construction companies to implement QMSs, and overcome the barriers experienced by businesses, thus promoting the achievement of higher levels of quality and customer satisfaction.

Keywords—Barriers, critical success factors, external factors, internal factors, quality management systems.

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QMSs have gained increasing attention within the construction industry from both researchers and practitioners. Adoption of QMS is necessary to ensure that adequate efforts have been made to attain the required level of quality for construction outputs that are both well planned and organized [1]. Moreover, implementing QMSs in construction projects also maintains the quality of executed works at the required standards as well as obtaining customer satisfaction, which may fundamentally establish longer-term competitiveness and ensure business survival for companies [2]. As a result, QMSs have been increasingly employed by construction companies as an initiative to tackle quality issues and meet the requirements of the client. The adoption of QMSs in the construction industry can provide various benefits to builders and their subcontractors. For instance, employing these systems in the construction sector has led to minimizing issues of poor communication, decreasing mistakes, minimizing rework and wastage of materials, and exercising better control of sub-contractors and suppliers [3]. However, the acceptance of QMSs in the construction industry widely differs from other industries due to the common perception of the cost of implementing these systems, as well as of other obstacles resulting from QMS implementation [4]. According to [5], some problems have been noted in the construction industry, such as fluctuating demand and variable workloads, which have led to difficulties in implementing QMSs in this sector.

An extensive review of the literature [3], [6]-[8] reveals a critical need to address all of the particular barriers affecting the adoption of QMSs in the construction industry in order to ensure successful implementation of these systems at the same high standard as in other sectors. In addition, exploring all of the CSFs for QMS deployment in the construction sector is identified as a crucial area that requires more study within the field. Specifically, as the effects of external factors are identified by the author as a clear gap in the study area, more focus is required to study impacts of these factors upon the successful implementation of QMSs in the construction sector. More importantly, whereas initiatives such as certification under the ISO 9000 standard have been made to improve the process of implementing QMSs in the construction industry, some authors posit that successful QMS implementation requires effectiveness in planning, operations and review as well as a continuity in system improvement at all levels of a company [9], [10]. However, within the construction industry,

the implementation of QMSs apparently differs from other sectors such as manufacturing [11]. This difference is due to several factors which make the construction sector unique from others. Unlike the manufacturing industry, construction projects are non-repetitive products and this hinders implementation of effective QMSs, and ISO 9000 series initiatives to the same level as demonstrated in other sectors [12]. Therefore, a comprehensive framework has yet to be fully developed in the sector to facilitate successful implementation of these systems.

The paper summarizes the data drawn from an extensive literature review conducted as the preliminary investigation for a larger PhD project. A comprehensive analysis to identify common and serious barriers facing successful employment of QMSs, CSFs (particularly the effects of external factors for effective implementation of these systems) is undertaken. As alluded to, investigating all of these factors in the construction sector is identified as a clear gap in the current research area. Within the overall research project, these factors will then be examined in some 'live' construction projects to demonstrate and explain the reasons behind the effective or ineffective implementation of QMSs in the selected case studies. Ultimately, the overall study will result in the development of a framework that integrates both internal and external factors for QMSs implementation, using both to facilitate the implementation of these systems in the construction sector, and also to tackle the barriers facing successful implementation of QMSs.

II. QMSs IN THE CONSTRUCTION INDUSTRY

During the last three decades, the concept of effective and efficient implementation of QMSs has been the primary concern for the company managers, in particular those which companies that are the leaders in the international construction market [13]. Since the early 1990s, QMSs have been implemented and adopted in the construction sector worldwide [3], [14]. However, despite this roll-out, it is clear that the construction industry still commonly encounters problems, such as decreased productivity, poor safety and health systems, poor working conditions, insufficient quality, cost and time overrun and workmanship defects [5], [15]. These problems have apparently resulted either from the deficiencies in adopted QMSs, or are due to the ineffectiveness of existing management systems within the construction industry [16]. Therefore, increasing attention from authors and researchers has led to extensive studies being conducted into the implementation of QMSs within the construction sector [15], [17]-[20]. Consequently, construction companies have been encouraged to implement QMSs for various reasons, namely, responding to client pressure, gaining and maintaining competitive advantages, enhancing the reputation of firms, reducing costs and removing previous quality problems [11], [21]. Similarly, meeting client requirements, sustaining the competitiveness of a company and managing quality problems have pushed companies to adopt QMSs [18]. Reference [3] confirms that whereas current research has been conducted to explore the role of QMSs in different sectors outside

construction, there is a real deficiency of comprehensive and relevant studies within the construction industry. This lack of studies is due to researchers focusing on the time, cost and conformance to specification outputs of projects more than focusing on the effective operation and benefits of QMSs [22], [23].

