# AN EXPLORATION OF FACTORS INFLUENCING QUALITY MANAGEMENT SYSTEM (QMS) IMPLEMENTATION: THE CASE OF THE AUSTRALIAN CONSTRUCTION INDUSTRY


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# Keywords

Quality management system (QMS), implementation barriers, external factors, internal factors, critical success factors, construction industry.

# Abstract

When applied in the construction industry, a quality management system (QMS) should be implemented to ensure sufficient effort is made to achieve the required levels of quality in constructed projects. Attainment of these quality levels results in customer satisfaction, which is fundamental to ensuring long-term competitiveness for construction companies. However, the construction sector still lags behind other sectors in relation to its successful adoption of QMSs, due to a relative lack of acceptance of, or interest in, these systems among industry stakeholders, as well as other barriers that impede their implementation.

For this research, an integrative review of the literature was performed to identify the barriers impeding successful implementation of QMSs in the construction industry, as well as investigating the critical success factors (CSFs) necessary for a more effective adoption of such systems. To date, although many studies regarding these factors have been undertaken in the construction industry context, no key research so far, has comprehensively investigated the impacts of all factors surrounding successful implementation of a QMS in the construction industry building sector (CIBS), especially on the impact of external factors. Also, no specific research has exclusively been carried out to explore the impact of CSFs, particularly when applied at project level.

Therefore, this research primarily aims to investigate an inclusive list of factors impacting on QMS deployment in the CIBS by focusing exclusively on the external factors and the CSFs of project level in order to develop a comprehensive framework of QMS deployment. To fulfil the aim and objectives of this research, the study proposed a conceptual framework encompassing those factors identified by literature review analysis, and that indicated the main gaps in the knowledge revealed in this study. This conceptual framework was used to guide the research examination throughout the data collection and analysis stages. This research has adopted a combination of qualitative investigation, data collection and analysis methodologies. This exploratory research was approached by collecting data through interviews and case-studies representing Tier 1 and 2 AustralianCIBS projects.

In Phase 1 of the research, an exploratory study was undertaken to fulfil first and second objectives of the study through investigating the level of QMS deployment in selected building organisations in South East Queensland in Australia, in order to gain an initial understanding of which external factors critically impact the implementation of QMSs in the CIBS. The study also assisted in providing a comprehensive overview of the CSFs necessary for QMS deployment, especially those that influence the project level. In the next stage of data collection performed to achieve third and fourth objectives of the research, three case-studies were conducted to investigate the level of QMS implementation in the context of these case projects. The examination of the studied cases helped in explaining the multifaceted issues encountered during the adoption of a robust QMS in the CIBS.

A number of qualitative-based techniques were used to analyse the collected data. These techniques involved using QSR International NVivo 11 software, pattern-matching, explanation-building as well as numerical counts logic. NVivo 11 software was used to support management of the research activities within and across the different phases of the research. In addition, a pattern-matching technique was followed throughout the processes of both within-case and cross-case analyses to compare the propositions developed during the exploratory study analysis with the case studies data, to either confirm or refute these propositions. An explanation-building was performed to extend case study ideas for further research through following a series of iterations commenced by creating initial propositions, and then comparing the findings of the initial case against these propositions prior to revising such propositions and comparing them again with the findings of other cases. Finally, numerical counts logic was utilised to rate the utility of each case, constructing a matrix of queries that generated theme-based assertions from all cases, ultimately developing tentative assertions derived from a comparative analysis of the findings of case studies.

The exploratory case study interviews emphasised the impact of external factors on the effective deployment of QMS in the CIBS. The study revealed that the implementation of QMS is affected by twelve external factors. The exploratory study also disclosed those CSFs that directly influence the adoption of a QMS that specifically impact at the construction project level. A sum of ten CSFs was identified by carefully analysing the data of the exploratory study.

The within-case and cross-case analyses explained the impact of these factors, the external factors, and the CSFs on the level of QMS implementation necessary in building projects. Assertions emerging from the results of the cross-case analysis were compared with the current literature to develop new insights about how the factors surrounding a QMS impacted on the outcomes of implementing such a system. This has been achieved by categorising the overall factors influencing the deployment of a QMS, based upon their impact and, ranking them in descending order, according to their significance on QMS deployment. This analysis led to the categorisation and of the external factors into drivers and barriers based upon their respective impacts on QMS adoption and implementation and ranking them in descending order. Most of these factors proved to be barriers, whilst two factors were confirmed to be drivers for the adoption of a robust QMS. The CSFs were also grouped into three categories, which grouped together those factors more likely to result in more robust outcomes from QMS deployment. These groups include CSFs at both the organisational and project levels, and CSFs also at both levels. Also, the cross-case analysis led to the ranking of all of these factors according to the significance of their respective impacts on QMS implementation.

The main contribution of this research is that a new categorisation of factors is vital for construction companies, in order to develop more precise requirements for QMS implementation and to establish a practical strategy to better facilitate project teams to manage the impacts of these factors. Further, the determination of the ranked CSFs applicable for each level of building organisation is fundamental to implementing a robust QMS, as well as tackling many of the inherent issues applicable in QMS deployment.

The overall insights and findings of this research assisted in establishing the fully developed framework for robust QMS adoption. The developed framework represents a comprehensive set of guidelines for the management teams of building organisations to address and maximise the distinct relationships between the effective deployment of QMS and the factors surrounding that implementation. The framework of QMS deployment potentially contributes to the improvement of QMS implementation in the CIBS, which can eventually facilitate delivery of higher quality outcomes. The development of this framework is expected to bring some significant benefits to the Australian construction industry building projects, with respect to qualifying project teams, assuring provision of essential resources for QMS adoption, and improving the overall perception amongst construction industry stakeholders of QMS significance.

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# List of Abbreviations

| | |
|---|---|
| **CIBS** | Construction Industry Building Sector |
| **CSF** | Critical Success Factors |
| **QMS** | Quality Management System |
| **QA** | Quality Assurance |
| **QC** | Quality Control |
| **QI** | Quality Inspection |
| **TQM** | Total Quality Management |

# Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: ____________________

Date: 26/05/2020

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# Chapter 1: Introduction

This chapter outlines the background of quality management system (QMS) implementation in the construction industry and presents the context of the current study and the main purposes for conducting this research. The chapter then explains the significance and scope of this research and provides definitions of terms used. Finally, an outline of the remaining chapters of the thesis is presented.

## 1.1 BACKGROUND AND RESEARCH CONTEXT

The construction sector is considered globally to be one of the most important contributors to Gross Domestic Product (GDP). It plays a significant role in determining the growth of most countries. In Australia, statistics indicate that the construction sector steadily and significantly contributes to the national economy (Chan, 2013). According to the Australian Bureau of Statistics, ABS (2017), in 2016, the construction industry was the third-largest GDP contributor, with the largest increase in sector gross value added as a share of GDP between 2000-2001 and 2015-2016. This sector enhances the Australian national economy, contributing in 2015 7.8% of GDP and 9% of the Australian workforce as the third largest employing industry (Industry, 2015; Zuo, Zillante, Xia, Chan, & Zhao, 2015). The Australian construction industry contribution to the workforce market also increased in 2018 by 3% in employment rates within the industry (Cartwright, 2018). Therefore, the construction industry essentially underpins socio-economic development, as it represents the delivery vehicle for fundamental physical infrastructure, such as railways, roads, ports, sewage treatment, water supply, schools, and hospitals (Hawkins & McKittrick, 2012). However, the industry in recent times has begun facing increasing economic stress as public expenditure decreases and the resource demands from emerging economies for commodities, such as traditional buildings (non-sustainable commercial buildings) drops (Zuo, et al., 2015). That has led to shrinking the Australia construction market and increasing the level of competition (ibid, 2015).

Much of the quality management literature and research has emphasised the significance of quality attainment as a key factor of project success in the construction sector in recent years, due to crucial shifts within the focus of this industry such as an increased perception of the significance of customer satisfaction (Dharani & Ganapathy Ramasamy, 2015). Consequently, theories emanating from the examination of quality management, quality control, and delivery to specifications, have been the primary focus of researchers not only within the construction industry, but also across other diverse businesses and industries due to them being recognised as the drivers to attaining continuous improvement and client satisfaction (Coffey, 2011). However, achievement of acceptable levels of quality within the construction sector has long been an issue since the industry annually wastes a considerable amount of time, money, and resources, both in terms of people and materials (Arditi & Gunaydin, 1997). This problem is due to the lack of existing quality management procedures, or the efficient implementation of these systems (ibid, 1997). Consequently, mismanagement of quality can result in inappropriate, defective, and unsafe infrastructure, which not only increases post-construction maintenance costs, but also leads to civil and criminal liability for damage and defects (Hawkins & McKittrick, 2012). For example, in 2001, two significant earthquakes in El Salvador destroyed more than 165,000 homes, and about 110,000 were severely damaged. In the most impacted regions, up to 85% of these houses were completely destroyed. Two major causes led to this level of destruction, the quality of building materials used, and the quality of buildings constructed and their subsequent maintenance (Benson & Twigg, 2007).

As a result of such examples and findings, quality management systems (QMSs) have gained increasing attention within the construction industry context from both professionals and researchers. A QMS is described as a management strategy that encompasses managing structure, responsibilities, processes, procedures, and management resources performed to implement the principles and action lines required to fulfil the objectives of organisation concerning quality expectations (Kiew, Ismail, & Yusof, 2016). Adopting a QMS is necessary to ensure that adequate efforts have been made to attain the required level of quality that is well planned and organised (Tan & Abdul Rahman, 2011). Thus, conventionally, QMSs have been related to the manufacturing sector where different QMS management and production strategies were adopted to direct and control the manufacturing process in order to assure end-product quality. Amongst these acknowledged QMSs, are Malcolm Baldrige National

Quality Award criteria, the ISO 9000 series of quality standards, Total Quality Management (TQM), Six Sigma and Lean Production, which have been successfully adopted worldwide amongst different sectors, especially the manufacturing industry (Kiew, et al., 2016; Rogala, 2016).

Therefore, the successful implementation of QMSs in various industries has also induced the construction industry to adopt and integrate QMSs for more than two decades, especially using the ISO 9000 series of Quality Systems Standards (Juanzon, 2017; Pheng L. & Omar F., 1997; Poksinska, 2010). Tan and Abdul-Rahman (2005) emphasise that implementing a QMS in construction projects maintains the quality of executed works at the required standards, as well as obtaining customer satisfaction, which may fundamentally bring long-term competitiveness for companies. As a result, individual construction companies have increasingly employed a QMS as an initiative to tackle quality issues and meet the requirements of the client (Ilango & Shankar, 2017). Certainly, employing these systems in the construction sector has led to minimising issues of poor communication, decreasing mistakes, lessening rework and wastage of materials, and exercising better control of sub-contractors and suppliers (Leong, Zakuan, & Saman, 2014). Nonetheless, the acceptance of QMSs among construction industry stakeholders differs widely from that in other industries, due to the common negative perception that exists in the CIBS towards the relatively high cost of implementing these systems, and other obstacles that can result from QMSs implementation (Samsudin, Ayop, Sahab, & Ismail, 2012b; Shio, 2016). Harrington, Voehl, and Wiggin (2012) also assert that some problems in the construction industry, such as fluctuating demand and variable workloads, have also led to difficulties in implementing a QMS in this sector.

An extensive review of the extant literature (Abdullah, Asmoni, Mohammed, Mei, & Ting, 2015; Chin & Choi, 2003; Femi, 2015; Leong, Zakuan, & Saman, 2014) discloses a critical need for addressing more comprehensively those particular barriers affecting the adoption of a QMS in the construction industry. In addition, exploring the critical success factors (CSFs) for QMS employment in the construction sector has been identified as a crucial area that requires more study within the field owing to the dearth of related research, especially research that was focused specifically at the project level (Abdullah, et al., 2015; Leong, Zakuan, & Saman, 2014; Psomas, Fotopoulos, & Kafetzopoulos, 2010). Notwithstanding this, investigation of the impact of external factors on the successful implementation of QMS in this industry has been clearly identified as a gap in the extant knowledge and research study areas. More importantly, whereas a number of initiatives have to date been made to improve some areas of the processes around implementing QMSs in the construction industry, a more detailed comprehensive framework integrating all the factors that impact a QMS deployment has yet to be fully developed in the sector to facilitate successful implementation of these systems (Abdullah, et al., 2015; Femi, 2015; Leong, Zakuan, & Saman, 2014).

The purpose of this study has been to undertake a detailed and comprehensive investigation of QMS implementation in the CIBS in order to identify an inclusive list of factors influencing a robust deployment of QMS in the CIBS. This research identified the prime obstacles inhibiting the effective adoption of a QMS, the CSFs for QMS implementation, and the external factors influencing the deployment of such a system in the sector. These elements were then examined in some 'live' case-study building projects, in order to demonstrate and explain the reasons behind effective, or ineffective implementation of QMSs in the projects of building organisations. Ultimately, this research has led to developing a new inclusive framework that integrates both internal and external factors that impact a QMS implementation after ranking them according to the relative importance of their effects as well as grouping them in different classes based upon the impact of each factor. This framework will be used to facilitate the implementation of these systems in the construction sector, and also to tackle the barriers facing successful implementation of any QMS.

## 1.2 RESEARCH PROBLEM AND RATIONALE

A significant amount of research has investigated the role of QMSs in different sectors, and some studies have explored the impact and advantages of implementing QMSs in the construction industry (Abdul-Aziz, 2002; Aichouni, Messaoudene, Al-Ghonamy, & Touahmia, 2014; Ilango & Shankar, 2017; Samsudin, et al., 2012b; Shio, 2016; To, Lee, & Yu, 2012). However, only a limited number of studies have exclusively examined the role of these systems in the context of the CIBS, since researchers more often explore the quality and its relationship with the cost of projects rather than the roles of the QMS (Kam & Tang, 1997; Leong, Zakuan, & Saman, 2014). Additionally, a number of studies have investigated the barriers that hinder the effective adoption of a QMS in the construction industry (Aggelogiannopoulos, Drosinos, & Athanasopoulos, 2007; Keng & Kamil, 2016; Rashed & Othman, 2015; Rogala, 2016; Tan & Abdul Rahman, 2011). Despite this, most researchers have only investigated these barriers based purely upon the results of previous studies and, therefore, might have overlooked other significant obstacles, such as external obstacles that may inhibit successful implementation of a QMS in the construction industry.

Furthermore, preceding research has focused on investigating the effect of internal factors that were either generated by the companies being studied, or that were associated with the various hierarchical systems of these organisations. On the one hand, a number of variables affecting project success in the construction sector have been studied including external factors (Akinsola, Potts, Ndekugri, & Harris, 1997; Chan, Chan, & Scott, 2004). However, most studies have investigated either the barriers to QMS adoption, or the CSFs for effective implementation of QMSs, but have not paid attention to the impact of external factors surrounding the projects of building organisations, such as governments, unions, suppliers, and so on. Preceding studies generally addressed different impacts of these factors on delivering a construction project successfully. Owing to the limitations of the focus of this previous research and due to the permanent issues continuing to face the construction industry in deploying QMSs successfully, there is an urgent and critical need to fully explore a more detailed and comprehensive list of all obstacles that impede theCIBS, in particular, the impact of external barriers.

In this research it was revealed from the extant literature that previous papers mainly identified CSFs of QMS implementation regardless of the sector (Kim, Kumar, & Kumar, 2011). This means that some CSFs may not specifically be applicable to, or suitable for, the construction industry. Also, only a limited number of studies investigating the CSFs of QMS implementation have been conducted in the construction industry, especially those focused on the CSFs at a project level (Abdullah, et al., 2015; Almeida, Muniz, & Antionio, 2014; Juanzon, 2017). Consequently, there is a further critical need to identify a holistic list of the CSFs for QMS deployment, by focusing not only at the organisation level, but also at a project level, of building organisations. Investigation needs to be immersed in the context of building organisations, since the focus of previous research was limited broadly on examining the projects of the construction industry. The identified gap also highlights the significance of, and need for, development of a comprehensive framework for

QMS implementation that integrates those various influential factors, both for facilitating the adoption of these systems in the construction industry, and also for overcoming the experienced obstacles.

## 1.3 RESEARCH AIM AND OBJECTIVES

The research primarily aims to develop a comprehensive integrated framework for QMS implementation in the CIBS. This framework subsequently, seeks to contribute to facilitating higher quality outcomes for building projects by promoting the implementation of more rigorous QMSs on these projects.

The principal objectives of this research are:

- To identify the external factors that impact on the implementation of a QMS in the CIBS.
- To explore the CSFs for effective adoption of a QMS in the CIBS.
- To explain the impact of the identified external factors and the CSFs on the successful implementation of a QMS in real-world building projects of the CIBS.
- To categorise the external factors depending on their influences on implementation of a QMS in real-world building projects of the CIBS.

In order to fulfil the objectives of the study, four critical questions are required to be answered, as follows:

RQ1. What are the main external factors influencing the effective adoption of a QMS in the CIBS?

RQ2. What are the crucial CSFs necessary for an effective QMS implementation in the CIBS?

RQ3. How do the external factors and the CSFs affect the successful adoption of a QMS in real-world building projects of the CIBS?

RQ4. How can the external factors be categorised based upon their impacts on the effective deployment of a QMS in real-world building projects of the CIBS?

## 1.4 RESEARCH CONTRIBUTION AND SCOPE

The literature review reveals that previous and extant research has not paid adequate attention to exclusively exploring factors affecting the adoption of a QMS in the CIBS. This study provides a comprehensive list of root causes of QMS implementation issues, indicating the impacts of the factors confronting the successful deployment of a system, especially. Further, research into addressing an inclusive list of CSFs for QMS adoption helps in highlighting the essential future focus for building organisations to facilitate implementation of more robust QMSs in building projects, thus assisting in overcoming the issues of implementation being experienced historically and currently.

This research also seeks to identify the external factors affecting QMS deployment and to explain their practical impact by examining them within the context of real-world building projects. The outcomes of this study are, therefore, fundamental to acquiring a better understanding of how QMSs can be more effectively deployed inCIBS projects and how adopting the CSFs identified also can improve the level of QMS implementation. This overall understanding is exemplified by the development of a comprehensive integrated framework for facilitating more rigorous QMS adoption that addresses the different factors impacting on the deployment of QMSs. This framework incorporates and integrates the various viewpoints gathered from the data collection and subsequently examined by comparing these views with the extant literature, in order to maximise the effectiveness and validity of the framework. The proposed framework provides guidance for construction managers and project teams and the critical information and strategic direction needed to more effectively implement QMSs in building projects, to eventually achieve greater customer satisfaction, through fully meeting the expectations of clients regarding quality.

In addition, the research provides a comprehensive understanding and deeper insights to add to the existing body of knowledge concerning the implementation of QMSs, in the context of construction project management. The resulting outputs of this research will significantly contribute to enriching the extant literature by providing a current and comprehensive perspective of the barriers hindering the effective adoption of a QMS and fostering a better and more comprehensive understanding of the CSFs for successful adoption of a QMS in the CIBS.

## 1.5 THESIS OUTLINE

The thesis is divided into nine chapters, which encompass sequential tasks required to fulfil the study aims and objectives and answer the research questions. The outline of these chapters is listed below in conjunction with a brief description of the content of each chapter.

**Chapter 1 (Introduction):** This chapter presents an introduction to the background and the justification of the research and indicates the prime aim and objectives of the study along with research questions developed to attain these objectives. Then, the significance and contribution of the research are elucidated.

**Chapters 2 and 3 (Literature Review):** These chapters contain an integrative literature review that discusses the extant literature associated with the research topic area. Chapter 2 provides explanations of the concepts of quality and quality management, concentrating substantially on examining QMS adoption in different sectors and presenting the inherent benefits of implementing a QMS. This chapter also critically analyses previous studies on QMS implementation and addresses the main issues encountered during the adoption of such systems across different sectors. However, to identify the research gap and problem, Chapter 3 more specifically determines the main factors impacting the deployment of QMSs in the CIBS. The chapter also contextualises and identifies the barriers that impede the successful adoption of QMSs and addresses those CSFs for QMS implementation that were of high significance when determining the knowledge gaps of the study where the lack of consideration of the impact of external factors was highlighted, and the need for identifying a holistic list of CSFs was emphasised. This focus resulted in a refinement of the scope of the study and development of the conceptual framework that was further examined throughout the succeeding stages of research.

**Chapter 4 (Methodology):** This chapter begins with a description of the philosophical position of this research. This chapter also elucidates the study approach and adopted methodologies applied to collect the required data and the justification supporting the employment of these approaches. It then explicitly describes the association between the research questions and data collection methods and rationalises the need to employ specific data analysis techniques to accomplish the objectives of the study.

**Chapter 5 (Data Analysis – Exploratory):** This chapter presents the results of the exploratory study interviews. It provides responses that help to answer the first and second research questions regarding what are the main external factors that impact QMS implementation and what are the crucial CSFs for facilitating a more effective QMS implementation in the building industry construction sector. This chapter also explains the processes involved in the exploratory study describing the sample selection, the interviews, and the data analysis.

**Chapter 6 & 7 (Data analysis – Case studies):** This chapter describes the analysed data results answering the third and fourth research questions. It was performed in two main stages, (a) a within-case analysis, and, (b) a cross case analysis. Chapter 6 reports on the main findings of the within-case analysis. It also provides a brief description about the selected case-study profiles, the case selection approach, and the demographics and background of the interviewed respondents. This chapter mainly aims to enhance the background details of each individual case prior to conducting the cross-case analysis in the next chapter. Chapter 7 presents the results of the cross-case analysis by performing comparative analysis across the findings of each case study and comparing them. The comparison is undertaken to identify the main similarities and differences between the findings of cases in order to develop a robust and plausible conclusion to the research.

**Chapter 8 (Discussion):** This chapter provides a general response to the research questions by discussing the main findings of the research. The chapter also discuss the implications of the study findings by comparing the derived concepts emergent from the literature analysis conducted in Chapters 2 and 3, with the results gained from Chapters 5, 6 and 7.

**Chapter 9 (Conclusion):** This final chapter outlines a summary of the main findings of this research and presents the overall conclusion of the study. The chapter presents the developed framework of QMS implementation in the CIBS. It also explains the significant contribution of the study, considers how this research could inform future research, and makes recommendations for QMSs and the CIBS.

# Chapter 2: An Overview of Quality and QMS

This chapter provides an overview of the literature reviewed for this research, exploring the current extant perspectives and knowledge on the major concepts of quality, and it analyses the current levels at which quality management systems (QMSs) are utilised to improve project outcomes. It also clarifies the multiple, and sometimes conflicting, current terminologies in use and their implementation. In this respect, key themes of quality management (QM) are elucidated and the evolution of the different approaches of QM is demonstrated in conjunction with explaining the purposes of using each of these QM methods. Finally, this chapter presents an overview of ISO 9000 QMS by focusing specifically upon the motivations for adopting ISO 9001 standards.

## 2.1 QUALITY CONCEPTS

Throughout history, quality issues (although not always specifically identified as such) have gained considerable importance as civilisations have emerged, and as greater skills in major construction were obtained (Rumane, 2011). For example, between 2589-2566BC, the pyramids were constructed in Egypt, and in Mesopotamia, the King of Babylon, Hammurabi 1792-1750BC, legislated laws that stipulated that maintaining the quality of buildings was the responsibility of builders who faced the death penalty if their buildings subsequently collapsed, causing death to others (ibid, 2011). Earlier in the 20th century, quality practices and processes were developed due to the emergence of new technologies, which required the accurate preparation of complex designs as well as effective execution of them. Immediately after World War II, the notions and techniques of contemporary quality were established in Japan, based on learning drawn from the United States (Juran & De Feo, 2010).

As a result of these and other developments in the industrial sectors globally, the term 'quality' has come to mean different things to different people (Rumane, 2011). Thus, there are various definitions of quality used in the literature and the concept of quality can be confusing due to the application of distinctive yet different criteria determining quality and the roles and personal perspectives of those involved in the chain of quality activities leading to planned outcomes. Quality definitions have been developed and presented by various quality pioneers, whose work, approaches to quality and achievements in the quality field are well known (Rose, 2014). Major examples of these are shown in Table 2.1 below. It is clear that most of the identified definitions of quality concern the satisfying of the requirements of customers who obviously produce quality needs.

Table 2.1: Definitions of quality

| Quality pioneer | Definition or Meaning of Quality |
|---|---|
| **Deming (1986)** | "Quality should be aimed at the needs of the consumer, present and future." |
| **Juran (1992)** | "Fitness for purpose or use and freedom from failures." |
| **Crosby (1979)** | "Conformance to requirements." |
| **Feigenbaum (1991)** | "Quality means best for certain customer conditions (a) the actual use and (b) the selling price of the product." |
| **Oakland (1993)** | "Quality is the customer's requirements." |
| **Taguchi (1986)** | "Quality is conformance to requirements." |
| **Subir (ISO: 9000)** | "Quality combines people power and process power." |
| **Groocock (1986)** | "Quality is meeting the customer's requirements in terms of quality, price, and availability." |
| **Beckford (2010)** | "Quality is a characteristic or attribute defined by the customer, not the supplier." |
| **Lewis (1989)** | "Quality is consistently meeting or exceeding customer's expectations." |
| **ISO 9000: 2008** | "The degree to which a set of inherent characteristics fulfils requirements." |
| **Rose (2014)** | "Quality is not a naturally occurring event." |
| **Ghobadian and Speller (1994)** | "Quality is an important competitive factor and in some markets a prerequisite of survival." |
| **Edwards (1986)** | "Quality consists of the ability to satisfy wants." |
| **Gilmore (1974)** | "Quality is the degree to which a specific product conforms to a design or specification." |

**Source**: Adapted from: Beckford (2010); Ghobadian, Speller, and Jones (1994); Ng (2012); Oakland (2004); Rose (2014).

The successful managing of the quality of exported products by the Japanese during the mass production era, in 1950s and 1960s, persuaded Western countries, in particular the United States and the United Kingdom, to pay more attention to the significance of achieving higher manufacturing quality (Low & Ong, 2014). A uniform national standard for the development and management of quality systems was published in the UK by the British Standards Institution (BSI); this was known as BSI 5750. BSI, together with representatives from other countries, subsequently proposed an international version of the standard and a new committee was formed to become the International Organization for Standardization (ISO), which was tasked with preparing global standards associated with quality assurance techniques and practices (Low & Ong, 2014).

More recently, quality has become a critical driver of organisational competitiveness, which pushes businesses to strive for higher visibility and prestige amongst companies within their contemporary local and global marketplaces (Ng, 2012). In this context, Palaneeswaran, Ng, and Kumaraswamy (2006) pointed out that quality is an essential factor for the sustainability of companies and to ensure customer satisfaction. Therefore, the focus of a quality approach has been transferred from the product itself to the requirements of clients and to not only meeting, but exceeding their expectations (Withers & Ebrahimpour, 2001). Expanding on this view, customer focus, variation, and continuous improvement were considered as the central issues in the delivery of contemporary quality by Rose (2014), who codified the concepts of modern quality in a single image named the Wheel of Quality and shown in Figure 2.1 below.

Rose (2014) also confirmed that the Wheel of Quality revealed the interaction between the elements of, client focus, variation, and continuous improvement where each element is related to others and shares a general boundary, and each of these factors is expressed by a more particular aspect of project work, including, processes, controls, and requirements. The author (ibid, 2014) highlighted the central roles of some external elements essential for achieving the quality of a project, such as suppliers and end user clients, who must be considered throughout the project as the internal customer necessary to promote the final products.

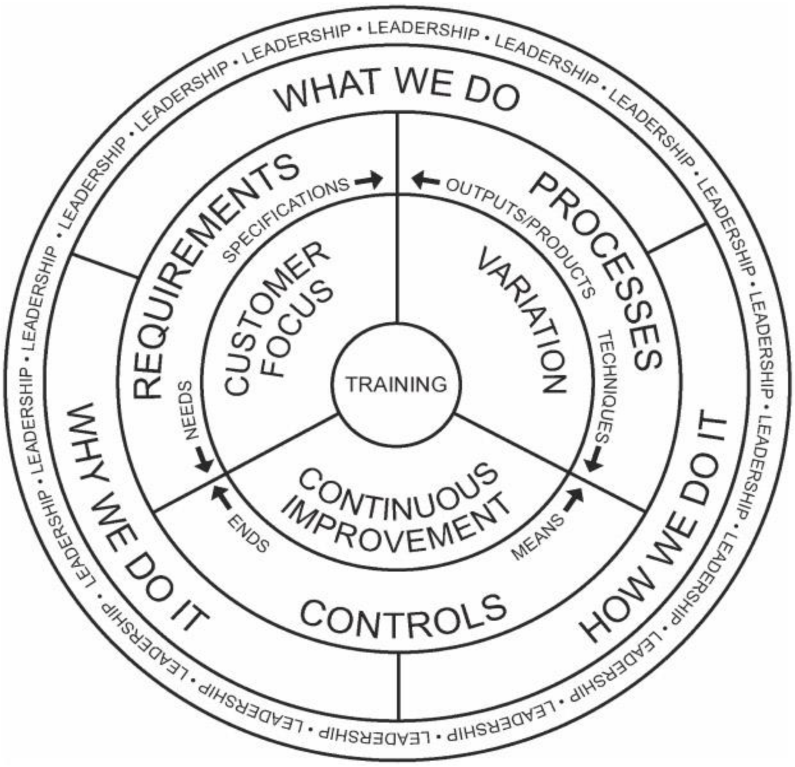


Figure 2.1: The wheel of quality (Rose, 2014, p. 13)

## 2.2 QUALITY IN CONSTRUCTION

Quality is the primary factor needed to create suitable business environments essential for competitiveness, and that can result in company success and growth (Kazaz & Birgonul, 2005; Maher Altayeb & Bashir Alhasanat, 2014). However, attaining satisfactory levels of quality within the construction sector has been identified as a long-term problem, due to the constant and repeated significant issues related to the poor quality of constructed buildings and other built structures (Arditi & Gunaydin, 1997). For instance, an enormous amount of time and money is annually expended by way of both human and material resources, and such waste can be traced back to the limited, or non-existent adoption of QMSs in the industry (ibid, 1997). This perennial problem still exists because quality management programs are often viewed as an additional and uneccessary cost by many construction companies (Ismyrlis & Moscgudus, 2015; Keng & Kamil, 2016). Much of the extra cost results from non-conformances of quality, such as the cost of wastage, errors, rework, and client claims (Love & Jafari, 2013). There are other major causes, such as the insufficency of budget, and delays in schedule, which also considerably overwhelm the cost of implementing quality programs (Elghamrawy & Shibayama, 2008; Rodríguez-Antón & Alonso-Almeida, 2011).

The benefits that accrue from achieving high-quality constructed outcomes on projects can lead to better marketability of the construction industry in the future and enhance customer satisfaction. However, it is often hard to find a precise and universal single definition of quality espoused within the construction industry, due to the complexity of construction projects (Carayon, Hoonakker, & Loushine, 2010). Arditi and Gunaydin (1997) asserted that project requirements most significantly define quality in the process of construction, which is divided into three major phases: planning and designing phase, construction phase, and operation and maintenance phase, shown in Figure 2.2 below. From this perspective, quality is defined by The American Society of Civil Engineers (ASCE), 2000 (as cited by Low & Ong, 2014, p. 30) as "*meeting established requirements*" and "*Quality in constructed projects is achieved if the completed project conforms to the stated requirements of principal participants (owner, design professionals, contractors) while conforming to applicable codes, safety requirements and regulations*". This definition means that within the construction sector, quality seems to be achieved whenever the conditions and needs of those entities, parties and people concerned with construction projects or services delivery, namely project managers, clients, consultants, contractors, and any other significant stakeholders, are accomplished (Heravi Torbati, 2014).

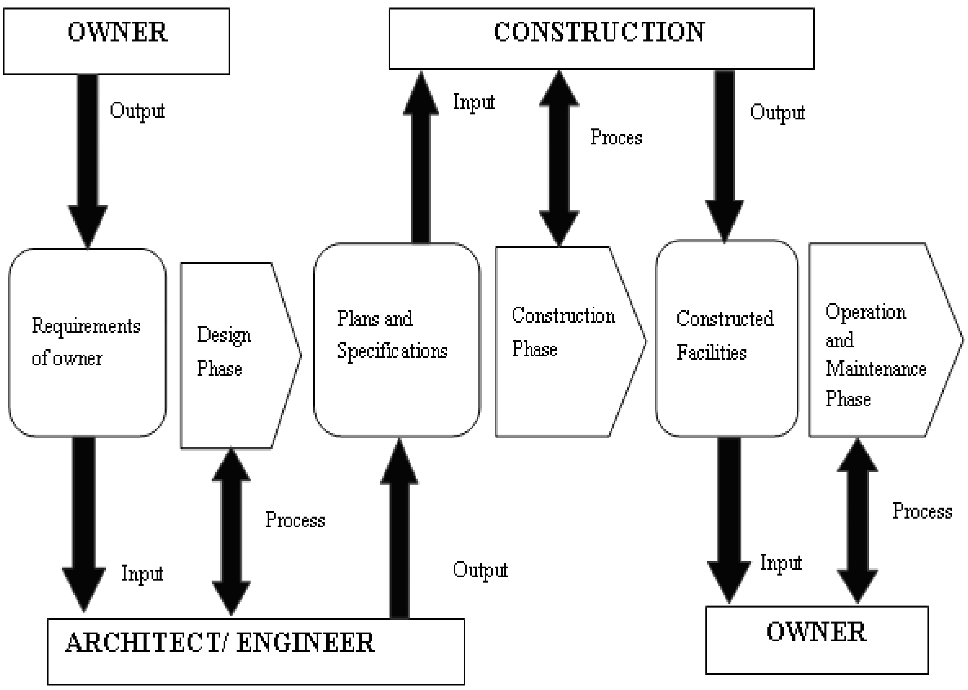


Figure 2.2: Construction process (Arditi & Gunaydin, 1997, p. 240)

Therefore, these project requirements are categorised in a 1988 American Society of Civil Engineers (ASCE) study (as cited by Arditi & Gunaydin, 1997, p. 236) as follows:

- Meeting the owner's requirements;
- Meeting the professional designers' requirements;
- Meeting the project constructor's requirements; and;
- Meeting the regulatory agencies' requirements.

Hence, the ASCE's definition for quality is adopted as the most appropriate to achieve the objectives of this research, because fulfilment of these requirements requires the implementation of a rigorous QMS. This definition summarises many of the definitions of quality identified in a review of the literature focused on achieving the requirements of customers accomplished by implementing an effective QMS.

In addition, awareness of, and meeting customer requirements, is a crucial element in the construction sector because of its complex and personal nature (Leonard, 2010). Figure 2.2, shown earlier, highlights the key roles of the client in the lifecycle of the project; the customer introduces the project requirements, and eventually, evaluates the attainment of these requirements. Adopting an effective QMS may also lead to more satisfactory levels of quality achievement, which conforms more closely to the client needs (Hussain & Younis, 2015; Magd, 2010). Therefore, in the quality evaluation of construction projects, the common demand is to emphasise that the QMS has functioned effectively, and the constructed project is able to satisfy customers (Liu, 2003). Ensuring effective implementation of a QMS during the construction phase is critical for eventual client satisfaction.

However, any low levels of customer satisfaction may not just be attributed to the ineffectual implementation of a QMS, but also to the poor quality and selection of appropriate materials, lack of workmanship, faulty design, and use of unqualified contractors (Kazaz & Birgonul, 2005; P.P.Mane & J.R.Patil, 2015). Thus, the investigation of the factors that affect a successful adoption of QMS within the construction stage of the project lifecycle, together with the identification of any barriers that need to be overcome to promote a more effective implementation of a system in the future, were the most critical objectives of this research.

On the other hand, defining the quality of construction projects differs from defining the quality for other other industries such as the manufacturing sector, since construction products and projects are not generally entirely repetitive. Besides this, quality in construction projects does not only relate to the quality of products and equipment used in the construction, but also to the total management approach utilised to undertake and complete the project, within the specified budget and schedule, to meet the defined purposes of the owner (Rumane, 2011). Turk (2006) claimed that ignoring quality within the construction industry is sometimes caused by the need to decrease the real required costs and time. Consequently, quality of construction can be seen as a part of a triangle in which contractors must fulfil the level of planned cost, achieve the scheduled deadlines, and meet the required level of quality (Valdez & Chini, 2003). The phenomenon of these three components, time, cost and quality, is called the "construction project trilogy" (Rumane, 2011). It is also called the "iron triangle", and its components are widely accepted as major elements in the measurement of the project performance (Leong, Zakuan, Saman, Ariff, & Tan, 2014). Concerning this phenomenon, Rumane (2011, p. 9) defined the quality of construction projects as "*the fulfilment of owner's needs per defined scope of works within a budget and specified schedule to satisfy the owner's/ user's requirements*". These components are shown in Figure 2.3.

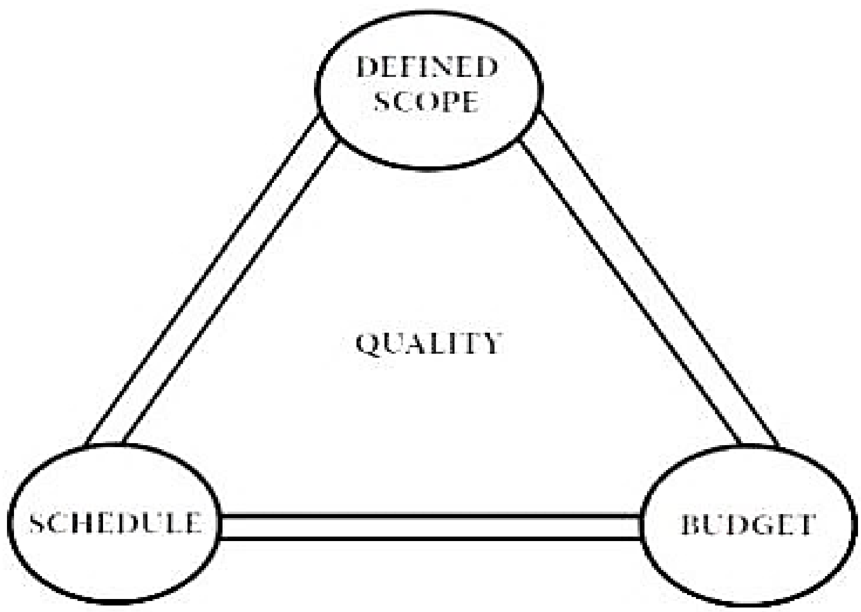


Figure 2.3: Construction project trilogy (Source: Rumane, 2011, p. 9)

However, at least one of the three critical elements of the iron triangle must be variable to some extent, in order to ensure the achievement of the satisfactory level of quality, which should represent the overall aim of any project (Scott, 2012). This is then often applied by making the 'iron triangle' an 'elastic triangle', varying one or more of its elements of scope, schedule or budget when required. This variation can be fulfilled by setting and defining the schedule, budget and quality requirements, prior to defining the scope of the project (ibid, 2012).

Whilst the clients of the construction industry, and to a degree the industry itself, are seeking improvement in the quality of projects, this improvement seems slow to happen and is fragmented primarily because of the historical reluctance of the industry towards changes, so to a large extent, the sector is still utilising traditional quality tools and programs (Haupt & Whiteman, 2004; Leonard, 2010). Therefore, adopting the scenario of the elastic triangle described earlier might represent a realistic solution to facilitating the attaining of satisfactory levels of quality within a construction company. This could also help to overcome issues that hinder effective adoption of a QMS in the CIBS. However, more recently, instead of the conventional triangle, a project management diamond has been proposed, consisting of four main vertices: cost, time, scope, and quality, with customer expectations representing the central theme of these vertices (Haughey, 2011). Figure 2.4 below depicts the project management diamond. On the other hand, it requires more research to prove the associate between delivering quality products in construction and the adoption of the project management diamond, since the industry is still confronting the same level of quality issues compared with the last two decades. Therefore, adopting this framework as a solution for quality issues in the construction industry requires deeper investigation of the potential improvements that adopting this management approach could provide, for handling these issues in construction projects.

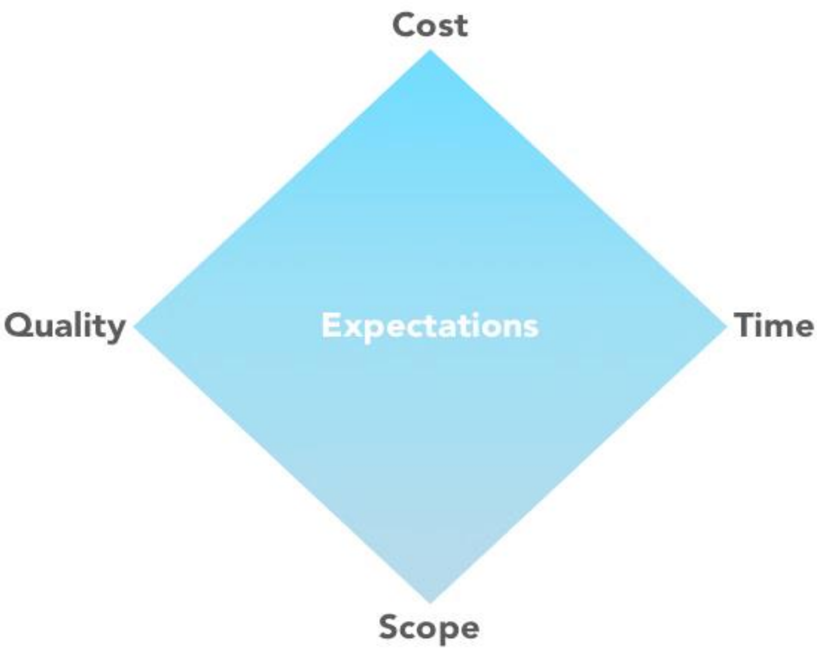


Figure 2.4: A project management diamond (Haughey, 2011)

## 2.3 QUALITY MANAGEMENT (QM)

Quality management is a philosophy for continuous success in an organisation by focusing on customer satisfaction, and depends on the participation of all employees in the processes of continual improvement of services, and products (Al-Asiri, 2004). Quality management has been described by Crosby (1979) (as cited by Low & Ong, 2014, p. 1) as "*a systematic way guaranteeing that organised activities happen in the way they are planned*"…*it is management discipline concerned with preventing problems from occurring by creating the attitudes and controls that make prevention possible".* In the context of construction quality management, Lam, Low, and Teng (1994) defined it as "*those aspects of the overall management function that determine and implement the quality policy*".