III. BARRIERS TO IMPLEMENTING QMSs

QMS in the construction industry are still considered as cost prohibitive by many construction companies, due largely to their lack of awareness about the potential importance (and benefits) of such systems [24]. This rather negative view helps to partially explain some of the obstacles preventing QMS implementation. Many previous studies have explored the barriers facing implementation of QMSs in the construction industry and whereas implementing QMSs can assist in solving some of the chronic problems that have faced the construction industry for a long time, there are still many inherent difficulties and barriers to the widespread effective adoption of these systems and realization of the benefits that they promise [14]. There have been few studies to collect, unify and integrate these obstacles together and categorize them dependent on the source of these barriers. This paper, therefore, attempts to fill this gap by collecting together a set of the most marked obstacles hindering successful adoption of QMSs and categorizing these barriers into seven prime classes as shown in Table I. These categorized headings represent a knowledge base to develop a framework for the effective implementation of QMS in the construction sector. Table I illustrates the major sources of barriers influencing successful implementation of QMSs. These barriers originate from managerial, organizational, financial, cultural, educational, or auditing sources. Furthermore, it is clear that critical obstacles hindering the effective implementation of QMSs in the construction industry have been well-identified and to a greater extent evaluated in the current literature. However, despite the previous research and the overall awareness of the impact that such obstacles have on QMS implementation generally, most studies have explored these obstacles from the context of different industries than construction, and to date there has been a dearth of similar research specifically focused on the latter sector. Due to this focus on different industries, previous studies have overlooked both the significant obstacles that may differently inhibit successful implementation of QMSs in the construction industry, and indeed any obstacles that only hinder that industry. Additionally, whereas various studies explore the influence of external factors on project success [39]-[41], most of the studies exploring the barriers relating to QMS implementation were focused on identifying those elements and factors internally generated by companies and organizations. The extant research, therefore, appears to largely neglect those significant external and/or environmental barriers, which critically hinder successful implementation of QMSs within the construction industry. The concept of "environment" represents all external factors affecting the construction process [40]. These factors can be categorized into six types:

Economic environment, social environment, political environment, and level of technology advancement [39].
environment, physical environment, industrial relation

TABLE I
CATEGORIZATION OF BARRIERS TO QMSS IMPLEMENTATION

Barriers	References	Barriers Category
1 Insufficient management support	[1], [9], [25]-[27]	Managerial
2 Procedures definition and maintenance	[14], [28]	
3 Unwell-design of reward system	[9], [29]	
4 Dissemination of QMS	[9]	
5 Assessment process of Customer requirements & satisfaction	[14], [30]	
6 Activating interaction between production departments and quality	[14]	
7 Conduct of human resources evaluation	[14]	
8 Difficult to control QMS implementation within all sites	[31]-[33]	
9 Misinterpretation for QMS requirements amongst involved staff	[28], [32], [33]	Organizational
10 More paper work	[1], [25]-[27]	
11 Documentation problem	[14], [25], [29], [30]	
12 Difficult to measure results	[1], [25]	
13 Insufficient motivation of workforce	[32], [34]	
14 Problem in controlling subcontractors	[1], [9], [25]	
15 Inadequate human resources	[1], [25], [27], [32], [33]	
16 Inefficient communication	[1], [9], [25], [29]-[31]	Communicational
17 Insufficient information	[1], [25], [26], [35]	
18 Lack of experience and knowledge	[1], [9], [16], [25]-[27], [29], [32]	
19 Required cost and time	[1], [9], [14], [25], [31], [32], [35]	Financial
20 Preferring lowest contractors' tender bids	[26], [29]	
21 Cost of certification	[27], [35]	
22 Decreased workforce productivity	[29], [31], [32]	
23 Considering QMSs as marketing tools	[34]	Cultural
24 Various cultures of workforce	[29], [31]	
25 Reluctant staff to accept quality systems	[1], [9], [25], [27], [31]-[33]	
26 Insufficient training for staff	[1], [25], [26], [29], [36]	Educational
27 Qualified employees	[26], [31]	
28 Lack of certified audits commitment	[33], [37], [38]	Auditing
29 Over-competition between audits	[37], [38]	
30 Lack of consultancy provided by audits	[37], [38]	
31 Lack of supervision system on certified audits	[37], [38]	