In quality management, since the focus is not only on the quality of products, but also on how to achieve that, different management systems and tools are utilised to attain consistent quality of products (Ng, 2012). Therefore, according to the Guide (2013, p. 227), quality management should include *"the processes and activities of the performing organisation that determine quality policies, objectives, and responsibilities so that project will satisfy the needs for which it was undertaken".* This perspective covers the needs of the projects in terms of time, cost and scope, and the needs of a project's customers in terms of defined requirements (Rose, 2014).

Ng (2012) argued that whereas quality management has evolved through different phases, the future will witness the emergence of different scenarios by adding and discarding approaches. Notwithstanding that, according to extant research on the history of quality, various forms of quality management have evolved as follows (Rumane, 2011): quality inspection, quality control, quality assurance, and total quality management. These approaches are explained below in order to clarify the confusion that sometimes exists between them, and to demonstrate the purposes of utilising each of these quality management methods.

### 2.3.1 Quality Inspection (QI)

Dale (1999, p. 25) defined *quality inspection* as "*a set of activities which includes measuring, examining, testing or gauging one or more characteristics of an entity and comparing the results with specified requirements to establish whether conformity is achieved for each characteristic*". An inspection, which is a specific examination, test, official evaluation practice and total appraisal of a process, product, or service, is conducted to ensure that products conform to established requirements (Mazher, Gharleghi, & Chan, 2015b). It is used to grade finished products in order to assure their desired quality (Dale, Wiele, & Iwaarden, 2007). An inspection is denoted as an effective and efficient way to discover any defect in the product and service at the desired level (Mazher, et al., 2015b). It is achieved by utilising non-destructive methods, such as visual inspection, ultrasonic testing, acoustic emission, and radiography (Rumane, 2011). In the modern view of quality, Rose (2014) pointed out that quality inspection can play a vital role in quality management, through ensuring the conformance of processes with what is planned, and by revealing deficiencies early, so that these can be corrected before causing any waste or rework.

### 2.3.2 Quality Control

*Quality control* has been defined by the Guide (2013, p. 227) as "*the process of monitoring and recording results of executing the quality activities to assess performance and recommend necessary changes*". ISO: 9000 (2015, p. 14) also defined quality control as "*part of quality management focused on fulfilling quality requirements*". This definition means that any activity, whether devoted to the control, management, or quality improvement, is considered to be a quality control event. On the other hand, Low and Ong (2014) claimed that quality control deals with problems associated with conformance to plans and specifications. Likewise, Judi, Jenal, and

Genasan (2009) asserted that quality control is the part of quality management associated with attaining requirements of quality by utilising statistical methods. It is also associated with the inspection of final products, although its focus is more on preventing any defects than inspecting them.

However, since quality control focuses on reducing defect incidence and providing consistent process control, it is not used as a benchmark to establish standards (Mazher, et al., 2015b). In construction projects, the principal target of quality control is to assure the effective accomplishment of all of the activities of a particular project, according to all contractual specifications, codes and standards or government regulations (Khan, Azhar, & Mahmood, 2008). Quality control can be carried out at every stage of the project by utilising various charts, diagrams, and checklists of control to analyse rejection causes and conduct necessary preventative and reformed actions (Rumane, 2011).

### 2.3.3 Quality Assurance (QA)

*Quality assurance* has been defined by ISO: 9000 (2005, p. 9) as the "*part of quality management focused on providing confidence that quality requirements will be fulfilled*". In the context of the construction project, Rose (2014, p. 75) described quality assurance as "*the set of defined activities that provide confidence that project performance will conform to project requirements*". Zantanidis and Tsiotras (1998) have pointed out that quality assurance is implemented at two levels within the construction sectors, namely the organisational level, which establishes the overall policy and system procedures of quality, and the project level that focuses on adopting the applicable factors of quality management within any project. In the construction industry, many approaches to quality assurance have been established, and implemented to an extent in recent years, such as partnering, business process reengineering, constructability review, and value engineering (Valdez & Chini, 2003).

### 2.3.4 Total quality management (TQM)

Total quality management has been defined as "*an integrative management philosophy aimed at continuously improving the quality of products and processes to achieve customer satisfaction*" (Kamalanabhan, Rajendran, & Joseph, 1999, p. 2201). Gunasekaran (2003, p. 361) described TQM as "*a management philosophy that encourages cost reduction, the creation of high-quality goods and services, customer* *satisfaction, employee empowerment, and the measurement of results*". However, there is a common belief that TQM is a result of gradual evolution of the preceding management approaches, QI, QC, and QA (Abusa, 2011; Agha, 2014; Syaj, 2015a; Talib a, Rahman, & Qureshi, 2011).

Implementing TQM in the manufacturing sector has improved productivity, decreased production costs and enhanced product reliability (Arditi & Gunaydin, 1997). According to some authors, TQM also offers some benefits for the construction industry, such as increasing customer numbers, improved employee job satisfaction and product quality, greater productivity, improved budget and schedule performance and increased market share; (Carayon, et al., 2010; Khadour & Darkwa, 2008; Metri, 2005). As mentioned, TQM is an important implementation strategy that has to some extent been already been used in the construction industry worldwide (Mazher, Gharleghi, & Chan, 2015a). It has in most instances, been mainly adopted to facilitate continuous improvement in the quality of implemented projects. This has attracted governmental attention in several countries since the early 1990s, and as a result, reports on the implementation and use of TQM have been published in countries such as Australia, USA and United Kingdom, in order to present the benefits of introducing TQM-based quality implementation to help construction companies improve performance and better achieve customer satisfaction (Harrington, et al., 2012). However, Harrington, et al. (2012) asserted that some problems in the construction industry, such as fluctuating demand and variable workloads, have led to difficulties in implementing a TQM approach in this sector.

## 2.4 QUALITY MANAGEMENT SYSTEMS (QMSs)

QMSs have been adopted worldwide across various industry sectors as a response to increased competition in the national and global arenas, which has forced organisations to assess their own product delivery systems. During the last three decades, the concept of effective and efficient implementation of the QMS has been a primary concern for the management of companies, in particular those that are the leaders in an international market (Zantanidis & Tsiotras, 1998). Therefore, increasing attention from authors and researchers has led to the conduct of extensive research into the implementation of QMSs within different sectors (Arditi & Gunaydin, 1997; Coffey, 2011; Low & Ong, 2014; Ng, 2012; Rose, 2014; Rumane, 2011). There are several definitions of a QMS identified from the literature review and many of these indicate that no standard or universal definition actually exists. A QMS is defined as*" a group of resources and rules properly implemented with the objective to guide each part of the company to execute standardly their tasks in harmony with the others, where the purpose is to achieve a good level of quality and productivity*" Maranhao, 2005 (as cited in Almeida, et al., 2014, p. 1113). Flynn, Schroeder, and Sakakibara (1994) also described the QMS as any integrated approach adopted to attain and sustain high quality outputs, focusing on continuous improvement through complying with requirements to meet or exceed customer expectations. This description seems more applicable to achieve the objectives of this research since it focuses on the performance (effectiveness) of implementing a QMS.

The literature exhibits some evidence from previous studies that implementing a QMS decreases communication problems and mistakes, minimises wastage of materials and rework, and enhances controlling subcontractors and suppliers (Bubshait & Al-Atiq, 1999; Leong, Zakuan, & Saman, 2014). Ng (2012) has emphasised that since QMSs are dynamic, and modifiable in meeting customer requirements and expectations, they can provide guidance for an organisation to establish processes for maintaining records, improving systems, and meeting customer's needs and expectations. Thus, these features together represent the primary rationale for QMS implementation (Dongmo & Onojaefe, 2013). QMSs also provide a great deal of support to improving the competitiveness and the profitability of organisations that successfully implement them (Psomas, et al., 2010; Zantanidis & Tsiotras, 1998). Implementing an effective QMS can help to guarantee sustainable development in small and medium enterprises (SMEs) and may help companies in developing and maintaining an appropriate and steady level of product quality (Angheluta, Pirnea, & Moisa, 2012; Rusjan & Ali, 2010).

However, Willar, Coffey, and Trigunarsyah (2015) posit that a successful QMS implementation requires effectiveness in planning, operations and review as well as a continuity in system improvement at all levels of a company. A simple concept of effectiveness means 'doing the right things' (Alvesson, 2013; Sink & Tuttle, 1989). Also, a QMS's effectiveness is defined as "*meeting prescribed quality objectives of the company and specified requirements*" (Oztaş, Güzelsoy, & Tekinkuş, 2007, p. 1221). For example, if a company implements a QMS to reduce rework on site, the effectiveness of the system is then judged by how well it does this (Al-Nakeeb, Williams, Hibberd, & Gronow, 1998). Some researchers have also described a QMS as the degree to which results (outputs) meet prescribed goals (Kafetzopoulos, Psomas, & Gotzamani, 2015; Psomas, Pantouvakis, & Kafetzopoulos, 2013).

For many organisations, the practical implementation of a QMS means the meeting of their specified quality requirements and objectives, which are fundamental to implementing successful business outcomes (Alvesson, 2013). Accordingly, the overall meaning of effectiveness in this sense is, firstly, the meeting of specified requirements of a company, and secondly, reaching the prescribed objectives included in the principles of the QMS (Willar, et al., 2015). Since the focus of this study is on investigating the implementation of QMSs in the CIBS, it is clear that identifying and exploring different aspects and particular factors related to an effective adoption of a QMS in this sector, is fundamental to identifying an observable research gap, and subsequently to developing focused research questions.

### 2.4.1 ISO 9000 QMS

ISO 9000, quality management system was first developed in 1987 by the International Standards Organization (ISO) based upon the UK quality management system standard, BS5750, which was aimed at promoting the quality of services and goods provided by different industry sectors (Chin & Choi, 2003; Keng & Kamil, 2016). Containing the revisions applied in 1994 and 2000, ISO 9000 became the development basis that QMSs could utilise to assure targeted quality in the services and manufacturing sectors at an international scale (Hoyle, 2009; Moatazed-Keani & Ghanbari-Parsa Sechi, 1999). ISO 9000 is produced in generic form to be applicable to all organisations in spite of the type and the size of business, so it can be adopted across various industries and sectors. Therefore, the ISO 9000 series is considered the fastest growing standards in history and it was very popular from the beginning (Aggelogiannopoulos, et al., 2007; Bergman, 1994). By 2004, more than 136 countries had deployed the series as national standards, and more than 650,000 businesses had been certified to ISO 9000:2000 by third-party organisations (Tsiakals, 2002).

ISO 9000 QMS initially aimed at providing a series of international standards that cope with quality systems and could be used for external quality purposes. Another important aim of the ISO 9000 was to provide information to organisations regarding how to design their own QMSs in accordance with individual company marketplace requirements (Aggelogiannopoulos, et al., 2007; Ferguson, 1996). However, the ISO standards are, in general, based upon the principles of QM, which are typically significant to improve the performance of an organisation that adopts these principles (Kiew, et al., 2016). Furthermore, to guarantee an effective implementation of any QMS, the International Organisation for Standardisation (ISO) has very recently identified seven (previously eight) principles of quality management systems, which are (ISO: 9000, 2015, p. vii):

Customer focus;

- Leadership;
- Engagement of people;
- Process approach;
- Improvement;
- Evidence-based decision making; and,
- Relationship management.

These prime concepts are helpful for managers to adopt in order to implement appropriate QMSs to enable their companies to utilise a systematic approach to quality management (Heravi Torbati, 2014). Adoption of these principles is therefore, promoted by ISO for application when developing, implementing and improving the effectiveness of QMSs of organisations, to enhance customer satisfaction by meeting client requirements (ISO: 9000, 2005; ISO: 9001, 2015).

### 2.4.2 Motivations for adopting ISO 9001 Standards

ISO 9001 QMS is one of the series of ISO 9000 standards that provides a sequence of guidelines for companies concerning how to develop their own QMS needed to manage the processes that impact products or services (Keng & Kamil, 2016). ISO 9001 certification motivations are grouped into internal and external (Georgiev & Georgiev, 2015; Kaziliunas A, 2010; Keng & Kamil, 2016; Sampaio, Saraiva, & Guimarães Rodrigues, 2009). The internal motivations are related to organisational improvements, which might include improvement of productivity and profitability, decreasing cost, improvement of quality reward system, team work, the measurement of performance and communication, continuous improvement (Coleman & Douglas, 2003; Georgiev & Georgiev, 2015; Gotzamani & Tsiotras, 2002; Sampaio, et al., 2009; Santos, Costa, & Leal, 2014). It is stated that when ISO QMS adoption based upon internal motivations is used to improve efficiency of processes, the gradual acquired social knowledge and experience becomes a complex valuable resource that is neither easily imitable, nor substitutable (Otieno, 2015; Tarí, Molina-Azorín, & Heras, 2012).

The external motivations are however, associated with improvements related more to marketing and promotional aspects, maximising customer satisfaction and enhancing of market share (Ebrahimpour, Withers, & Hikmet, 1997; Georgiev & Georgiev, 2015; Gotzamani & Tsiotras, 2002). On the other hand, organisations consider that obtaining ISO 9001 certification is essential to enhance their reputation in the market, by responding to the demands from clients, suppliers, trade unions or government (Prajogo, 2011). This implies that the legitimacy of being certified is more important for companies than the benefits of implementing ISO 9000 QMS itself. As an external motivation factor, ISO 9001 certification is frequently utilised as a marketing tool, as companies believe that ISO 9000 certification is necessary to enable to be offered a significant number of contracts (Douglas, Coleman, & Oddy, 2003; Kaziliunas b, 2010; Poksinska, 2010). Hence, customer pressure is also considered as one of the major motivations by companies driving them to achieve ISO 9000 certification (Cianfrani & West, 2013; Juanzon, 2017). However, several authors have pointed out that if an organisation is solely motivated to adopt the standard for external reasons, it is more likely to implement the standard just to meet those external requirements rather than for improving the internal performance (Fotopoulos, Psomas, & Vouzas, 2010; Tarí, et al., 2012).

Therefore, Kaziliunas A (2010) emphasised the existence of sturdy interdependence between the motivations to gain certification and the results obtained from adopting the standard. In terms of obtaining certification, if organisations simply react to external pressures, they probably consider ISO 9000 certification as a key goal in itself (Georgiev & Georgiev, 2015; Santos, et al., 2014). By contrast, organisations that seek to obtain ISO 9000 certification as an opportunity to improve internal processes and systems are more likely to build a QMS that yields broader and more positive outcomes (Keng & Kamil, 2016; Llopis & Tari, 2003). However, there are cases reported of organisations that, although they intended to improve the performance of QMSs, have diligently maintained their existing QMSs rather than incorporating the necessary improved processes (Micaela Martínez, 2007). Overall, if there are robust internal motivations inducing organisations to improve quality by developing a rigorous QMS, more external benefits are likely to be gained, such as improving a company's position in the market (Psomas, et al., 2010).

## 2.5 SUMMARY

This chapter explored and evaluated the relevant extant literature related specifically to quality and quality management, with a focus on their definitions and adoption in the construction sector. It presented a detailed literature review on the critical concepts of quality and quality management in the construction industry and highlighted the issues faced when trying to achieve high levels of quality in the construction building projects being executed by the industry. It also examined the significance of the consideration of client requirements when evaluating attained levels of quality. The chapter then explored the evolution of quality management during the last century and explained the various features of different quality approaches employed within the construction industry. The final part of the literature review further explored the nature of QMSs by specifically focusing on the impacts of ISO 9000 on QMS implementation and examined the essential concepts and the main motivations for organisations to become certified to ISO. The next chapter will present the extant preceding literature related to QMS deployment in the construction industry. It will explore concepts, definitions, benefits, problems, and processes of QMS implementation. It will also elucidate the perceptions of QMS in the construction industry and outline the major motivations and benefits of implementing a QMS on building projects. Finally, Chapter 3 will identify common barriers to QMSs implementation that prohibit an effective deployment of such systems in construction building projects, in conjunction with investigating CSFs for effective adoption of QMSs in the construction industry.

# Chapter 3: QMS Implementation in the Construction Industry

## 3.1 INTRODUCTION

Chapter 2 presented and explained the preceding literature on quality and quality management, and specifically focused on the concepts of quality and quality management in the construction sector. The chapter then examined the evolution of quality management during the last century and elucidated the various features of different quality approaches employed in the construction industry. This chapter examines the extant literature on quality management system (QMS) implementation in the construction industry by investigating concepts, definitions, benefits, problems, and processes of QMS deployment. It also clarifies the perceptions of QMS in the construction sector and critically reviews the preceding research and other topics related to QMS implementation. It outlines the major motivations and benefits of adopting a QMS on building projects and discusses common barriers to QMS deployment that weaken the anticipated outcomes of implementing such systems in construction building projects. These barriers are investigated and the main causes for them are then examined and explained. The most notable barriers impeding QMS deployment are grouped under seven major categories. The chapter then investigates the critical success factors (CSFs) for effective deployment of QMSs in the construction industry. The gap of inherent knowledge that exists in previous studies is highlighted here, and the critical need for developing an inclusive framework that integrates all impacting factors that can guide future QMS deployment is emphasised. This chapter also seeks to identify the most appropriate data collection approaches used in previous research, in order to develop a suitable design to be adopted for this research.

## 3.2 BACKGROUND OF QMS IMPLEMENTATION IN THE CONSTRUCTION INDUSTRY

QMSs have been implemented and adopted in the construction sector worldwide over the last two or three decades (Cachadinha, 2009; Leong, Zakuan, & Saman, 2014). Despite this, 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 (Arditi & Gunaydin, 1997; Harrington, et al., 2012). These problems have apparently resulted from the deficiencies of the application of the adopted QMSs, or the ineffectiveness of integrating QMSs with existing management systems within the construction industry (Rashed & Othman, 2015). Various authors have posited that construction companies have been encouraged to develop and implement QMSs for various reasons, namely, responding to client pressure, gaining and maintaining competitive advantage, enhancing the reputation of firms, reducing costs and removing previous quality problems (Al-Nakeeb, et al., 1998; Oztaş, et al., 2007). Similarly, other authors have determined that meeting client requirements, sustaining the competitiveness of a company and managing quality problems are among the main drivers that have pushed companies to adopt a QMS (Low & Ong, 2014).

Leong, Zakuan, and Saman (2014) confirmed that whereas a body of research has been conducted to explore the role of a QMS in different industries and sectors, there has been a real deficiency of comprehensive and relevant studies specifically undertaken within the construction industry. This dearth of research is largely due to researchers focusing on the cost and quality outputs of projects more than on their QMSs (Kam & Tang, 1997; Xiao & Proverbs, 2002). Some of the main types of quality-related systems that have been investigated are ISO 9000, TQM, Kaizen and Business Process Reengineering (BPR). These studies have been categorised into seven groups as shown in Figure 3.1 below (Leong, Zakuan, & Saman, 2014). By examining these studies using the following criteria, a further research gap has been identified:

- Objectives of research;
- Research scope;
- Targeted group of research, and;
- Essential theories.

Adopting these criteria by this research facilitated narrowing the focus of the study essential to identify the critical gaps of the research. The scope of analysing a relevant research critically was performed through focusing specifically on the studies that investigated ISO 9000 QMS in the construction industry rather than focusing upon other QMSs, such as TQM. Also, more than 300 journal articles associated with QMS deployment in the construction industry have been critically analysed in order to identify the prime gaps of this research. The investigation of the literature critically focused upon studies published within the last 10 years, 2006 and beyond in order to acquire contemporary views concerning QMS implementation in the construction industry. Some older research, however, were also explored to obtain a historical knowledge about quality and QMS in construction. These studies indicate after comparison using the criteria above, that the focus of most of them is on the role of a QMS within the industry, rather than focusing on how to overcome the problems faced when employing, or developing, a framework for effective implementation of these systems. Therefore, there is still a critical need to identify a holistic list of barriers surrounding the implementation of QMS, including those external obstacles as well as addressing the most important CSFs that are adopted by building organisations in order to cope with these barriers successfully.

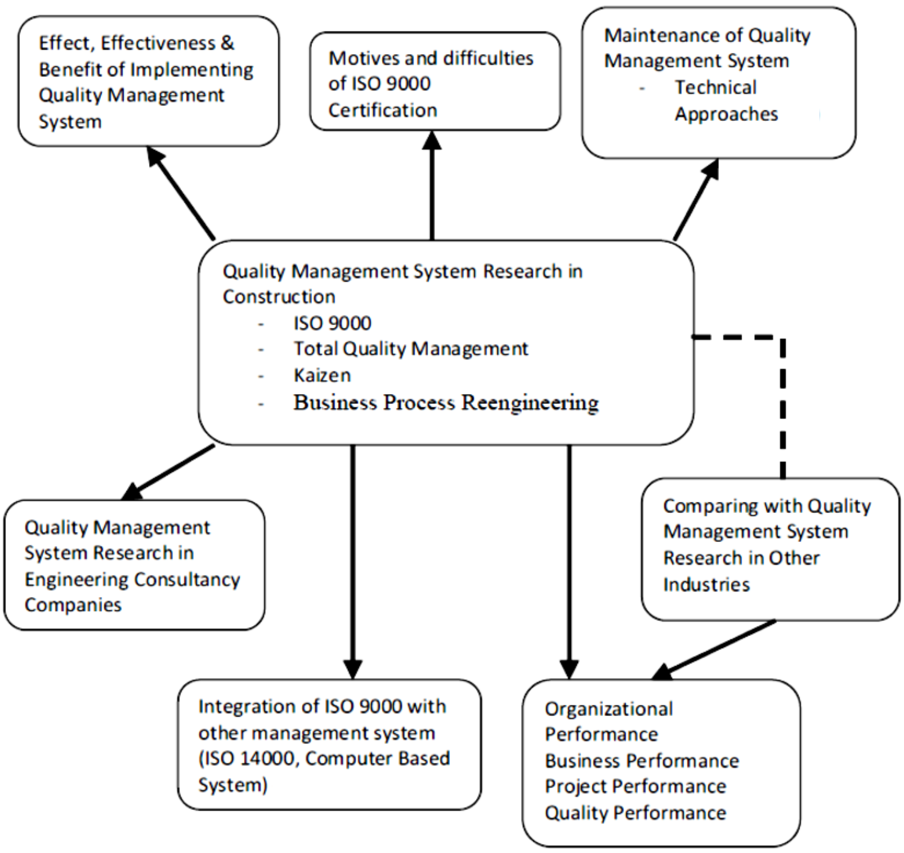


Figure 3.1: Scope of construction industry QMS studies (Source: Leong, Zakuan, & Saman, 2014, p110)

Within the construction sector, a QMS is specifically defined as *"the people and processes in place to ensure that construction meets owner's requirements"* (Rajendran, Clarke, & Andrews, 2012, p. 40). Thorpe, Sumner, and Thorpe (2004) also defined a QMS more broadly as "*a formal statement of an organisation's business policy, management responsibilities, processes and their controls that reflects the most effective and efficient ways to meet (or exceed) the expectations of those it serves, while achieving its owned prime business objectives*". This latter definition indicates that the effectiveness of adopted systems is one of the most critical factors considered by internal stakeholders of a company (Willar, Coffey, & Trigunarsyah, 2010). However, a QMS is also described as *"the management system used to direct and control an organisation with regard to quality"* (Kiew, et al., 2016, p. 3). This definition of a QMS accords closely with the objectives of this research since the overall aim of this study is to improve the level of QMS deployment in the CIBS. Also, overcoming long-standing inherent issues of quality is obviously associated with adopting a successful QMS, because this definition also connects the purpose of QMS implementation to achievement of the required level of quality.

### 3.2.1 The effectiveness of QMS Implementation in the construction industry

The successful implementation of a QMS on a construction project requires effective operation, planning, review and continuous improvement of the system across the project team. Since each construction firm sets its own requirements and expectations regarding implementing its QMS, the effectiveness measure of the system depends on the definition of the purpose of the system (Willar, et al., 2010, 2015). Thus, (Oztaş, et al., 2007, p. 1221) define QMS effectiveness in respect to ISO 9000 compliance as *"meeting prescribed quality objectives of the company and specified requirements of ISO 9001:2000"*. Measuring the effectiveness of the implemented system is significant in order to evaluate the goals of managers and to enable them to improve work processes by making the right decisions (Oztaş, et al., 2007). Therefore, the effectiveness of a QMS is considered one of the most important factors for the internal stakeholders of organisations (Thorpe, et al., 2004). Hence, the above definition can be broadly used to describe the effectiveness of any QMS, including those adopted by organisations because effectiveness in that definition represents the original aim for adopting that QMS.

Turk (2006) emphasises that a company's management and project teams must assure that an established QMS is effectively implemented and maintained in order to meet the quality objectives of that organisation. However, because the major aim of adopting a QMS by most construction organisations is probably to respond to client pressure, or to meet the expectations of clients regarding quality, it is significant to ascertain the effectiveness of a QMS specifically in respect of meeting the expectations of clients and not solely meeting industry norms (Kam & Tang, 1997; Keng & Kamil, 2016). Hence, implementation of a QMS is considered effective if the pre-assigned objectives of quality, and QMS requirements are fulfilled (Kam & Tang, 1997; Oztaş, et al., 2007). Since the main focus of this research is to examine the level of QMSs in building organisations, the main benchmark used to ensure the effectiveness of system deployment in building projects is the extent that these organisations felt they met their quality objectives and achieved customer expectations regarding quality.

### 3.2.2 Uniqueness of the construction sector

In the construction industry, a number of factors make the sector an 'exceptional case' compared with other industries, thus when considering the quality issues around the implementation of a QMS, it should be noted that it differs significantly from other sectors, such as manufacturing (Oztaş, et al., 2007; Rumane, 2011). This difference is due to several factors which make the construction sector different from others. Unlike the manufacturing industry, the uniqueness of construction projects results in non-repetitive products, so this hinders the deployment of a QMS to the same level as demonstrated in other sectors (Karim, Marosszeky, & Kumaraswamy, 2005). Many studies have stated the features that have made the construction industry unique. Oztaş, et al. (2007) stated that several factors differentiated the construction industry from other industries and made implementing a QMS harder, namely:

- Required time to complete construction projects;
- Relationships formed;
- Ambiguous definition of quality standards;
- Difficult for feedback of the processes; and,
- Difficult to determine an estimated cost.

Polat, Damci, and Tatar (2011) asserted that the construction sector is different from other industries due to several factors, namely one-of-a-kind product, deficiency in top management and leadership support, unqualified employees, and low team effectiveness. In contrast, project size, project environment, available time of project (duration), the complexity of construction, relationship of a project team, and materials and supplies are considered the unique main features of the construction sector (Pheng & Teo, 2004). Expressing a different view, Carayon, et al. (2010) confirmed that the involvement of many stakeholders who try to protect their particular interests within the construction industry, is a significant and distinct feature of the sector.

Thus, the manufacturing industry (where production is conducted in controlled places within factories) differs greatly from construction, where products are made (projects undertaken) in dispersed locations. These conditions can make close supervision of the workforce more difficult (Pheng L. & Omar F., 1997). In fact, construction projects are often unique in terms of collection of workforce, equipment, and materials that are brought together to execute a project at a unique location under unique weather conditions, whilst in the manufacturing sector, all of these factors are consistent to produce typical products over and over again within mass production systems (Ismyrlis & Moscgudus, 2015; Oztaş, et al., 2007; Phenol, 1994). Consequently, the factors described above complicate transferring of the concepts of continuous improvement assured by QMS adoption from manufacturing to the construction industry (Oztaş, et al., 2007). Therefore, during this study, the impact of construction industry uniqueness was taken into account, to indicate the influence of this factor on the overall level of QMS adoption in the CIBS.

## 3.3 BENEFITS OF A QMS IMPLEMENTATION IN CONSTRUCTION

Within the literature, the issue of quality has been considered a major concern for the construction industry. Therefore, several studies have been conducted to explore the impact and benefits of QMS implementation, aimed at integrating resources effectively for improving quality performance within the construction sector (Ali, 2014; Cagnazzo, Taticchi, & Fuiano, 2010; Keng & Kamil, 2016; To, et al., 2012). While these studies often focus on various aspects of the QMS and utilise different parameters to analyse their results, the overall target of the studies is to reveal potential improvement margins in implementing a QMS (Grigoroudis, 2011). Recent research demonstrates that deploying a QMS in the construction industry has resulted in decreased communication issues, reduced mistakes, minimised rework and wasted materials, and improved control of sub-contractors and suppliers (Leong, Zakuan, & Saman, 2014; Westelius, Lundmark, & Tekniska, 2006). These positive indicators may gradually lead construction companies to achieve increased productivity, profitability, and market share, thus enabling contractors to meet customer requirements more closely (Motwani, Kumar, & Hung Cheng, 1996; Zin, Chen, & Ali, 2009). Other authors have concluded the overall benefits that are summarised below (Abdullah, et al., 2015; Palaneeswaran, et al., 2006; Samsudin, et al., 2012b; Zantanidis & Tsiotras, 1998), namely:

- Improving communication;
- Reducing rework;
- Improving quality requirements of products;
- Saving additional money and time;
- Enhancing continuous improvement and work performance;
- Improving market share and company competitiveness;
- Improving productivity, and;
- Enhancing origination ability in problem-solving and non-conformance detection.

Based on these studies, adoption of an effective QMS can help a company in critical areas, such as decreasing defective products, improving internal communication, increasing customer satisfaction and market share, minimising quality cost, reducing wastage rate, and decreasing delays (Aggelogiannopoulos, et al., 2007; Dongmo & Onojaefe, 2013; Ismyrlis & Moscgudus, 2015; Santos, et al., 2014). In the Saudi Arabian construction industry context, employee satisfaction, increased profit and savings, and teamwork enhancement have all been identified as further benefits of QMS implementation (Aichouni, et al., 2014). According to some authors, (Arumugam, Ooi, & Fong, 2008; Rashed & Othman, 2015), adopting a QMS can often ensure continuous improvement of work performance within the construction industry projects. Moreover, Turk (2006), who examined the QMS implementation in the Turkish construction sector, emphasised that applying a QMS within a construction industry context can offer significant advantages for companies to gain (i) well-defined responsibilities; (ii) enhanced communication with clients; (iii) improved operation procedures of company, and; (iv) tighter control of sub-contractors.

On the other hand, within the relevant studies, improvement of documentation and organisational quality perception, the discipline of the work environment, consistency within the company, and developing client confidence are the most common benefits gained by implementing QMSs, such as are espoused under the ISO 9000 series (Alam & Bhuiyan, 2005). By contrast, To, et al. (2012) asserted that whilst implementing multiple management systems can lead to additional benefits to the company, adoption of QMSs also results in increased management costs and more complexity in implementation (Zeng, Tian, & Tam, 2007). Thus, the benefits of QMS implementation may be different amongst companies due to differences in the efficiency and effectiveness of the application of implementation (Leong, Zakuan, Saman, et al., 2014). The variation in the efficiency and effectiveness of deploying a QMS depends on quality requirements set and the level of commitment to achieve business excellence (Poksinska, 2010; Santos, et al., 2014). Therefore, the correlation between the motivations to adopt a QMS and the benefits gained from its implementation was the top focus of many studies (Dongmo & Onojaefe, 2013; Georgiev & Georgiev, 2015; Gotzamani & Tsiotras, 2002; Santos, et al., 2014). For instance, construction companies that aim to obtain ISO 9000 certification in response to internal motivations are more likely to acquire achieved internal improvements in processes and systems, as benefits of adopting such a QMS (Poksinska, 2010). In contrast, if companies seek to obtain a certification to attain external motivations, the main benefits gained from implementing a QMS would be solely limited to external benefits (Georgiev & Georgiev, 2015; Williams, 2004).

To sum up, the review of the extant literature identifies that the significant and crucial benefits for a QMS adoption in the construction industry result eventually in improving productivity, enhancing the competitiveness of the company, and satisfying the customer. On the other hand, some evidence indicates that the construction sector currently lags behind other industries in employing contemporary QMSs and therefore, the serious adoption of more contemporary QMSs has been a phenomenon only over the last two decades (Cachadinha, 2009; Landin, 2000). Hence, it appears that all construction organisations aiming to implement effective and successful QMSs, should plan to overcome the upcoming potential barriers that they are expected to encounter during the process of implementation. Accordingly, although the advantages of QMSs implementation are well-known at the higher strategic company level, construction staff are still struggling to transfer them at the project level (Abdullah, et al., 2015). This is possibly another reason for the lack of relevant studies on the role of QMSs in the CIBS, whereas numerous research studies have been conducted in other sectors (Leong, Zakuan, Saman, et al., 2014).

## 3.4 BARRIERS TO A QMS IMPLEMENTATION

QMSs in the construction industry are still considered as cost prohibitive by many construction companies due to the lack of awareness about their potential importance (and benefits) (Elghamrawy & Shibayama, 2008). This common view derives from the fact that whether a QMS impacts on firm performance, competitiveness and the operations management of construction organisations, is still debatable (Cagnazzo, et al., 2010; Ilango & Shankar, 2017). This negative view is a basis for the obstacles preventing effective QMS implementation. Many previous studies have explored the barriers facing the adoption of a QMS in the construction industry. Whereas implementing a QMS can assist in solving chronic problems that have faced the construction industry for a long time, there are still difficulties and barriers in the effective adoption of these systems (Cachadinha, 2009; Keng & Kamil, 2016). Karipidis, Athanassiadis, Aggelopoulos, and Giompliakis (2009) argued that it is essential to identify the major barriers impeding effective implementation of a QMS, as well as the benefits of these systems, since these advantages and obstacles might affect decisions regarding adopting a QMS within companies, as shown simplistically in Figure 3.2 below. While this diagram splits the barriers to QMS deployment into internal and external barriers, no specific research has been carried out to investigate the external barriers impeding a robust deployment of QMS in the construction industry. This dearth of relevant research emphases the critical need to investigate the external factors in order to elaborate the different impacts of these factors on QMS deployment, especially in the CIBS. The need for further research is also attributable to the significance of investigating holistic barriers to QMS implementation and identify how these obstacles can effectively be tackled, to improve the performance of construction organisations (Cagnazzo, et al., 2010).

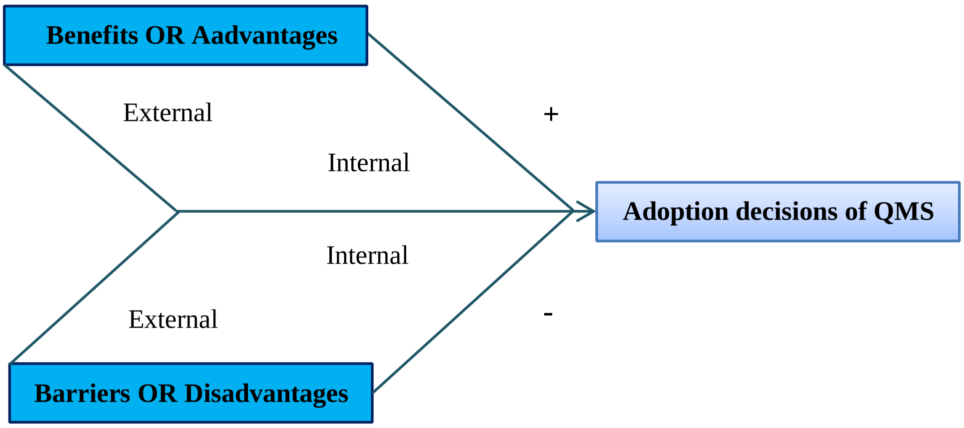


Figure 3.2: Impact of benefits and barriers on the decisions of adopting a QMS (Source: Karipidis, et al., 2009, p. 94)

The major obstacles to QMS implementation are summarised by some studies to encompass (Al-Najjar & Jawad, 2011; Rogala, 2016; Tan & Abdul Rahman, 2011):

- Insufficient management support;
- Reluctant staff to accept a quality system;
- Difficulty in understanding the systems;
- More paper work;
- Documentation problems;
- Difficulty in measuring results;
- Problems in controlling subcontractors;
- Inefficient communication;
- Increased required cost and time;
- Inadequate human resources;
- Insufficient information; and,
- Lack of expertise in quality systems.

In addition to the above, some companies have encountered considerable obstacles during planning and implementing QMS, and these problems are mainly due to lack of experience and knowledge in the company and in the industry (Shio, 2016). For instance, insufficient training for staff, inadequate financial resources, and gaining staff commitment towards QMS implementation are the main obstacles. (Aggelogiannopoulos, et al., 2007). Lack of awareness and knowledge have been asserted as major obstacles to implementing a QMS in the construction industry (Keng & Kamil, 2016; Rashed & Othman, 2015). However, this lack of an adequate level of qualification may also result from insufficient training for project teams, which is key to providing staff the required perception and familiarisation with QMS requirements (Chin & Choi, 2003; Tan & Abdul Rahman, 2011). From a different perspective, Samsudin, Ayop, Sahab, and Ismail (2012a) categorised the problems that face effective QMS implementation into five groups, including considering a QMS as purely marketing tools, a lack of knowledge and expertise, insufficiency in motivation, lack of training, and qualification in the conducting of quality audits.

Lack of management commitment is considered one of the main issues confronting the implementation of a QMS in the construction industry (Al-Asiri, 2004; Psomas, et al., 2013; Salem Hiyassat, 2000). The issue of management commitment is associated with the lack of perceiving QMS adoption benefits, in which quality is not placed as the priority against time and cost by many top managements of construction organisations (Kiew, et al., 2016; Tan & Abdul Rahman, 2011). The construction sector is hindered by managerial challenges during a QMS implementation in the fields of organisational structuring, documentation control, procedures definition and maintenance, customer satisfaction, activating interaction between production departments and quality, and costs and conduct of human resources evaluation (Cachadinha, 2009).

In a study carried out by Valdez and Chini (2003), the authors observed that the main ranked obstacles that discouraged construction companies from adopting QMSs such as ISO 9000 were at a high level; these included: personal involvement, the high cost of certification, inappropriateness to construction firms, lack of information provided, required time of registration process, the privacy of management, and may not be needed for national projects. These authors (ibid 2003) confirmed that the cost and duration of deploying a QMS are the most significant obstacles that prevent construction companies from implementing a QMS. This cost makes construction organisations hesitant to implement a QMS, especially because the benefits of adopting such systems are still uncertain for these organisations (Bubshait & Al-Atiq, 1999; Carayon, et al., 2010; Shio, 2016). This is a negative misunderstanding of quality cost, which is common across many construction organisations, who consider the cost of implementing a QMS is unnecessary spending (Keng & Kamil, 2016). However, the cost of non-conformance works, such as rework, correcting error, and reacting to client complaints, is often overwhelming (Hadidi, Assaf, Aluwfi, & Akrawi, 2017; Keng & Kamil, 2016).

Aichouni, et al. (2014), who investigated adoption of a QMS within the Saudi Arabian construction sector, categorised barriers to implementing a QMS into two main groups depending on organisational perspective and cultural point of view. From an organisational point of view, the obstacles ranked according to their importance include management preferring lowest contractors' tender bids, pushing for equal effectiveness of teams, deficient skills and training in employees, lack of quality improvement resources, and lack of management support. The barriers identified in cultural perspective are as follows: required resources and cost, required paperwork, the pressure of work, non-relevant quality programs, lack of required time, and complications of QMSs (Aichouni, et al., 2014). The difference in both perspectives indicates poor perception about a QMS implementation, and the organisational culture as a main barrier for implementing a QMS in the Saudi Arabia construction industry (ibid 2014).

Other authors support some of the barriers referred to above and confirm that these and several others impede construction companies when obtaining QMS, ISO 9000 certification and subsequently implementing their QMSs within the construction sector context, as follows (Keng & Kamil, 2016; Salem Hiyassat, 2000; Turk, 2006):

- Required time of registration process;
- The cost of obtaining certification;
- Management support for a new QMS;
- Lack of knowledge about QMS;
- Awareness of QMS importance;
- Required resources and paperwork; and,
- Reluctance of company employees.

As an illustration, reluctance of staff to change is one of the serious barriers facing successful deployment of QMS in the construction industry wherein these employees need to quickly adapt to the continual changes associated with QMS maintenance and improvement (Ilango & Shankar, 2017; Salem Hiyassat, 2000). This resistance is attributed by related staff to considering any change to QMS requirements as threatening in terms of creating uncertainty and displaces that required new knowledge and skills. In addition, such change or improvement probably requires additional works in respect to necessary training and documentation as well as required time to cope with these changes where a workforce suffers from a tight timeline (Keng & Kamil, 2016; Salem Hiyassat, 2000). Also, required paperwork and documentation is a serious barrier to QMS implementation in construction projects (Gilbert & Sia, 2001; Ilango & Shankar, 2017). Since implementing an effective QMS involves coping with a huge amount of documentation work throughout the deployment of a system, lack of clear perception or ignorance of the essentials of documentation requirements causes a considerable amount of extra paperwork that is difficult to use or control (Gilbert & Sia, 2001; Heras-Saizarbitoria & Boiral, 2013).

Other studies conducted specifically amongst construction contractors concluded that the major obstacles discouraging them from implementing a QMS successfully were high required cost, staff reluctance to change, decreased workforce productivity, management support, qualified employees, difficulty in controlling QMS implementation within all sites, ineffective communication, and the various cultures of workforce (Bubshait & Al-Atiq, 1999). An effective deployment of a QMS requires an efficient internal and external communication, which is clearly an obstacle to the adoption of a QMS due to poor communication (Femi, 2015; Kam, 2000). Poor communication in construction organisations is rationalised to limited information and resources, and lack of experience and training as well as miscommunication between staff members due to different background and culture (Berrouiguet, 2013; Keng & Kamil, 2016).