IV. CSFs FOR QMSS IMPLEMENTATION

In studies that have been carried out since the 1960s, most are focused on the identification of the concepts and applications, of CSFs [42] in the context of metrics for managing and measuring success in organizations. Although in the context of project management, the notions of success and failure were initially introduced by [43], the terminology "CSFs" was used for the first time by [44] to examine the existing methodology of management information systems, as mentioned by [45]. Following its introduction into the management vernacular, this terminology was subsequently utilized by other industries, including the construction sector [46]. In spite of a number of relevant studies on CSFs, there is still a lack of agreement on universal CSFs in the construction industry, mainly because of the different perceptions of stakeholders towards success factors, and also due to the various natures and ultimate objectives of projects; Thus researchers are continuing to conduct more work in the area of examining the efficacy and implications of CSFs [41], [47], [48]. The term CSF in the construction context is usually taken to mean a particular element contributing to the construction

project success; however, the determination of the precise CSFs supporting project success or failure has yet to be made clear since these factors might vary depending on the scope and purpose of studies [49]. Therefore, this variation results in lacking a holistic list of CSFs which makes the evaluation of projects success or failure difficult for both researchers and managers of these projects [49].

Whereas there are some examples of successful implementation of QMSs in construction, there is still a constant need to identify and explore the CSFs to address the issues facing the more sustainable implementation of QMSs [38]. In addition, to provide a better understanding of QMS implementation, it is vital for industry and management researchers to identify the major factors which drive effective QMS implementation [6]. Although there are extensive studies that have investigated the impact of CSFs for QMS adoption in other sectors than the construction industry, only a few studies have been conducted to explore CSFs of QMSs implementation in the construction sector, particularly at the project level [6], [8], [26], [50]. Table II illustrates the prime CSFs for QMSs implementation identified by analyzing the

extant and relevant literature.

TABLE II
CSFs FOR QMSs IMPLEMENTATION

No.	CSF	Authors
1	Top management commitment	[8], [16], [51]-[55]
2	Leadership support	[51], [52], [56]
3	Management review (feedback)	[8], [50]
4	Continuous improvement	[51], [57]-[59]
5	Attitude to change	[53], [60]
6	Quality culture	[26], [53], [61]
7	Teamwork	[6], [59], [62]-[64]
8	Communication and coordination	[55], [59], [65], [66]
9	Education and training	[16], [51], [54], [55], [67]
10	Employees empowerment	[55], [60], [68], [69]
11	Customer satisfaction	[6], [54], [55], [68], [70]
12	Use of ICT	[6], [8], [59], [71], [72]

Whereas a number of studies have been carried out to identify the CSFs of effective adoption of QMSs in the construction sector [6], [53]-[55], [58], these studies did not sufficiently pay attention to the effects of external factors that represent the prime drivers towards the successful implementation of QMSs in the construction industry.

V. RESEARCH QUESTIONS

The research questions that emerge from a critical analysis of the literature and that address the gap in knowledge identified are as:

- RQ1 What are the crucial obstacles affecting QMSs implementation in the construction sector?
- RQ2 What are the central CSFs for effective QMSs deployment in the construction industry?
- RQ3 What are the major external factors influencing the effective adoption of QMSs in the construction sector?
- RQ4 How do all of these factors affect the successful adoption of QMSs?
- RQ5 How the external factors can be categorized depending on their impacts on successful employment of QMSs?

VI. CONCEPTUAL FRAMEWORK

Based on the following, (i) a thorough analysis of the literature regarding the implementation of QMSs in the construction industry; and (ii) the identification of a significant knowledge gap regarding factors affecting the successful adoption of QMSs, there is a critical need to develop a conceptual framework of QMSs implementation in order to facilitate the successful deployment of these systems. As one of the major outcomes of this paper, this framework highlights the critical impacts of external factors on the successful implementation of QMSs in the construction sector. The conceptual framework drawn from the literature review is illustrated in Fig. 1.