Furthermore, a study carried out by Willar, et al. (2015) concluded that the main obstacles that hinder the Indonesian construction companies from effective ISO 9001 QMS implementation, include unawareness of QMS purposes and terminology, poor design of reward system, dissemination of QMS, lack of top management support, deficiency in required cost, difficulty in controlling sub-contractors and suppliers, ineffective internal and external communication, lack of company commitment, and reluctance towards QMS implementation. In spite of these detailed obstacles, these authors (ibid 2015) assert that management attitude and purposes are the most common obstacles faced when adopting QMS within construction companies in Indonesia. On the other hand, although the obstacles that hinder the practical implementation of an ISO 9001 QMS before and after certification are generally similar, unsuccessful defining of responsibility and authority, together with misinterpretation for QMS requirements among involved staff, are asserted to be the main barriers facing the effective implementation of QMSs after obtaining certification (Chow-Chua, Goh, & Boon Wan, 2003).

Misinterpretation of QMS requirements is indicated by many studies as a barrier confronting a successful adoption of QMS (Al-Asiri, 2004; Gilbert & Sia, 2001; Rogala, 2016; Salem Hiyassat, 2000). This issue is associated with the complicated requirements of a QMS, which are often hard to understand owing to the nature of their terminologies being abstract and not easy to be grasped (Shio, 2016). The difficulty in understanding the requirements of a QMS is somewhat due to the lack of knowledge and resources in a company (Keng & Kamil, 2016). On the other hand, lack of required control over sub-contractors probably leads to increasing the level of misunderstanding of QMS requirements because the degree of controlling subcontractors by the main contractor is limited (Salem Hiyassat, 2000; Samsudin, et al., 2012a). As a result, an adequate control over subcontractors may result in facing critical non-conformance that requires undertaking corrective actions, which impact a QMS due to the required time to handle such non-conformance (Gilbert & Sia, 2001; Santos, et al., 2014). Although insufficient time is considered as a hindrance to the effective adoption of QMS in construction, this issue is probably associated with poor planning performed at the early stage of a project, resulting in company failure to meet the proposed deadline (Keng & Kamil, 2016).

In another study undertaken by Alam and Bhuiyan (2005) in the Canadian construction industry, the major items that impeded implemention of ISO 9000:2000 QMSs were assessment process of customer requirements, process of client communication, process monitoring and measuring, process of product design, process of quality management, process of non-conformance management, process of record keeping, process of internal audit, process of purchasing, and process of quality management. According to several other authors, the effectiveness of audit has a direct impact on the sustainability of an ISO 9001 QMS implementation (Rajendran & Devadasan, 2005). In this context, some issues associated with the effective audits of QMS have been revealed by Zeng, et al. (2007). These issues are, namely the lack of certified bodies commitment, too much competition between certified bodies, lack of consultancy provided by these bodies, and lack of supervision system on certified individuals. The latest version of QMS, ISO 9000:2015 was released, and this version introduces prime changes relative to the 2008 version in the number and type of principles of quality management systems (ISO: 9000, 2015); these shifts may represent new barriers for companies to transfer their QMs adapted to the latest version.

### 3.4.1 Categorisation of identified barriers

Critical obstacles hindering the effective implementation of a QMS in the construction industry have been well-identified and, to a greater extent, evaluated in the current literature. Despite those identified barriers and the overall awareness of their impact on QMS implementation, there are only a few studies that gather, unify and integrate these barriers together, and classify them into different groups based upon the source of generating these obstacles. The current research, seeks to fill this gap, by gathering together a group of the most remarked-on barriers impeding the effective deployment of a QMS and categorising these barriers into seven key-classes as shown in Figure 3.3. This grouped heading model symbolises a knowledge base to be used later in a developed framework of a QMS implementation in the CIBS. Grouping these barriers facilitates management teams to cope with the impacts of the barriers of each class, by redirecting their focus to a specific group in which a barrier is generated. Table 3.1 below, however, exhibits the main barriers generated from their seven sources, generally impeding an effective deployment of a QMS in the construction industry.

Table 3.1: Barriers to QMS implementation according to source

| No. | Barriers Category | Barriers | References |
|---|---|---|---|
| 1 | **Managerial** | Inadequacy of management support | (Aichouni, et al., 2014; Al-Najjar & Jawad, 2011; Rogala, 2016; Tan & Abdul Rahman, 2011; Turk, 2006; Willar, et al., 2015) |
| | | Procedures definition and maintenance | (Cachadinha, 2009; Chow-Chua, et al., 2003; Keng & Kamil, 2016) |
| | | Unwell design of reward system | (Al-Asiri, 2004; Cagnazzo, et al., 2010; Kam, 2000; Syaj, 2015b; Willar, et al., 2015) |
| | | Dissemination of QMS | (Al-Asiri, 2004; Hadidi, et al., 2017; Rogala, 2016; Willar, et al., 2015) |
| | | Lack of sufficient assessment of customer requirements | (Alam & Bhuiyan, 2005; Cachadinha, 2009; Cagnazzo, et al., 2010) |
| | | Inadequacy of interaction between production departments and quality | (Al-Asiri, 2004; Cachadinha, 2009; Salem Hiyassat, 2000; Tan & Abdul Rahman, 2011) |
| | | Lack of human resources evaluation | (Cachadinha, 2009; Gilbert & Sia, 2001; Ilango & Shankar, 2017; Kam, 2000; Keng & Kamil, 2016) |
| | | Difficulty of controlling a QMS implementation within all sites | (Bubshait & Al-Atiq, 1999; Keng & Kamil, 2016; Salem Hiyassat, 2000; Shio, 2016) |
| 2 | **Organisational** | Misinterpretation of QMS requirements amongst involved staff | (Chow-Chua, et al., 2003; Gilbert & Sia, 2001; Keng & Kamil, 2016; Rogala, 2016; Shio, 2016) |
| | | More paperwork | (Aichouni, et al., 2014; Al-Najjar & Jawad, 2011; Keng & Kamil, 2016; Tan & Abdul Rahman, 2011; Turk, 2006) |
| | | Documentation problem | (Al-Najjar & Jawad, 2011; Alam & Bhuiyan, 2005; Cachadinha, 2009; Syaj, 2015b) |
| | | Difficulty of measuring results | (Al-Najjar & Jawad, 2011; Salem Hiyassat, 2000; Tan & Abdul Rahman, 2011) |
| | | Dearth of motivations of workforce | (Keng & Kamil, 2016; Rusjan & Ali, 2010; Samsudin, et al., 2012a; Shio, 2016) |
| | | Problem in controlling subcontractors | (Al-Najjar & Jawad, 2011; Ilango & Shankar, 2017; Tan & Abdul Rahman, 2011; Willar, et al., 2015) |
| | | Inadequacy of human resources | (Al-Najjar & Jawad, 2011; Keng & Kamil, 2016; Shio, 2016; Tan & Abdul Rahman, 2011; Turk, 2006) |

| | | | |
|---|---|---|---|
| 3 | **Communicational** | Inefficient communication | (Al-Najjar & Jawad, 2011; Alam & Bhuiyan, 2005; Bubshait & Al-Atiq, 1999; Rogala, 2016; Syaj, 2015b; Tan & Abdul Rahman, 2011; Willar, et al., 2015) |
| | | Insufficient information | (Aichouni, et al., 2014; Al-Najjar & Jawad, 2011; Cagnazzo, et al., 2010; Tan & Abdul Rahman, 2011; Valdez & Chini, 2003) |
| | | Lack of experience and knowledge | (Aichouni, et al., 2014; Al-Najjar & Jawad, 2011; Rashed & Othman, 2015; Shio, 2016; Syaj, 2015b; Tan & Abdul Rahman, 2011; Turk, 2006; Willar, et al., 2015) |
| 4 | **Financial** | Required cost and time | (Al-Najjar & Jawad, 2011; Bubshait & Al-Atiq, 1999; Cachadinha, 2009; Keng & Kamil, 2016; Shio, 2016; Tan & Abdul Rahman, 2011; Valdez & Chini, 2003; Willar, et al., 2015) |
| | | Preferring lowest contractors' tender bids | (Aichouni, et al., 2014; Gilbert & Sia, 2001; Ilango & Shankar, 2017; Kam, 2000; Syaj, 2015b) |
| | | Cost of certification | (Cagnazzo, et al., 2010; Tan & Abdul Rahman, 2011; Turk, 2006; Valdez & Chini, 2003) |
| | | Decreased workforce productivity | (Bubshait & Al-Atiq, 1999; Salem Hiyassat, 2000; Shio, 2016; Syaj, 2015b) |
| 5 | **Cultural** | Considering a QMS as marketing tool | (Cagnazzo, et al., 2010; Keng & Kamil, 2016; Samsudin, et al., 2012a; Tan & Abdul Rahman, 2011) |
| | | Various cultures of workforce | (Bubshait & Al-Atiq, 1999; Gilbert & Sia, 2001; Syaj, 2015b; Tan & Abdul Rahman, 2011) |
| | | Reluctance of staff to accept QMSs | (Al-Najjar & Jawad, 2011; Bubshait & Al-Atiq, 1999; Keng & Kamil, 2016; Shio, 2016; Tan & Abdul Rahman, 2011; Turk, 2006; Willar, et al., 2015) |
| 6 | **Educational** | Insufficient training for staff | (Aggelogiannopoulos, et al., 2007; Aichouni, et al., 2014; Al-Najjar & Jawad, 2011; Syaj, 2015b; Tan & Abdul Rahman, 2011) |
| | | Lack of required qualifications of employees | (Aichouni, et al., 2014; Bubshait & Al-Atiq, 1999; Kam, 2000; Tan & Abdul Rahman, 2011) |
| 7 | **Auditing** | Lack of certified audits commitment | (Keng & Kamil, 2016; Rajendran & Devadasan, 2005; Rogala, 2016; Zeng, et al., 2007) |
| | | Over-competition between audits | (Rajendran & Devadasan, 2005; Zeng, et al., 2007) |
| | | Lack of consultancy provided by audits | (Rajendran & Devadasan, 2005; Rogala, 2016; Zeng, et al., 2007) |
| | | Lack of supervision system | (Rajendran & Devadasan, 2005; Zeng, et al., 2007) |

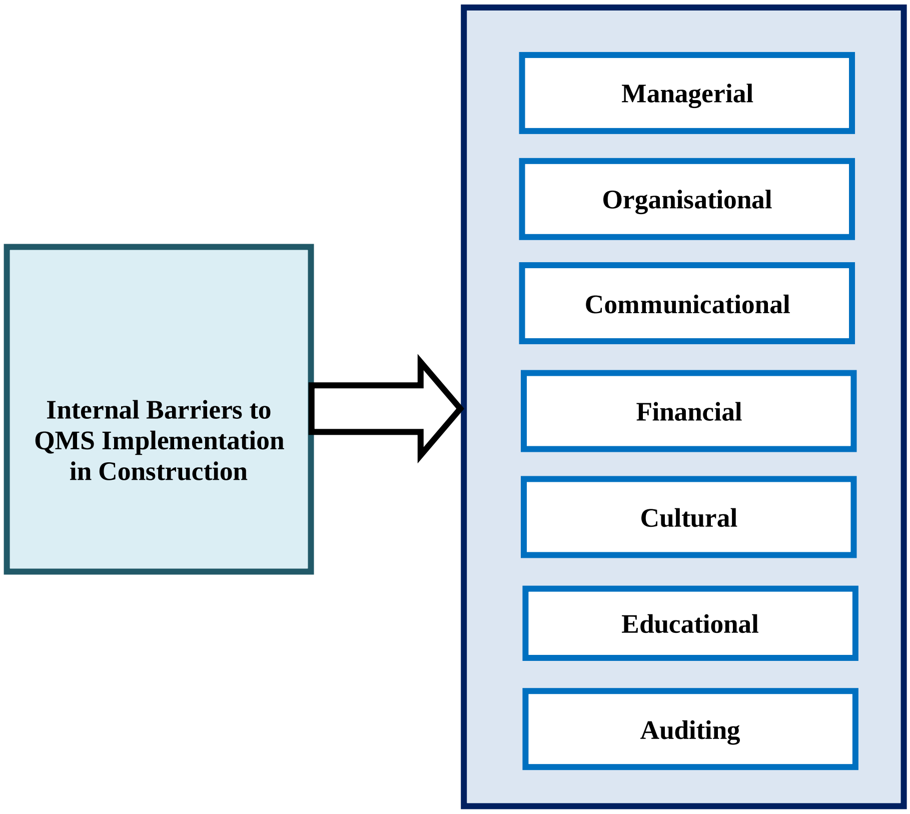


Figure 3.3: Classes of QMS barriers model

## 3.5 CSF FOR EFFECTIVE IMPLEMENTATION OF QMS

The construction industry is one of the most important sectors in the economy of most countries, not only because of the key contribution of this industry to the Gross Domestic Product (GDP) of a national economy, but also due to the association of such industry with other sectors through a complex set of interrelationships. Therefore, achieving a satisfactory performance of the construction industry is fundamental to the well-being of several other industries and, vice versa. Some studies have been carried out since the 1960s, focused on the identification of the concepts and applications of Critical Success Factors (CSFs), (Ammar et al., 2009) in the context of metrics for managing and measuring success in organisations. Although in the context of project management, the notions of success and failure were initially introduced by Rubin and Seelig (1967), the terminology *critical success factors* was used for the first time by Rockart (1982a) to examine the existing methodology of management information systems, as mentioned by Sanvido et al. (1992).

Following its introduction into the management vernacular, this terminology was utilised by other industries, including the construction sector (Norizam & Malek, 2013). In spite of a number of relevant studies on CSFs, there is still little agreement on CSFs because of the different perceptions of stakeholders towards success factors and due to the various nature and objectives of projects. Researchers are, therefore, continuing to conduct more work in the area of examining the efficacy and implications of CSFs (Kog, Loh, & Chua, 1999; Phua, 2004; Toor & Ogunlana, 2008). The term 'critical success factor' 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 standing behind project success or failure have to be made clear (Belassi & Tukel, 1996). Toor and Ogunlana (2008) established a new conceptual framework, which clarifies the significance of the appraisal of CSFs, by categorising construction project management into three phases: input, process and outcome, and into two primary domains, process and performance, which are illustrated in Figure 3.4 below.

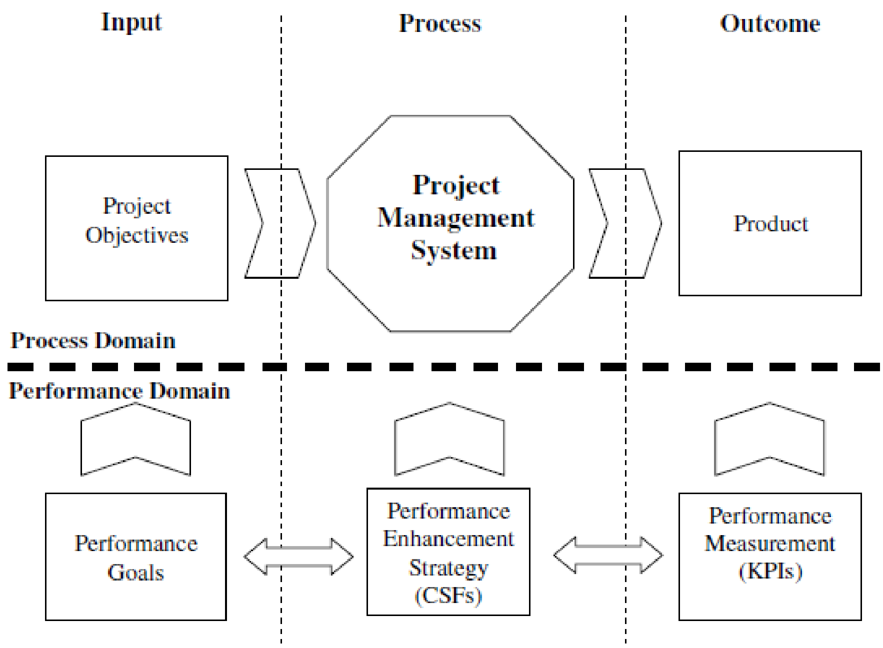


Figure 3.4: A conceptual framework of the significance of CSFs appraisal (Toor & Ogunlana, 2008, p. 428)

During the input stage, the process domain is regarded as setting up the objectives of the construction project. This process then takes into consideration devising an adequate management system to achieve project objectives in the form of products during the process stage. However, the performance domain concerns setting up performance goals during the input phase, and then in the process phase, CSFs are established as a strategy to enhance project performance. Performance measurement is achieved by using key performance indicators (KPIs) during the outcome phase (ibid 2008). CSFs have been defined as "*The critical areas which organisation must accomplish to achieve its mission by examination and categorisation of their impacts*" by Oakland, (as cited in Ismail Salaheldin, 2009, p. 218). Rockart (1982b, p. 4) also defined CSFs as "*Those few key areas of activity in which favourable results are absolutely necessary for a particular manager to reach his or her goals*". However, CSFs have also been described as " *the few key areas where things must go right for business to flourish*" (Leidecker & Bruno, 1984, p. 23).

### 3.5.1 The CSFs for effective implementation of QMS in construction

The construction industry is considered as a project-based sector in which the definition of quality mainly focuses on meeting client expectations (Abdullah, et al., 2015; Jha & Iyer, 2006). QMS in construction is categorised into two levels, namely: company-based QMS and project-based QMS. However, the success of QMS adoption should be measured at project level wherein the QMS is implemented to fulfil client expectations regarding quality (Almeida, et al., 2014; Jha & Iyer, 2006). Most of the studies that examined the CSFs for QMS adoption in construction were conducted at company level rather than project level (Abdullah, et al., 2015; Ismyrlis, Moschidis, & Tsiotras, 2015). While there are many examples of successful implementation of a QMS in construction, there is still a constant need to identify and explore the CSFs to address the issues facing the sustainable implementation of such a system (Zeng, et al., 2007). Nevertheless, investigating CSFs provides positive indications of success within the construction industry in multiple areas, namely competitive strategy, market condition awareness, organisational structure, technical applications, and employee enhancement (Abraham, 2003).

Furthermore, to provide a better understanding towards QMS implementation, identifying the major factors which drive effective QMS implementation is a vital role of researchers. Whilst there are extensive studies that have investigated the impact of CSFs for QMS adoption in other sectors, in the construction industry, only a few studies have been conducted to explore the CSFs for QMS implementation, particularly at the project level (Abdullah, et al., 2015; Aichouni, et al., 2014; Chin &

Choi, 2003; Pheng L. & Omar F., 1997). However, following are the CSFs for QMS implementation identified by analysing the extant and relevant literature.

***Top management commitment***

Top management commitment demonstrates those elements that measure the involvement and support the quality of people at higher levels of a company's hierarchy (Hietschold, Reinhardt, & Gurtner, 2014). Many researchers have emphasised the significance of top management commitment for practical implementation of a QMS (Abdullah, et al., 2015; Chin & Choi, 2003; Mohamad Al-Sabek, 2015; Ugboro & Obeng, 2000). It is clear that top management commitment impacts as a driver in initiating a deployment of QMS within any company (Hussain & Younis, 2015), since the adoption of any tools or elements of quality depends on them (Fening, 2012). Chin and Choi (2003) asserted the positive roles of top management commitment in implementing an effective QMS is practised by identifying and applying efficient technical skills to qualify employees. These encompass providing essential resources, making better decisions towards problem solutions, and ensuring continuous improvement through making values, goals and systems to satisfy client expectations and ensuring better company performance (Amar, 2012; Ismyrlis, et al., 2015). These factors relating from such commitment demonstrate high value for the business as managers who communicate a quality commitment, stimulate their employees to implement changes, allow them to participate in their decisions, and motivate them (Almeida, et al., 2014; Claver, Tarí, & Molina, 2003).

To realise the benefits of top management commitment, such management should focus on updating facilities, equipment, and technological resources within the company as well as ensuring adequate motives for QMS implementation (Psomas, et al., 2010). In other words, top management should dedicate and provide enough initiatives and resources for successful implementation of QMS (Rashed & Othman, 2015). However, according to Lin and Wu (2012) whose work evaluated the quality of Taiwan's construction sector, lack of top management commitment in pursuing outstanding quality has resulted in an ambiguous QMS and weak competition of local companies against foreign enterprises. Although quality and productivity are the responsibility of everybody within the company, top management must lead the process to achieve a satisfactory level of quality, by introducing constant purpose and thus making this process possible for everyone within the organisation to achieve (Deming, 1981). To this end, Hussain and Younis (2015) conclude that top management commitment is a driver to initiate the early stage of a QMS adoption within a company.

Therefore, the focus of top management should be on understanding the requirements for, and investing in, improving and developing quality, adopted systems and customer requirements, formulating quality and policy, defining responsibilities, authorities, and process of communication, and these will probably lead to facilitating the effective implementation of a QMS (Magd, 2010). Arumugam, et al. (2008) asserted that top managers can ensure the maintaining of a high level of client focus and continuous improvement, which are significant determinants contributing to quality performance, by enhancing their knowledge of effective continuous improvement practices. On the downside, regardless of quality significance, as an element of focus and concern, this is still lagging behind cost and time in the eyes of top management, and lacks the necessary resource allocation thus impeding attainment of a satisfactory level of top management commitment (Tan & Abdul Rahman, 2008).

***Leadership support***

Leadership support is considered as of the main CSFs for QMS implementation in construction (Abdullah, et al., 2015; Fening, 2012; Ismyrlis, et al., 2015; Ugboro & Obeng, 2000). The term 'leadership' has variously been explicated by different scholars with respect to responsibility, position and personality, but directing a group towards meeting a goal is the most commonly utilised description of leadership (Fening, 2012). The focus of this section is to examine the ability of leadership to impact an organised group of a project towards goal achievement effort. Leadership behaviour is a significant element that has a direct impact on the success of project management because leadership effectiveness is a key for every construction project (Gharehbaghi & McManus, 2003). Leadership support manifests a comprehensive commitment and involvement of top management in the process of a QMS implementation (Ismyrlis, et al., 2015). To achieve high quality in the construction process, management leadership is fundamental in promoting a QMS and ensuring continuous quality improvement (Gunaydin & Arditi, 1998).

However, the effectiveness of leadership within construction projects might be affected by passive personal attributes of managers, such as unfair use of power, inadequate ability to communicate, insufficient experience, inadequate capability to manage complex circumstances, as well as organisational obstacles, namely deficient resources, inadequate planning and control, and ineffective management strategy (Toor & Ogunlana, 2009). Notwithstanding that, personal consideration, inspiration and motivation of leadership directly impact a final project quality because all significantly spread down to the workforce of a project where creativity in problem solving and quality outcomes are enhanced (Bani Ismail, 2012). Therefore, ISO 9001: 2015 made a significant change to the introduction of Leadership instead of Management Responsibility to emphasis the role of top management in the effective operation of QMS, in which top management should be involved 'personally' in QMS activities to control processes and in attaining the intended outcomes, rather than be restricted on taking responsibility (ISO: 9000, 2015; Kerekes & Csernátoni, 2016). Bhuvan and Bansal (2017) argued that senior management should practise their philosophy of management by immersing themselves in the process of QMS deployment by engaging with different stakeholders of a project to gain a clear vision about the required actions to improve the level of implementation.

***Management review and feedback***

Management review helps to ensure that an adequate evaluation of QMS implementation adequacy is done regularly (Chini & Valdez, 2003; Pheng L. & Omar F., 1997). This evaluation leads to making practical decisions based upon data and information analysis to check the effectiveness of QMS and quality performance (Willar, et al., 2015). Management review may be conducted to check purposes (Ismyrlis, et al., 2015; Pheng L. & Omar F., 1997), such as:

- New requirements of customer;
- Any potential changes in the domain of company work;
- Critical non-conformance; and,
- Main identified non-compliance.

Top management, therefore, should review a QMS of organisation during planned intervals, to assure the effectiveness, adequacy, continuing suitability, and alignment of a QMS with the strategic direction of company (ISO: 9000, 2015). To determine if there are opportunities or needs required to be indicated as part of continuous improvement, the results of analysis and evaluation by means of feedback gained from management review should be considered by organisations (Chini & Valdez, 2003; Kerekes & Csernátoni, 2016). However, management review significance is associated with the need for effective decisions towards QMS deployment, in which these decisions are supported by data analysis gained from performance indicators, effectiveness indicators, and control points of QMS (Piskar & Dolinsek, 2006).

***Continuous improvement***

Continuous improvement provides evidence of a QMS meeting ongoing operations and business environment requirements (Pheng L. & Omar F., 1997). Continuous improvement also aims to improve the level of organisational performance by providing focused changes of processes where needed (Wu & Chen, 2006). According to ISO: 9000 (2015), improvement is fundamental for a company to maintain current levels of performance, to stimulate changes in its internal and external environments and to provide new opportunities. Therefore, to keep a QMS alive, in progress, growing, and competitive, it is necessary to enhance continuous improvement towards the processes, staff, and systems inherent in that QMS (Ab Wahid & Corner, 2009). Since continuous improvement has a direct key influence on organisational performance (Hussain & Younis, 2015), it is the responsibility of management to interpret its own desired goals of continuous improvement by activating involvement of employees into quality improvement activities (Chin & Choi, 2003).

Because quality is considered an essential element for sustainability and customer satisfaction, in construction, quality performance is key for gaining client satisfaction (Palaneeswaran, et al., 2006). Hence, continuous improvement primarily seeks to acquire excellence in customer satisfaction by developing robust requirements of QMS, which mainly aim at meeting client expectations regarding quality (Ilango & Shankar, 2017). To gain a better understanding of a QMS, it is essential to be able to identify the major factors that drive the effectiveness of QMS implementation and continuous improvement. Thus, these influential factors should be taken seriously into account by all levels of management (Willar, et al., 2015). For this reason, construction organisation should determine and provide the essential resources required for the implementation, maintenance, establishment, and continuous improvement of QMS (ISO: 9000, 2005; ISO: 9000, 2015).

***Attitude to change***

The continuously changing nature of the construction sector is necessary to service new client demands and changing technology requires immediate attention from all stakeholders within the industry (Abraham, 2003). Acceptance or rejection of changes for QMS implementation depends upon the supportive attitudes of employees as well as their orientation towards quality (Hietschold, et al., 2014). Positive attitude to change, however, is essential to support management review and continuous improvement of QMS where the conscience of employees is critical for upgrading a QMS by adapting to established changes (Almeida, et al., 2014; Chin & Choi, 2003). Thus, there is a connection between positive attitude of employees towards QMS and their overall commitment concerning organisation goals, especially if they perceive the expectations of quality (Dargahi & Rezaiian, 2007). On the contrary, gaining positive attitude to change to facilitate implementation of a QMS in an organisation requires adequate education and qualification of employees as well as an effective participation in QMS deployment (Dargahi & Rezaiian, 2007).

***Quality culture***

Many previous studies have stressed the positive effect of developing a quality culture and promoting change management (Abdullah, et al., 2015; Chin & Choi, 2003; Juanzon, 2017; Psomas, et al., 2013). The main purposes of cultural changes are to open the company to advanced communication, motivate employees, improve training and education on quality, enhance safety and healthy working environment, satisfy the client, and ensure continuous improvement (Chin & Choi, 2003). Psomas, et al. (2010) confirmed that it is fundamental to draw attention to culture change by creating a robust internal environment directed on achieving effective QMS implementation. Changing the organisational culture by enhancing awareness programmes and training among different levels of staff within the construction sector can prominently contribute to overcoming the barriers hindering QMS implementation (Aichouni, et al., 2014). On the other hand, unless an appropriate quality culture is presented, or improved and changed to support and sustain adopting QMSs, it seems meaningless to implement them (Khoo & Tan, 2002).

Therefore, top management should pay attention to organisational culture because it represents one of the most critical elements to obtain a robust internal environment that creates a basis for effective adoption of a QMS (Almeida, et al., 2014;

Psomas, et al., 2010). On the other hand, the absence of a quality culture and inadequate awareness concerning the importance of ISO 9001 are attributable to the lack of management support and training for a workforce since these factors are directly associated with poor perception of quality amongst employees (Psomas, et al., 2013). Construction organisations should, therefore, focus upon changing the quality culture across all levels of a company, starting from top management down to a project team where a QMS is implemented, along with a transformational vision for a quality oriented culture (Almeida, et al., 2014; Kiew, et al., 2016).

***Teamwork***

Teamwork is a key startegy to accomplish any task or activity. Teamwork is defined by Herriot and Pemberton, 1995 (as cited in Stonehouse, 2011, p. 351) as "*a small number of people with complementary skills who are committed to a common purpose, set of performance goals and approach for which they hold themselves mutually accountable*". Since quality teams provide a structured environment that is fundamental for successful QMS implementation and a continuous improvement process, the principal aim of teamwork ultimately is to ensure the involvement of everyone into the process of quality improvement (Gunaydin & Arditi, 1998). Teams provide an essential mechanism to listen to and communicate with the customer, and to measure customer satisfaction levels (Arditi & Gunaydin, 1997). Accordingly, teamwork should concern all the construction parties, such as customers, consultants and contractors, to achieve an overall goal, togetherness, and integration between them (Abdullah, et al., 2015). The primary roles of teamwork commitment include sharing public awareness of performance requirements, approving new project roles, sharing common goals of the project, providing a high level of cooperation, utilising adequate communication tools, offering a high degree of trust, and contributing to conflict solution within construction projects (Chan & Tam, 2000).

However, since some members of teams view the aim of teamwork as being irrelevant, uninteresting, and insignificant, obtaining the participation of those members is a core factor of successful teamwork within a company (Stonehouse, 2011). Notwithstanding that, assuring an effective teamwork requires a precise definition of the responsibilities and roles of the employees involved in the process of QMS adoption, in conjunction with a distinct description of the tasks associated with QMS procedures (Almeida, et al., 2014). Effective teamwork needs the participation and involvement of every employee to primarily ensure familiarity and understanding between them essential to assure effective teamwork throughout the project (Stonehouse, 2011).

***Communication and Coordination***

Communication is considered one of the major factors impacting the effective implementation of QMS, regardless of the type of QMS being adopted (Abdullah, et al., 2015; Hawrysz, 2014; Ilango & Shankar, 2017). Communication is described as an exchange of meanings, through a complex layered and dynamic process (Adler, 2007; Hawrysz, 2014; Hawrysz & Hys, 2015). Gunaydin and Arditi (1998) revealed that efficient communication and effective coordination during the design phase of construction projects may minimise those costly and negative factors, such as rework, design changes, constructability issues, and frequency of changes during the construction phase. When a company intends to initiate adoption of a new QMS, it also needs to introduce internally some communication skills, long-term focus as well as strategic teamwork training (Achanga, Shehab, Roy, & Nelder, 2006). However, the efficiency of internal communication is often determined by two groups of factors, including organisational and socio-cultural factors (Adler, 2007). Socio-cultural factors indicate the cultural background of the communication and personal characters of a communicative workforce (Hawrysz, 2014). Organisational factors, however, represent an objective framework of communication processes that highlights the significance of efficient communication on the configuration of the organisational structure and the distribution of decision-making authority as well as the division of work (Olkkonen, Tikkanen, & Alajoutsijärvi, 2000).

According to Hawrysz (2014), there is a significant correlation between the effectiveness of QMS and the selected elements of communication. For example, the official system of communication for exchanging information between different parties within the company, and workers talking with managers about workplace changes to clarify any misunderstood concepts associated with QMS implementation, might result in more employee empowerment (ibid, 2014). Conventional management practices, typically concerned with top-down strategic planning, and dictation and control of different levels of management, may typically lead to inhibiting bottom-up communication by making exchanges more complex (Alhwairini & Foley, 2012). This lack of efficient communication results in a deceptive and unclear perception of QMS processes, which can adversely impact the project performance (Almeida, et al., 2014). Thus, improving the frequency and quality of communication can lead to increasing the probable satisfaction towards customer expectations (Esmaeili, Franz, Molenaar, Leicht, & Messner, 2013).

***Education and Training***

Employee training and education are critical factors that attract significant attention from organisational management in order to facilitate successful QMS implementation (Hussain & Younis, 2015; Patil, Ullagaddi, & Jugati, 2012; Rashed & Othman, 2015; Rodríguez-Antón & Alonso-Almeida, 2011). Training programs aim to enhance workforce awareness and to initially make employees familiar with QMS benefits in order to faclitate their participation in adopting a QMS (Rashed & Othman, 2015). These programs also increase staff involvement in achieving the strategic objectives of the company (Claver, et al., 2003). Training should target all levels of a construction company, such as management, engineers, technicians, office staff, and field workers (Gunaydin & Arditi, 1998). A QMS deployment provides employees with an incentive to train and improve work conditions, to become qualified and more active, so they might be more satisfied when they can detect enhancement of their own personal skills (Rodríguez-Antón & Alonso-Almeida, 2011). Therefore, employees must be educated to obtain sufficient knowledge and skills about quality concepts, utilising quality tools and techniques, current attitudes towards active listening and cooperation (Abdullah, et al., 2015) .

Furthermore, qualifying employees may facilitate effective application of QMS standards and adoption of a continuous improvement philosophy in which they can participate (Karia & Hasmi Abu Hassan Asaari, 2006). This strategy can be achieved by exposing employees to extensive training, depending on the size and complexity of the company, and associating with principles and tools of QMS (Patil, et al., 2012). Nonetheless, employees who have a low level of qualification may not dedicate themselves to implementing new QMS (Achanga, et al., 2006; Keng & Kamil, 2016). Maintaining a high degree of quality requires qualified employees who better understand quality-related problems as well as their roles in implementing a QMS (Hietschold, et al., 2014). Despite that, determining the competence level of employees essential to achieve allocated works under their control, which eventually impacts performance and effectiveness of QMS, requires ensuring that these workforce members are competent on the basis of appropriate training, education, or experience (ISO: 9001, 2015).

***Employee empowerment***

The concept of employee empowerment, which is closely associated with employee involvement, is widely under-utilised and may, as a result, not be representative of the size of the employee population within the construction industry (Patil, et al., 2012). Employee empowerment is defined as "*the process of shifting authority and responsibility to employees at a lower level in the organizational hierarchy*" (Ghosh, 2013, p. 95). In the other words, it means "*a transfer of power from the managers to their subordinates*" (ibid 2013, p. 95). Persuading employees to react to quality-related issues, and providing them the essential resources and authority in their jobs to contribute to decision-making towards quality improvement, often stimulates employee empowerment. (Ugboro & Obeng, 2000). The use of such strategies can translate to improvement of the levels of customer satisfaction. Thus, employee empowerment assists organisations gain sustainable competitive advantages as long as such empowerment is performed smoothly and effectively (Ghosh, 2013).

In order to achieve the above scenario, employees should first acknowledge customer requirements and be aware how they themselves contribute to fulfilling customer expectations, and this perception should be considered when tackling and resolving actual issues of QMS deployment (Poksinska, 2010). Summarising this, top management commitment plays a significant role in introducing and implementing the programs of employee empowerment by making an appropriate strategy and system, and in enabling culture to impact on and help develop effective programs of employee empowerment within a company to stimulate an interested, desired, willing workforce towards these programs (Hietschold, et al., 2014). This not only affects company performance positively, but also improves development of employees by enhancing their feelings of being important, valued, and significant in decision-making within their business (Poksinska, 2010). However, to ensure an effective adoption of QMS, construction organisation should ensure that employees recognise their roles and responsibilities, and their duties should by performed through practising group participation and decision making (Dargahi & Rezaiian, 2007). Besides, gaining customer satisfaction needs an effective attraction between a client and frontline workforce, which can be facilitated by motivating and empowering employees to enhance their involvement and perception about a quality culture (Ugboro & Obeng, 2000).

***Customer satisfaction***

Customer satisfaction and the meeting of customer requirements are critical factors of quality management (Benson, Saraph, & Schroeder, 1991) since customer focus is a significant element of quality management closely affecting quality performance (Arumugam, et al., 2008; Palaneeswaran, et al., 2006). Customer satisfaction is defined by ISO: 9000 (2015, p. 25) as the "*Customer's perception of the degree to which the client's expectations have been fulfilled*". Hence, Poksinska (2010) asserts that customer requirements are a primary motive that persuade companies to implement a QMS. Customer satisfaction is affected by QMS adoption both directly, and indirectly by operational performance and employee work methods (Del Alonso-Almeida, Bagur-Femenías, & Llach, 2015). The most effective way to enhance customer satisfaction is through developing and implementing a QMS that ensures a consistent, constant, and timely delivered quality product (Dongmo & Onojaefe, 2013). Because of this, improving customer focus by enhancing satisfaction is a crucial strategy for the company to increase competitiveness in times of crisis (Del Alonso-Almeida, et al., 2015). Therefore, to attract customer focus, the company should foster awareness towards current and future customer needs, meet customer requirements, and strive to exceed customer expectations (ISO: 9000, 2005).

The essential conditions required by contractors to support a QMS deployment, such as adequate budgets, the right choice of quality consultant, and incentives towards achieving quality, are provided by customers (Abdullah, et al., 2015). Thus, customer satisfaction is found as one of the main reasons for adopting a QMS in construction organisations (Dongmo & Onojaefe, 2013). This has rationalised the deeper focus of ISO: 9001 (2015, p. 1), on emphasising the overall aim of ISO 9001 that *"aims to enhance customer satisfaction through the effective application of the system, including processes for improvement of the system and the assurance of conformity to customer and applicable statutory and regulatory requirements."*. However, the construction quality performance of stakeholders is also taken into account by customers when they judge how to make interim payments and offer incentives (Hadidi, et al., 2017; Juanzon, 2017). Ugboro and Obeng (2000) stated that a customer satisfaction focus requires empowered and motivated employees to obtain an essential interaction between the staff and clients, which asserts the necessity of the change in organisational culture towards quality.

## 3.6 THE RESEARCH GAP

The implementation of QMS in the construction industry is influenced by many factors owing to the nature of the sector, which is unique in general. Critical obstacles hindering the effective implementation of QMS in the construction industry have been well-identified and to a greater extent, evaluated in the current literature. Despite the numerous identified barriers and the overall awareness of their impact on QMS implementation, most studies have explored these obstacles based upon research in different industries to construction, and to date there has been a dearth of similar research specifically focused on the latter sector. Due to the different industries being focused on, previous studies have overlooked the significant obstacles that may inhibit successful implementation of QMS in the construction industry.

In this research, the classification of the identified barriers, highlighted by the content analysis conducted throughout the literature review, reveals that most of these identified barriers are associated with the internal context of the organisation. It is noted that these barriers are either created by a construction organisation or related to the hierarchical system of organisation. More importantly, most of the studies exploring the barriers relating to QMS implementation were focused on identifying those elements and factors related to internally generated company and hierarchical system of organisation. Extant research, therefore, appears to largely neglect those significant external barriers, which critically hinder successful implementation of QMS within the construction industry. The concept of 'environment' represents all external factors affecting the construction process (Akinsola, et al., 1997). These factors are categorised into six types: economic environment, social environment, political environment, physical environment, industrial relation environment, and level of technology advanced (Chan, et al., 2004). Accordingly, it is clear that these studies neglect largely critical external factors that may represent prime drivers or obstacles towards the successful implementation of QMS in the construction industry.

Although a number of studies have been carried out to identify the CSFs of effective adoption of a QMS in the construction sector, these studies did not sufficiently pay attention to the CSFs of different levels of organisation. Surprisingly, the focus of most studies exploring the CSFs for QMS was at the company level although the effectiveness of QMS adoption should be measured at project level rather than company level, as construction is a project-based endeavour (Abdullah, et al., 2015; Almeida, et al., 2014; Keng & Kamil, 2016; Rashed & Othman, 2015; Rogala, 2016). It seems that many of these studies did not comprehensively examine the views and perspectives of all stakeholders within the industry when they investigated the CSFs since most of them focused only on contractors as a sample of their study populations. The focus of this research was primarily conducted at a project level and specifically during the construction phase, since this phase is essential to ensuring the effective functionality for QMS in the construction industry, which will ultimately impact most on client satisfaction (Liu, 2003). Most of the scholars to date have conducted their research to examine the context of the construction industry in general, while there is no specific study so far that has been carried out to investigate the implementation of QMS in the context of the CIBS in particular. Therefore, this research was performed to explore a QMS deployment in accordance with the context of building organisation projects.

A thorough analysis of the literature review of QMS implementation in the construction industry, and the identification of an obvious gap in the knowledge around the factors affecting successful adoption of such a system, led to the clear need for developing a conceptual framework, which is one of the major objectives of this study. This study, therefore, sought to establish a conceptual framework based upon the intensive analysis of related literature to indicate the main identified factors impacting a QMS adoption and address the prime gap of this study. This proposed framework highlights the critical impacts of external factors, be that on the initial decision of a QMS adoption or successful implementation of QMS throughout the project. The proposed conceptual framework drawn from the literature review is illustrated in Figure 3.5 below.