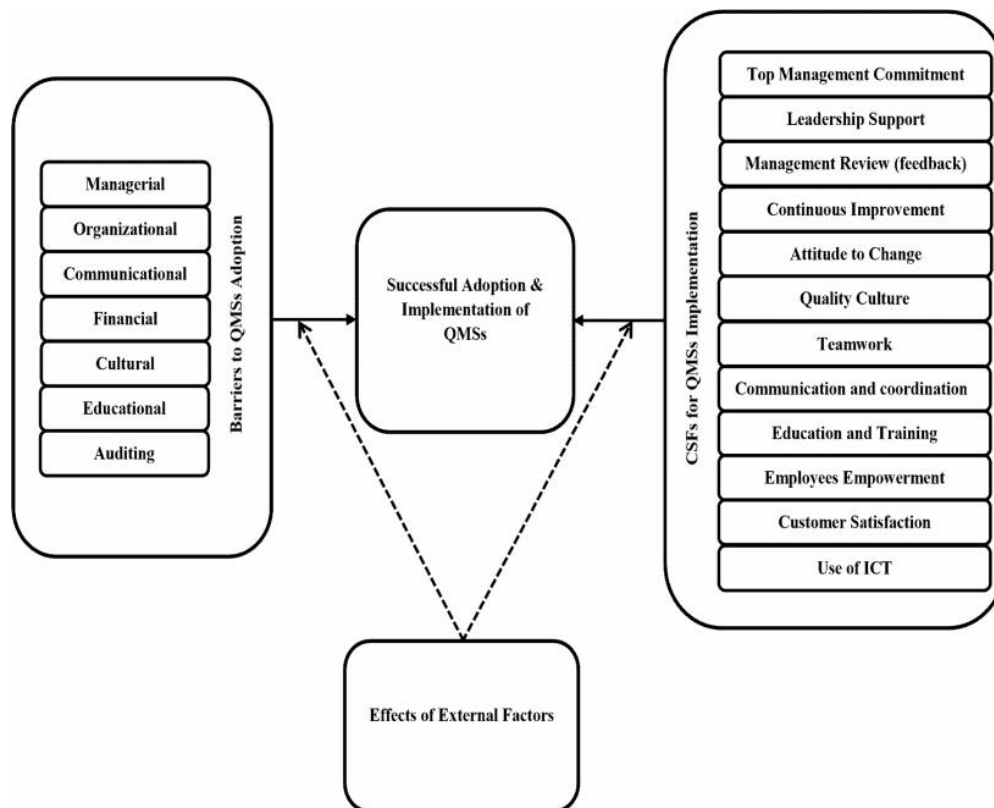


Fig. 1 A conceptual framework of QMSs implementation

VII. METHODOLOGY

The overall study will employ a mixed-methods approach, (both quantitative and qualitative data collection and analysis), to facilitate the accomplishment of the stated paper objectives. This approach includes the use of a quantitative survey, qualitative in-depth interviews and case studies to collect the required data. Finally, a focus group will be utilized to ensure the validity of the framework that is ultimately developed from this paper. These various data collection stages and methodologies are described below.

A. In-Depth Interview

Interviews will initially be employed to collect the required data related to external factors and CSFs for QMSs adoption in the construction industry. The selection of the interview methodology is affected by the nature of the objectives and the study questions. Therefore, this study will employ semi-structured, face-to-face, in-depth interviews to obtain specific and focused knowledge of the research phenomena. The interview schedule will include open-ended questions to provide respondents with the freedom to discuss and express their perspectives and enable the researcher to obtain feedback from interviewees.

The interview questions will be formulated to define the external factors affecting successful adoption of QMSs in the construction sector. Next, questions will be constructed to identify a comprehensive list of CSFs for QMS implementation, since CSFs identified from the literature review might not be holistic enough to be investigated later using the questionnaire survey. The estimated time of each interview is approximately one hour, which should provide individuals with adequate time to express their opinions about specific issues. All respondents will be asked to give their permission to record the interviews, with the researcher simultaneously recording their answers by note-taking, which might be used later if any problems occur in recorded interviews. The interviews will be undertaken with the same population which will be later used as the target pilot sample for the questionnaire survey. Moreover, the results obtained from analyzing the data of interviews will be used to design a questionnaire survey.