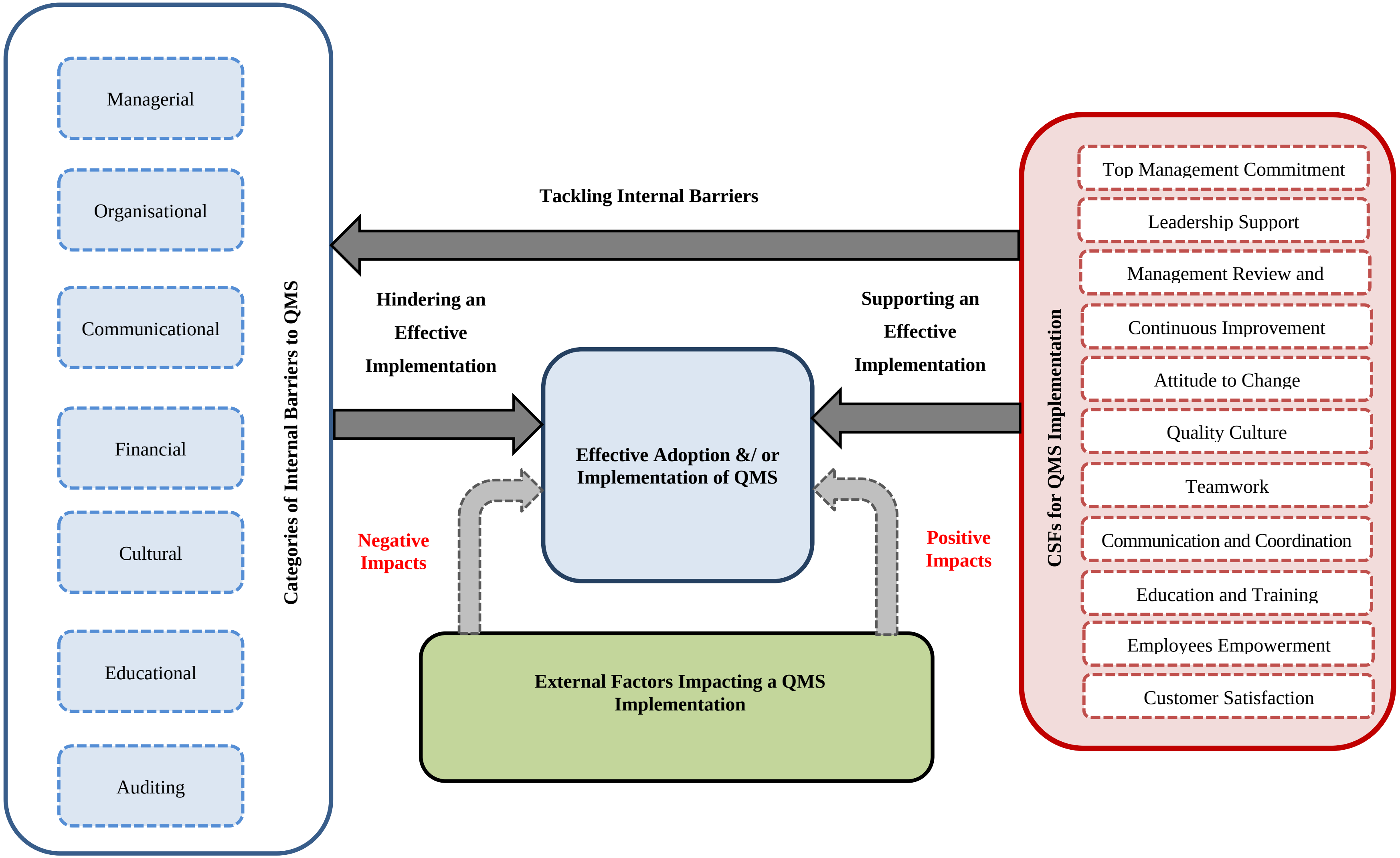


Figure 3.5: A conceptual framework of QMS implementation in construction

## 3.7 SUMMARY

This chapter has explored and evaluated the relevant extant literature related to QMSs, with a focus on their definitions and adoption in the construction sector. It presented a detailed literature review on the critical concepts of QMS in the construction industry, by focusing on QMS implementation in this sector, and investigates the benefits of a QMS, the barriers to adopting QMS, and the CSFs of QMS implementation. Hence, this chapter addressed the gap in the field of QMS deployment and suggested a need for greater adoption of QMS in the CIBS by overcoming barriers facing the implementation and adopting comprehensive CSFs across all levels of a company. That can be fulfilled by addressing external factors, which appear to be significantly largely neglected by previous studies and critically inhibit successful adoption of QMS or may represent prime drivers towards the effective employment of QMS. Accordingly, this review of literature has firmly confirmed the need for more studies in order to identify the current problems hindering the successful deployment of QMS.

This chapter also highlighted that many of the preceding studies did not comprehensively examine the CSFs of all levels of construction companies, since the major focus was on a company level. Accordingly, to bridge this gap, this research sought to consider all CSFs influencing the effective implementation of QMS in the CIBS, specifically those impacting at project level. The next chapter will present the design of this research and proposes the most appropriate methodology adopted to fulfil the major aim and objectives of this study and answer the research questions.

# Chapter 4: Research Design

## 4.1 INTRODUCTION

The previous chapters dealt with the review and critical analysis of the extant literature that led to identifying the relevant gaps in the current knowledge and development of a conceptual framework of a Quality Management System (QMS) for implementation in the construction industry. The philosophical perspective and research paradigm, design and approach of the research, methodology, as well as data collection and analysis methods, are comprehensively justified within this chapter. The chapter also sets down the data collection methodologies, and identifies the study population, describes the sampling strategy and selection of respondents, and presents and justifies the proposed analysis methodology.

Therefore, this chapter describes the design of the research, and proposed methodology applied to meet the main aim and objectives and answer the main research questions. Using a qualitative approach, data is collected and later analysed to obtain a comprehensive understanding of, and explain, the impact and outcomes of different internal and external factors impacting on the effective implementation of a QMS in the Australian construction industry. Figure 4.1 below presents an integrated overview of the theoretical framework of the research philosophy, strategy and process which guided this study throughout all of the research stages.

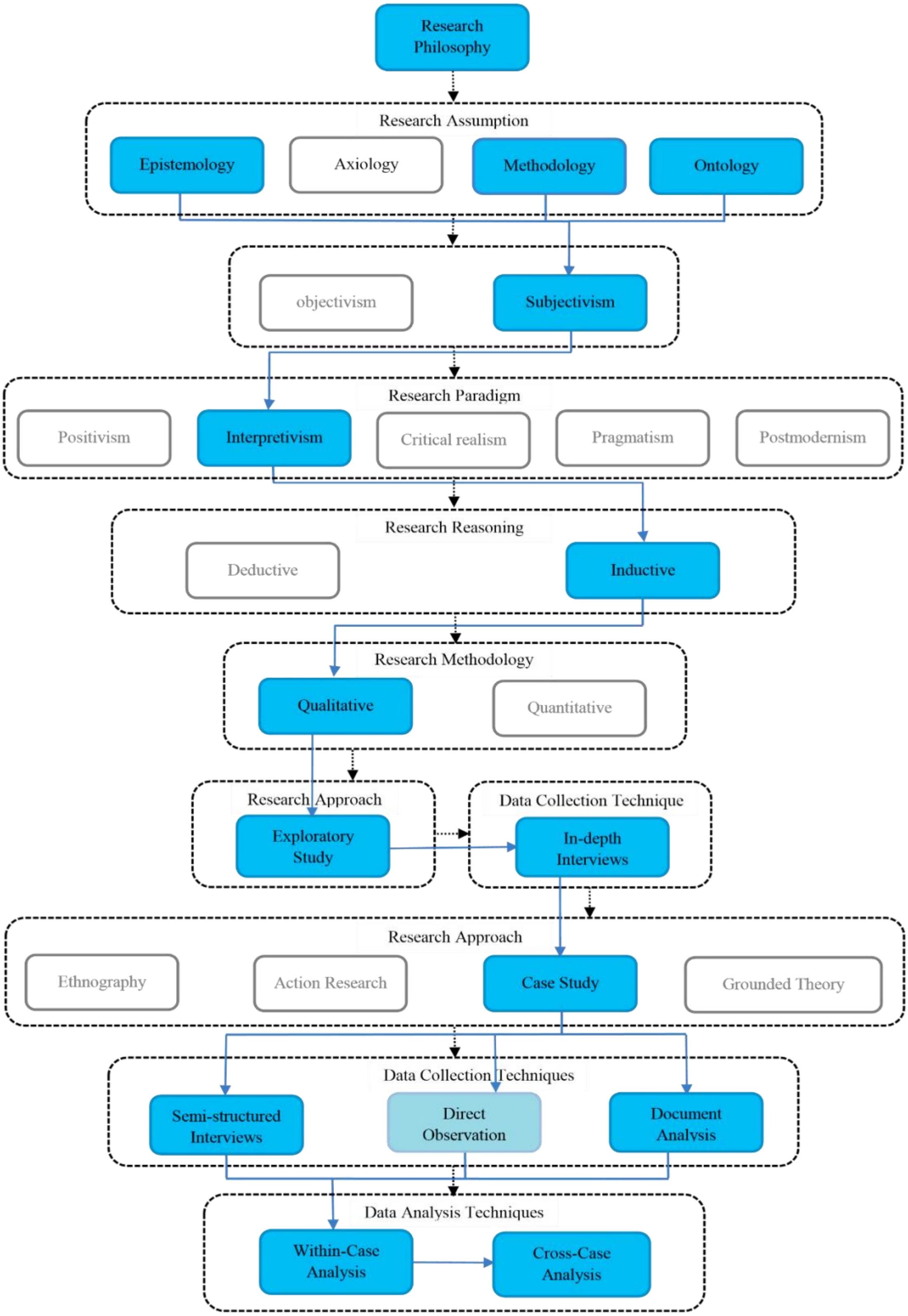


Figure 4.1: A framework of research philosophy and process, derived from (Creswell & Poth, 2018; Gray, 2014; Saunders, Lewis, & Thornhill, 2016)

## 4.2 RESEARCH PROBLEM

The foremost research problem emerged from the absence of any comprehensive framework that accumulates various factors identified previously that are closely related to the effective deployment of a QMS in the construction industry. Achieving this overall aim of research required identification of a comprehensive list of factors impacting the process of deploying an effective QMS in the CIBS to be utilised along with the internal barriers identified by intensive analysis of literature to develop the final framework. The focus of this study was, therefore, primarily concerned with exploring the overall external factors affecting QMS deployment, which was identified as a distinct gap in the context of QMS research. The research was concerned with investigating a comprehensive list of CSFs for effective implementation of QMS, especially those that would be adopted at project level. Finally, the study examined all these identified factors in the context of building organisations to validate the impact of these factors and to gain insights into how these factors either facilitate QMS adoption or impede such implementation. In order to attain the main aim of this research study, the following research questions were formulated:

*RQ1. What are the main external factors influencing the effective adoption of a QMS in the CIBS?*

As alluded to previously, currently no salient studies on how the external factors generated from the environment surrounding the deployment of QMS have been identified from the extant literature. Hence, the first question (RQ1) was developed to initially define those external factors by investigating their context within the construction sector building industry.

*RQ2. What are the crucial CSFs necessary for an effective QMS implementation in the CIBS?*

As already stated, the CSFs for effective implementation of a QMS have been investigated within a broad spectrum of studies based on the context of particular sectors (Ab Wahid & Corner, 2009; Abdullah, et al., 2015; Abraham, 2003; Almeida, et al., 2014; Kog, et al., 1999; Obop, 2015). Despite the number of studies undertaken to explore the CSFs, and the factors they have identified, there are few studies that have been conducted to identify a holistic list of CSFs for QMS implementation in the context of the construction industry, especially at a construction project level, since most of these studies were focused at an organisational level (Abdullah, et al., 2015). Hence, there was a clear need to develop an integrated and holistic catalogue of CSFs prior to developing any framework for effective QMS adoption, and thus the second question (RQ2) is designed to obtain such a comprehensive list of CSFs at the project level within building organisations.

*RQ3. How do the external factors and the CSFs affect the successful adoption of a QMS in real-world building projects of the CIBS?*

The previous questions aim at developing a comprehensive list of different factors that variously impact on the deployment of QMS in building organisations, however, an exploration of these factors alone is insufficient to draw a novel conclusion for this research. In order to gain a deeper understanding of how different factors affect the effective deployment of a QMS within the construction building industry, the third question (RQ3) sought to explain the various impacts of different factors identified in the literature review, and from the answers to the previous questions. RQ3 examined the impacts of the identified factors in the context of typical projects in the construction sector building organisations.

*RQ4. How can the external factors be categorised based upon their impacts on the effective deployment of a QMS in real-world building projects of the CIBS?*

Whereas RQ1 was used to explore the external factors that influenced the successful adoption of a QMS, RQ4 was used to categorise those factors based on their specific effects on QMS implementation as either a driver or a barrier. This categorisation sought to facilitate the examination of the real impacts of these factors on typical current construction projects.

## 4.3 RESEARCH PHILOSOPHY

Prior to the conducting of any research, it is fundamental to review the justification for the philosophical approach. The term, ‘research philosophy’ describes the system of beliefs and assumptions about knowledge development available to a researcher, and represent a philosophical framework to guide how scientific research should be undertaken (Saunders, et al., 2016). Crotty (1998) asserted that these assumptions inevitably help researchers to shape what research questions are to be asked, the methodologies to be utilised, and how to interpret findings. In addition, a consistent set of assumptions helps to shape a reliable research philosophy that supports a selected methodology, research strategy, and data collection and analysis techniques, which are referred to as a research design (Saunders, et al., 2016) as illustrated in Figure 4.2 below.

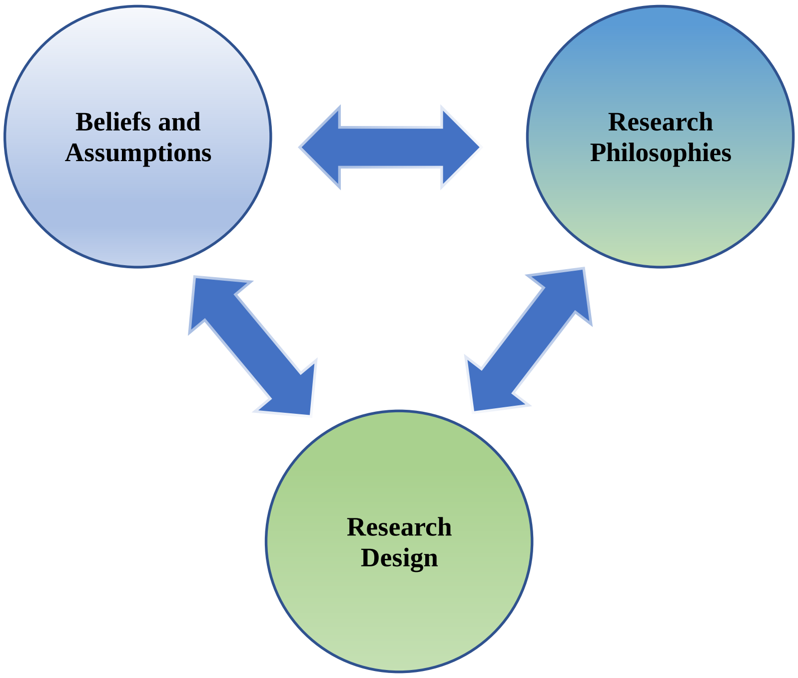


Figure 4.2: Developing a research philosophy: A reflexive process (Saunders, et al., 2016, p. 126)

### 4.3.1 Research Assumptions

Research assumptions are split into four main classes, namely **ontology**, **epistemology**, **axiology,** and **methodology**, and these assumptions differ based on the procedures of a research study (Creswell & Poth, 2018; Denzin & Lincoln, 2018; Saunders, et al., 2016). However, only research assumptions associated with this study's nature are explained as follows:

**Ontology** concerns assumptions about the nature of reality, it constitutes the way in which the researchers view and study research objects that involve organisation, management, working lives of individuals, and organisational events (Creswell, 2014; Denzin & Lincoln, 2018; Saunders, et al., 2016). There are two major aspects of ontology, including **objectivism** and **subjectivism**. A research work is claimed to be objectivist or independent from the investigator if there is a single reality or method of investigating or understanding the research (Creswell, 2014; Saunders, et al., 2016). Subjectivism, however, accepts that social phenomena are created by use of language, conceptual categories, perceptions, and consequent actions (Saunders, et al., 2016). Subjectivist research has more than a single reality or construct; in qualitative research, these realities might involve the researchers, participants being investigated, and research audience of interpreting a study (Creswell, 2014).

The ontology of this research was distinctly subjectivist since the data collection methodology was based upon the perspectives and perceptions of the study participants. In addition, because this research adopted a qualitative approach to collect the primary data, interviews and case studies, where a number of informants were interviewed, it was clear that the research consisted of several realities, which situated it in the subjectivist paradigm. The research examined physical, human and material constructs in order to understand the reality behind the research phenomenon. Human constructs involved participants who had thorough experience in QMS implementation in building organisations as the success and failures of the project depended on their specific perspectives and decisions. Physical or material constructs consisted of various documents related to QMS implementation, such as quality manuals, project quality plans, and guidelines and standards that directed staff understanding during the implementation.

**Epistemology** refers to assumptions about knowledge and what compromises are acceptable, and what is actually justifiable knowledge (Saunders, et al., 2016). Once the nature of reality is defined (whether it is single or not), a researcher is then concerned as to how to acknowledge that reality. Thus, epistemology is concerned about the relationship between the researcher and what is being studied (Creswell, 2014; Denzin & Lincoln, 2018). In essence, epistemology explains 'how' a researcher knows about the reality and makes assumptions regarding how knowledge should be obtained and accepted (Audi, 2011; Pathirage, Amaratunga, & Haigh, 2008). For this research, qualitative approaches, namely interviews and case studies, were used to gather the data required since the epistemological assumption of this research concerning how knowledge should be gained, inferred that qualitative techniques were the best way to investigate the phenomenon being studied within the related context.

**Methodology** in qualitative research, is typically characterised as inductive and procedures that emerge and that are shaped by the experience of the researcher in gathering and analysing data (Creswell & Poth, 2018). For this current research, qualitative approaches were adopted to collect data, because the topic of the research was believed to have more than a single reality shaped by the phenomenon being studied.

### 4.3.2 Research Paradigms

There are five major research paradigms, namely **positivism**, **critical realism**, **interpretivism**, **pragmatism**, and **postmodernism**, and the specific use of any of these paradigms for a particular research study depends upon the objectives of the study (Creswell & Poth, 2018; Sarantakos, 2013). According to Love, Holt, and Li (2002), a review of the construction management field disclosed the domination of two major paradigms within this field, namely, positivism and interpretivism. This section, however, focuses on explaining and justifying the adoption of interpretivism by this research owing to the distinct nature of this study, which is clearly qualitative research.

**Interpretivism**

An interpretivist paradigm posits that reality is created by humans and differs from physical phenomena when creating meaning (Gray, 2014). This suggests that meanings are created by investigating how the different perspectives of people result in new, richer understandings, and interpretations of contexts (Saunders, et al., 2016). An interpretivist paradigm, therefore, emphasises the examination of text, in order to establish embedded meanings about how people utilise language and symbols to define and formulate social practices (Kura, 2012). As a result, interpretivism aims at exploring the ways in which individuals make sense of their world or investigate the processes of constructing social situations (Creswell, 2014; Merriam & Tisdell, 2016; Saunders, et al., 2016). Thus, Saunders, et al. (2016) argued that an interpretivist viewpoint is highly considered in both business and management research, not only because of the complexity of business situations, but also because of the uniqueness of the produced context.

This research, therefore, followed an interpretivist paradigm since qualitative methodologies were used to collect the required data, and the research topic associated with, and explored, more than a single reality. It also aimed to understand the effects of internal and external factors on the effective implementation of QMS in the construction sector building industry. More specifically, the purpose of this study was to grasp how the external factors identified either impeded or facilitated the successful deployment of QMS, and how they drove effective implementation of these systems within the industry. Since the research required several constructs to understand the reality beyond the topic of research, it was clearly positioned within a subjectivist ontology (Guba & Lincoln, 1994).

Furthermore, the research first utilised an exploratory study to identify the external factors surrounding QMS implementation process, as well as acquiring a comprehensive list of CSFs for effective deployment of QMS in the CIBS. Then followed some case studies, undertaken to obtain explanatory in-depth meaningful data regarding how these different external factors impact the successful implementation of QMS, and to acquire interpretive perspectives on how the CSFs for effective implementation of QMS contribute to facilitating successful implementation of these systems. In the next section, the justifications and reasoning behind the choice, and adoption, of the methods of research are explained.

### 4.3.3 Research reasoning

Research design refers to the types of inquiry within quantitative, qualitative and mixed methods approaches (Creswell, 2014). The level of clarification that researchers have in the early stage of their research leads to two contrasting approaches, namely deductive and inductive reasoning (Saunders, et al., 2016). It is essential to understand the difference between these two reasonings as that consideration represents the significant foundation of the research (Farquhar, 2012). Figure 4.3 below illustrates the prime difference between the two approaches.

**Deductive** reasoning happens when the conclusion is logically derived from a set of hypotheses, and this conclusion is considered true if all these hypotheses are true (Ketokivi & Mantere, 2010). However, in **inductive** reasoning, a gap in the logic argument appears between the observed hypotheses and conclusions that are drawn from observations that are made (Ketokivi & Mantere, 2010). Therefore, researchers utilising inductive reasoning tend to be involved with the context in which such events take place, and thus the study of a small sample of subjects is appropriate (Saunders, et al., 2016). Since inductive reasoning is a less structured method, it naturally prioritises sitting within the interpretivist approach. Inductive methods research is particularly applicable to qualitative research wherein methodologies are undertaken to ascertain different perspectives about a specific phenomenon (Creswell, 2014). Thus, the inductive approach is commonly adopted in case study research, in which the aim of the research is to identify patterns from the data (Farquhar, 2012; Maylor & Blackmon, 2005). However, that does not imply that inductive methodology starts without any affiliation with extant theories or ideas (Swanborn, 2010; Yin, 2003a, 2014). It is perhaps commenced with primary theory, which often comprises of some vague ideas regarding reality, especially in case study research (Swanborn, 2010).

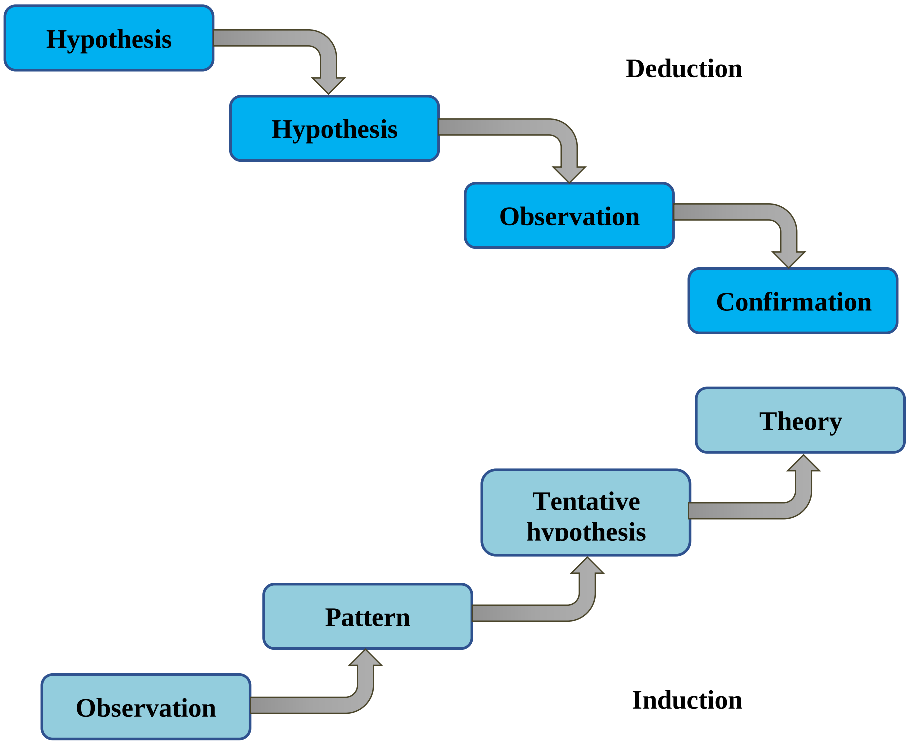


Figure 4.3: Deduction and induction reasoning methods (Farquhar, 2012)

This research study approach followed the inductive research reasoning, since the research method aligned with the interpretivist paradigm as previously explained. The current research was specifically concerned with explaining how the different external factors either impeded successful implementation of QMS or drove successful deployment of that system in the CIBS. Whilst there were some ideas from, and affiliations to, extant theories identified by the critical analysis of literature, a comprehensive understanding of, and explanations concerning, the impacts of external factors surrounding QMS implementation have yet to be explored within the field. Also, since the other major approach adopted is the case study methodology, an inductive approach was the most appropriate method to guide this current research.

## 4.4 RESEARCH METHODOLOGY

The methodology can be selected from three standard approaches dedicated to conducting research: quantitative, qualitative and mixed methods. The research methodology is defined as "*the way in which the research objectives can be questioned*" (Naoum, 2013, p. 39). Therefore, the careful choice of an applicable method and strategy is a significant part of any research to improve the process of data collection, according to Abowitz and Toole (2010) Moreover, Yin (2009) demonstrated three major factors to be considered in choosing the most suitable data collection technique, namely the types of research questions, the extent of control that researcher has upon the variables concerned, and the degree of focus on contemporary, as opposed to, historical events. These required elements were illustrated by Fellows and Liu (2008) and are presented in Table 4.1 below.

Table 4.1: Requirements of different research styles/ strategies: Derived from Yin 1994 (Fellows & Liu, 2008, p. 24)

| Style/ Strategy | Research Questions | Control Over Independent Variables | Focus on Events |
|---|---|---|---|
| **Survey** | Who, what, where, how many, how much? | Not required | Contemporary |
| **Experiment Quasi-experiment Archival Analysis** | How, why? Who, what, where, how many, how much? | Not required | Contemporary Contemporary/past |
| **History Case Study** | How, why? How, why? | Not required | Past Contemporary |

Thus, a qualitative approach was adopted as the prime methodology of this current research study. A literature review was initially conducted to obtain a preliminary understanding around the research topic, identifying specific gaps in the current knowledge of the research issues and to identify the appropriate methodologies that were chosen to achieve the objectives of this project. Following this, an exploratory study was undertaken to identify the external variables surrounding a QMS implementation, which might impact on the successful deployment of these systems. This study also aimed at obtaining a holistic list of CSFs for effective implementation of QMS within the construction industry, specifically in the building sector. Within this phase, some interviews were conducted with a sample of senior and middle managers from Tier 1 and Tier 2 of Australian construction companies because organisations from Tier 3 declined to participate, owing to lacking the target managers or the formal QMS to be explored. Following these, a series of case studies were conducted to explain the multifaceted issues related to the adoption of CSFs identified by previous stages, and the real impacts of external factors on effective implementation of QMS. Figure 4.4 illustrates the plan of this research study.

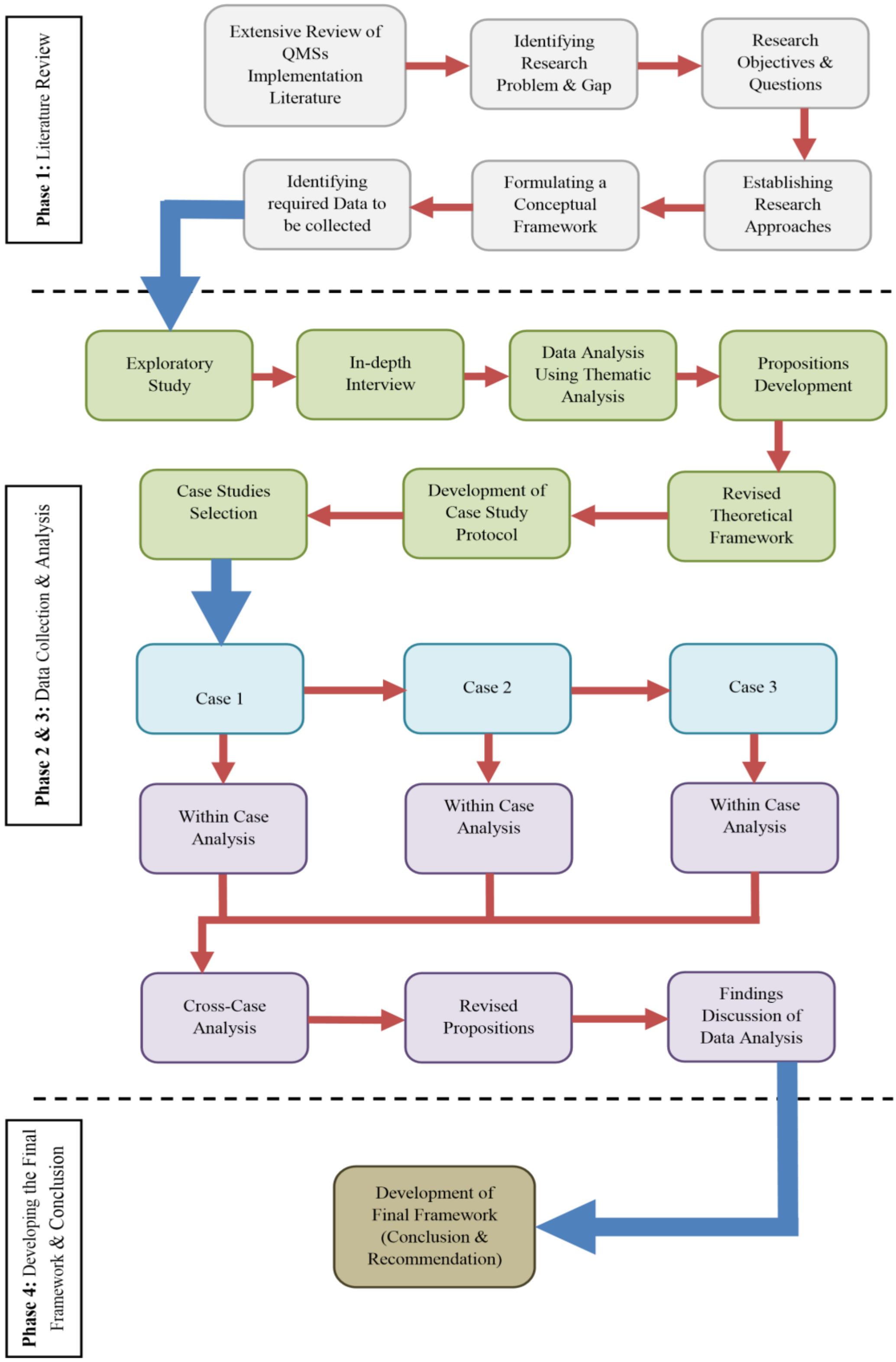


Figure 4.4: Research plan

### 4.4.1 Qualitative research methodology

The use of a qualitative methodology facilitates the collection of valuable data through focusing more on how individuals interpret their experiences and not just by applying statistical and numerical data (Fellows & Liu, 2008; Merriam & Tisdell, 2016). A qualitative approach is defined as "*a research strategy that usually emphasises words rather than quantification in the collection and analysis of data*" (Bryman & Bell, 2003, The nature of qualitative research, para 1). Merriam (1998) also described qualitative research as a concept that covers several forms of inquiry to assist a researcher understand and explain the meaning of social phenomenon. A qualitative approach may be conducted by observation, or, by interviews, case studies, focus groups, and projective techniques (Hair, Celsi, Money, Samouel, & Page, 2016). This research has employed two approaches of qualitative research: in-depth interviews (exploratory approach) and a case study methodology (explanatory approach). The rationale for adopting these approaches is explained in the following sections.

### 4.4.2 Exploratory study

In the social sciences, exploratory research studies are being increasingly recommended, especially those in which new research themes are anticipated, or in which existing issues need to be addressed based upon contemporary perspectives (Mason, Augustyn, & Seakhoa-King, 2010). Gray (2014) asserts that exploratory study is especially valuable when there is insufficient information about a phenomenon being investigated. Most exploratory studies have frequently utilised a qualitative technique to collect data when they have been undertaken (Creswell, 2014; Stebbins, 2001). Further, Mason, et al. (2010) asserted that interview data collection techniques are particularly appropriate when researchers intend to capture the viewpoints of informants in their own words. There are three types of interview, depending on constraints placed on the interviewer and respondents, namely, structured, semi-structured, and unstructured, which are also known as in-depth interviews (Fellows & Liu, 2008; Saunders, et al., 2016). The in-depth interview is considered a robust tool to gather qualitative data because of its features of extensive probing, meaning that the researcher is likely to gain the ability to explore specific issues in depth (Aaker, 2010).

Therefore, within the exploratory study of this research, the unstructured in-depth interview is utilised to ascertain what is happening concerning QMS adoption in the CIBS, and to understand the significant background or context of the system deployment (Saunders, et al., 2016). The in-depth interview is utilised to explore the external factors affecting QMS implementation as well as the CSFs for effective adoption of the system by providing the informants the opportunity to express their viewpoints about events, behaviours, and beliefs related to QMS adoption (Gray, 2014; Saunders, et al., 2016). Open-ended questions were used to provide respondents with the freedom to discuss and express their perspectives outside the structure of a formal questionnaire. That enabled the researcher to obtain highly personalised feedback from interviewees. The interview questions were first formulated to identify the external factors affecting successful adoption of QMS in the construction sector building organisation. Then, some questions were constructed to identify a comprehensive list of CSFs for QMS implementation by focusing, in particular, on project level due to a dearth of studies conducted, especially at that level.

A series of in-depth interviews were individually conducted to avoid cross-respondent effects and regression to the mean in responses (Creswell & Poth, 2018; Gray, 2014). The time of each interview ranged between forty-five minutes to one hour, providing respondents with adequate time to fully express their opinions about specific issues. Initially, all participants were asked to give their permission to record the interviews, and the researcher simultaneously summarised and annotated their answers by note-taking, which could be used later if any problems occurred with the recorded interviews. The interviews were used to answer research questions (RQ1) and (RQ2), and eventually to fulfil the following objectives:

- ❖ *Identify the external factors that impact on the implementation of a QMS in the CIBS, and;*
- ❖ *Explore the CSFs for effective adoption of a QMS in the CIBS.*

The interview consisted of ten questions (see Appendix A) designed to explore the research phenomenon regarding factors impacting QMS deployment in the CIBS. Whilst some broad questions were utilised to gain general information about QMS adopted by target companies of participants, other more specific questions were used to gather valuable information that contributed to answering these research questions. The demographic information of all interviewees was also collected.

### 4.4.3 Case study approach

A case study approach focuses on collecting data about particular events or activities. The case study is described as a research approach that examines a contemporary phenomenon within the real-life context of that phenomenon (Sekaran & Bougie, 2013; Yin, 2014). However, Creswell and Poth (2018, p. 97) defined the case study as *“a qualitative approach in which the investigator explores a real-life, contemporary bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information"*. The preceding description and definition are highly applicable to the current research, as both can guide the researcher to accomplish the prime objectives of the research. Moreover, the case study approach can be utilised to facilitate the specific investigation of a phenomenon by securing theoretical validity of data, and supporting research propositions by engaging in in-depth analysis of specific projects (Fellows & Liu, 2008; Naoum, 2013).

Further, as Bryman and Bell (2003) have noted, case study methodology is the most popular and widely utilised research approach adopted in business research (Eisenhardt & Graebner, 2007). Also, as stated by Fellows and Liu (2008), within construction management research, the case study approach is specifically utilised to develop:

A source of insights and ideas;

A description of the phenomena;

A project-biography; and,

Illustrative anecdotes.

Moreover, case studies do not just try to describe situations, but are also performed to attribute *casual relationships* that the researcher intends to uncover between a phenomenon being studied, and the context in which this phenomenon occurs (Gray, 2014).

Therefore, in this research, conducted case studies disclosed the relationship between the phenomenon of QMS implemntation and the context of building organisations in which it was happening. Detailed explanations of the phenomenon being investigated and its context within this research are established at a later stage of this study. In addition, Yin (2014) argued that case study research can be utlised for all research purposes, exploratory, explanatory or descriptive. As a consequence, the selection of the case study methodology to answer research questions of this study was justified in accordance with the three major elements to be accommodated to select the most suitable data collection technique, as stated by Yin (2009). These elements include (a) **the types of research questions asked**, (b) **the extent of control that researcher has upon the variables concerned**, and (c) **the degree of focus on contemporary, as opposed to, historical events**.

*Types of research questions*

A case study is an ideal approach to answer the 'how' and 'why' questions to obtain a comprehensive picture of the exact situation required to explore a real-life example (Hair, et al., 2016; Merriam, 1998; Yin, 2009). Also, case studies seek to explain events and issues in which the correlation between variables are ambiguous and uncertain (Gray, 2014). On the other hand, “what”, “who”, “where”, and “how many”, are the questions that likely favour a survey approach (Gray, 2014). On the contrary, a case study approach is appropriate to answering descriptive questions such as, (*What is happening?*), or explanatory questions like, (*How, or why, did something happen?*) (Yin, 2012).

Therefore, because of the dearth of knowledge regarding the factors affecting successful implementation of QMS in the construction industry, especially those of external factors, this research explored these factors to understand their contextual sense rather than to extract quantifiable measures. That was performed by conducting an exploratory study to answer RQ1 and RQ2. Although these questions have been partially answered by a critical analysis of extant literature, there was still a need to validate and contextualise those factors impacting QMS deployment within the construction organisation context. That resulted in developing a holistic list of external factors and CSFs, to be examined in the case study. The current research questions established in this study, along with the methodologies adopted, and data collection techniques used, are illustrated in Table 4.2 below. As a consequence, case studies were utilised to answer questions RQ3 and RQ4, since both required a deeper understanding of the effects of external factors and CSFs on effective implementation of QMS in building organisations. In general, the research strived to explain the casual relationships in real-life settings, which is more complex to explain by survey or experimental approaches, because of the dearth of relevant knowledge regarding the phenomenon studied, as explained previously. Whilst QR4 is concerned with understanding the real impacts of external factors and CSFs on effective deployment of QMSs, RQ3 is concerned with explaining how the external factors can be categorised based upon their influences.

Table 4.2: Selection of research approaches and data collection techniques

| Research Question | Research Objectives | Selected Methodologies | Data collection Approach | Data Collection Techniques |
|---|---|---|---|---|
| What are the main external factors influencing the effective adoption of a QMS in the CIBS? | To identify the external factors impacted on the implementation of a QMS within the building industry. | Qualitative | Exploratory Study | In-depth Interviews |
| What are the crucial CSFs necessary for an effective QMS implementation in the CIBS? | To explore the CSFs for effective adoption of a QMS in the CIBS. | Qualitative | Exploratory Study | In-depth Interviews |
| How do the external factors and the CSFs affect the successful adoption of a QMS in real-world building projects of the CIBS? | To explain the impact of identified external factors and CSFs on the successful implementation of a QMS in the real-life of the building projects of CIBS. | Qualitative | Case Study | Interviews, Documentation Analysis, and Direct Observation |
| How can the external factors be categorised based upon their impacts on the effective deployment of a QMS in real-world building projects of the CIBS? | To categorise external factors depending on their influences on implementation of a QMS. | Qualitative | Case Study | Interviews, Documentation Analysis, and Direct Observation |

*Extent of Control upon Events*

Case study methodology is highly recommended to be undertaken first, if the researcher has less control over a contemporary set of events (Merriam, 1998). Moreover, unlike experiments when researchers can accurately and systematically manipulate variables within a laboratory setting, the case study is much preferable to examine contemporary events in which there is no distinct control over relevant behaviours (Yin, 2014). Therefore, because in the topic of this research, there was a clear lack in the extant studies related to factors affecting QMS implementation in building organisations, especially regarding the impacts of external factors, and CSFs, it was clear that the researcher had either little or sometimes no control over the study. Consequently, the researcher sought to examine the phenomenon being studied within its real-life context in order to acquire comprehensive understanding regarding the influences of those different factors. This holistic explanation has required entering the real world where participants can express their viewpoints concerning the phenomenon being studied.

*The Degree of Focus on either contemporary or historical events.*

Case study methodology relies on up-to-date sources of evidence, namely direct observation of the issues being examined, and interviews of individuals concerned in the events being studied (Gray, 2014). Moreover, the uniqueness of the approach lies in its capability to deal with a wide range of evidence to examine contemporary phenomena (Yin, 2003b). Therefore, it becomes the most appropriate approach to employ since the focus of this research is to understand the emergent behaviours of QMS in the context of its implementation in order to explain the impacts of different factors, especially those of external factors on recent deployment of these systems or their impacts on decision-makers to adopt robust and applicable systems. Using contemporary evidence is also fundamental in capturing rich data to develop a distinct understanding of the research problems, and meanwhile to retain the characteristics of the reality under examination.

## 4.5 CASE STUDY DESIGN

Research design, in general, refers to issues of how to construct concrete design of the research. Research design is defined as *"a plan for collecting and analysing evidence that will make it possible for the investigator to answer whatever questions he or she has"* (Ragin, 1994, p. 191). Qualitative research design is often flexible, emergent, and responsive to adjustment to suit the conditions of ongoing research (Merriam, 1998). Yin (2009) established five key components of case study research design, namely:

Questions of case study;

Cases study propositions;

Unit (s) of analysis; the logic used to link the data to the propositions; and,

The criteria to demonstrate the outcomes.

The first component was discussed when research questions were precisely clarified regarding their nature. In addition, research questions should be developed in the sense that they are still open to additional modification or further improvement during the ongoing research (Gray, 2014). For the second component, each proposition utilised within the scope of the study should be examined by directing attention towards specific events related to this proposition (Yin, 2009). In this research, therefore, the propositions established from analysing the data collect by exploratory study interviews were utilised within case studies to gather in-depth understanding about factors related to those propositions, and ultimately these propositions were either confirmed or refuted by cases. Within the third component, the researcher needs to clearly define the case and to instil boundaries around this case in order to specify the unit of analysis (which can be individuals, entities or events) (Yin, 2003b). Also, in case study research, the researcher needs to carefully choose data analysis steps during the design stage, in order to create a more robust and solid foundation for the later analysis stage (Yin, 2014). The selection of case study and the unit of analysis for this research will be clarified in the next sections of this thesis. The fifth component of research design seemed irrelevant to this current research, since a common explanation of this component arises only if statistical analyses are relevant (Yin, 2009). Therefore, based upon the nature of this study, which gathered an in-depth understanding of QMS deployment in the CIBS rather than of any statistical aspects, it was clear that the fifth component of research design did not suit this research.

### 4.5.1 The utilisation of multiple case studies

A case study commonly comprises of two major types, namely single case study and multiple case studies (Creswell & Poth, 2018; Gray, 2014; Merriam & Tisdell, 2016; Saunders, et al., 2016; Yin, 2012, 2014). A single case design is used when the case can significantly play a prime role to either test hypotheses or theory (Gray, 2014). On the other hand, single case designs have been constantly vulnerable to considerable criticisms because of their simplicity and due to the level of commitment involved in conducting these studies (Yin, 2014). However, multiple case designs have increasingly become widespread in business and management studies (Bryman & Bell, 2003). As such, multiple cases study design distinctly differs from single case design in terms of the evidence gathered from multiple cases, which is considered more fascinating, and the overall findings of the study are consequently considered more vigorous (Yin, 2012).This sort of research is concerned with gathering and analysing data from several case studies in which the single case is attractive since it belongs to a specific collection of cases (Merriam & Tisdell, 2016; Stake, 2014). Thus, one of the most significant roles of a researcher who undertakes multiple case designs is to explain how the phenomenon performs in different contexts by observing events, asking about them, analysing the records (documents) (Bryman & Bell, 2003; Stake, 2014).

As demonstrated in Chapter 2, the phenomenon of QMS implementation originated in an excess of descriptive expertise throughout the managerial levels in the CIBS, ranging from supervisors to quality managers. Because of the nature of this research, multiple case design was utilised to compare the data collected from the various cases, and to enhance the external validity or generalisability of the study findings (Collins & Hussey, 2003; Denzin & Lincoln, 2018; Yin, 2014). The undertaking of a multiple case study approach was more likely to fulfil the main aim of the current research in meeting some of the study objectives, including:

- *Explain the impacts of external factors on the successful implementation of a QMS in the real-life of the construction sector building projects.*
- *Categorise external factors depending upon their influences on implementation of QMS.*
- *Explain the effects of adopting the CSFs for a QMS deployment on the successful implementation of these systems in the context of the building organisations.*

This research examined and explained how external factors and CSFs impact the successful implementation and deployment of QMS. Also, this explanatory phase of research is designed to ascertain in more detail how the CSFs for QMS implementation can affect the levels of quality achievement whilst supporting effective implementation of these systems.

### 4.5.2 Conceptual framework

A framework is generally considered as a constructed frame that allows researchers to create part of a method and add further variables and details when required (Zhang, 2006). However, the terms *conceptual framework* and *theoretical framework* are often utilised interchangeably in the literature (Merriam & Tisdell, 2016). Also, the conceptual framework, which comprises concepts or theories, is considered as the underlying structure, the scaffolding, or the frame of the research (Creswell, 2014). The conceptual framework of this research illustrated in Figure 3.5

was derived by means of a comprehensive and critical analysis of extant literature related to QMS implementation in the construction industry. Hence, this conceptual framework was built on the connection of various facts and conclusions, developed from previous research. The framework concepts reflect the prime concepts identified from literature analysis into the components of the framework. The framework was used to convey the researcher from a theoretical position to a practical position since the key constructs of framework throughout underpin the study, and it aims to guide the researcher during the conduct of field works. In addition, the framework was utilised to delimit the study by drawing the boundaries of the research, which result in specific value of interpretation, to direct the choice of cases and unit of analysis, the data collection process, and data analysis.

## 4.6 THE IMPLEMENTATION OF CASE STUDY APPROACH

This section explains the implementation of the case studies, including the selection of cases, unit of analysis, case study protocol, and sources of evidence collected.

### 4.6.1 Case study selection and unit of analysis

The selection of case studies is a significant stage in a research project since the targeted population defines the set of organisations from which the sample for study is selected (Eisenhardt, 1989). The main objectives of sampling are, initially, to decide how primary data will be collected by the researcher, and then to ensure that the number of respondents is representative of the targeted population (Proctor, 2003). In case study research, there are, basically, two types of sampling, namely random sampling and purposive sampling (Merriam & Tisdell, 2016). In random selection, the cases can be selected to fill theoretical categories and provide examples of opposite situations (Eisenhardt, 1989). Purposeful sampling on the other hand, depends upon the researcher's assumption where the aim is to establish, understand and acquire insights. Thereby, the sample must be chosen from the most representative cases according to the researcher, where a significant issues can be observed (Merriam & Tisdell, 2016). (Eisenhardt, 1989) mentioned that purposive sampling is undertaken where cases are selected for theoretical and not statistical reasons to fill theoretical gaps within an existing body of knowledge of knowledge.

Therefore, because qualitative research is concerned with generating in-depth understanding, the cases of this research were selected purposively with the intent to answer research questions by gaining in-depth explanation about QMS implementation in the CIBS. Thus, in this research, the case studies were chosen for the purpose of filling the theoretical gaps that appeared to exist between the underlying rationale for companies to adopt a QMS in the CIBS, and the effective/non-effective implementation of these systems identified by the literature review. The population of the cases was taken from the top three Tiers of Australian construction companies (Industry, 2015). Although the companies involved in Tier 3 represent more than 98% of all Australian construction companies (Industry, 2015), the case studies population was intended to involve all three top Tiers, in order to gather more holistic knowledge regarding QMS implementation in organisations of different sizes with different levels of complexity.

The selection of companies to participate in the case studies was performed based upon their official numbers of employees. Table 4.3 illustrates the classification of the Australian construction companies. The case study approach was directed at considering how selected organisations implemented a QMS within their projects, and how, and to what extent, the identified external factors impact the effectiveness of implementation. Additionally, the cases studied focused on how the adoption of the CSFs for effective implementation of QMS contributed to the applications of these systems, as well as explaining why some of these CSFs were not applicable to some of these organisations. Furthermore, in total, three case studies were selected to be examined within building organisations. These case studies were purposively selected to represent the different Tiers of building organisations, in order to gain a more comprehensive insight regarding QMS deployment across the whole CIBS. While multiple case studies were chosen, each case study was considered as a distinctive individual enquiry to minimise irrelevant variations and to strengthen research constructs (Yin, 2012).

Table 4.3: A classification of the Australian construction organisations, ABS 2012 (as cited in Industry, 2015, p. 6)

| 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** |

Moreover, to start purposive sampling, the investigator should initially decide which criteria are fundamental to selecting people or organisations to be studied, and these developed criteria should directly reflect the main aim of the study and guide the researcher to identify knowledge-rich cases (Creswell, 2014; Merriam & Tisdell, 2016; Patton, 2015). Generally, the purposive selection of the three cases of this research was based upon the following criteria:

- ✓ **Industry Sector:** The study aims organisations belong to the construction industry, more specifically those of building organisations.
- ✓ **Role and Position of Participants:** Relying on the hierarchy of organisations regarding the adoption of QMS, general managers, quality managers, construction managers, project managers or site managers.
- ✓ **Experience of Participants in QMS Implementation:** At least 10 years of experience in quality and QMS implementation.
- ✓ **Size of Potential Nominated Organisations:** The research targets various sizes of companies depending on their classification within the Australian construction companies.
- ✓ **Geographical Location of Cases:** Queensland, Australia
- ✓ **Adopted QMS:** The potential cases should adopt various QMSs, such as ISO 9000, own developed QMS, or initial system that indicates an early move towards official QMS.

### 4.6.2 Case study protocol

The protocol of the cases was developed prior to conducting the case studies. Yin (2009) confirmed that development of a case study protocol strengthens the reliability of a case study and maintain the consistency of the study when an investigator intends to examine multiple cases. During this research, a protocol was adhered to that practically retained the focus of the cases and could be used to foresee the potential issues that might impede the completion of the case study examination. The detailed protocol for this research is illustrated in Appendix B.

### 4.6.3 Field procedures

To examine the phenomenon in the real-life context, the researcher must learn how to integrate the events of the real-world with the requirements of the data collection plan when they do not have control across the data collection environment (Yin, 2014). In order to gain access to the key informants from potential organisations, they were initially contacted either by their email, or by using business social media, namely LinkedIn. Once potential participants expressed their consent to being involved in the research, they were approached directly by email to finalise arrangements for participation.

Participants were knowledgeable informants, who were extensively involved in the process of QMS implementation within their organisations, so had developed the knowledge basis to view the QMS deployment from different perspectives. These prime respondents represented different managerial levels, namely Quality Managers, Project managers, and Construction Managers. The privacy and confidentiality agreements were thoroughly explained to participants before announcing the interviews. Thus, the strict confidentiality and non-disclosure of any information on their identities or on the company name were presented in the information consent form. Further, the voluntary nature of their participation, in which they could withdraw from interviews, was also indicated. The information consent form has also been attached in Appendix C.

After signing the information consent form by participants, permission to record the interview was granted by respondents. Each interview commenced with an explanation of general concepts of QMS deployment along with the key concepts. External factors and CSF were distinctly described at the beginning of each interview.

Each interview required approximately between one and one-and-a-half hours. All gathered data from these individual interviews were recorded using a recording device in conjunction with written field notes. The collected data was then thoroughly transcribed before organising such data in a form that provided readable descriptions of the main points examined.

### 4.6.4 Source of evidence

According to Yin (2014), different data collection methods can be used within the case study approach, namely, interviews, documentation, direct observations, archival records, participant-observation, and physical artefacts. This research adopted a hybrid of methods to collect data required within the case studies, namely, in-depth interviews, document analysis and direct observations. The combination of various sources of evidence has provided richer conclusions to the research questions being examined. This section provides a clear explanation about how these sources of evidence were utilised in this study.

### 4.6.5 Semi-structured interview

The interview approach is considered to be the most significant source of evidence within case study research (Yin, 2014). As previously mentioned, an interview is diversely categorised by different authors using different typologies based on levels of formality and structure (Gray, 2014; Merriam & Tisdell, 2016; Saunders, et al., 2016). According to Saunders, et al. (2016), semi-structured interviews are appropriate when an investigator has a list of themes to be examined in a specific context. In this research therefore, approximately three face-to-face semi-structured interviews were performed in each case; however, four interviews were carried out in case 3 owing to obtaining an opportunity to review a further project manager. As alluded to, these interviews were undertaken with managers from different levels associated with QMS deployment. That is to say, semi-structured interviews were adopted to collect the data from cases because some themes were already identified by a critical analysis of extant literature, and also from the data gathered from the exploratory study. These themes were utilised in the development of the conceptual framework illustrated in Figure 4.5 in Section 4.4.2. The research was focused on explaining the impacts of these thematic factors on the effective implementation of QMS within the context of the projects of building organisations.

Furthermore, the interview questions were constructed, using open-ended questions, prior to conducting interviews. This allowed informants to express their perspectives of events and the phenomena being explored. These interviews provided strength insights into the impact of external factors on QMS deployment within the context of building companies. Besides, interviews also disclosed the implications of adopting identified CSFs for QMS implementation in enduring an effective deployment of that system along with indicating the organisation levels wherein these factors should be adopted. Also, the interviews provided a platform to explain information gained from the literature through valuable feedback acquired from informants in regard to the topic of research. Most of these interviews exceeded one hour to provide informants an opportunity to express their answers to the research questions as well as to formulate their own reality through thinking about alternative situations that are associated with the QMS deployment (Yin, 2003a).

### 4.6.6 Document analysis

In case study research, documents are significantly used to provide extra evidence to support and augment evidence gathered by other sources (Gray, 2014; Yin, 2014). In fact, document review serves as a non-intrusive methodology usually performed along with other data collection techniques to seek corroboration and convergence amongst data gathered by case studies (Patton & Appelbaum, 2003). According to Merriam and Tisdell (2016), documents to be analysed might include all routine records on clients, documents generated by or for a program, financial and budget records, charts of organisational rules, and so on. Document analysis performed in this research aimed to examine a series of organisational documents related to QMS deployment, including own-developed QMSs, quality manuals, quality plans, audit checklists and reports as well as any other documents associated with QMS deployment, such as client survey and feedback. Reviewing these documents sought to acquire historical context and background regarding QMS implementation to examine how these organisations coped with encountered issues. Moreover, review of documents helped to highlight the level of adopted policy, requirements and procedures to implement a QMS by each case and indicate the main differences between cases and causes of them.

### 4.6.7 Direct observation

Observation is a principal technique used for data collection within case study research where the steps of observing a phenomenon within the field-setting is undertaken through use of note-taking and recording for evidential purposes (Creswell & Poth, 2018; Merriam & Tisdell, 2016). Thus, in this research, direct observations were utilised to gain an opportunity to observe and record how the performed cases fulfilled the requirements of QMS implementation within the projects being investigated. Besides, direct observation was adopted to gain a closer understanding about how QMS is positioned amongst the overall responsibilities of the related team and the extent of resources dedicated to the implementation. Besides, this technique was performed through conducting several pre-planned visits to the examined projects to gain the target information. Consequently, this method strengthened the overall understanding of the case study issues, through acquiring observational evidence that enriched additional knowledge about QMS adoption in the CIBS projects.

## 4.7 THE PROCESS OF DATA ANALYSIS

The focus of the analysis stage is primarily to transform the results of the interviews, and case studies into beneficial and reliable outcomes as well as to ensure that these collected data fulfil the research objectives and questions. Flick (2014, p. 370) defined qualitative data analysis as "*the interpretation and classification of linguistic (or visual) material with the following aims: to make statement about implicit and explicit dimensions and structures of meaning making in the material and what is represented in it*". Meanings, in qualitative research, are basically derived from words and images, which may have multiple meanings, not from numbers as in quantitative research. Thus the quality of qualitative research is based upon the interaction between data collection and the data analysis process in order to explain and explore the meaning (Saunders, et al., 2016).

In case study research, researchers should carefully prepare and organise their data prior to conducting the analysis process (Flick, 2014). According to Yin (2009), data analysis consists of a number of activities, namely examining, categorising, tabulating, and recombining the evidence to address the initial propositions of the research. Yin (2014) further suggested four main strategies to be conducted in case study research to guide the investigator throughout the analysis process, namely:

- Relying upon Theoretical Propositions,
- Working the Data from the “ground up”,
- Developing a Case Descriptive Framework, and
- Examining Plausible Rival Explanation.

‘Examining plausible rival explanation’ was determined to be the most appropriate strategy to achieve the aims of the data analysis of this study. The rationale to adopt this strategy is that it can work in combination with all of other strategies. This strategy is also capable of linking the data of case studies to some main concepts of the study that was providing the analyst a sense of direction in analysing such data (Yin, 2014).

Of five analytic techniques recommended by Yin (2012), this research study adopted multiple techniques to analyse the data collected from the case studies. Three main techniques were used, namely, (a) pattern matching, considered to be one of the most desirable analytical techniques for case studies, (b) explanation building (Yin, 2009) in conjunction with (c) numerical counts analysis that suggested by Bazeley and Jackson (2013). These techniques and rationales for adopting them are later explained in Section 4.5.5. These techniques enabled the researcher to summarise the collected data under the perceived headings and meanings in order to clarify the real effects of the key factors influencing the implementation of QMS in the construction industry as explained later in Section 4.5.5.

Combining the results of the analysis of the exploratory data (collected primarily by the interviews), and the qualitative data (collected principally through case studies), provided the basis for developing the new framework proposed by this study. The framework was developed as a holistic integrated system consisting of CSFs, which were derived from the analysis of data in the construction sector, to effectively implement QMS within the industry. Other components of the final framework also included the external factors identified by data analysis of exploratory study interviews and examined within the performed cases as well as the internal barriers identified by intensive analysis of literature and grouped later in accordance to their impact.

### 4.7.1 Data coding processes

In qualitative research, Charmaz (2006, p. 43) defined coding as "*naming segments of data with a label that simultaneously categorises, summarises, and* *accounts for each piece of data*". Coding is essentially concerned with developing concepts that are utilised to label, sort, and compare data excerpts (Flick, 2014). However, unlike quantitative data analysis, in which the used statistical tools are explicitly understood, there are no strong and fast rules for how qualitative data should be coded (Gray, 2014). Despite that, in this research, the use of coding was rationalised based upon the low model for qualitative data analysis introduced by Miles and Huberman (1994). According to those authors, the process of data analysis comprises three concurrent sub-processes, namely (a) condensing data (data reduction); (b) exhibiting data, and; (c) drawing and verifying conclusions. The purpose of data condensation is to summarise and simplify the data collected (Saunders, et al., 2016), and condense it by categorising data collected (Miles & Huberman, 1994). Data exhibition includes organising and assembling data that will lead to drawing and verifying conclusions. Also, data display is performed by using either matrices or a network approach (Miles & Huberman, 1994; Saunders, et al., 2016).

In this research, a network technique was used to display the data collected as a collection of nodes that are linked by lines, in order to indicate relationships derived from collected data. These nodes also involved brief descriptions concerning identified variables from the analysed data. The main purpose of coding in this research was to facilitate the accessibility of each piece of data to be used for further analysis (Saunders, et al., 2016). To assist with data arrangement and analysis, QSR international NVivo 11 software was used to analyse the data collected during both the exploratory phase and also the case studies.

### 4.7.2 Using QSR International NVivo 11 software

To enhance the value of this research, qualitative analysis software, QSR NVivo (QSR International Pty Ltd. Version) version 11, released in 2016, was used to analyse data collected from the exploratory study and case studies (NVivo, 2016). This particular software was utilised to underpin management of the research activities within and across the different phases of the research. Also, it gradually developed a data repository, which was frequently revisited as data was collected and analysed (Bandara, 2006). This software also offers many advantages by speeding-up handling, managing, searching and exhibiting data and items related, such as codes or memos (Flick, 2014).

The process of data coding in this research was started by uploading all of the transcribed interviews to the software. Then, the construction of nodes that represent a code, theme, or idea about the data in NVivo was carried out by deriving related nodes from the data. Such nodes and their derived tree nodes were stored into files allocated to different topics of research interest. Sorting concepts into branches of tree nodes prompted the researcher to identify common categories and make early comparisons. While the data gathered for this research was mostly in the form of interview transcripts, the software was also used to accommodate many additional types of data gathered by document analysis, namely Microsoft Word and Adobe PDF documents, as well as other types of documents. This method of storing of information enabled the investigator to retain the original sources of data to facilitate using them when required. However, Yin (2014) argued that although the originators of grounded theory have contributed to the field of qualitative research by providing a guidance that its procedures allocate various types of coding techniques (Corbin & Strauss, 2015), the resulting guidance can be adopted by all kinds of case study research. Hence, in this study some additional coding techniques were used, namely:

***Open-Coding (initial coding)***

Open-coding implies "*naming and categorising of phenomena through close examination of the data*", according to Corbin and Strauss (2008, p. 62). In this research, an open-coding process was initially performed by disaggregating the data into as many categories or conceptual units as possible to allow new concepts to emerge (Fernández, 2004; Saunders, et al., 2016). Besides, open coding is conducted by asking questions based upon considering the objectives of the research and making constant comparisons between a newly emerged category with previous category instances (Gray, 2014). Afterwards, further nodes were created by analysing such data to add to new lines of enquiry that arose from these instruments. These categories and nodes were also utilised to consider where the data collection process should be concentrated in the later stages (Saunders, et al., 2016). Hence, during the coding process, the investigator frequently referred back to the main research questions to ensure that all emerged nodes and categories aligned with these questions and objectives (Corbin & Strauss, 2015; Gray, 2014). Also, the researcher re-conceptualised any unexpected results generated from the data analysed, to be aligned within the research boundaries presented in the initial framework.

***Axial-Coding (Pattern coding)***

Axial coding is used in this research to make connections or relationships between the nodes emerging from the open-coding process (Gray, 2014; Saunders, et al., 2016). Thus, each category was examined independently prior to comparing this category with others to group them into sub-categories, in accordance with the similarity of patterns identified (Fernández, 2004; Miles & Huberman, 1984). Once the relationships between categories were acknowledged, they were rearranged into a hierarchal form with the sub-categories displayed in order to explore and explain a research phenomenon (Saunders, et al., 2016, p. 599). This process was iteratively performed in this study between open and axial coding throughout the data analysis until an exhaustive parent and child node structure was evolved during the analysis of exploratory study interviews.

***Selective Coding***

Selective coding seeks to identify one of the main categories as the central, or core category, in order to connect other categories to this category with the intention of developing an explanatory theory (Saunders, et al., 2016). Therefore, in this study a series of nodes arising from both open-coding and axial-coding processes were reviewed during the selective coding process, in order to develop a distinct story line across the core of data information that emerged from those different themes. However, some child nodes produced comparable content regarding how the phenomena of QMS implementation should be explained, although finally this generally led to providing redundant information. As a consequence, in order to facilitate more effective content analysis, new nodes were created from the redundant information and connected to other nodes. Afterwards, the structure of coding was consistently established following the successful regrouping and fragmenting of nodes.

### 4.7.3 Within-Case Analysis

In case study research, there is a need to perform a within-case analysis before undertaking a cross-case analysis, in order to gain an in-depth understanding of the phenomena under study (Eisenhardt, 1989; Gray, 2014; Yin, 2012, 2014) In this research, the within-case analysis was undertaken to detect how the processes or patterns disclosed in that case underpinned, expanded, or rebutted derived propositions from analysing the exploratory study interviews (Paterson, 2009). Hence, each case study was treated as a single case in which the intrinsic aspects of QMS deployment were identified; these aspects may be generalised to other cases throughout later cross-case analysis. Therefore, undertaking the within-case analysis before conducting a cross-case analysis, facilitated gaining in-depth exploration and description of the studied phenomenon of QMS implementation within a single case as a stand-alone entity (Eisenhardt, 1989; Paterson, 2009; Yin, 2009, 2012). More importantly, in order to foster the emergence of unique attributes and patterns of a single case prior to pushing towards generalising patterns across cases, single-case analysis was carried out to enable investigators to be entirely immersed and intimately familiar within the data of each single case (Eisenhardt, 1989; Gray, 2014; Paterson, 2009).

### 4.7.4 Cross-case analysis

A cross-case analysis was utilised to strengthen the validity, enhance the generalisability, and foster theoretical elaboration of this research (Burns, 2009). Also, a cross-case analysis provided more robust precise outcomes compared with those gained from using merely a single-case analysis (Burns, 2009; Miles & Huberman, 1994; Yin, 2014). The robustness of cross-case analysis comes from the fact that this data analysis approach essentially follows a replication logic or pattern matching technique suggested by Yin (2009). This technique is similar to that used in multiple-experiments where collect data is considered based upon various viewpoints (Amaratunga & Baldry, 2001; Burns, 2009; Yin, 2012). In this research, cross-case analysis was performed to identify common similarities and differences between the three cases. To find these similarities and differences, a comparison was performed between the derived concepts from the analysis of each individual case and previous theoretical constructs that had emerged from the literature review and the exploratory study. This comparison was iteratively carried out to verify either the commonalities and variances revealed amongst the cases, and to confirm or refute the initial propositions derived in the exploratory study.

Furthermore, to avoid the emergence of premature or imprecise conclusions from cross-case analysis, QSR International NVivo 11 software was utilised to perform the required text search, coding, numeral counts, and matrices. These techniques were carried out to determine the utility of cases in demonstrating the factors affecting QMS implementation and to develop the matrices for generating theme-based assertions to determine the significance of these factors depending on the findings of each individual case.

### 4.7.5 Dominant Techniques of Analysis

As mentioned in Section 4.5, in this research, three analytical techniques, namely pattern-matching, explanation building, and numerical counts analysis were evidently justified to be the most effective analytic techniques in explaining the data gathered by case studies.

***Pattern-Matching***

Patten matching logic, for case study analysis, is considered to be one of the most preferable techniques because it can strengthen internal validity of research (Trochim, 1989; Yin, 2014). Reinforcement of internal validity was fulfilled by comparing empirical patterns of cases with the predicted pattern of outcomes based upon theoretical propositions developed in the exploratory study in order to explain what is anticipated to be gained from analysing such data (Saunders, et al., 2016; Yin, 2009). Therefore, these propositions were used to develop the conceptual framework, which was afterward tested as a means to explain the findings of cases (Saunders, et al., 2016). A pattern-matching technique was followed throughout the processes of both within-case and cross-case analyses. The prediction of patterns initially illustrated in the conceptual framework was compared with the empirical data of the exploratory study. Then, the propositions developed during the exploratory study analysis were compared with the case studies data to either confirm or refute these propositions. The pattern-matching technique was extended to involve a search for similarities and differences between other empirical and predicted factors of QMS implementation within and across the cases being examined.

***Explanation Building***

Explanation building aims to analyse the data of a case study by building an explanation about such a case, and its procedure is primarily used in explanatory case studies (Yin, 2014). Although the process of explanation building is considered to be similar to a pattern-matching procedure, the objective is not to produce a comparative conclusion, but to extend case study ideas for further research (Yin, 2009, 2012). Due to the explanatory nature of this research, the analysis followed a series of iterations that represent the stages of analysis, including:

Deriving the propositions regarding factors impacting QMS adoption,

Comparing the findings of the initial Case against these propositions,

Revising the propositions,

Comparing the revised propositions against the findings of other Cases,

Repeating the revision process as many time as required (Yin, 2014, p. 143).

The iterating process started by creating propositions concerning the impact of factors, external factors and CSFs, on QMS deployment. Then, the findings of the initial Case were compared against these propositions before revising such propositions and comparing them again with the findings of other cases. When the findings from the cross-case analysis were compared with the initial propositions and then the propositions were revised and compared again with the findings of all Cases and vice versa, the explanation building gradually became plain. This analytical technique was, therefore, fundamental to understanding the relationships between the factors impacting QMS implementation and their implications on assuring robust deployment of the system. This process was repeatedly performed as long as it was required before developing the final assertions of cross-case analysis as explained below.

***Numerical Counts Analysis***

A numerical counts analysis was adopted, in this research, as a proxy for indicating the significance of the factors affecting QMS deployment, including the external factors and CSFs (Bazeley & Jackson, 2013). The process of data analysis using this logic was generally used to evaluate the significance of each factor through counting the number of informants or documents **(number of remarks)** that addressed the issue, and counting the number of times such a factor was broached (Bazeley & Jackson, 2013). To analyse the data generated from the case studies numerically, several techniques were utilised, namely rating the utility of each case, constructing a matrix of queries that generated theme-based assertions from all cases, and ultimately developing tentative assertions derived from comparative analysis of findings of case studies (Stake, 2014). The utility of cases for each factor were rated as **H** (high), **M** (medium), or **L** (low) utility. The scale of utility of each case was chosen in accordance with their **usefulness** in developing the knowledge of a related factor and the number of **remarks** that supported that factor.

Furthermore, a matrix for generating theme-based assertions was developed for each case study to first, emphasise the findings of each case that highlighted the level of the impact of factors affecting QMS adoption, and second, to create a basis of the tentative assertions that would be derived based on the findings of different cases (Stake, 2014). Each finding of Cases was rated according to its importance for understanding QMS deployment through a specific external factor by utilising a **3-point scale** mentioned above. In addition to transferring the utility information as well as indicating the most important factors to be used in establishing case assertions, parentheses were used around the factors that obtained high utility from Cases. These factors were given extra (double) parentheses to indicate that they should carry further weight in drafting related assertions (Stake, 2014).

Furthermore, the tentative assertions were derived based upon the findings of cases, and the significance and prominence of the factors of each case. In a cross-case analysis, the assertions represent the findings of the investigator concerning QMS implementation in the CIBS, derived depending on the evidence gained from the Cases (Stake, 2014). These assertions derived were based upon evidence gained from more than one case (almost all cases) to vigorously underpin these assertions. Therefore, they have a single or common focus, and a contribution concerning understanding QMS deployment. Furthermore, to introduce final assertions, tentative assertions were thoroughly reviewed to recognise if there is any overlap, the need for rewriting them, or an immediate requirement for re-arranging their order (Stake, 2014). Ultimately, the tentative assertions were frequently reordered to develop the final assertions that ranked in descending order. The criteria used to reorder the tentative assertions were based upon the number of **remarks** gained from informants or document analysis that supports these assertions, the significance of a factor for explaining the implementation of QMS according to the weight of the external factor utilised to draft these assertions, and uniqueness of assertions to clarify QMS deployment (Stake, 2014). A summary of developing the final assertions process is depicted in Figure 4.5 below.

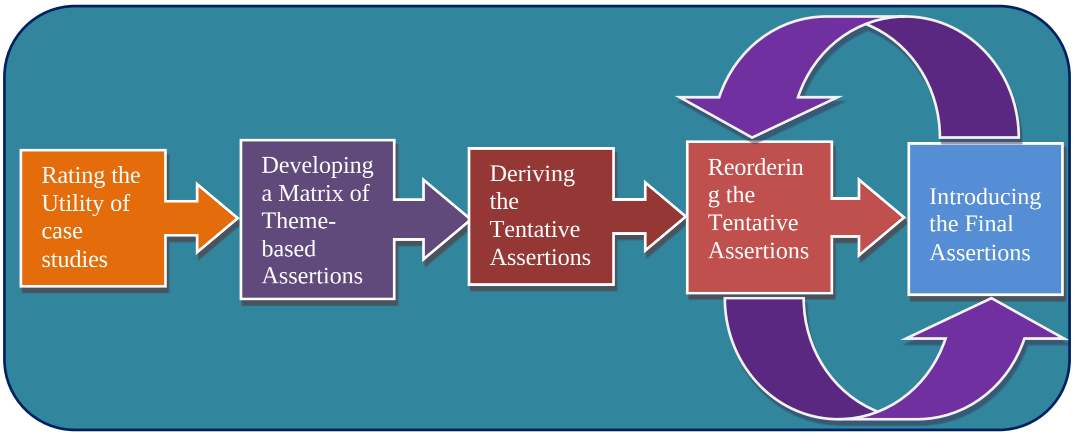


Figure 4.5: The process of developing final assertions

## 4.8 CRITERIA FOR JUDGING THE QUALITY OF RESEARCH

Many researchers point out that qualitative research must reach certain logical tests to evidently demonstrate the quality and credibility of research design and methodological approach adopted (Eisenhardt, 1989; Gray, 2014; Patton, 2015; Yin, 2014). Therefore, different criteria have been used by researchers to test the rigour and validity of their research (Gray, 2014; Yin, 2012). However, there are no precise or unique criteria or terminology to assess the rigour and strength of qualitative research, thus the traditional terminology of validity and reliability used by quantitative research is adopted to judge the quality of qualitative research (Merriam & Tisdell, 2016). Nevertheless, Yin (2014) pointed out that the quality of case study research can be judged by adopting accepted tests of validity and reliability as well as generalisability or transferability (Farquhar, 2012).

### 4.8.1 Validity

In qualitative research, validity is utilised to determine whether the outcomes of a specific study have produced the expected findings, or have confirmed what was initially claimed by the research (Farquhar, 2012; Gray, 2014). Yin (2014) suggested three types of validity in doing case study research, including **construct validity**, **internal validity**, and **external validity**. Construct validity refers to the extent in which the study investigates what it is that is claimed to be investigated (Farquhar, 2012; Yin, 2014). In case study research, two strategies are used to ensure construct validity, namely **triangulation**, and establishing an obvious **chain of evidence** in order to explain how the investigator moved from research question to conclusion (Gibbert & Ruigrok, 2010; Yin, 2014). Internal validity refers to the question of how the study findings meet reality, and are the inquirers observing or measuring what they think they are measuring (Merriam & Tisdell, 2016). External validity, however, refers to the degree to which research outcomes can be generalised or replicated (Bryman & Bell, 2003; Farquhar, 2012).

In this research, a chain of evidence was collected to meet the requirements of construct and external validity. A number of interviews were undertaken to gain a comprehensive viewpoint on the reality of QMS implementation. Also, other types of gathering data techniques, namely document analysis, and direct observation, were also utilised to maintain the chain of evidence of collected data. Moreover, to enhance the chance of generalising the research findings beyond the immediate case study, the investigator adopted a multiple case study method, rather than a single case study approach. Adopting multiple case studies in this research enabled the inquirer to replicate the findings of the first case by replicating multiple cases. Thus, those findings may be duplicated in the other cases, and, therefore, they are considered robust and rigorous (Farquhar, 2012; Yin, 2014). **Triangulation** is also utilised to shore up the greater rigour and integration of the research (Merriam & Tisdell, 2016). In this study, the researcher clearly used triangulation in different ways to strengthen a rigour of the study (Patton, 2002; Sutrisna, 2009). First, triangulation of data collection techniques was adopted to compare the data collected from different sources, and to compare the perspectives of informants from different points of view. Also, different types of documents were analysed to corroborate what interview informants reported.

Furthermore, the investigator assured internal validity by closely examining emerging concepts from investigated cases with the extant literature, and this exploration provides opportunities for obtaining deeper insight in the study (Eisenhardt, 1989). In addition, **pattern-matching** and **explanation building** approaches were adopted to link between evidence and theoretical ideas, and to increase the confidence of making inferences from the data analysed (Gray, 2014; Yin, 2014).

### 4.8.2 Reliability or Consistency

Reliability simply means the extent to which the findings of research can be replicated (Merriam & Tisdell, 2016). The reliability of data collection refers to the degree of consistency in which the adopted methodology can yield consistent outcomes that are similar to those assigned by other researchers who replicated the study by using the same data collection instruments and techinques (Hair, Celsi, Money, Samouel, & Page, 2011). However, since in qualitative research the phenomena are studied in different contexts, and the design of qualitative study precludes prior controls, attaining reliability in the conventional sense is not only imaginary but also unattainable (Merriam & Tisdell, 2016). Thus in qualitative research, reliability is claimed by adopting the words of transparency and replication (Farquhar, 2012). According to Yin (2014), in case study research, transparency is explained by careful documentation and references of the case study database, which also leads to corroborating the arguments for construct validity. Replication is, however, performed by references to the planning and execution of a coherent strategy of research, as well as known protocols used to facilitate the study (Farquhar, 2012; Yin, 2014).

In this study, a comprehensive protocol for case studies was developed to provide an obvious depiction of the procedures being followed to collect the data required. Moreover, to maintain a case study database, all types of data gathered, and interview transcripts were stored in such a way that enabled the investigator to easily retrieve them at a later stage. The researcher ensured the reliability of the outcomes by selecting analytical methods carefully, developing modest objectives initially, and developing researcher analytic knowledge gradually (Yin, 2009). Therefore, within this research, multiple analytic techniques were used to obtain reliable results from the case studies, as previously explained. Besides, two series of analyses, including within-case analysis and cross-case analysis, were performed over a three-month span to assure the reliability of the final research findings.

### 4.8.3 Generalisability

Generalisability or transferability refers to whether or not specific findings can be transferred to another similar context or situation, whilst still maintaining the meanings and inferences from the research completed (Eisenhardt, 1989; Houghton, Casey, Shaw, & Murphy, 2013; Yin, 2014). The inquirer is responsible for providing detailed descriptions for the audience to enable them to make decisions about the transferability of the findings to their specific contexts (Bogdan & Biklen, 2007; Lincoln & Guba, 1985; Stake, 1995). In case study research, Yin (2014) mentioned that generalisability can be attained by the findings being generalised to theoretical propositions known as **analytic generalisation**. Therefore, in this research, generalisability was confirmed in several ways. Firstly, generalisability was strengthened by using the similar technique used to ensure external validity, and secondly by comprising research findings with the extant literature as stated by Gray (2014). Hence, research findings were compared with previous studies analysed during the literature review. Also, because a series of evidence supported the outcomes of the research, this emphasises that the initial claims and assumptions of the study were valid and also that the analysis of data generally depended upon appropriate evidence (Gray, 2014).

## 4.9 ETHICAL CONSIDERATIONS

All researchers need to take into consideration ethical principles when they undertake their studies (Gray, 2014). This study conforms *with Queensland University of Technology (QUT) Code of Conduct for Researchers (2014*). *The QUT Research Ethics and Integrity Committee* provided the research with an Ethics Approval Number to start the case studies undertaken. The study was attributed to be **Negligible Low Risk Research** based upon the questions of research to be asked because there was no predictable risk of harm or discomfort to the potential participants. However, in qualitive research, ethics can raise a specific issue for investigators who regularly work more closely for longer period of time with study participants (Punch, 2014). Such a problem is associated with the nature of qualitative research, where the flexibility of research design is the most notable feature, so research questions and focus might be amended during the research process (Gray, 2014).

In this research therefore, research questions were carefully constructed by using more suitable words representative of those used in the literature related to the subject, in order to decrease the potential need to amend the research questions throughout the process of the study. Besides, it was unforeseen that participants would face any physical, economic, social, psychological or legal risks. Therefore, informant’s organisational premises were prioritised to undertake all the interviews to ensure that the participants were comfortable, and to minimise the probability of any potential risk to their safety. Moreover, confidentiality of all data collected, including documents and participants’ conversations throughout, was maintained. All publications related to the research will ensure that information of participants is depicted in an unidentifiable manner to maintain the relationships built during the study with their organisations.

## 4.10 SUMMARY

This chapter has demonstrated the philosophy of methodological stance, which was utilised by this research to answer research questions and ultimately achieve the objective of the study. Thus, a theoretical framework of research philosophy and process was firstly established, as shown in Figure 4.1. Such a framework was developed in order to ensure that all research options were taken into consideration before making the final decision about the most appropriate process of this research. Then, the chapter in detail clarified the research assumptions to rationalise the most appropriate assumption of this study. The research strategy, and the reasoning and philosophical views of the investigator, which justified this study as being interpretivist research, were presented. Thereafter, the reasonings behind the research design were explained, and the justification of choosing an inductive logic of research was noticeably demonstrated.

Furthermore, adopting the inductive logic of research design led to justifying the selection of qualitative methodology, which is firmly related to interpretivism. Afterwards, two methodological approaches were amply justified to be selected as the main methodologies to collect the data required, namely in-depth interview as an exploratory study, and the case study method. In this regard, the design of case study, selection of cases, and the types of data collection techniques, including interviews, direct observation and document analysis, were demonstrated in detail. Later on, the analytic techniques to be used in this study were explicate, and the correlation between those techniques was also explained. Finally, quality of the research was also discussed in this chapter by focusing on the validity, reliability, and generalisability.

# Chapter 5: Exploratory Study

## 5.1 INTRODUCTION

Chapter 4 outlined the methodological approaches and analytical techniques utilised in this research. This chapter encompasses the prime results of the exploratory study and starts by outlining the procedures of conducting interviews performed within the exploratory study, and then, it describes the demographic characteristics of participants. The data analysis process and the main results achieved are also displayed in this chapter. Throughout the data analysis, a sample of some of the comments expressed by informants is presented because they are fundamental to subsequent refinement of research questions, the selection of potential case studies, and development of propositions to be tested within these case studies.

## 5.2 PROCESS AND METHOD

In-depth interviews were conducted to collect the required data. As the selection of the interview methodology is affected by the nature of the objectives and the research questions, this study employed semi-structured, face-to-face, in-depth interviews to obtain specific and focused knowledge of the study phenomena. This section describes the processes of data collection, transcription, and coding.

### 5.2.1 Background of Respondents

The findings of this study are based on 15 interviews conducted with different construction organisation managerial levels whose major responsibilities were the implementation of QMSs within their organisations. The participants symbolised 12 building organisations. These participants have at least ten years' experience in the construction industry. Table 5.1 below illustrates nature of participated organisations, and a demographic information of participants.

A limitation was that whilst the author intended to involve participants from different tiers of Australian building organisations, most of the interviewees were drawn from Tier One, and some from Tier Two companies, since these were the most actively responsive to the researcher's invitations. There were no participants from Tier Three, because those organisations either did not respond to invitations or declined to participate due to a lack of managers who are directly responsible for implementing QMS, or due to not having in place any adopted quality systems. Figure 5.1 below illustrates the nature of participating organisations in conjunction with demographic information of participants. In this table, the abbreviation "P" has been utilised to refer to participants along with the number each participant for the purposes of anonymity.

Table 5.1: The nature of participated organisations and demographic information of participants

| Participant | Organisation Number | Tier of Organisation | Nature of Organisation | Position | Years of Experience |
|---|---|---|---|---|---|
| **$P_1$** | 1 | 1 | Construction, Property Development, and Infrastructure Development | Quality Manager | 20 |
| **$P_2$** | 2 | 1 | Building Projects, and Fit-out & Refurbishment Projects | Construction Manager | 21 |
| **$P_3$** | 3 | 2 | Design, Building Projects, and Civil Engineering Projects | Quality Manager | 27 |
| **$P_4$** | 4 | 1 | Construction and Infrastructure Projects | Construction Manger | 27 |
| **$P_5$** | 5 | 1 | Construction, Engineering, Transport Solutions, and Infrastructure | Project Manger | 11 |
| **$P_6$** | 1 | 1 | Construction, Property Development, and Infrastructure Development | Project Manager | 20 |
| **$P_7$** | 6 | 1 | Construction, Civil Infrastructure, and Mining Services | Quality Manager | 11 |
| **$P_8$** | 7 | 1 | Commercial Construction and Restoration Projects | Construction Supervisor | 22 |
| **$P_9$** | 8 | 1 | Design, Construction, and Infrastructure Projects | Construction Manager | 11 |
| **$P_{10}$** | 9 | 1 | Building Projects, and Engineering Projects | Project Manager | 20 |
| **$P_{11}$** | 10 | 1 | Building Projects | Project Manager | 12 |
| **$P_{12}$** | 5 | 1 | Construction, Engineering, Transport Solutions, and Infrastructure | Project Manger | 10 |
| **$P_{13}$** | 11 | 2 | Commercial and Industrial Projects | Quality Manager | 18 |
| **$P_{14}$** | 11 | 2 | Commercial and Industrial Projects | Construction Manager | 25 |
| **$P_{15}$** | 12 | 2 | Building Projects, and Infrastructure | Project Manager | 10 |

However, the maximum number of interviews conducted in this research was based upon achieving ‘**theoretical saturation**’, and this is considered to have been reached when the inquirer starts to observe a series of relatively 'pointless knowledge' that arises from the previously 'experienced phenomena' (Eisenhardt, 1989; Eisenhardt & Graebner, 2007). Moreover, the number of interviews undertaken is based on the questions being asked, the data being collected, the analysis in progress, and the resources that the inquirer has to underpin the research, such as time and cost (Merriam, 1998). In this research, theoretical saturation, namely closely similar and matching responses and knowledge was started to be observed, and no new forthcoming information was able to be gathered after completion of the fifteenth interview, and at this point, the researcher decided to restrict the total number of interviews to 15.

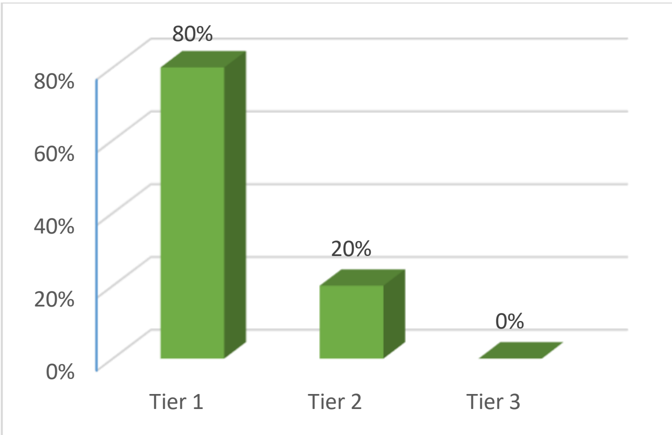


Figure 5.1: Distribution of participating organisations according to their official Tiers

The interviews were conducted at different managerial levels within participating organisations based on their roles in a QMS implementation. There were four participants who represented Construction Managers whilst another 4 participants were Quality Managers. However, Project Managers symbolised 6 informants. Also, one of the informants was a construction supervisor who was nominated by his organisation to participate in the interviews since that participant was responsible for QMS implementation within the projects of that organisation. Figure 5.2 below depicted the distribution percentage of participants based upon their official positions.