B. Questionnaire Survey

A survey will be employed to quantify the factors affecting the effective implementation of QMSs in the construction industry. Using this methodology will facilitate answering the first three questions of the paper; *RQ1*, *RQ2*, *RQ3*. The primary reason for utilizing this methodology is to help the researcher to investigate impediments to the effective implementation of QMSs in the construction sector by reaching a wide range of participants within Australian construction companies. The survey methodology will also be used to explore the CSFs for implementing QMSs effectively in the construction industry. Finally, the questionnaire will also assist to investigate the external factors influencing the adoption of QMSs within the sector.

The questionnaire will be constructed to collect data

regarding four main aspects explained in the sections below. Furthermore, the formulation of the questions will be based mainly upon the results gathered from the interviews, especially the questions regarding CSFs and external factors.

Section 1: Personal and company Demographics

This section is developed to collect personal and background information about participants, such as age, level of qualifications, years of experience, position within their company, and role within their company. This section will also involve some questions regarding the main features of the participating company, including the size of the firm, company revenue, company location, and type of works conducted.

Section 2: Barrier to QMSs Implementation

This section consists of items exploring the major barriers impeding successful implementation of QMSs in the construction industry. The items in this section will be based on the barriers previously identified in the literature review. The responses to questions are selected from a five-point Likert scale. According to [73], this is the most common scale for obtaining opinions from respondents by determining their agreement or disagreement with a statement. The respondents will be asked to indicate their levels of agreement or disagreement regarding the obstacles to successful implementation of QMSs by selecting one of five statements, ranging from strongly agree to strongly disagree.

Section 3: CSFs for QMSs Implementation

This section includes the survey questions related to investigating the CSFs for the successful adoption of QMSs. The items will be based on the CSFs identified from the literature review, and the CSFs resulting from analyzing the data from interviews conducted prior to the questionnaire survey. A five-point Likert scale will also be used to construct the questions in this section.

Section 4: External Factors Affecting QMSs Implementation

The final section of the questionnaire survey is designed to explore the external factors affecting successful adoption of QMSs in the construction industry. The purpose of this section is to emphasize the impact of environmental factors defined previously during the interviews. After listing and grouping external elements identified by the interviews, the questions of this section will also be constructed using a five-point Likert scale.

The expected outcomes of the survey will help to identify, the obstacles impeding the effective implementation of QMSs in the construction industry, the CSFs for successful implementation of QMSs and, finally, the environmental factors influencing effective employment of QMSs in the construction sector.

The population of the questionnaire survey consists of the main three tiers of Australian construction companies, namely, tier 1, tier 2, and tier 3 [74]. Although the companies involved in tier 3 represent more than 98% of all Australian

construction companies [74], the questionnaire population will involve all tiers to gather a more holistic knowledge regarding QMS implementation in different sizes and levels of complexity of organizations. The selection of companies to participate in the main questionnaire will be undertaken on the basis of their official number of employees. Table III illustrates the classification of the Australian construction companies. The anticipated sample targeted to participate in this study comprises approximately 250 Australian construction contractors, with several participants within each company being expected to participate in the questionnaire survey. These participants will be representative of different managerial levels, such as project manager, construction manager, quality manager and site manager, to obtain a comprehensive overview of factors affecting QMSs implementation.

TABLE III
CLASSIFICATION OF AUSTRALIAN CONSTRUCTION COMPANIES ABS 2014 (AS CITED IN [74])

Tier Level	Number of Employees	Number of Companies	Percentage of Companies (%)
Tier One	200+	197	0.1
Tier two	20-199	4698	1.3
Tier three	1-19	333349	98.6
Total	-	338226	100.0

C. Case Study

Three types of construction contractors will be chosen as case studies to collect the data required to answer *RQ4* and *RQ5* of the study. The nature of each case study company will be as:

- a contractor who has adopted an ISO 9000 type QMS,
- a contractor using a non-ISO 9000-based QMS, and
- a middle-placed contractor who is already applying some tools of quality that indicate an early move towards an official QMS.

These case studies, therefore, will explore how the internal and external factors impact a real-life setting, and explain the significance of these factors for QMS implementation, especially the effects of external factors.