Figure 5.2: Distribution of participants based upon their official positions

### 5.2.2 Interview procedures

The interview included open-ended questions to provide respondents with the freedom to discuss and express their perspectives and enable the researcher to obtain personal views of interviewees. The interview questions were formulated to identify the external factors affecting successful adoption of a QMS in the construction sector. The estimated time of each interview was scheduled for approximately one hour, in order to provide individuals with adequate time to express their opinions about specific issues. All informants were asked for permission to record interviews, with the investigator simultaneously supplementing recordings by note-taking, which could be used later if any problems occurred with recorded interviews. The sample of the interviews was drawn from the top two tiers of Australian construction companies (Industry, 2015). The selection of companies chosen to participate in the interviews was based on their official numbers of employees depicted in preceding chapter, Section 4.6.1, Table 4.3.

Potential participants were initially identified via official websites of organisations, or through LinkedIn social media. These participants were then approached via email, and upon acceptance to participate, official invitations were sent in conjunction with a consent form to be signed by them. The emails (that contained a flyer briefly describing the research project), detailed the research questions, objectives, and the overall aim of the study along with the potential advantages that participating organisations might acquire from the research. As alluded to, the participants represented different managerial levels in their building organisations selected in order to gain an inclusive portrait of those closely involved in QMS implementation in building organisations. The interviews were undertaken from 1

March 2017 and 30 May 2017. All interviews were carried out at participants' offices. During each interview session, an initial explanation was provided to informants explaining the prime elements that could affect QMS implementation, such as the external factors, internal factors, and CSFs. That included brief definitions of these factors, and a summarised elaboration of how these factors might affect an effective deployment of QMS based upon a knowledge gained from literature review. Also, the list of identified CSFs from literature analysis has been presented to the interviewees prior to asking them about any further CSFs that could be adopted to assure a robust deployment of QMS, and about the CSFs that could specifically adopted at a project level to ensure successful implementation of such system. In addition, any other issues that might cause some confusion to participants were precisely demonstrated.

### 5.2.3 Data Analysis and Coding process

As previously mentioned, the main purpose of undertaking interviews was to develop a comprehensive understanding regarding a QMS implementation in the CIBS. The voice-recorded interviews were completely transcribed with the use of verbatim and written styles simultaneously with carrying out other interviews to allow the researcher to capture the major perspectives and ideas expressed by informants. Furthermore, the content of transcriptions was organised based on the sequence of questions of interview to simplify data analysis. QSR NVivo (NVivo, 2016), was utilised to analyse the data collected from the interviews. Once the transcriptions were uploaded to NVivo, the data coding process was performed to analyse the data, as demonstrated in Chapter 4.

During the coding process, the collected data was primarily selected and simplified by reduction of such data. Further, the reduced data was grouped into main themes to enable data display. The previous stages, data reduction and display were performed throughout open-coding activities by breaking the data into as many groups as possible. These categories were then labelled and stored into allocated files by means of tree nodes and parent nodes. To develop a comprehensive parent and child nodes structure, an iterative process was performed by using an axial coding process to compare the nodes generated from the open-coding process depending on the similarity of patterns identified. Such nodes were ultimately developed into three different levels, namely Parent Node, Child Node, and Sub-Child Node, and correlation between these nodes is illustrated in Figure 5.3.

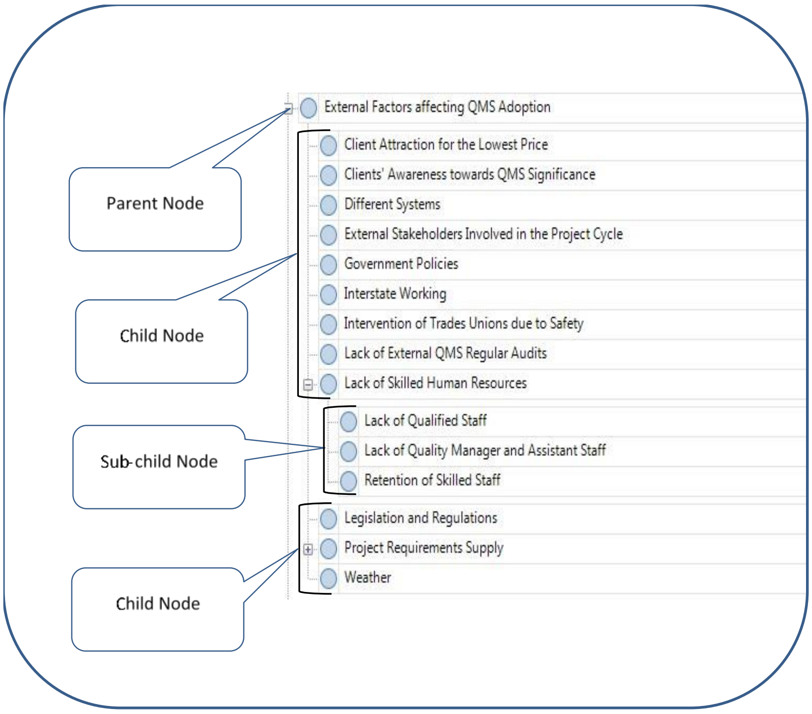


Figure 5.3: Corrolation between different nodes

All the above procedures were performed by using QSR NVivo Version 11 software following recognised strategies and steps that can facilitate understandings drawn from qualitative research as an iterative process. These procedures are exhibited in Figure 5.4.

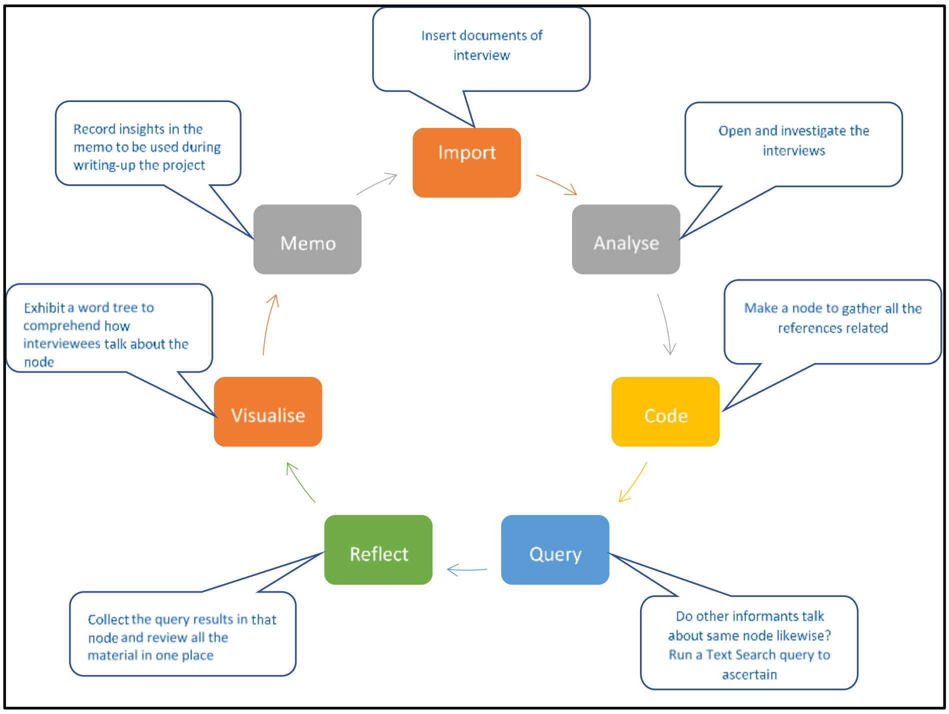


Figure 5.4: A framework of interview analysis using QSR NVivo (Nvivo11, 2017, p. 7)

## 5.3 STUDY ANALYSIS AND RESULTS

A qualitative analysis of the data collected by exploratory study was primarily undertaken to answer the following research questions (RQ1): *What are the main external factors influencing the effective adoption of a QMS in the CIBS?* and, (RQ2): *What are the crucial CSFs for an effective QMS implementation in the building industry?* Therefore, the exploratory study was sought to identify the external factors surrounding the construction industry that potentially impact on the effective implementation of QMS in building organisations. Likewise, the study concern was with identifying a comprehensive list of CSFs for effective implementation of QMS through focusing on identifying those CSFs that might affect at project level. The qualitative data analysis carried out in this research thoroughly followed a logical approach wherein gained data were portrayed, connected into small groups of similar meanings in order to allow for new ideas and themes to emerge (Gray, 2014). That was performed by presenting the findings gained from interviews of the exploratory study through utilising quotes and comments expressed by informants, along with interpretations of quotes including text and tables.

### 5.3.1 Internal Barriers to QMS Implementation

As demonstrated in Chapter 3, most of the barriers confronting an effective implementation of a QMS in the construction sector were determined to be internal barriers, because they are either generated by companies throughout the QMS implementation, or related to the overall hierarchical structure of construction organisations (Aichouni, et al., 2014; Carayon, et al., 2010; Femi, 2015; Ilango & Shankar, 2017; Rogala, 2016). Moreover, although the main focus of this study was to identify the external factors that influence the effective deployment of QMS and the CSFs for effective and timely implementation of QMS, the identification of an inclusive list of internal barriers proved fundamental to develop a comprehensive framework for robust implementation of QMS, which is the prime aim of this research. Therefore, after categorising such barriers into several groups based on where in organisations and/or their environments these obstacles are generated, this list of barriers was made known to the interview participants. The purpose of doing this was to first validate that these barriers are related to the context of Australian building organisations and their QMS implementation efforts, and secondly to ascertain whether the grouped barriers are positioned in the appropriate categories, as well as to ascertain that this constitutes an inclusive list of barriers to QMS implementation.

### 5.3.2 External Factors affecting successful implementation of QMSs

The research findings demonstrated that there are twelve key external factors impacting effective implementation of a QMS in building organisations. Also, some sub-factors associated with the main external factors were also identified by analysing the data obtained. Table 5.1 below shows a brief description of the identified external factors that impact the deployment of QMS in the CIBS.

All informants revealed that the implementation of QMS in building organisations is influenced by external factors. As an illustration, $P_5$ clearly stated that: "*External factors are probably the biggest issue with QMS on projects. I mean generally projects are now being delivered on extremely tight schedule and that's due to government issues when they award contracts and then when they want to finish a part, so we've got really tight timeframes, really tight budgets*". In regard to this perspective, $P_7$ and $P_6$ also mentioned QMS deployment is extremely reliant on many external factors to achieve every project. On the other hand, other informants clarified their perspectives by exemplifying a specific impact of an external factor. For example, P2 associated between the extent of external factors impact on QMS and the number of subcontractors involved in the project, in which assuring compliance of the subcontractors with the requirements of QMS is a serious challenge. Similarly, there was a distinct connection between the level of QMS implementation in building companies and the expectations and knowledge of clients, whose impacts were clearly referred to as external influence by the majority of participants, either explicitly or implicitly ($P_7$, $P_{13}$, $P_5$ & $P_1$). However, in order to more closely examine the impact of each external factor, a number of propositions are established to be used later in this study for developing a framework that will be tested within the case studies. These external factors are explained in detail in Table 5.3 below.

Table 5.2: Description of the identified external factors impacting QMS deployment

| No. | Name of External Factor | Description | Illustrative Quote |
|---|---|---|---|
| **1** | **Client Attraction for the Lowest Price** | Attraction about project cost offered by company | "*We are now in a situation where we are trying to compete with contractors who no longer have a problem about QMS, and they just put in a super low price and then smash the client with variations* " (P1). |
| **2** | **Client Awareness towards QMS Significance** | Understanding the importance of QMS and the requirements of effective implementation | "*The hardest part is getting the client to define what quality is, what are you expecting as the outcomes from that QMS? It is because regularly, when you have your numerous stakeholders, I have got different ideas of what is quality for them*" (P13). |
| **3** | **Different quality systems** | Systems adopted by main contractor or subcontractor | "*Even if subcontractor has his own QMS and you have a different QMS, which QMS are you going to adopt within your project? We need a consistent system because we need a system that staff can follow internally, where the head contractor will have our system in place*" (P13). |
| **4** | **Complexity of external project stakeholders' involvement** | All external stakeholders out of the organisational system of company | "*There's challenges in terms of project's structure of construction. So, we don't have a consistent workforce employed as that in some places for 5-10 years. In the majority of our works, 99% are subcontractors, so in this situation, we are not directly responsible for the quality, we've engaged another party to undertake that work for us. To what extent are we able to manage each of the subcontractor's defections and inspections and materials so that it works for us?* " (P11). |
| **5** | **Government Policies** | Any policy established regarding QMS in the construction industry | "*I think government policy obviously has positive effects on QMS implementation, but maybe it's not going far enough at the moment, maybe it could go further*" (P5). |
| **6** | **Interstate working** | Executing projects in different states | "*We know we have different issues operating a unique QMS across different states. So, if we have a single road authority, with only one set of standards, and a single set of requirements, we will be able to put together a QMS that manages road operating across everywhere. But because now each state has its own QMS, its own engineering systems, it makes it more expensive for us to try manage all of that and create a consistent QMS working with that*" (P13). |
| **7** | **Intervention of Trades Unions** | Trades Unions regarding safety | "*Intervention of trades unions is probably more for buildings sector. In saying that, QMS is a part of safety, if you want to stand on a scaffold or on a slab and there's no paperwork to cover it, then that has an effect, it's an issue. Yes, it will affect time and money, but it comes down to organising a good QMS", and that needs to be ready on site*" (P12). |
| **8** | **External audit of QMS** | An audit conducted by external parties | "*Because you go hard in the beginning, you get the quality you want. But that is a very difficult discipline to be employed internally in an organisation. It is much easier to have an external party to engage that. So, how tough the clients are, directly drives the quality of what we build*" (P1). |
| **9** | **skilled Human Resources** | Human resources essential for QMS implementation | "*I think a key one to affect QMS actually is lack of skilled human resources. Because right now we're in a boom and in the construction industry, you do find you're not getting the same type of tradesmen that you'd have seen 10 years ago, and you do find that you have a lot more defects at the end of a project then maybe you used to have, because of the lack of skilled labour*" (P11). |
| **10** | **Legislation and Regulations** | All legislation and regulation related to QMS deployment including standards | "*I think government regulations and government legislation obviously have positive effects on QMS implementation, but maybe it's not going far enough at the moment, maybe could go further* " (P5). |
| **11** | **Project Supply Chain** | The chain of supplying the required materials and equipment | "*In a globalised supply market now, very little product is made in Australia, 80% of our material is imported, weak government regulation and competent issues on contractors and engineers make it very difficult to consistently deliver quality product for us and because it's a big challenge to make sure these products are compliant with QMS requirements*" (P6). |
| **12** | **Weather** | Different weather conditions that can influence a process of QMS deployment | "*QMS implementation is sometimes affected by weather, you can say that environmental contribution, because rain sometimes is an issue, because it will influence the quality of implemented work* " (P3). |

***Client Attraction for the Lowest Price***

Eighty percent of informants revealed the impact of **client attraction for the lowest price** on the effective implementation of QMS. $P_1$ affirmed that: *"We are now in a situation where we are trying to compete with contractors who no longer have a problem about QMS, and they just put in a super low price and then smash the client with variations"*. Hence, if contractors do not win a project at the right price, quality issues more probably occur owing to huge challenges expected to confront implementing a robust QMS ($P_5$ & $P_8$). However, the issue of lowest price acceptance may be attributable to a lack of awareness concerning QMS significance by clients who do not perceive the importance of their builder employing quality-oriented staff in order to ensure successful project quality outcomes ($P_{10}$ & $P_7$). This can potentially be a serious issue facing the successful implementation of a QMS ($P_1$, $P_6$, $P_{14}$). Thus, $P_6$ noted that working with such severe time and budget constraints, corners get cut and a robust QMS that ensures delivery of a quality product is not achievable.

**Proposition 1:** Client attraction for the lowest price significantly impedes the implementation of an effective QMS in building organisations projects.

***Client Awareness towards QMS Significance***

Almost half of participants disclosed they believed that there was an impact of **client awareness towards QMS significance** on successful implementation of QMS. Most interviewees recognised that understanding QMS significance directly influences the level of implementation of an effective system in building organisations. For instance, $P_{13}$ acknowledged that *"the hardest part is getting the client to define what quality is, what are you expecting as the outcomes from that QMS? It is because regularly, when you have your numerous stakeholders, I have got different ideas of what is quality for them"*. This suggests that clients currently fail to heed how QMS is deployed on their projects because they have no distinct perspective in respect of the structure that supports QMS implementation ($P_{10}$). On the other hand, some interviewees thought that this issue was exacerbated due to the wide range of the clients of construction ($P_{13}$ & $P_2$). $P_{13}$ clarified that the difference of a client of each project, which ranges from a residential domestic homeowner to international super fund clients, results in extreme variance in the level of quality expectations and eventually level of focus on QMS significance. Thereby, promoting quality and importance of good QMS amongst such clients is a challenge because some are not interested in such 'sophistication' ($P_2$).

However, some informants believed that within the public sector, in organisations such as the government departments, clients are more aware of the significance of QMS ($P_9$, $P_7$ & $P_{15}$). $P_9$ recognised that this clear perception concerning QMS significance is more likely to support the system adoption by dedicating an extra budget known as 'non-price criteria column', which can be utilised to resource QMS deployment. On the contrary, other informants acknowledged that a client's level of interest is also considered a significant influential factor on QMS implementation ($P_7$, $P_3$ & $P_{12}$). As an illustration, it is important to note that the main driver for clients appears to be mainly the overall cost of project offered within bids, even if companies intend to clearly promote their QMSs being adopted ($P_{15}$). This implies that construction companies critically need to attract their clients' focus and commitment about the significance of QMS through either ensuring effective involvement of such clients in discussions about how projects are to be carried out, or by establishing a focused priced requirement for use or implementation of a QMS within their bids ($P_3$, $P_9$ & $P_4$).

**Proposition 2:** Client awareness towards QMS significance would appear to be a challenge encountering a QMS implementation in building companies.

***Different Quality Systems***

Adoption of **different quality systems** by main contractors and other stakeholders, such as subcontractors, was identified by 47% of informants as an external factor influencing the successful implementation of a QMS. These adopted QMSs were also sometimes different due to the requirements of differing sized projects, and these differing requirements challenge the implementation of a unique QMS in all projects in construction organisations ($P_4$, $P_{13}$, $P_{14}$ & $P_{11}$). In this regard, $P_4$ mentioned that: "*We are doing, as a company, a QMS to suit various different projects, but different requirements are obviously a challenge in having a QMS which can do all those correctly. For us the challenges are to try and make those amendments to our system and to make it more streamlined"*. On the other hand, the issue of the difference between an own QMS of subcontractor and a QMS adopted by the prime contractor often results in lacking the consistency in implementing a QMS ($P_{14}$, $P_{13}$ & $P_1$).

That highlights the vital need for initial assessment of the QMSs of subcontractors in order to determine if they can execute their own QMSs, or whether they need to adopt that of the major contractor ($P_4$, $P_{11}$ & $P_{12}$). Thus, any final implemented QMS in projects may result from integrating different information obtained from external subcontractors through their QMSs with the information provided by the main contractor's QMS ($P_{13}$ &$P_1$).

**Proposition 3:** Adoption of different quality systems in building projects directly impedes the successful implementation of QMS due to the absence of the consistency of such systems.

***Complexity of external project stakeholders' involvement***

The **complexity of external project stakeholders' involvement** was referred to by only a few informants, as being an influential element in the robust implementation of a QMS. These informants demonstrated that involving a number of external stakeholders in building projects complicates a QMS deployment throughout the project cycle. There is a wide range of influence on effective adoption of QMSs based upon the type of stakeholders involved, and the stage of the project that they are involved in. For instance, the issue of client engagement with, and understanding of, the significance of QMS implementation to motivate building organisations to undertake certification of their adopted QMSs was affirmed as extremely important for organisations that seek to be client focused. This point of view was advocated by $P_2$, who stated that: *"...another external stakeholder impact such as the client is obviously very important to us if we are to be client-focused. So, that means obviously trying to explain our QMS to them is a serious challenge in getting an accreditation from them".*

The main role of prime contractors' organisations is to manage subcontractors and attempt to make them compliant with the main QMS ($P_2$). On the other hand, $P_4$ acknowledged that a compliance of subcontractors with a QMS implemented is another issue related to the complexity of external stakeholders of the project. Consequently, absence of consistency has been a significant challenge for the construction industry for several decades (e.g., the first ISO 9000 certifications for builders in the UK began to occur in the mid to late-1980s) ($P_2$ & $P_1$). Other challenges currently encountered on many construction projects are the consistency of the labour force, wherein currently small groups of employees are used to deliver projects and are controlled by a main or managing contractor, and that ultimately hinders successful deployment of QMS on building projects ($P_1$).

Further, the issue of the quality of designs has increasingly become a challenge in the construction industry, where the costs of designs are constantly being increased whilst the level of design detailing is deteriorating due to the lack of commitment in providing an inclusive detail design prior to announcing the project ($P_1$). Whilst a QMS implementation during the project design and execution stages has no difference in the process, getting contractors to provide both design and construct services will probably help facilitate the implementation of QMSs, because in this case, companies have more impact on the design in order to facilitate QMS implementation ($P_4$).

**Proposition 4:** the complexity of external project stakeholders' involvement in building organisations is a barrier to a rigorous implementation of QMS.

***Government Policies***

A total of 40% of informants disclosed **government policies** as an external factor that impacts on a robust implementation of QMS in the building organisations. With reference to that, $P_{14}$ pointed out that: *"If the government took a thought process to be an educator, rather than a governor, I think life would be so much easier for everybody in our industry. I think that would be easy for subcontractors, easy for the head contractor and I think the government would get some value in that change of mindset"*. Whilst government intent can positively impact on QMS implementation, it may cause some negative influences at the company level and impact on the way in which an organisation develops a QMS in order to achieve their target outcomes, according to ($P_{13}$). $P_5$ also recognised that whereas there is some positive impact of government policy on QMS deployment, related policies need further focus in order to meet the expectations of building organisations.

Furthermore, the research data affirms that current government policy should focus on encouraging the construction industry to conduct some education around QMS implementation on construction sites to ensure more effective, efficient, and consistent deployment of QMSs ($P_{13}$). However, in the view of one participant, the lack of establishment of a comprehensive government policy concerning QMS requirements appears due to the dearth of a national body of knowledge to produce that policy ($P_{11}$). As a result, $P_9$ acknowledged that current government policy may actually negatively impact on QMS implementation in several areas, such as pushing companies towards employing a less educated workforce, which leads to lack of a cohesive environment to implement a successful QMS.

**Proposition 5:** Government policies distinctly hinder implementing a vigorous QMS in the CIBS projects.

***Interstate working***

A total of 40% of informants uncovered the influence of **interstate working** on the effective implementation of QMS. Across all statements concerning interstate working, it seemed that a general issue arises when organisations intend to develop a broad QMS that can be applied in a nationwide context. $P_1$ explained this issue by stating that:

> "We know we have different issues operating a unique QMS across different states. So, if we have a single road authority, with only one set of standards, and a single set of requirements, we will be able to put together a QMS that manages road operating across everywhere. But because now each state has its own QMS, its own engineering systems, it makes it more expensive for us to try manage all of that and create a consistent QMS working with that".

This problem also represents serious challenges for construction companies to implement a comprehensive QMS owing to the change in workplace circumstances, different standards and specifications, and different requirements of QMSs across different states ($P_{12}$).

Some informants recognised that because there are differences in legislation and standards between different states, these differences are likely to create ineffectiveness and inefficiency in applying and following a consistent QMS during a project ($P_{13}$ & $P_{14}$). On the other hand, the expectations of obtaining different levels of human resource required for implementing a QMS also varies across the country ($P_7$, $P_3$). Further, some obstacles of interstate working result from the process of addressing issues for different levels of government where the focus of federal government is only on addressing the national issues rather than state-based issues ($P_{13}$). Consequently, the impact of interstate working on QMS implementation is different and varies based on the complexity of QMS of a specific state in which some states have developed more sophisticated expectations concerning a QMS adoption ($P_7$).

**Proposition 6:** Interstate working is a serious challenge confronting an effective implementation of QMS in building organisations due to the difficulty of establishing a universal QMS that can fulfil the expectations of different states concerning QMS adoption.

***Intervention of Trades Unions***

A total of 40% of informants acknowledged the influence of **intervention of trades unions** on the implementation of robust QMSs in building organisations. $P_{12}$ observed how intervention of trades unions affects QMS deployment in the CIBS by stating, *"Intervention of trades unions is probably more for buildings sector. In saying that, QMS is a part of safety, if you want to stand on a scaffold or on a slab and there's no paperwork to cover it, then that has an effect, it's an issue. Yes, it will affect time and money, but it comes down to organising a good QMS"*. This evidence highlights that unions can have a serious impact on QMS deployment, and companies should maintain a healthy relationship with them as much as possible. However, this is often difficult to achieve due to the number of employees working in construction projects and the differing levels of expectations ($P_7$).

In many cases, companies spend a considerable amount of time and money to cope with safety related requirements (as these are statutory, meaning that they can be prosecuted for breaches), whereas that time could be expended elsewhere to manage QMS related requirements, according to some participants ($P_{14}$, $P_{11}$, $P_{13}$ and $P_3$). This difficulty is mainly due to the authority of trades unions to stop a work if any safety related issues occur, so that induces construction companies to push towards a safety culture more than focusing on quality related issues ($P_{11}$). On the other hand, $P_{13}$ argued that there is a distinct link between intervention of trades unions and government policies related to upskilling the construction workforce. Hence, the issue of intervention of trades unions is often difficult to be handled by construction organisations.

**Proposition 7:** It is evident that the intervention of trades unions due to safety matters is a barrier to the vigorous deployment of QMS in building projects.

***External audit of QMS***

Fifty-three percent of informants revealed the influence of the **external audit of QMS** on the successful deployment of such system in building organisations. The majority of these participants associated the lack of regular external audit of QMS with the low performance of implementing such system ($P_1$, $P_{15}$, $P_{12}$ & $P_6$). $P_1$ noted that: *"Because you go hard in the beginning, you get the quality you want. But that is a very difficult discipline to be employed internally in an organisation. It is much easier to have an external party to engage that. So, how tough the clients are, directly drives the quality of what we build"*. Across most of the interviewees' perspectives, it was noted that external audit is only carried out on large or complex mega projects in which a regular third-party audit was provided by the clients on those projects, but this was missing on smaller projects owing to the lack of required budget. Consequently, many issues related to the lack of required QMS audits are due to either lack of budget (external), or most of the internal staff being under the pressure of time constraints that hinder them to undertake required audits (internal) ($P_{15}$).

Therefore, another reason for failure to implement effective QMS in building projects, especially for small projects, as opposed to the success of QMS implementation in the civil sector, is that the latter conducts different types of external verifications as a matter of course ($P_6$ & $P_{13}$). However, it is not only the lack of external audit that affects a QMS implementation, but also the backgrounds of external auditors who are nominated to carry out such audits wherein they might be nominated from different backgrounds, such as an engineering background, or a manufacturing background ($P_9$ & $P_{14}$). Consequently, understanding what is being achieved concerning the QMS requirements is an exceedingly difficult task to be undertaken internally ($P_{12}$).

**Proposition 8:** External QMS audit notably impedes the effective deployment of QMSs in building organisations that still do not undertake adequate external audits due to the lack of required budget devoted to this checking mechanism.

***Skilled Human Resources***

Eighty per cent of interviewees felt that the robust implementation of QMS is distinctly influenced by the **skilled human resource**. Participants expressed their views on the impact of human resource inadequacies in three different ways, namely:

*Qualified Staff*

The impact of insufficient qualified workforce on the robust deployment of QMS in building organisations was indicated by 33% of interviewees. $P_7$ mentioned that:

> "We are in a situation where we have a reduced number of people working on our jobs which makes implementing a robust QMS a big challenge for us. That's also related to an expectation gap in what we expect university graduates to come up with, because now graduates are coming out of the university with a range of skills from the business perspective, but with less technical knowledge".

In respect of this, the data provides evidence that the education levels of potential staff influence the implementation of a QMS, because it is currently challenging construction companies to recruit the required numbers of qualified staff in Australia ($P_3$, $P_6$ & $P_{12}$). Despite that, the lack of skilled workforce is related to the fact that the construction industry is in a boom era, in which the market is increasingly competitive and construction organisations are currently experiencing different levels of success employing suitable tradesmen. Hence, that impacts on obtaining the required staff for QMS deployment ($P_9$ & $P_{11}$). However, the problem of lacking qualified staff is an internal one relating to the issues of the lack of specific budget dedicated to employ required staff for QMS deployment, whilst externally salaries of the construction workforce (not employed on QMS implementation) are increasingly higher than other sectors ($P_{15}$).

**Proposition 9:** Lack of qualified staff is remarkedly a barrier to implement an effectiveness QMS in the CIBS projects.

*Quality Manager and Assistant Staff*

Fifty-three percent of informants revealed the impact of **quality managers and assistant staff** on the robust deployment of QMS in building organisations. This issue is specifically recognised to affect the process of QMS operation within small projects, as stated by ($P_{15}$, $P_5$, and $P_6$). $P_5$ pointed out that:

> "In big projects, there is a quality manager who tries to oversee maybe 25 engineers to make sure that every engineer is following the QMS. But on the smaller jobs, generally there would be no quality manager, no safety manager, no environmental manager; they are really all relying on engineers to be doing the right thing".

It is obvious that building organisations are still lacking adequate quality manager resources compared with other sectors of the construction industry, such as the civil sector, and thus it is quite difficult to demonstrate how the QMS resources are tracking on a construction project ($P_5$ & $P_6$). Although larger building companies may have either a state quality manager or a project quality manger, their responsibilities are not exclusively managing the QMS, but also carrying out other jobs ($P_6$).

Most informants recognised that having an inadequate budget to recruit quality mangers is the main cause of the lack of employment of such quality manger on each project ($P_{11}$, $P_{13}$, $P_8$). Thus, building organisations exceedingly rely on Project Mangers to manage the QMS as a minor role under their responsibilities on the project ($P_{15}$, $P_7$ & $P_4$). Also, recruitment of the required human resources (in terms of quality managers) is distinctly cost and time driven as there is a need considering the wide competition for work for companies to be driven to run a lean resource team ($P_8$). This issue appears to be due to the fact that at the project level, preliminaries in bills of quantities are distinctly tight, therefore it becomes unaffordable to recruit a quality manger, as mentioned by ($P_{11}$). Accordingly, building companies tend to adopt a simpler form of QMS that can be managed by a low-level staff, or they disseminate the responsibilities of managing a QMS across different members of staff to manage along with their everyday responsibilities ($P_3$, $P_8$, $P_{11}$, $P_{15}$). As a result, these nominated staff often struggle to attain their jobs, because they find themselves overloaded with various types of competing works or are surprisingly not compromised as to which work gets done and which work does not, according to both $P_8$ & $P_{10}$.

**Proposition 10:** Lacking a quality manager and assistant staff noticeably hinders deploying an effective QMS in building projects.

*Retention of Skilled Staff*

**Retention of skilled staff** was revealed by one third of participants to be a factor impacting on the successful implementation of QMSs in building organisations. $P_2$ acknowledged that: *"Retention of workers is a big one that affects our QMS implementation and we're actually part of that. The problem is you lose people over time as well, all that knowledge of the QMS will be lost, and that's why we make mistakes"*. This issue is associated with the lack of skilled labour of the construction industry, making it harder to find the appropriate human resources to deliver projects, according to ($P_{11}$ & $P_7$). Building organisations are, therefore, highly likely to lose the experienced workforce that they have invested time and money into training how to successfully implement a QMS within their projects, which is especially critical where the QMS implementation level is so much based on personal capability ($P_2$, $P_{12}$, and $P_{11}$).

Notwithstanding this, $P_2$ felt there was evidence that showed a distinct association between staff retention and their focus on external issues, such as home and personal circumstances and searching for better working opportunities across different sectors. That would result in losing all the invested resources spent in upskilling such staff about the processes of QMS implementation ($P_7$ & $P_{10}$). From a different point of view, $P_5$ acknowledged that losing QMS staff throughout the implementation process probably results in lacking the consistency and effectiveness of adopting such a system.

**Proposition 11:** Retention of skilled staff is a serious challenge confronting an implementation of a rigorous QMS in the CIBS projects.

**Proposition 12:** Skilled human resources widely hinders the effective deployment of QMS in building companies, especially with regard to obtaining adequate qualified staff, employing a quality manager, and retaining upskilled staff.

***Legislation and Regulations***

The influence of **legislation and regulations** on the effective implementation of QMS in the building organisations was disclosed by 73% of informants. $P_5$ mentioned that: *"I think government regulations and government legislation obviously have positive effects on QMS implementation, but maybe it's not going far enough at the moment, maybe it could go further"*. $P_7$ & $P_{10}$ felt that the extent to which government legislation and regulations impacted on QMS implementation ranges from how companies should manage their business right through to how they should audit their subcontractors, as well as how companies should engage them. Thus, evidence from the data indicates that most participants felt strongly that the impact of legislation and regulations from a compliance with an extant standards viewpoint benefited smooth working ($P_6$, $P_1$, $P_{14}$ & $P_{15}$). One informant, $P_{15}$ opined that the reality is that such legislation and regulations are established by various governmental or non-governmental authorities, such as federal government, councils, or QBCC. The legislation and standards have been developed aimed at having a positive effect on construction company QMS implementation, because they offer several options that companies can use to ensure complying with all these regulations and requirements ($P_6$ & $P_{15}$).

$P_1$, however, acknowledged that established regulations in terms of standards are not often easy to comply with during QMS adoption because the standard community is usually run by suppliers, not constructors and end-users of these standards. Although legislation and regulations can exceedingly impact a QMS implementation process, building companies are extremely limited in their impact extent regarding the changes of these legislation and regulations. This scenario explicates the impact of this factor on the procedures of implementing QMS ($P_7$). On the other hand, $P_1$ noted that for extremely huge organisations, such as Tier One companies, it seemed much easier for them to cope with the changes made in the current laws owing to the higher levels of quality human resources that are recruited to ensure compliance with new requirements by analysing these requirements, addressing gaps, and developing training programs. In contrast, for small companies, such as Tier Two organisations, it is notably hard to address these issues when they are just guessing about what actions to carry out ($P_2$). According to $P_3$, there is a clear need to establish legislation and regulations in Australia in respect to the level of the required quality of delivered projects, and construction companies should be enforced to implement QMSs to satisfy safety and quality requirements.

**Proposition 13:** Legislation and regulations are a significant driver for ensuring a successful implementation of a QMS in the CIBS.

***Project Supply Chain***

A majority of participants (73%) revealed that the **project requirements supply** impacted significantly on the robust implementation of QMS within building organisations. However, they categorised the impact of this factor on the successful deployment of QMS into two different categories, namely **quality of imported products**, and **suppliers**.

*Quality of Imported Products*

**Quality of imported products** was revealed as an influential factor on the effective implementation of QMS in building organisations by 60% of informants. $P_6$ mentioned that:

> "In a globalised supply market now, very little product is made in Australia; 80% of our material is imported, weak government regulation and competent issues on contractors and engineers make it very difficult to consistently deliver quality product for us and because it's a big challenge to make sure these products are compliant with QMS requirements".

$P_7$ added that the procurement strategy adopted in the construction industry currently favours procuring overseas materials to enable medium-sized companies to compete with larger organisations, but it is problematic for these medium-sized organisations to attain the required quality of such imported products. Unlike locally made materials where preceding factory inspections can be conducted by companies, however for overseas-made materials, companies' capability to inspect the quality of such materials is extremely limited, resulting in lacking control of quality, according to ($P_{10}$).

Whereas imported products are often attached with quality documentation that affirms the compliance of products to related standards, it is extremely hard to have some confidence concerning the quality of such products, especially those that come from some countries wherein the regulations are distinctly different and more flexible than here in Australia, as stated by $P_{12}$. Some informants also declared that shipping policy is another issue that increases the influence of imported products on the level of QMS deployment ($P_{11}$, $P_{14}$ & $P_8$). In this regard, the view of $P_8$ and $P_{14}$ was that QMS implementation is explicitly affected by shipping policies established by governments, since a huge number of products are currently imported from overseas, and as a country, Australia places more liability on companies to be responsible for controlling the quality of imported products through QMS deployment.

**Proposition 14:** Deployment of an effective QMS in building projects is evidently affected by the quality of imported products, especially for such products to attain the expected quality owing to the difficulties in carrying out regular preceding inspections.

*Suppliers*

The influence of **suppliers** on the robust implementation of QMS in building organisations was disclosed by some informants. $P_{12}$ observed that: *"I've never seen a supplier integrate with a QMS; a supplier is very similar to a subcontractor, but they're less involved. So, I've never seen an external supplier have access to a QMS and automatically just update as required. That's a big one because on a big project, you* *have a lot material required to be supplied"*. According to $P_5$, suppliers impact on the process of implementing a successful QMS because some contractors accept poor quality materials and use them in the project works owing to the lack of a robust QMS being in place, directing relevant staff to ensure that all materials provided to site are of appropriate quality. Some informants felt that the increasing impact of suppliers on QMS implementation is often attributable to the limited ability that companies have to influence overseas suppliers if these suppliers do not comply with a QMS of such organisations ($P_{10}$ & $P_1$). Whereas some organisations have a representative wherein materials are manufactured to ensure that they are being made off the required quality, these products may not necessarily comply with the requirements and standards, and inevitably, companies in some cases are going to use these materials because the process of manufacturing and the time of returning them will lead to delaying the project ($P_{12}$). Therefore, $P_5$ stipulated that organisations should initially operate a robust QMS in place to ensure a compliance of all supplied materials.

**Proposition 15:** Suppliers are a clear barrier influencing how effectively the QMS will be implemented in building projects.

***Weather***

The influence of **weather** on the robust implementation of QMS in the building originations projects was revealed by only a few informants. It was referred to as the influence of weather on the process of QMS deployment in regard to the impact of rain on the quality of finished works, such as pouring concrete ($p_3$ & $P_{11}$). In respect to this, $P_3$ recognised how rainy weather can influence the implementation of QMs by stating that: *"QMS implementation is sometimes affected by weather, you can say that is environmental contribution, because rain sometimes is an issue, because it will influence the quality of implemented work"*. Therefore, companies should pay attention to how to set the procedures of QMS implementation in which such procedures may work in some regions, whereas these might not be functional in others due to the environmental factors that companies confront, such as tropical heat or humidity, as recognised by $P_7$ & $P_3$. For this reason, $P_1$ stipulated that building organisations are encouraged to conduct lessons to explain how the issues related to weather can be handled to mitigate the impact on the procedure of QMS deployment.

**Proposition 16:** Weather is noticeably a barrier to the robust deployment of QMS in building companies' projects due to some certain weather conditions, of Australian regions.

### 5.3.3 CSFs for QMS Implementation

This section presents the principal findings of the exploratory study obtained by analysing the data gathered by interviews. Data analysis reveals a further ten key CSFs for QMS implementation in the building organisations that can be adopted to ensure robust deployment of these systems, especially at project level. Moreover, examining such data by identifying the relevant themes unveiled some sub-factors related to the main CSFs. All identified CSFs will be discussed rigorously in this section. The informants explicitly addressed that there are CSFs that are either so far adopted or need to be adopted by building companies, in order to achieve a satisfactory level of QMS implementation. Figure 5.5 below illustrates the percentage of responses of disclosed CSFs for QMS implementation.

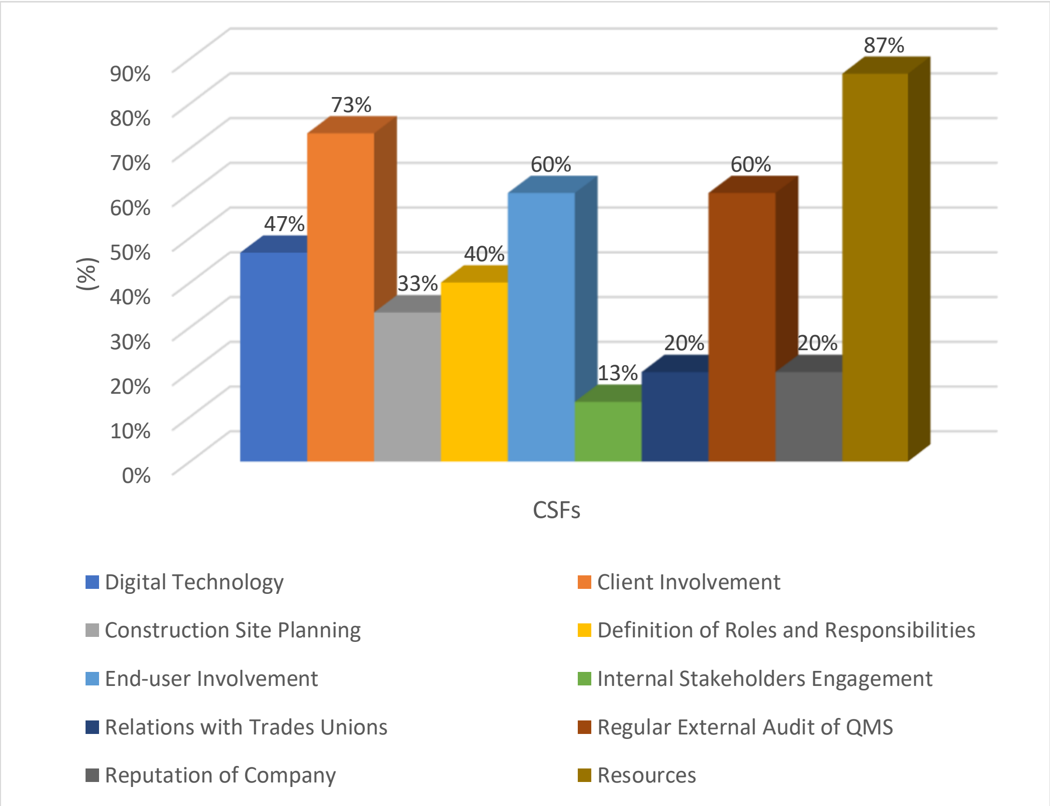


Figure 5.5: CSFs for QMS implementation in building organisations

Table 5.3: Description of the identified CSFs for QMS implementation

| No. | Name of CSF | Description | Illustrative Quote |
|---|---|---|---|
| 1 | **Digital Technology** | Any digital technology, such as iPad used to facilitate the adoption of QMS | "*I think technology and mobile technology is probably a huge CSF for QMS and huge improvement in what currently being done, because currently it's taking too much time, so engineers are not doing it. The job can't stop, they just keep going and then they deal with the consequences a couple of months later when they haven't closed the paperwork of QMS* " ($P_5$). |
| 2 | **Client Involvement** | An effective involvement of client into QMS deployment throughout project stages | "*Customer involvement can have a huge impact on QMS; it depends on the individual client, so sometimes we get clients and their representatives that are very good, so it doesn't take very much for us to explain to them what we are doing, explain some of the issues we have. So, the level of involvement of a client can be a huge thing*" ($P_3$). |
| 3 | **Internal Stakeholders Involvement** | Involving all internal stakeholders of company in the process of QMS adoption | *"There is one missing CSF, which is engagement of internal stakeholders. It is not actually the best of the company they are doing, which is, they actually haven't said anywhere, engagement say engagement of the internally related stakeholders. So, you've got achieve the engagement, well that's who's buying the QMS" ($P_{13}$)* |
| 4 | **Construction Site Planning** | A planning performed at the early stage of project to facilitate QMS deployment during the implementation | "*When we talk about site planning, we're talking about project planning. Planning is so much of QMS implementation in terms of where we locate the cranes, where we locate accommodation for the project offices, where we can store materials for efficient access, access to the site, parking all those things. probably for a project these might be critical things.*" ($P_7$). |
| 5 | **Definition of Roles and Responsibilities** | A process of defining all roles and responsibilities assigned for project team to ease the procedures of QMS adoption | "*Defining responsibilities is also a big one. Because sometimes even we have a QMS within our job and we know that everything has to be implemented, but I don't know this is my responsibility. We need to ensure and make sure that others are up front of the implementation; this is the responsibility of someone*" ($P_{11}$). |
| 6 | **End-user Involvement** | Involvement of end-user of project in QMS process to understand their requirements | "*End-user involvement in the QMS process is up for discussion, that's quite topical because at the end of the day, with Age Care, the client will have employees that are also the-end user. So, for end-user involvement, we need to make sure what does the client want, when does the client want the end-user to be involved in the project*" ($P_{14}$). |
| 7 | **Relations with Trades Unions** | Building healthy relations with trades unions to mitigate their impact on QMS deployment | "*Trades Unions, and industrial relations with trade unions are very important for our QMS. Well, theoretically, again we shouldn't. Our industrial relations should be in a positive way, not rallying the troops today and go marching on them tomorrow. The unions are very adversarial and therefore we're not on board with their thought processes but under our own board with our thought processes or the industry body*" ($P_{13}$). |
| 8 | **Regular External audit of QMS** | An external audit performed by third party to evaluate the level of QMS implementation | "*The external audit always is the best and a very good option to make sure the quality is being in a client satisfactory and the QMS is implemented correctly, and also to make sure everything is handled once, rather than double handling and repeating the same mistake or repeating the job which costs time and is also financially costly*" ($P_{15}$). |
| 9 | **Reputation of Company** | Maintaining a company reputation by committing to implement a robust QMS to deliver a quality product to client | "*Reputation is really important for QMS implementation. So, we don't want to provide a product that's not quality or a product where the perception is there's not quality*" ($P_6$). |
| 10 | **Resources** | Any necessary resources required to implement an effective QMS, including time, budget, and human resources | "*Resource is also a critical factor for QMS whether or not it's a return on investment. Yes, it would make a difference to QMS implementation and how thoroughly it's being followed. The return on investment is preventing us from having quality defects*" ($P_{10}$). |

Table 5.4 above depicts a brief description of the identified CSFs for effective adoption of QMS in the building organisations. As alluded to, the abbreviation "P" has been used to reference the participants in conjunction with the number of each participant for the purposes of anonymity.

***Digital technology***

**Digital technology** was revealed by 47% of participants as a CSF for QMS deployment, as Figure 5.5 illustrates. $P_5$ recognised how digital technology can facilitate the implementation of QMS, especially at project level. In respect to that, this informant stated that: *"Probably, the most CSF is for the construction industry to take up technology and have QMSs that are all mobile, so it's not paper-based anymore, and you then capture the full activities, having quality documentation in one place"*. Hence, building organisations start to transform hard copy requirements of QMS into soft copy, which would be more accessible by using laptops or iPads. Such transformation is attributed to the difficulties of producing a super document that collects all QMS requirements, and can be easily usable quality related staff, according to $P_9$. Some informants declared that digital technology not only saves a considerable amount of time, but also decreases the required paperwork that may result in efficient outcomes of QMS deployment ($P_{10}$, $P_4$, and $P_{12}$).

Along with saving time, adopting such technologies can facilitate involvement of clients by simplifying efficient communication between related stakeholders, such as subcontractors and clients, which can lead to handling all quality related issues more quickly, namely fixing identified defects ($P_1$, $p_6$, $P_{11}$ & $P_2$). As a consequence, the best tool that can be used to deliver a project at required level of quality by facilitating QMS implementation and maintaining efficient communication is to adopt technology, according to $P_{15}$. On the other hand, $P_{12}$ emphasised that digital technology is particularly appropriate to the construction industry due to the fact that it is a mobile sector. Consequently, it is obvious that digital technology is a fundamental CSF for QMS implementation that can save substantial amount of time required to conduct the requirements of QMS ($P_5$).

**Proposition 17:** Digital technology can exceedingly facilitate the deployment of a rigorous QMS in the building organisations through saving a considerable amount of time and minimising the excessive required paperwork.

### *Client Involvement*

**Client involvement** was revealed by 73% of informants as a CSF for QMS implementation in building organisations, as depicted in Figure 5.5. $P_{11}$ explained the significance of client involvement for successful implementation of QMS by addressing that: *"Client involvement is a key factor for QMS implementation. I have to say that our client has been very upfront, and very helpful just telling us the lessons learned on what they have done next door, what hasn't been done correctly, what we need to look out for, which for us is great, it will save us time and money, and it all goes back to QMS"*. Clients can positively affect in their level of how they want to be involved when they institute high clear expectations concerning a quality, which are essential to establish precise requirements of QMS ($P_{10}$). Data evidence also demonstrates the main role of the client within the process of QMS deployment, in which such client represents the key external determinant whether building companies implement a robust QMS or not ($P_1$, $P_{11}$, $P_3$ & $P_6$). Thus, client involvement can be enhanced by maintaining a well-organised communication with them in order to ensure meeting their requirements (P6).

However, the impact of client involvement on the robust implementation of QMS is various based upon the level of their established expectations ($P_6$, $P_{13}$ & $P_7$). On this matter, $P_{13}$ affirmed that client involvement is a key CSF for QMS deployment, because different clients would have different requirements in respect to quality that are significant to determine the potential outcomes of QMS. In contrast, the influence of customer involvement on the rigorous implementation of QMS can be extremely varied, based upon the individual client and their level of experience and focus on obtaining a quality product ($P_7$).

**Proposition 17:** Client involvement is a prime CSF for implementing an effective QMS that is essential to achieve the requirements of client.

### *Construction Site Planning*

**Construction site planning** was disclosed by approximately one-third of informants as a CSF for effective implementation of QMS in building companies, as depicted in Figure 5.5 above. $P_{14}$ indicated the significance of site planning on QMS implementation by stating that: *"Internally, site planning for me is a key factor for QMS implementation, that's the sixth piece, 'proper preparation prevents poor performance'. We really do concentrate on providing time to the project team upfront* *to sit down and workshop. How we're going to plan and implement the system"*. Therefore, well-planned project is not only potentially delivered successfully, but also the implemented QMS would lead to deliver quality products. That requires adopting the right strategy, planning well how to recruit a required workforce, and clearly organising how to deal with client requirements, according to P13. Besides, site planning provides a safe environment for a workforce, which represents a huge factor to avoid intervention of trades unions, and this would assure a consistent adoption of a QMS throughout the project cycle (P8). Therefore, a project team should primarily plan all the required equipment, such as cranes, accommodation of the project offices, stored materials, as well as access to the site to ensure a smooth process of QMS deployment (P7 & P11). Thus, a thorough preliminary construction planning carried out by companies to prepare an appropriate working condition can directly be reflected on how effectively the QMS is implemented (P8). Consequently, beforehand site planning is essential to facilitate an encompassing process of QMS implementation (P8, P7 & P11).

**Proposition 18:** Construction site planning is prime CSF that assists in implementing an effective QMS in building projects, particularly by concentrating on preparation of appropriate safe working conditions.

***Definition of Roles and Responsibilities***

Forty per cent of informants revealed that **definition of roles and responsibilities** is a CSF for implementing an effective QMS in building companies, as depicted in Figure 5.5. P13 recognised how definition of responsibilities impacts on QMS deployment through stating that:

> "The next CSF is though the definition of roles and responsibilities, that gets back to lack of skilled staff, because most people say they lack skilled people on the jobs. The reason they lack skilled people on the job is because they've not actually understood what the roles and responsibilities are. We get all these people who are really good in the team structure; they really want to help, but they don't know what to do".

Companies need to precisely ensure defining roles and responsibilities of their staff to avoid the cross of responsibilities which can negatively impact on QMS implementation (P14 & P13) Thus, definition of roles and responsibilities is a key CSF for implementing a rigorous QMS in building projects, especially in mega projects where there are a vast number of employees involved ($P_{11}$).

Furthermore, some of the informants made a link between a rigorous definition of roles and responsibilities and introducing related training programs ($P_1$, $P_6$ & $P_8$). As an illustration, $P_1$ stipulated that deploying a successful QMS requires not only defining clear roles and responsibilities, but also conducting a related training to the assigned responsibilities that highlights the priorities across these responsibilities, to ensure a consistent adoption of QMS. Thereby, companies are induced to conduct these training sessions associated with the requirements of QMS implementation and quality plans at the initial stage of a project rather than during the implementation stages, to assure an accurate perception of the defined responsibilities of staff ($P_6$). As a consequence, if a QMS-related staff properly obtain sufficient training programs, and they completely understand what they are doing and why they are doing it, that would probably be supportive for implementing a robust QMS in building organisations, as mentioned by ($P_{12}$).

**Proposition 19:** definition of roles and responsibilities is a significant CSF that facilitates the deployment of a robust QMS in building projects.

***End-user involvement***

Sixty per cent of interviews addressed **end-user involvement** as a CSF for QMS deployment in building organisations, as illustrated in Figure 5.5. $P_5$ addressed the impact of end-user involvement by explaining that that: *"End-user customer I think is important, if we involve the end-users in the design process and get their opinions on things. Generally, the whole process of QMS and project will be better. I think in Australia specifically if people not happy with the products, they complain about that"*. Besides, the significance of end-user involvement is normally associated with the need to meet their expectations, especially when certain client intends to entail such end-user within some stage of project to achieve such expectations ($P_{14}$, $P_6$ & $P_3$). For instance, within government projects, project briefs are often held to invite user groups and to conduct regular meetings with such users ($P_6$ & $P_3$). According to data evidence, end-user involvement in certain projects, such as in hospital or school, is often performed throughout the project cycle to assure successful implementation of QMS by meeting the expectations of end-users ($P_{13}$ & $P_6$).

In certain scenarios where the end-user represents the investor of a project, such as in some residential projects, these end-users are likely to establish a high level of expectations concerning the required quality. Hence, these expectations highly contribute to implementing a robust QMS because they are used to develop precise requirements of adopting the system, according to ($P_{10}$). $P_{13}$ however, acknowledged that construction organisations have a limited capacity to affect or engage the end-user and such involvement is distinctly associated with a client attraction. Notwithstanding that, some informants addressed that the focus of end-user and level of expectations introduced may be related generally to local community culture ($P_7$ & $P_8$). Local community culture has an impact on QMS implementation in respect to the level of education wherein some end-users are often completely aware about their needs, and what quality they are expected to obtain based on their initial expectations ($P_7$).

**Proposition 20:** End-user involvement is a prime CSF for implementing an effective QMS in the building organisations, in which involving an end-user at early stage is fundamental to meeting their expectations regarding the QMS deployment throughout.

***Internal stakeholder's engagement***

Merely a small number of informants disclosed the **internal stakeholders' engagement** as a CSF for QMS deployment in building organisations. $P_{14}$ argued that internal stakeholder's engagement is one of the most key CSFs for QMS implementation. As an illustration, $P_{13}$ detailed the significance of internal stakeholder's engagement in the process of QMS implementation by stating that:

> "What about engagement from the end-user of QMS? When I say end-user, I mean internal stakeholders. So, Mr Site Manager, Mr Site Engineer, Mr Procurement Manager and the administration staff, the procurement staff, that's right. Everybody within the internal walls of the company, if they follow the QMS, then that should ensure a quality end product".

Internal stakeholders' engagement is fundamental to implement a rigorous QMS because such involvement can lead to ensuring involvement of all related staff, assuring continuous improvement, enhancing the potential outputs of lessons learned, and obtaining wide acceptance of QMS amongst the workforce of a project ($P_3$). On the other hand, $P_{14}$ stipulated that performing an effective involvement requires a wide acceptance from related stakeholders regarding the significance of adopting an effective QMS to deliver quality products.

**Proposition 21:** Internal stakeholder's engagement is a key CSF for QMS adoption that facilitates a robust deployment of QMS in the CIBS.

***Relations with trades unions***

**Industry relationship with trades unions** is disclosed by some informants as a CSF for deploying a robust QMS in building organisations. $P_7$ addressed the impact of this factor by mentioning that:

> "…so, unions can have big impact on our QMS, and we have to maintain a healthy relationship with them as much as possible. So, industry relations, particularly in terms of how we look after the workforce on the site, can be a CSF for QMS implementation, because unless labours have everything that they could want to feel comfortable in work environment, things can very quickly go back and contrariwise impact our QMS".

This significant impact of such a factor is attributable to the exceedingly powerful influence that trades unions can have throughout the procedures of QMS implementing ($P_3$). However, some informants declared that it is still a serious challenge encountered by building organisations, in maintaining a friendly relationship with such unions ($P_{11}$, $P_6$, $P_{15}$). In this respect, $P_{11}$ acknowledged that to maintain healthy relations with trades unions, contractors would constantly follow the instructions of such unions, which in some occasions represent difficult tasks to cope with as they take the focus of the project team away from QMS requirements.

**Proposition 22:** Healthy relations with trades unions is a significant CSF for QMS deployment that leads to an effective adoption of such a system in building projects.

***Regular external audit of QMS***

Sixty percent of informants addressed that a **regular external audit of QMS** is a key CSF for implementing an effective QMS in building projects, as shown in Figure 5.5. $P_{10}$ recognised how a regular external audit of QMS contributes to the effective deployment of QMS by explaining that:

> "External audit of QMS can be a critical factor to ensure high level of QMS implementation. It's a carrot and a stick, that's QMS by fear, which is one way

> of putting it. We run internal audits but an external audit, especially one that leads to a review of accreditation, is a big deal, as it does change the way we document and verify the work that we've done".

Conducting a regular external audit of QMS is the best way to assure coping with the requirements of QMS once rather than repeating the same mistakes. That is fundamental to delivering a quality work to ensure satisfactory fulfilment of the expectations of a client, as stated by $P_6$ &$P_{15}$. Furthermore, some informants rationalised the significance of undertaking a regular external audit of QMS according to different reasons ($P_5$, $P_{11}$, & $P_{10}$). For instance, $P_{11}$ stipulated that building organisations should carry out more regular external audits to ensure that a QMS team constantly follows system requirements, such as fulfilling all the essential documentation and paperwork on time, since that is considered as a constant check station that a project team needs to pass during every stage of implementation.

However, the need for both external audit alongside internal audit remains essential to acquire extra validity about achieving the requirements of QMS ($P_5$). Notwithstanding, $P_{10}$ emphasised that external audit should constantly be carried out in order to ensure obtaining a persistent positive reinforcement to deliver a successful QMS in the projects. Consequently, undertaking a regular external audit of QMS can enhance the perception of related staff towards the significance of QMS requirements throughout the stages of projects instead of accumulating them to the final stage of such projects, as $P_{11}$ mentioned. On the other hand, conducting a regular external audit of QMS varies across different companies based upon the size of organisation, size of project, type of client of project, as well as the mindset of company towards the significance of such an audit, according to $P_1$, $P_8$ & $P_3$. As an illustration, quality of client affects the focus of contractors concerning the importance of external audit, in which some clients enforce contractors to undertake an external audit as part of their requirements compared with others who have no perception about such audits ($P_1$).

**Proposition 23:** Regular external QMS is a key CSF that noticeably assists in adopting a vigorous QMS in building projects.

***Reputation of Company***

Solely some informants revealed a **reputation of company** as a CSF for effective execution of QMS in building projects. $P_{11}$ recognised how reputation of company is critical for adopting a successful QMS by stating that:

> "Reputation of company is actually a huge one for adopting a robust QMS. If you're a client building a $600 million development, you're going to go with a tier one, tier two company who you know can deliver a tier one quality building, but it's the same thing, reputation. If you get to the end of the job, we've got 32 storeys here, and you've got minimal defects, and things look really good, there's a great chance that that developer's going to use you on the next job".

Reputation of a company also contributes to deploying a rigorous QMS, because maintaining an honourable reputation represents a key incentive for companies to adopt a robust QMS essential to deliver quality products that meet expectations of clients ($P_6$). Hence, evidence from research data shows that building organisations clearly consider reputation of company as a critical factor for maintaining company competitiveness in the construction market ($P_{11}$, $P_{12}$ & $P_6$). Therefore, construction companies that already have an honourable reputation within the construction sector market are more likely to adopt that factor as a CSF in order to maintain their reputation by enforcing a rigorous deployment of QMS in their projects ($P_{12}$). Hence, adopting a proper QMS within projects can successfully maintain the reputation of organisations, and that is especially true about organisations dealing with federally funded projects ($P_{11}$).

**Proposition 24:** Reputation of company is a prime CSF for adopting an effective QMS in building organisations.

***Resources***

Most informants revealed **resources** as a key CSF for adopting an effective QMS in building organisations. For instance, ($P_3$) recognised that:

> "I think resources are very important to manage our QMS, in the building industry, in most projects we have safety coordinators who manage safety, but we don’t have quality coordinators or quality managers. Therefore, we lack their influence, the focus of a project manager of course is to get a job done on time, meet money for the project, achieve product quality, but QMS requires documentation, we don’t have enough staff to do that documentation".

Notwithstanding, most informants expressed their perspectives by splitting the resources CSF into three sub-factors based on their impacts on deploying a robust QMS in construction projects, namely:

*Provision of Resources of Time and Cost*

Forty-seven per cent of informants revealed that **provision of resources of required time and cost** is a key for implementing an effective QMS in building organisations. $P_9$ asserted the impact of such factors by mentioning that:

> "Time and cost under the umbrella of resourcing is very important, if we have enough money paid to the QMS programs, then we can devote that for more human resources. We don't have any kind of dedicated site engineer; we have a project engineer who distributes himself across a series of projects and is very heavily services orientated; doing the day-to-day project implementation of the QMS is not in his role. Then it's left to the site manager, but if we don't have the resources to implement a QMS and we don't have the time to implement it, often that will be the first thing to suffer, the implementation of a QMS".

Therefore, adopting a successful QMS is clearly connected to provide time and budget essential for implementation, since meeting the timeline of project and delivering the project under the scheduled budget are the main aims of any construction company, as addressed by ($P_{15}$ & $P_7$). However, focusing on meeting a timeline of a project without providing the required time to implement a QMS is a main issue that leads to many quality defects in the CIBS ($P_7$).

On the other hand, it is obvious that sufficient time for QMS implementation is fundamental to effectively executing such systems throughout the lifecycle of a project in which required time should be spent on coping with QMS requirements and assuring compliance with these requirements ($P_{12}$ & $P_5$). However, deploying a successful QMS needs dedication of the requisite cost for implementing such system ($P_9$ & $P_{11}$). As an illustration, $P_9$ recognised that unless a building contractor wins the project at the anticipated price, the first thing that would suffer is a QMS due to deviation from implementation requirements leading to occurrence of quality issues. Thereby, the lack of providing a required budget for QMS implementation demonstrates the scenario of why building organisations often lean on the expectation that subcontractors implement their own QMSs to deliver quality products rather than devoting sufficient resources to implement a consistent QMS appropriate to all related stakeholders ($P_9$).

**Proposition 25:** Provision of required resources of time and cost greatly assists in deploying a robust QMS by recruiting the essential human resources for QMS implementation.

*Recruitment of Experienced Quality Managers*

**Recruitment of experienced quality mangers** is disclosed by 67% of informants as a critical part of resources for implementing an effective QMS in building organisations. $P_4$ recognised how a quality manger is critical to deploy a robust QMS by stipulating that: *"I think it's more significant to have a quality manager as the QMS evolved, when you have SharePoint or other systems, it becomes a lot more in unison, managing the quality side or the system side of the document on the site"*. Besides, $P_{10}$ argued that employing a quality manager is a critical returned investment that building organisations need to focus on, because a project manager would make a huge difference in the level of focus of a project team on QMS implementation requirements, as recruiting a quality manager would prevent the occurrence of potential quality defects. As a result, construction companies currently start to devote more resources to employ required human resources for QMS implementation, especially in terms of quality managers, because of the increased requirements of auditors or due to the change in the mindset of these organisations about QMS significance ($P_{15}$ & $P_{12}$).

On the other hand, data evidence indicates that recruitment of a quality manger is distinctly associated with the budget of project or the size of project implemented ($P_9$, $P_3$ & $P_5$). However, P5 emphasised that every project should have somebody who is specifically assigned merely to ensure that QMS processes are implemented through assure the compliance of related team with QMS implementation requirements. In contrast, a perception of the significance of employing a quality manager is mainly associated with the capability of both contractors and their clients to measure the benefits of recruiting such a manager for QMS deployment ($P_6$ & $P_{11}$). On most occasions, a client of a building organisation is unwilling to dedicate further budget to be utilised to employ a required human resource for QMS implementation ($P_{10}$). Accordingly, $P_5$ stressed that it is fundamental that clients, including governments, should shift their mindset about the significance of the cost of recruiting humane resources for QMS adoption and its criticality to deliver a quality project.

**Proposition 26:** Recruitment of qualified quality manager assists in the deployment of a rigorous QMS in building projects through conducting an effective schedule to manage all the requirements of implementation.

*Recruitment of Qualified Subcontractors*

**Recruitment of qualified subcontractors** was revealed by almost half of informants as a CSF for effective deployment of QMS in the CIBS. As an illustration, $P_{11}$ addressed that:

> "Recruitment of qualified subcontractors is number one for us doing this job, and for implementing our QMS. We've got a full procurement schedule in place and we spend weeks procuring. We usually try to go for the subcontractors that we know, trust we know, they'll leave a quality job at the end. It's paramount to get the qualified and quality subcontractors".

Hence, building organisations should spend adequate time to nominate the most appropriate subcontractors that are capable to cope with the requirements of QMS adoption in order to ensure delivering a required quality to client ($P_7$). In point of this fact, it is obvious that recruitment of qualified subcontractors requires adopting a clear strategy to assess them throughout the lifecycle of a project, to facilitate choosing appropriate subcontractors in the future jobs ($P_2$). However, building companies need to clearly determine their expectations prior to recruiting subcontractors to initially assess their capability to implement a QMS, according to $P_{10}$.

In contrast, the ability of subcontractors to comply with the requirements of QMS is based upon the extent of their qualifications and experience ($P_7$). Hence, unprofessional subcontractors may not be committed to implement a QMS, and therefore the main contractor is likely to lose the benefits of their engagement in such a system, lack the efficiency of QMS implementation, and waste a huge amount of time to manage the process of deploying such system ($P_{12}$). Accordingly, building organisations are still struggling to obtain competent subcontractors who can consistently implement a QMS and eventually deliver a quality project.

**Proposition 27:** Recruitment of qualified subcontractors is an underlying factor for effective implementation of QMS in building projects.

## 5.4 A SECOND STAGE OF A CONCEPTUAL FRAMEWORK DEVELOPMENT

The outcomes of the exploratory study interviews along with propositions established resulted in a second stage of developing the initial conceptual initially that established based upon a literature review analysis. This framework was then further developed to visualise the external factors identified by analysing the data of the exploratory study as well as portraying a holistic list of the CSFs that identified by a literature review analysis and the exploratory study results. Such framework illustrates incipient impacts of these factors based upon the outcomes of the exploratory study. These initial impacts will be investigated within the projects of three case studies in order to explain the influences of the framework elements on the successful deployment of QMS within real construction situations, and to eventually validate the impact of factors by either confirm or refute such impacts. Figure 5.6 below illustrates the framework developed based upon the outcomes of the exploratory study and the propositions derived throughout data analysis.

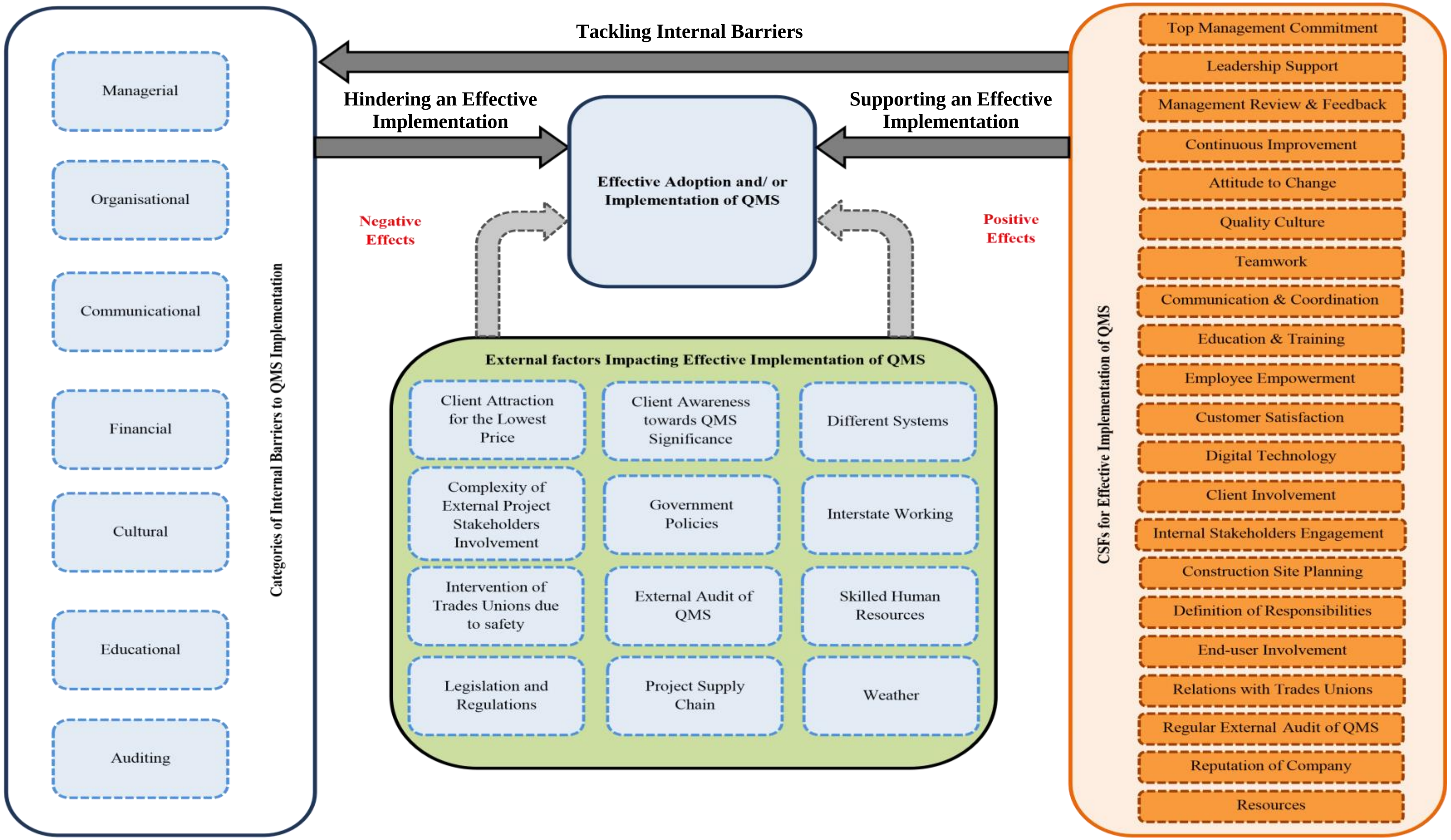


Figure 5.6: A conceptual framework for QMS implementation developed according to the derived propositions

## 5.5 SUMMARY

This chapter presented an inclusive analysis of the data gathered during the exploratory study by conducting 15 interviews. Such analysis demonstrated the main external factors impacting on the successful implementation of QMS in building organisations and explained the nature of these factors by clarifying the ways in which these factors can either positively or negatively influence the vigorous deployment of QMS. Moreover, data analysis led to addressing the key CSFs identified by analysing such data, and to recognise the levels wherein adopting these CSFs can facilitate the effective implementation of QMS, namely company level and project level. Also, the results obtained from analysing the data unveiled some sub-factors related to the main external factors and to the prime CSFs. In addition, the outcomes the exploratory study interviews were utilised to derive propositions that addressed the impact of each identified factors in order to examine them in the next stage of data collection. The overall process of data analysis led to developing a second version of the conceptual framework that will be examined in conjunction with the propositions with the case study investigation.

# Chapter 6: Within-Case Analysis

## 6.1 INTRODUCTION

Chapter 5 demonstrated the findings obtained by exploratory study in regard to the external factors influencing the QMS implementation and the CSFs for effective deployment of such a system. The outcomes and propositions established by analysing the data in the previous chapter led to a second stage of developing a conceptual framework initially identified from the literature review as illustrated in preceding chapter, Section 5.4. This framework was then further tested within the projects of three case studies in order to explain the impact of its elements on the successful deployment of QMS within real construction situations and to validate the factors identified from the outcomes of the exploratory study and literature review.

This chapter now reports the results obtained from conducting three case studies within building organisations from different tiers of the industry. These results are used to answer *RQ4* on how the external factors and the CSFs identified in the first stage of data analysis and literature review affect the successful adoption of QMS in an actual operating construction context. The chapter consists of three main sections. Each section performs to outline the results obtained from each case study in regard to the impacts of the external factors and the CSFs on the effective deployment of QMS in building projects being investigated. The chapter ends with a summary of the major findings gained from this study.

## 6.2 WITHIN-CASE ANALYSIS PROCEDURES

The main purpose of performing within-case analysis is to obtain in-depth understanding of the phenomenon being studied (Eisenhardt, 1989; Gray, 2014; Yin, 2014). In this research, within-case analysis was used to explain the influential relationships between all identified factors and implementation of an effective QMS in building projects. The investigation of each case starts by providing an individual overview of the project and then explains how the implementation of QMS was affected by the external factors being examined. In addition, explanation is provided regarding how adoption of the identified CSFs can facilitate the deployment of a robust QMS within companies being investigated, especially at project level.

Although the aim of the case studies was to involve all three tiers of Australian construction companies, only organisations classified under Tier 1 and Tier 2 participated in this research. This is because no Tier 3 companies wished to participate in this study since they do not operate official QMSs, or due to the lack of quality-specific personnel suitable to be interviewed. The cases being investigated included two companies from Tier 1 and one from Tier 2. All companies are located in Brisbane although one of the case projects was based on the Sunshine Coast.

### 6.2.1 Data Analysis Procedure

The process of data coding carried out for the case studies was explained in Chapter 4. The main purpose of data coding was to understand, from the unstructured data, what the data is about and to categorise such data in relation to the associated themes. To perform this task, QSR International NVivo 11 software was utilised to facilitate the analysis and coding process, namely checking, analysing, grouping, and comparing such data in addition to exporting or importing data to other tools when required (Hoover & Koerber, 2011). Such a process provided a variety of queries that were used to search all of the various content of a project, including text search, coding, word frequency, and matrices. Also, a pattern-matching technique was also performed throughout within-case analysis to build a comprehensive explanation of the phenomenon being investigated during analysis of the data of each case study as precedingly explained in detail in Chapter 4. The results of investigating case studies disclosed which patterns underpin, refute or expand on the initial propositions developed during the first stage of data analysis.

## 6.3 CASE STUDY (1)

### 6.3.1 Profile of Company

Organisation A is an Australian owned international company established in the 1950s. It has local expertise across the core markets of Australia, the Americas, Asia and Europe with approximately 12,000 employees globally. Therefore, based on the classification of Australian construction companies it is classified as a Tier one company according to the size of its workforce, (ABS, 2014 ( as cited in Industry, 2015)). Also, Organisation A engages more than 50,000 sub-contractors that support the delivery of executed projects worldwide. The projects undertaken by Organisation A span across different sectors, namely Construction, Services, Property, Urban

Regeneration, Engineering, Retail, Building, Investment Management, and Development. Moreover, Organisation A combines Development, Construction and Investment processes in order to gain sustainable competitive advantage by providing innovative integrated solutions for customers.

Organisation A fully utilises a mature QMS within the projects, which is nationally adopted to meet the expectations of clients concerning quality and ensures that QMS requirements are performed on projects ($P_{A1}$). However, Organisation A has also developed internal procedures which support QMS deployment, such as design review procedures, and review personnel ($P_{A3}$).

A total of three participants were interviewed within this case in order to gain representative insights on the implementation of QMS on projects. These respondents included Quality Manger ($P_{A1}$), Project Manager ($P_{A2}$), and Construction Manager ($P_{A3}$). In addition to the interviews, documentation specifically associated with the QMS implementation and procedures, such as the Project Quality Management Plan (PQMP) and Project Documentation Procedure (PDP) were also provided by Organisation A for perusal and document analysis.

### 6.3.2 External Factors Affecting QMS Implementation

This section describes how external factors influence the successful deployment of a QMS within the context of Organisation A. In this regard, respondent $P_{A1}$ noted that the most influential external factor impacting on the level of QMS deployment was due to the subcontractors as most of works executed in the case study building project were subcontracted. On the other hand, all of the external factors previously identified by this research to a degree also impacted on the QMS implementation in the case study project as corroborated by all three respondents and from the analysis of documents obtained from Organisation A. The influences of twelve specific factors, in conjunction with other sub factors, are explained in detail below.

***Client Attraction for the Lowest Price***

The influence of **client attraction for the lowest price** on the successful deployment of QMS in the case study project was acknowledged by all respondents. $P_{A3}$ noted that: *"Our client is often looking for the cheapest price, and really doesn't understand the difference in quality; if you either have a QMS in place or not, they want it to be done quickly and cheaply…"*. $P_{A2}$ also stressed that if the case study project had been won based upon the lowest price of tender, the QMS would more likely be implemented on site to lower standards and the provision of required resources for QMS deployment would be a huge challenge. Consequently, in this project, to avoid any difficulty in meeting the expected level of quality by conducting a less than robust QMS, Organisation A included the required budget for QMS within their tender to avoid the impact of this factor (PA1 & PA3).

***Client Awareness towards QMS Significance***

Participants of Organisation A supported the impact of **client awareness towards QMS significance** in the context of the project being examined. PA2 elaborated that: *"This factor is the toughest one for us to come to grips with in this project, because that has probably the biggest influence. So, a client needs to understand our QMS by being involved constantly in this project"*. Thus, to avoid the negative influence of a client's awareness, it was decided that the project team would approach the client at an early stage of the project, to ensure alignment between the expectations of the client and the requirements of QMS (PA3 & PA1). The client of this project, therefore, aims at gaining a high-quality product by providing all the essential resources, to assure a high level of QMS deployment (PA1, PA2 & PA3). Thus, client awareness about QMS is a driver for the effective deployment of QMS for this case study project.

***Design Process***

**Design process** was a new external factor revealed by the respondents from the pilot case study of Organisation A. They explained how the influence of design process impacted on the successful deployment of their QMS within the context of the case study project, especially where the design is provided by an external party (PA1, PA3 & PA2). PA2 stated that: "*Design process is very important to ensure successful implementation of QMS. Quality wise, having your design process in place managed right is a huge driver on the project, very important*". In response to this situation, Organisation A had allocated certain experts in various fields, such as hydraulic, electrical, mechanical engineering and façade installation, to review the design documentation of the project to avoid any quality issues that could be expected to emerge in the future, owing to any lack of precise design documentation (PA3). Hence, it was critical for the project team to acquire comprehensive design documentation at the beginning of the project to avoid any issues on QMS deployment resulting from incomplete design. This need is explicitly stressed in the Project Quality Management Plan (PQMP, p10), as follows:

> "Construction and design drawings need to be approved by the Project Manager following a review by the construction management team. Each project shall have a documented red stick process, which ensures that appropriate stakeholders have reviewed these drawings prior to the Project Manager approving".

In brief, the design process was viewed as a serious challenge confronting the effective implementation of QMS in the case study project and was addressed by the whole project team adopting an effective system of peer reviews of the relevant design documentation.

***Different Quality Systems***

The influence of **different quality systems** on the deployment of QMS was emphasised by all respondents of Organisation A. $P_{A2}$ indicated that several QMSs existed in the examined project and mentioned that *"In this project, there's always going to be multiple different QMS systems. For fitting out this room, the guy doing the plasterboard and the guy doing the flooring are going to have…different QMSs"*. Certainly, to mitigate the implications of adopting different QMSs, the project team had operated with very clear checklists and guidelines that clearly indicated the expectations regarding the requirements of QMS implementation before subcontractors had commenced their work on site ($P_{A3}$ & $P_{A1}$). Notwithstanding, it was a major challenge for Organisation A to develop a unique QMS that was usable by subcontractors (who all had their own quality systems) and was also largely due to the relatively unique nature of the project specific quality requirements as compared with previous projects, and the expertise of subcontractors ($P_{A3}$ & $P_{A1}$). According to $P_{A1}$ these issues made it difficult to ensure that all subcontractors complied with the project QMS.

***Complexity of External Project Stakeholders Involvement***

Respondents corroborated the impact of the **complexity of external project** stakeholders' involvement on the procedures and level of QMS implementation on the project. In this context, $P_{A3}$ noted the stakeholders involved and described how they affected the QMS implementation on the project stating that:

> "Within our project, we have a lot of external stakeholders. Like we have clients, we have subcontractors, we have a designer also as an external stakeholder. Involving all these external stakeholders in the cycle of our project absolutely affects the implementation of the QMS, because each stakeholder has a different focus within the project with different interests".

It was observed that external stakeholders had a major influence on the implementation of the QMS, due to the major roles they performed during different stages of the project. Thus, the project team shared the requirements of QMS implementation with all external stakeholders at the early stage of the project to avoid any negative implications arising from the involvement of so many different parties ($P_{A2}$). Moreover, consultants provided precise design documentation at the early stage of the project to ensure delivery of a high standard of implementation of the QMS through assuring compliance by external stakeholders with QMS requirements ($P_{A1}$ & $P_{A3}$).

***Government Policies***

The impact of **government policies** on the effective implementation of QMS was described by the respondents of Organisation A. $P_{A1}$ underpinned this by stating that on the case study project: *"Government policy is driving a QMS implementation in this project, because we have to have an increased level of documentation on certain products, that sort of thing"*. $P_{A3}$ acknowledged that compliance with such policies is a serious challenge confronting the QM team, particularly when there are incomplete documents of materials provided by suppliers necessary to meet the requirements of such policies. Also, a contradiction between the requirements of Councils and the requirements of a client often complicates a contractor's effort to adhere to these policies, which can eventually affect the process of QMS deployment ($P_{A2}$). Nonetheless, Organisation A employs a team at a company level to ensure compliance with such policies by creating quality alerts, which can be used as a benchmark to assure required compliances by QMS team ($P_{A3}$).

***Interstate Working***

Most respondents underlined the impact of **interstate working** on the effective deployment of QMS in the context of the case study project ($P_{A2}$ & $P_{A3}$). $P_{A2}$ demonstrated the influence of interstate working by mentioning that: *"Each state has different requirements. Each state needs to have a state specific QMS; the regulations* *would be different; codes would be slightly different. Each state needs to have their local rules from the centre, so it is a barrier to QMS implementation”*. Besides, PA3 stressed that working interstate is a clear barrier to QMS implementation owing to a huge amount of time required by a QMS team to perceive new requirements of QMS adopted by this state. In the case study project, interstate working impacts adopting a rigorous QMS, with respect to the absence of a unique QMS provided by Organisation A because of generalisations required to make the QMS applicable across different states.

***Intervention of Trades Unions due to Safety***

The influence on the rigorous implementation of QMS by the **intervention of Trades Unions due to safety** was discussed by the respondents, according in the context of the case study project. PA2 recognised the impact of this factor stating that: *"It's a barrier to QMS implementation because of the way the Unions run the industry. They try to enforce different subcontractors on us, who may not be as good. Otherwise you can get your job shut down, as they create a safety issue. It's a huge barrier"*. Other respondents commented that because of the authority that trades unions hold, they can stop work on site due to often uncertain potential issues. As a result, project teams pay more attention to safety related issues whereas many of the the quality defects encountered in this project were the result of insufficient attention to the requirements of QMS deployment (PA2 &PA3). To sum up, the intervention of trades unions due to safety notably impedes the successful adoption of QMS in the project of Organisation A.

***Regular External QMS Audit***

The impact of a **regular external QMS audit** on the effective deployment of QMSs was discussed with all respondents and PA2 emphasised both the need for, but lack of, regular an external QMS audit on Project A stating: *"I believe I have never had an external QMS audit; this is a problem. Yesterday in the project, we had workplace Health and Safety doing all that's here, safety, safety, safety, never had a quality one. It's an issue, it's honestly a barrier"*. Similarly, PA3 observed that the lack of such audits dissipates the focus of the project team from the work necessary to assure compliance with the requirements for implementing a QMS. PA1 opined that this results in discovery of serious defects in executed works throughout the project implementation. Thus, the lack of regular external QMS audits is a barrier to a rigorous deployment of QMS in Project A.