In the case studies, the significant consideration is how the required data will be gathered. This research will employ hybrid methods to collect required data within the case studies, namely, interviews and direct observations. Firstly, within each case study, in-depth interviews will be undertaken with managers from different levels, such as project managers and quality managers. The interview questions will be constructed, using open-ended questions, prior to conducting interviews. Secondly, direct observations will also be used in a case study approach to provide the researcher with an opportunity to observe and record what is seen and heard. This method will enhance the overall understanding of the case study issues, since observational evidence is useful to gain additional knowledge about the topic being studied [75]. Furthermore, the protocol of the case study will be developed prior to conducting the case studies. The protocol consists of the instruments and procedures to be followed when

undertaking case studies. Therefore, this protocol will guide the researcher during the data collection process. The case study protocol consists of four sections, explained below:

- Section 1: Case study introduction: This section of the protocol concerns the prime questions of the case study and the role of the protocol in guiding the researcher.
- Section 2: Procedures for data collection: This section includes the names of sites to be visited and the individuals to be contacted, as well as the plan for data collection — for example, the type of evidence to be collected, the roles of interviewees, the event to be observed, and finally the preparation required before visiting the sites, including determining specific information and problems to be interviewed and covered.
- Section 3: Report outline for case study: This section will consist of a list of individuals interviewed and the main observations recorded.
- Section 4: Data analysis: This section will explain the main findings and results of the case studies by analyzing the collected data using multiple techniques, explained later.

It is anticipated that the case studies will explain the effects of all internal and external factors identified by previous methodologies, upon the successful implementation of QMSs in the construction industry. It will also facilitate the categorization of external factors as drivers or obstacles, depending on their impacts on QMS implementation within the construction industry.

VIII. DATA ANALYSIS

The focus of this stage will be primarily to transform the results of the interviews, questionnaire and case studies into beneficial and reliable outcomes as well as to ensure that these collected data fulfil the research objectives and questions.

The statistical analysis of the collected quantitative data will be undertaken primarily using appropriate statistical analysis software, namely, the Statistical Package for Social Sciences (SPSS) version 22 [76]. In addition, descriptive statistics, especially central tendency measurement (mean and median), and variation measurement (standard deviation), will be utilized to analyses the questionnaire responses to understand the data collected. The purpose of using these statistical methods is to profile the research respondents in terms of their age, qualifications, years of experience, the type of projects they are involved in, and their position within the company. Moreover, the variability of the data collected will be measured. A parametric analysis of variance (ANOVA) test will be used to describe the causes of variation in the collected data. Furthermore, to enhance the value of the research, qualitative analysis will also be applied to analyses the data collected from interviews and case studies. Qualitative data analysis software, QSR NVivo (QSR International Pty Ltd.) version 11, released in 2015 [77], will be used to analyze data collected from interviews and case studies. Multiple analytic techniques will also be used to analyze the data collected from the case studies. These techniques are: (a) pattern matching techniques, considered to be one of the most desirable

analytical techniques for case studies; and (b) cross-case synthesis, which is particularly suited to analyzing the results of multiple case studies [75]. This qualitative analysis will enable the researcher to summarize the collected data under the perceived headings and meanings to clarify the real effects of the key factors influencing QMS implementation in the construction industry.

IX. CONCLUSION

As stated, implementing QMSs is fundamental to confirm that adequate efforts have been made to achieve the required level of quality that is well planned and organized. In this paper, the focus is on identifying the requirements for developing a comprehensive framework for QMS implementation in the construction industry based on a comprehensive literature review. To date, the focus of most authors and industry practitioners has been on overcoming the barriers generated from sources inside organizations, without considering the impact of external factors. However, this paper identifies and extracts the obstacles hindering the successful implementation of QMSs in the construction industry which are generated either prior to adopting these systems, or during QMS implementation. These identified obstacles have been placed into seven key categories: managerial, organizational, communicational, financial, cultural, educational, and auditing. In addition to developing this set of categorizations, the paper also describes the proposed research methodologies to be applied for gathering data and analyzing the same to further develop and validate this framework for use in the construction industry for better application, implementation and more effective operation of QMSs. These methodologies of data collection include semi-structured interviews, a survey, and case studies, to develop a more detailed list of current barriers by taking into consideration the effects of external factors, and to establish their inter-relationships and impacts impeding successful QMS implementation. CSFs for more effective deployment of these systems will be identified by considering, in particular, the effects of external factors. 'External Factors', in this study, refer to those found in the construction industry environment that are largely generated by external sources which, unlike internal factors, might not directly be responsible for organizational impacts, such as economic, social, political, cultural, and industrial relations sources. The final set of all the extant and identified factors (internal and external) will be utilized and modelled to develop a framework for effective QMS implementation in the construction industry. Finally, the focus group approach will be deployed to examine the validity of the newly developed framework and the findings of the study.

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