***Skilled Human Resources***

**Skilled human resources** are one of the most important factors of the overall research, and findings from the Project A case study indicated that this factor externally impacted on the effective deployment of the QMS in the project. It should be noted that this factor influenced the implementation of the QMS in different ways; namely **qualified staff**, **quality manager and assistant staff**, and **retention of skilled staff** as explained in the previous chapter. The influence of each individual sub-factor is demonstrated below.

*Qualified Staff*

The impact of **qualified staff** on the rigorous adoption of QMS was raised during interviews with the respondents. For instance, PA2 remarked on the impact of qualified staff by explaining that*: "Qualified staff have a huge impact on our QMS in this project. I'm going to put that as a barrier as the lack of staff has a huge impact on our handover"*. PA1 also recognised that lack of qualified staff was a serious issue confronting robust QMS implementation on the project due to the difficulty in obtaining an expert workforce that was capable of coping with the documented QMS. Both respondents attributed this firstly to the quality of a recently graduated workforce that needed to be sufficiently qualified before commencing their jobs, and secondly to the high competitiveness within theCIBS market regarding ability to employ the required level of experienced and qualified workers (PA1, & PA2). To sum up, the results show that on Project A, the builder's project team struggled to acquire the necessary qualified workforce for QMS implementation.

*Quality Manager and Assistant Staff*

The respondents of Organisation A highlighted the impact of **quality manager and assistant staff** on the effective implementation of QMS in Project A being examined. PA2 addressed the influence of the quality manager by clarifying that*: "a quality manager exactly affects us the same as a lack of qualified staff. We've got a safety manager on our job, but we'll never ever have a quality manager. It's usually the responsibility of the project manager or the senior engineer to look after QMS requirements"*. Moreover, in the context of Organisation A, there was a regional quality manager for the Queensland branch. However, in the project being investigated, the roles of QMS deployment were being shared across different members of staff, such as project manager, engineers, or foremen (PA3). This lack of a quality manager in the project is clearly indicated in the Project Organisation Chart, found in the Project Quality Management Plan (PQMP, p13) as illustrated in Figure 6.1 below.

In further support around the potential impact of this factor, PA1 stressed that recruiting a quality manager is fundamental for QMS deployment stating that: *"We need to have a quality manager in this job - his responsibility is to make sure that what we've got to do to meet our policies/ procedures is happening. We don't have anyone on this site normally who's purely quality and nothing else"*. In Organisation A there was a common perception that everyone is supposed to be responsible for quality as part of their overall responsibilities (PA1 &PA3).

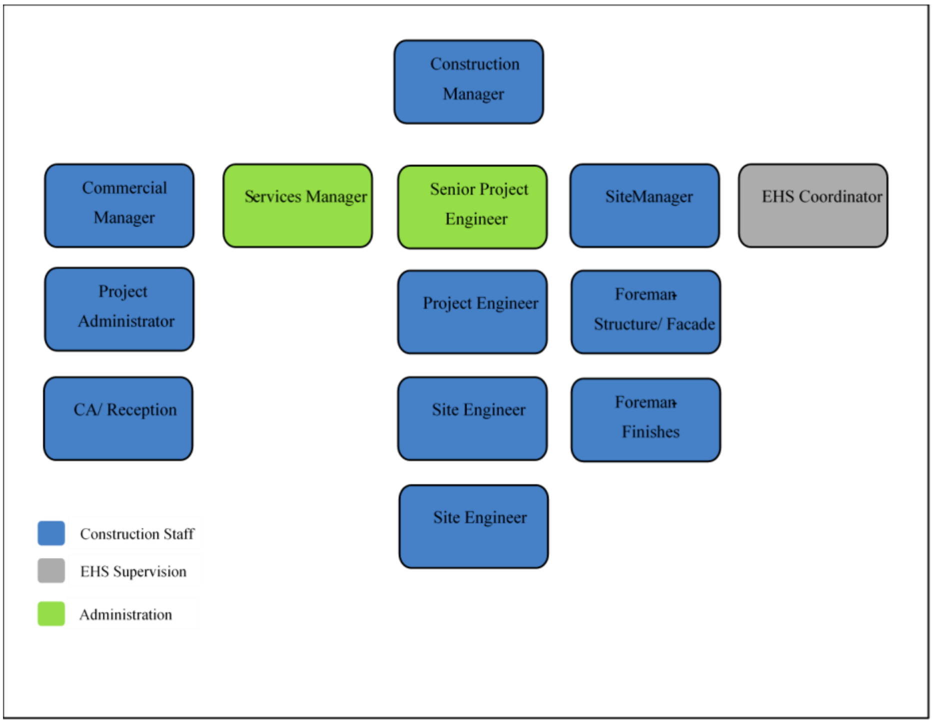


Figure 6.1: Project organisation chart (PQMP, p13)

*Retention of Skilled Staff*

The impact of **retention of skilled staff** on the successful deployment of QMS was referred to by respondents. PA1 highlighted the influence of this factor during QMS deployment, stating that: *"Retention of skilled staff is very frustrating. It takes a lot of time and effort from us to upskill new staff to get them used to our QMS, and to then see them leave and not have any loyalty to go to somewhere else chasing the dollar is* *very, very disappointing"*. In this project, staff leaving their jobs is attributable to both internal and external rationales ($P_{A1}$ & $P_{A3}$). For instance, $P_{A1}$ related the difficulty of staff retention to the tight program of the project, rigid allocated budget, and the pressure of undertaking too many responsibilities. However, the external factors that encourage workers to leave their jobs are, remote or difficult location of the project over which the company has no control, personal circumstances, and also the competitiveness of the construction workforce market ($P_{A3}$, $P_{A1}$). As a result, retention of skilled staff is a major challenge facing the project team whilst striving to successfully implement an effective QMS on the project.

***Legislation and Regulations***

**Legislation and regulations** impact on QMS adoption as corroborated by respondents from Organisation A. $P_{A2}$ indicated this stating that:

> "Legislation and regulations are the main driver to QMS implementation. Let's say for instance Australian Standards, they're on everyone's desk out there. They're main drivers of the leading guys that walk the job multiple times every day to make sure about the compliance of executed works according to these standards".

$P_{A3}$ also attributed the effect of such factors to the criticality of complying with such legislation and regulations, thus facilitating a successful deployment of QMS. As a response to this, Organisation A has developed a system of Non-conformance and Defects Reporting (NcDR) to: *"Identify aspects of the built works that do not comply with the requirements of the contract specifications"* and to *"capture data on the cause and cost of defects that can be analysed to enable [Organisation A] to plan preventive actions in the future"* (NcDP, p.4). To summarise, legislation and regulations have helped to drive Organisation A towards a more effective adoption of QMS on the case study project, due to the critical role they play in assuring compliance with requirements and standards.

***Project Supply Chain***

The influence of the **project supply chain** on the implementation of the QMS on the case study project was clearly highlighted by all of the respondents especially due to the two sub-factors associated with the main factor, namely **quality of imported products** and **suppliers**.

*Quality of Imported Products*

PA1 explicitly recognised how the quality of imported products had impacted the QMS deployment in the case study project by claiming that: *"Most of the issues we have make compliance with QMS requirements as a burden for us, are from imported products from overseas, especially from China...We know this as historically in the last five years there's been issues with these"*. In the case study project, the QMS team struggled to assure compliance of these products with Australian regulations and standards, although compliance notes for all relevant test standards and/or certification are usually attached to these imported products (PA3). Thus, the quality of imported products is a barrier to the QMS implementation within the context of the investigated case study project.

*Suppliers*

All respondents indicated the critical impact that **suppliers** have on the process of effective QMS deployment in the case study project of Organisation A. PA3 explained how suppliers can impact on the QMS implementation: *"When we talk about suppliers we deal with, they have their own QMS and we are trying to make sure that the implemented QMSs are as per the design manuals and this is critical for certain things"*. Another reason given by respondents for the influence of suppliers on QMS adoption and deployment posing a barrier, was due to a perception that clients intend to save more cost by switching to cheaper products. PA2 gave an example where the client had signed off on timber flooring nominated to be used in the project, but during the flooring manufacturing, the client attempted to make a cost saving by decreasing the depth and the thickness of the timber. This caused serious quality issues throughout the installation process (PA2). However, PA1 noted that, in order to mitigate the impact of suppliers on the process of QMS adoption, Organisation A developed a criterion used nationally to categorise suppliers based on the performance and quality standards of materials they already supplied to the company for engagement on future projects. Thus, suppliers are often a barrier to effective QMS deployment in the case study project, due to the issue of ensuring the compliance of their supplied materials with QMS requirements.

***Weather***

The influence of **weather** on the QMS implementation was agreed to be a major factor by the participants of Organisation A. PA3 commented on the impact of weather by stating that: *"In our project, weather has an influence on the level of QMS implementation. It can be definitely a barrier for how we plan the project. Like humidity, we can't lay out floors if the concrete hasn't cured correctly. There's always checks that need to be done before we can progress the working according to the program"*. However, the issue is specifically associated with unexpected weather conditions, such as rain and storms for which it is sometimes difficult to avoid the resultant impact owing to the unpredictable nature and timing of occurrences ($P_{A2}$). Therefore, whilst weather conditions may not directly impact on QMS implementation, it can negatively influence the quality of executed works ($P_{A1}$ & $P_{A2}$). Given these views, weather is, on most occasions, an obstacle to implementation of a robust QMS in the project being examined, due to its unpredictability.

### 6.3.3 CSFs for effective Implementation Of QMS

This section demonstrates how adoption of the CSFs identified in the research can facilitate the effective implementation of QMS within the context of the project being examined. In this context, the views obtained from participants, along with evidence from the analysis of documents, clearly explains and supports the impact of CSF adoption on assurance of a robust deployment of the QMS in the project of Organisation A. The importance and critical nature of all twenty-one CSFs will be explained thoroughly, in addition to the influences of a range of sub-factors related to some of the major CSFs. Firstly, the impact of implementing each individual CSF is described in detail below.

***Digital technology***

**Adopting digital technology** as a CSF for QMS deployment is fundamentally underpinned by comments obtained from the participants of Organisation A, due to the potential benefits that are gained ($P_{A1}$, $P_{A2}$ & $P_{A3}$). $P_{A1}$ recognised how digital technology facilitates the adoption of QMS by explaining that:

> "Digital technology assists in implementing an effective QMS. For capturing defects, for example, we have an app [Author: application] that can go six words top, walk in a room, hit the camera on a wall, take a picture, put in six words, next, then share it with other stakeholders as well and they'll go back to fix; they'll issue it straight to the subbie…That saves us a huge amount of time and paperwork".

Moreover, using such technology is especially appropriate to the construction sector, wherein mobile access to laptop, phones, and iPad, for example, saves a huge amount of time throughout the procedures of QMS deployment (PA2 & PA1). On the other hand, in this project, all the requirements of QMS implementation are positioned into just one specific application to facilitate sharing and making them accessible for all related stakeholders through various digital technologies (PA3). To summarise, digital technology strongly facilitates the effective deployment of QMS in the project being investigated.

***Attitude to change***

The significance of **attitude to change** for successful implementation of QMS in the case study project was clearly justified during interviews with respondents. PA3 in particular recognised the importance of this factor explaining that: *"We always plan to adopt positive attitudes towards change, look at how we adopt and modify our QMS to implement that correctly. So, the critical factor within what I deal with on a day-to-day basis is getting the construction teams to buy into the QMS"*. Whilst attitude to change is dependent on the perceptions of the workforce about the significance of implementing a rigorous QMS, staff on this project were initially assessed based on their capability to implement the requirements of the required system (PA1). Although most of the workforce recruited for the project satisfied the established attitudinal level related to implementing QMS requirements, attitude to change is specifically related to either the background of staff or the level of education they obtained (PA2). Consequently, educated staff are more familiar with the changeable requirements of QMS than less educated workers (PA3 & PA2). Importantly, these perspectives provide evidence for the significance of adopting attitude to change, as a CSF for effective implementation of QMS in the examined project.

***Client Involvement***

Participants of Organisation A corroborated the significance of **client involvement** for effective adoption of QMS in the project being investigated. In this sense, PA2 clearly expressed the impact of this factor by stipulating that: *"Client involvement is a key factor for implementing a robust QMS. They've given us a full list of lessons learned, things that have gone wrong there and want us to implement it into our quality measures. They've been very upfront and very forthcoming with information from data"*. In addition, within this project, client involvement is critical to implementing a successful QMS for which the high level of expectations established by the client guide the procedures involved in deploying such system by developing clear requirements for the QMS ($P_{A1}$ &$P_{A3}$). Thus, client involvement plays a significant role in facilitating the implementation of the QMS in the case study project.

***Communication and Coordination***

The significance of **communication and coordination** for effective implementation of QMS in the project is well supported by both the interviewed participants and examined documents from Organisation A. $P_{A3}$ addressed the crucial role of this factor by stating that:

> "If the communication's poor, then we're not going to have an implemented QMS that's going to work correctly. It's key for us that management disseminates the information and any lessons learned to the project team, so that we're not just adopting the QMS, but we also keep developing to pick up any changes that are required as well".

Moreover, the significance of communication and coordination is also stressed by a PDP that distinctly indicates the factor's importance by stating that: *"In undertaking any project, it is important to consider how you as the Project Manager will manage and coordinate all facets of communication and documentation to ensure clarity and accuracy between the various project stakeholders whilst undertaking the project "* (PDP, p4). Therefore, to assure effective communication between all involved stakeholders and the project team during project execution, regular weekly meetings and constant contact between the management team and project staff were performed ($P_{A2}$ & $P_{A1}$). Additionally, the project team undertakes effective coordination to share changes to QMS requirements amongst related stakeholders, to coordinate education and training programs, and to coordinate timing between different tradies' work in the same place ($P_{A1}$). As has been noted, communication and coordination assist in implementing a successful QMS in the investigated project.

***Construction Site planning***

The data collected clearly indicates the key role played by **construction site planning** for ensuring effective implementation of QMS. $P_{A3}$ confirmed the significance of this factor by stating that*: "Construction site planning is a key one for our QMS implementation. That's all about making sure we've got the right number of staff, the correct budgets for each element of the works, so that we can successfully* *adopt the QMS. It also makes people aware of what they're expected to do"*. Hence, prior to launching the project, the project team performed a Preconstruction Review to *"present their strategies, planning, controls, processes and team responsibilities that have been developed to successfully deliver the project"*, according to the company Preconstruction Review Procedure (PRP, p.4). Further, in order to ensure that all the requirements of QMS implementation were completely prepared and organised to be implemented, the project team carried out a Project Quality Start-up Workshop (PQSW) to discuss all of the project requirements. An example of a typical workshop is depicted in Appendix D. Additionally, construction site planning was undertaken to ensure provision of safe access for staff across the project, suitable accommodation requirements, and positioning cranes and car parking ($P_{A1}$ & $P_{A2}$). To summarise, construction site planning facilitates the adoption of an effective QMS in this case study project.

***Continuous Improvement***

Adopting **continuous improvement** as a CSF for QMS implementation was corroborated by $P_{A1}$ recognising the impact of continuous improvement by observing that: *"Continuous improvement, that's obviously a big one for our QMS, a lot of that's got to do with things like lessons learned. We're actually set up for lessons learned today on the requirements of our Quality Plan"*. Thus, lessons learned are a significant part of continuous improvement where those issues that have often confronted QMS implementation in previous projects are utilised to develop guidance for use going forwards ($P_{A2}$). On the other hand, $P_{A1}$ recognised that performing continuous improvement is sometimes difficult owing to the uniqueness of each project. This uniqueness is due to the new requirements of the project, maybe not experienced before ($P_{A1}$). The number of defects experienced and the cost of fixing them is considered as the main quality Key Performance Indicator (KPI) adopted by Organisation A to assess the performance of their QMS implementation in the project. This is illustrated in Table 6.1 below.

This KPI emphasises the need for continuous improvement during the project implementation, to ensure the application of essential changes to QMS requirements, so helping to avoid the occurrence of potential defects ($P_{A3}$ & $P_{A1}$). To sum up, continuous improvement significantly supports the deployment of QMS in the case study project.

Table 6.1: KPIs of QMS performance (PQMP, p10)

| Measure | Target | | Means of Assessment |
|---|---|---|---|
| Defects (i.e. design/ construction/ supply issues) that occur post-practical completion | Excellent | Zero defects that cost (anyone) more than $5000 to rectify | End of job review |
| | Good | No single defects more than $10,000 | |
| | Satisfactory | No single defect more than $15,000 | |
| | Unsatisfactory | Defects that cost more than $50,000 &/or loss of repeat work with client | |

***Customer satisfaction***

The significance of **customer satisfaction** for effective implementation of QMS is underpinned by the case study data. $P_{A2}$ alluded to a key role of customer satisfaction stating that: *"Our main role is to keep the client obviously on time, on budget, and defect-free, most of all to keep the client happy. Our client is very, very involved in the QMS. They want to have a say and they want to sign off every single sample"*. In this project, it was critical for the project team to assure customer satisfaction through adopting a robust QMS to meet the expectations of their client concerning quality ($P_{A3}$). The PQMP specifically refers to utilising QMS deployment to achieve these expectations: *"The project will ensure that the client's expectations are fulfilled, and satisfaction is achieved. This will be achieved by clearly identifying needs and requirements, the QMS helps to achieve this"*. $P_{A1}$ stipulated that customer satisfaction is used in this project as a benchmark during QMS implementation to ensure delivery of appropriate products to the customer. In either case as stated, customer satisfaction is adopted in this project to ensure an effective deployment of QMS throughout the project cycle.

***Definition of Roles and Responsibilities***

The evidence from the data clearly underpins the significance of **definition of roles responsibilities** for facilitating a rigorous deployment of QMS in the case study project. $P_{A1}$ recognised the prime role of this factor explaining that:

> "Definition of roles and responsibility is a key to QMS implementation. All the people have roles and responsibility, at the end of the day you've got to do everything that is required to perform your work whether it's written in your roles and responsibilities or not. That's probably at the very bottom of a QMS".

Moreover, P$_{A3}$ asserted that precise definition of roles and responsibilities is fundamental for staff to cope with the implementation of QMS, because the workforce of the project is often overloaded with many and various responsibilities during the execution of a project. Hence, the definition of roles and responsibilities is highlighted as being one of the main purposes of the Preconstruction Review Procedure (PRP) undertaken in the project being examined. During that review, the proposed structure of the team, start dates, key roles and responsibilities were completely assessed and allocated (PRP, p9). In addition, there is an annual review to ensure that every member of staff is clearly aware of their allocated roles and responsibilities, especially concerning QMS requirements (P$_{A2}$). Thus, the definition of roles and responsibilities is a key factor for effective implementation of QMS in Organisation C's project.

***Education and Training***

The significance of **education and training** for deployment of a rigorous QMS in the case study project was highlighted by the data evidence. P$_{A2}$ recognised the critical nature of education and training by stating that: *"Education and training are very important to make sure that our QMS is applicable and can be implemented. We got inducted into a QMS plan and then we're left to fend for ourselves which is good, and we've got some really good stuff in here, so we know how to train the others"*. Thus, most documents related to the QMS implementation explicitly indicated the need to ensure a satisfactory level of training is provided to all related stakeholders of the project that require this (PQMP, p.11 & SMM, p.3). For instance, concerning the level of qualification of the workforce of subcontractors, PQMP, p.12, affirms that: *"a Subcontractor will need to demonstrate that their workers are competent to complete the work task and where there are any deficiencies train their workers prior to them completing the tasks"*. Also, project teams of Organisation C are offered a wide range of training aids, including online resources, to enhance their awareness of the requirements of quality in particular (P$_{A3}$). On the other hand, it is still a serious challenge to adequately educate and train the project staff regarding effective adoption of QMS. This issue is associated with some uncertain requirements of the QMS, and also the short time available for staff to fully understand such requirements (P$_{A3}$ & P$_{A1}$).

***Employee Empowerment***

The impact of **Employee empowerment** on the successful deployment of QMS was raised by several respondents. $P_{A2}$ explained how employee empowerment facilitates the implementation of QMS stating that: *"Every person on this team, if you're working in the administration side of things or working on the safety side, they all have an impact on quality. If I only gave power to two people out there to implement a QMS, it wouldn't be implemented"*. Other respondents stated that to ensure implementing a rigorous QMS in the project, there needs to be a distinct focus on empowering the project team to emphasise the significance of delivering a quality product ($P_{A3}$ & $P_{A1}$). However, $P_{A1}$ stipulated that assuring effective staff empowerment requires a precise definition of their responsibilities and also assurance that the empowered workforce is adequately qualified to undertake allocated roles.

***End-user Involvement***

The significance of **end-user involvement** for effective deployment of QMS is underpinned by evidence collected from the examined project. Considering this, $P_{A2}$ said: *"I think end-user involvement has more impact on the process of QMS implementation in the projects like hospitals, schools and maybe even public projects, it does much in these sectors"*. In the case study project, involvement of end-users was also critical to ensure successful adoption of the QMS throughout the project cycle as this was a fairly unique project with highly precise QMS requirements. Hence, system users had to be involved in the early stages of a project, such as the design stage, to consider the precise requirements prior to establishing the final design documentation ($P_{A1}$ & $P_{A2}$).

***Internal Stakeholders Engagement***

The importance of **internal stakeholders' engagement** for ensuring effective deployment of QMS was clearly supported by the respondents. $P_{A2}$ recognised the impact of this factor, mentioning that:

> "Internal stakeholders engagement goes hand in hand with ensuring good QMS. We manage, we don't actually build, we managed all our subcontractors. For our design manager and the whole team to manage those contractors to ensure that their QMS actually ticks all the boxes that's required in our brief and other plans, that's very important".

In this project, many internal stakeholders were involved, all performing diverse roles during the process of QMS implementation, to ensure that all internal stakeholders were aware the significance of the QMS ($P_{A1}$). Hence, the critical role of internal stakeholder engagement justifies the additional focus of CRP on encompassing a wide range of internal stakeholders from both organisational and project levels at the Pre-Construction Review meeting and beyond.

***Industry Relations with Trades Unions***

The influence of maintaining healthy **industry relations with Trades Unions** during the adoption of the QMS was corroborated by respondents. $P_{A2}$ elucidated the significance of this factor by clarifying that: *"If you had healthy relationships with the unions, you could probably afford to pay a full-time quality manager that can make sure that all the requirements of QMS are done correctly. Right now, we spend so much money in trying to keep the unions happy, so it would make a huge difference"*. However, sometimes the increased focus of the unions around safety related issues due to complying with well-established policies and regulations disperses the focus of the project team to implement a successful QMS required to deliver quality products ($P_{A1}$). Given these views, a huge challenge clearly faces the project team to maintain healthy industry relations with trades unions despite the well-perceived benefits mentioned by respondents.

***Leadership Support***

The impact of **leadership support** on the effective implementation of QMS in the examined project was justified by the case study respondents. $P_{A1}$ explicitly highlighted the critical role of the factor by observing that:

> "Leadership support, that's very much important for our QMS implementation. If we've got an issue, we need to be comfortable that we can go to other people. Another thing is the motivation of the team members which goes back to leadership, so the most important part of QMS implementation and improvement is the leadership support".

Moreover, leadership support is essential when sharing of experiences of quality issues, or challenging aspects of QMS deployment across different projects to avoid repeating them within this ongoing case study project ($P_{A2}$). However, $P_{A3}$ asserted that when quality and QMS are clearly indicated by the leaders as being the top focus for them, it is much easier to gain a commitment of the project workforce to implement a successful QMS at project level.

***Management Review and Feedback***

The evidence gained from interviewing participants and document analysis emphasises the significance of **management review and feedback** for effective deployment of QMS. $P_{A2}$ highlighted this importance in the case study project by stating that:

> "Management feedback is very important for QMS implementation. It's good to speak to the other project managers as well. Like if you've got a new trade coming up and they've just finished using that trade, what were the issues, what were the positives? You can ensure that with the positives, you support them, and with the issues, you try to ensure that you nip them in the bud before they start".

Hence, within the examined project, it is mandatory to produce a monthly or six-weekly report that indicates the expected quality risks, quality issues, number of experienced defects and so on. Then, the project is required to: *"analyse their significant positive achievements (e.g. initiatives, good ideas, innovations) and raise these in the Project Review Report to share them"* (PQMP, p21). All of these matters from different sites will be discussed with senior managers and shared amongst the workforce along with management feedback ($P_{A1}$). However, several of the quality issues raised at meetings and reviews are handled by the management team and used for continual improvement throughout the life cycle of the project, as exhibited in Appendix E (PQMP).

***Quality Culture***

The significance of a **quality culture** for QMS deployment was underpinned by the respondents of Organisation A. $P_{A3}$ recognised how quality culture is fundamental to QMS deployment in the examined project by mentioning that: *"Typically, our company has a good culture towards quality and QMS significance. We want to deliver the best; we want to be recognised for delivering quality products. So, we typically have our own standards and go above and beyond the middleman requirements that flow through"*. Thus, management always indicates to employees the significance of encouraging a strong quality culture in order to implement a robust QMS across all the project team of the investigated project ($P_{A1}$ & $P_{A2}$). However, $P_{A1}$ stressed that quality culture is reinforced by sharing with the staff the critical consequences of delivering non-quality products, as typified by the cost of fixing defects, and how this can eventually affect the reputation of the company ($P_{A2}$). On the other hand, ability to adapt to quality culture is associated with the background of staff members, namely the level of education they obtained and also the amount of training they espoused to in regard to QMS requirements ($P_{A3}$ & $P_{A2}$).

***Regular External QMS Audit***

The evidence gathered from respondents and related documents corroborates the importance of a **regular external audit** for effective deployment of QMS. $P_{A1}$ highlighted the essential role of this factor stating that: *"Regular external QMS audit is a big one for QMS implementation; if we got an external party doing that audit and showing what our mistakes are, they might share knowledge of others with us".* Other respondents agreed that the main purpose of an external QMS audit is to ensure that the related staff understand, and are always compliant with the requirements of QMS, especially concerning the upkeep of the quality documentation and other paperwork ($P_{A3}$ & $P_{A2}$). Within the case study project, several levels of audits are performed by parties external to the project. These audits are carried out by the National and Regional Quality Managers ($P_{A1}$ & PQMP). However, there is no external regular QMS audit performed by any third party from outside of Organisation A.

***Reputation of Company***

The significant function of **reputation of company** for effective implementation of QMS was supported by the respondents of the investigated project. $P_{A3}$ explained the factor's impact as follows:

> "Reputation of company is definitely a driver for implementing a successful QMS, we want to have repeat workers. To get that repeat work, we've got to make sure we deliver as per the client's expectations. The last thing they want is no defects or issues down the track. QMS is made into an actual, and we mitigate that risk".

This view was supported by the other respondents, who agreed that the QMS certainly plays a critical part in this project related to maintaining company competitiveness across the market due to the obvious association between the quality of delivered projects and the market reputation of company ($P_{A2}$ & $P_{A3}$). Accordingly, the project team fully realises the criticality of deploying a robust QMS to deliver quality projects in order to maintain a satisfactory reputation ($P_{A1}$).

***Resources***

The evidence collected from the context of the case study project thoroughly underpins the critical role of adequate and appropriate **resources** for implementing an effective QMS. For example, $P_{A1}$ reported that: *"Resources are most important for this job to start QMS implementation properly. It's been hard to start the job; it was so hard for us to staff, because the job started off slowly and then it peaked quite rapidly".* However, the respondents mainly expressed their perspectives based on the sub-factors identified by the first stage of data analysis, namely **provision of resources of time and cost**, **recruitment of experienced quality managers** and **recruitment of qualified sub-contractors** as explained below.

*Provision of Resources of Time and Cost*

Evidence gained from the respondents emphasises the critical importance of **provision of resources of time and cost** for the deployment of QMS in the investigated project. $P_{A3}$ claimed that: *"Provision of enough time and budget was scheduled in the planning of the project upfront. With my project, we had made sure we allocated the correct number of staff required to manage the QMS and that was the construction managers' responsibility during the planning phase".* However, despite this, according to other respondents, the project team still struggled to obtain sufficient flexibility of time and budget required to ensure successful deployment of the project QMS ($P_{A1}$ & $P_{A2}$). $P_{A2}$ identified that the difficulty in recruiting sufficient staff for QMS implementation was not only due to the tight budget of the project in general, but also to the client not being willing to spend extra budget to be used solely to obtain the right number of staff members. Thus, respondents felt that the provision of adequate resources of time and cost is essential to deploying the QMS and that challenges in obtaining these resources are a barrier to be overcome.

*Recruitment of Experienced Quality Manager*

The critical role of **recruitment of experienced quality manager** for QMS implementation was acknowledged by all respondents. $P_{A1}$ emphasised the importance of this factor by stating that:

> "Recruitment of an experienced quality manager would make a huge difference in QMS implementation. I suppose if you recruit a quality manager

> in each project, you want them to be proactive, you want them to help out, but I've worked on projects with this really tight quality manager, it makes a huge difference to QMS procedure".

However, there was no quality manager actually employed on this project due to the lack of specific budget being set aside for this, as well as the difficulty of obtaining a quality manager within theCIBS market at the time of the project ($P_{A1}$ & $P_{A3}$). However, another consideration related to this factor is related to the mindset of Organisation A managers, who held a common belief that assuring quality is the responsibility of each member of staff and not of one dedicated person ($P_{A3}$). All participants disagreed with that view and reiterated that the recruitment of a qualified quality manger is fundamental for adopting a successful QMS, although in this project, the team struggled to engage one.

*Recruitment of Qualified Sub-contractors*

The case study respondents unanimously agreed the positive impact of **recruitment of qualified sub-contractors** on QMS adoption. $P_{A3}$ highlighted the significance of the factor by stating that: *"The recruitment of sub-contractors is crucial for implementing a robust QMS, because if we don't have the right resources from the sub-contractor then how can they implement a QMS"*. $P_{A1}$ supported this view and stressed that recruiting qualified subcontractors is the most important CSF for QMS implementation because it is the subcontractors who actually execute the major portion of the project works. Prior to selecting and engaging them, the project team primarily assesses subcontractors, suppliers and consultants to ensure that they are competent to deliver the project, based upon the quality procedures and requirements developed by Organisation A (PQMP, p12). Hence, $P_{A2}$ acknowledged that in this project, there was a strategy to recruit subcontractors that had previously delivered quality products and services for Organisation A, and whose quality systems were known to be adequate by the organisation.

***Teamwork***

The key role of **teamwork** for facilitating the successful deployment of QMS in the examined project was highlighted by respondents. $P_{A1}$ stated that:

> "Team work's obviously very important to make sure we're able to implement a QMS in our job. There's no 'I' in this team, there is a victory. teamwork's on a job like what we do, we all live or die together. That's the subbies as well,

the subbie isn't an enemy, we've got to work together. We're all on the same page".

Additionally, $P_{A2}$ opined that teamwork, in this project, had been crucial to ensure successful deployment of QMS, due to the limited workforce employed in the project, however, $P_{A3}$ stipulated that a balance of experience, education and training regarding implementing a QMS assisted a teamwork approach facilitating upskilling of less-qualified staff. On the other hand, $P_{A1}$ observed that the ability of employees to work together as a team often depends on their personalities, and on how much management focuses on encouraging a teamworking approach or not.

***Top Management Commitment***

Respondents corroborated the prime role played by **top management commitment** in encouraging and supporting the rigorous implementation of the QMS in the case study project. $P_{A3}$ clearly supported this critical factor by explaining that:

> "Top management commitment is a key for implementing a robust QMS; if we haven't got management commitment, then they have the high level QMS that we implement. We got the state quality manager example, he will do all his measure with complying with our QMS, so we know as a project that we have to comply with that standard and we implement it accordingly".

$P_{A1}$ indicated that when top management demonstrates a visible commitment towards quality and QMS requirements, this is more likely to encourage a project team to implement a QMS properly and this was certainly true in the case study project ($P_{A1}$).

## 6.4 CASE STUDY (2)

### 6.4.1 Profile of Company

This section summarises the background of the organisation investigated in Case Study (2). In this research, the abbreviation "**Organisation B**" has been utilised to refer to the company undertaking the case study project. Organisation B was established in the early 1980s as a national construction and mining services contracting organisation. The organisation currently employs more than 1,000 workers across all Australian states and territories. Thus, according to ABS, 2014 (as cited in Industry, 2015), Organisation B is classified as a Tier One company based on the number of its employees. While Organisation B executes some mining projects, building projects represent the majority of its works. These projects are spread amongst different sectors within the building industry, namely, commercial, residential, health and science, defence, education and sports.

Furthermore, Organisation B has developed its own QMS based on the requirements of government legislation and regulations, as well as industry expectations and ways of working. Although Organisation B has been ISO 9000 certified since 1995, within the projects of company, their own internally developed QMS is adopted and implemented owing to the perception of management that ISO 9000 is more applicable for business use rather than at the project level ($P_{B1}$).

For this case study, several data collection techniques were applied, namely in-depth interviews, document analysis as well as direct observation. Three participants, in total, were interviewed to obtain deeper insights regarding the level of QMS deployment in the project being investigated. Respondents were Quality Manger ($P_{B1}$), Project Manager ($P_{B2}$), and Construction Manager ($P_{B3}$). In conjunction with these interviews, different types of documents related to the procedure of QMS execution, such as Project Quality Plan (PQP) and Construction Management System Manual (CMSM) were obtained and examined to gain an inclusive understanding concerning the implementation of QMS.

### 6.4.2 External Factors Affecting QMS Implementation

This section explicates how the external factors impact on the effective implementation of QMS within the case study project of Organisation B. All respondents generally agreed that the influence of external factors generally impacted on the robust deployment of QMS on the case study project. The respondents also provided information on the impact of each factor on quality procedures and QMS deployment during the project life cycle. The information obtained from respondents was also supported by the evidence from related documents examined during the case study investigation, along with further data collected by means of direct observation. The influence of a total of twelve external factors on QMS implementation is explained in detail below, along with the impact of some sub-factors related to these main factors.

***Client Attraction for the Lowest Price***

Evidence from analysis of the research data explains the influence of **client attraction for the lowest price** on the level of QMS implementation within Case Study 2. In Project B, implementation of the QMS was a distinct challenge for the project team and gaining the best outcomes from the QMS was somewhat difficult because allocating a specific budget for QMS adoption requirements in the tender price in the view of respondents, would have meant losing the job due to the focus of the client on gain the lowest price ($P_{B3}$ & $P_{B1}$). One respondent reported that employing the right of human resources essential for successful adoption of QMS was a serious challenge because of the limited budget allocated for actual QMS implementation ($P_{B1}$). As a consequence, this factor had significant effects on the overall QMS implementation throughout the project where the responsibilities of QMS requirements implementation are distributed across the project team rather than handling them by a quality representative ($P_{B1}$). Amongst these were the increased number of quality issues, and complications to the processes of ensuring compliance with Australian Standards when not adopting a rigorous QMS ($P_{B2}$ & $P_{B3}$).

***Client Awareness towards QMS Significance***

The influence of **client awareness towards QMS significance** on the effective execution of QMS was clearly recognised by the participants. $P_{B1}$ mentioned that: *"Client awareness about QMS significance, actually is a driver because they want to see a QMS on site. They really want to see all this stuff properly done"*. Because some project clients are aware of the significance of a well-operated QMS to deliver a quality project, contractors are often encouraged by them to adopt a robust QMS ($P_{B2}$). As a result, such clients support the required QMS deployment by providing adequate resources not only to implement the system but by also encouraging the use of lessons learned from their previous projects to help to avoid mistakes being repeated ($P_{B1}$ & $P_{B3}$).

***Design Process***

Two of the respondents talked about the effect of **design process** on the rigorous implementation of QMS in the case study. $P_{B3}$ emphasised the influence of this factor and explained in his view how to mitigate any impact:

> "Design process is a big part affecting our QMS process. If things aren't made in the construction sense, or the design isn't constructible, it's going to affect our QMS. It's important that the construction team and the design team work together before finalising the design, so that the outcomes of design are in the best place for the construction team to deliver the work".

Moreover, the design process also affects the QMS implementation from a time and scheduling perspective, as on every project there are several design-driven critical path activities relating directly to QMS deployment, such as constructability review of the design, and reviewing and documenting alerts associated with each package of design ($P_{B2}$ & PQP, p21). As a result of this, $P_{B1}$ confirmed that the project team tries to handle design issues before they become barriers that will hinder the QMS deployment.

***Different quality systems***

The respondents all attested to the great influence that adoption of different quality systems had on the robust deployment of QMS on the case study project. $P_{B1}$ confirmed that: *"The problem of adopting different quality systems in the project is a big challenge confronting QMS implementation. It takes a lot of time to change to take everything from this QMS and rework all the data, so it fits into other systems".* More specifically, $P_{B2}$ & $P_{B1}$ both agreed that adopting different quality systems in this project was a major barrier to developing a consistent and unique QMS to be implemented throughout the project. $P_{B1}$ acknowledged that as a result of this, the project team to a great extent relied on the QMSs of their subcontractors rather than implementing the major QMS of their own, which would gather in one place, all of the requirements developed specifically for this unique project.

***Complexity of External Project Stakeholders Involvement***

Impact of **complexity of external project stakeholder's involvement** was clearly acknowledged by all of the respondents. $P_{B2}$ and $P_{B3}$ clarified that the external stakeholders of the case study project often assisted in enhancing the adopted QMS by providing new ideas captured from their experience, and they often attempted to implement their own QMSs rather than complying with the main system adopted by the prime contractor. $P_{B1}$ confirmed that to ensure the use of a more applicable QMS for the external stakeholders, the QMS adopted in this project was initially adjusted by introducing requirements specifically based upon the different expectations of the stakeholders involved in the project. Consequently, the complexity of an external project stakeholder's involvement was definitely a crucial obstacle confronting the successful execution of the QMS on the Case Study 2 project.

***Government policies***

All respondents referred to the impact of **government policies** on the process of QMS execution. $P_{B2}$ stated that: *"Government policies have a positive impact in using those policies and procedures for leverage to better manage QMS. So, it is a good driver for our QMS implementation"*. On the other hand, $P_{B1}$ stressed that compliance with these policies is often a challenge for the project team, especially when amendments to these are released. According to $P_{B3}$, government policies are less likely to affect a QMS at project level due to the organisationally focused requirements of these policies.

***Interstate Working***

The respondents all agreed that the influence of **interstate working** on the rigorous deployment of QMS in the project of Organisation B was significant. $P_{B1}$, explained that: *"Working interstate is a barrier to QMS implementation because it's definitely a challenge, but by the same token, again, I view it as an opportunity because it introduces diversity of thought"*. $P_{B2}$ added that for the case study project team, working interstate seriously affected their QMS deployment, particularly regarding specific requirements that vary, or have a state-based bias across different locations; examples of this would be the Codes of Practice which have state-based requirements. As an example, in the Case Study 2 project, respondents confirmed that Queensland's Codes of Practices are extremely stringent, and the project team needed to ensure that those non-negotiable requirements were precisely listed in the adopted QMS ($P_{B2}$ & $P_{B3}$). Consequently, $P_{B3}$ pointed out that the hindrance to implementing an effective QMS caused by interstate working is because of the need to introduce a universal system to cover quality issues according to various expectations of the different states, rather than just implementing a unique system solely applicable to the case study project.

***Intervention of Trades Unions due to safety***

The factor of **intervention of trades unions due to safety** within the case study project was agreed by all respondents to have a significant impact on QMS deployment. $P_{B1}$ acknowledged this was a distinctly negative influence by affirming that: *"Intervention of trade unions has caused huge damage to our business, definitely it impacts our QMS. It's all about how you plan around it, plan for it, and work through it. Big impact for programming, planning, very, very negative influence on* *implementing a robust QMS"*. In this project, the unions were exceedingly focused on safety related requirements and this was taken seriously by the project team because the unions have the authority to suspend the job indefinitely. Thus, the main focus of the project team became compliance with safety requirements and resources were devoted to developing extremely high standards of safety on the project site whilst the requirements for QMS execution lagged well behind safety ($P_{B3}$ & $P_{B1}$). These respondents also opined that on future projects, it is essential that safety and quality be implemented at the same level to ensure consistent deployment of QMS along with the project safety system, thus establishing high-level requirements for both systems ($P_{B1}$ & $P_{B3}$).

***Regular external QMS audits***

The critical influence of a **regular external QMS audit** on the QMS deployment was clearly explained by respondents as well as by examination of related documents. Notably, $P_{B1}$ emphasised the key role of this factor by clarifying that: *"External QMS audit is super important to implement a successful QMS. That means, not only we are checking that the teams are covering everything in the procedures, but also that our procedures are realistic"*. In the same way, regular external QMS audit is fundamental to implementing a robust QMS not only to indicate non-compliance of executed works with standards, but also to provide guidance on how to deploy a successful QMS by sharing information and experience drawn from amongst different organisations ($P_{B3}$). On the one hand, within this project, planned and documented internal audits were regularly performed to verify compliance with the requirements of the QMS, however, the only external QMS audit that was carried out on the project was associated with external certification surveillance audits under the ISO 9001 standard that were required to achieve renewal of the organisation's certification according to (PQP, p17). Hence, the lack of external audits was considered by respondents to be the major barrier to implementation of an effective QMS in this project, especially the negative effect it had on continual improvement ($P_{B3}$ & $P_{B2}$).

***Skilled Human Resources***

Respondents spoke about the impact of **skilled human resources** on the QMS implementation and their views were also justified by other evidence gathered from a review of pertinent company documents. As an illustration, $P_{B3}$ acknowledged that: *"Skilled human resources definitely affect the implementation of QMS. It is a major* *barrier. If we don't have the right people in the right role, it's going to affect our QMS, definitely in the implementation"*. All respondents specifically expressed their perspectives based upon the sub-factors of skilled human resources, including **qualified staff**, **quality manager and assistant staff**, and, the **retention of skilled staff**, as described in detail below.

*Qualified Staff*

Regarding the influence of **qualified staff** on the successful deployment of QMS, $P_{B2}$ clearly addressed the impact of this factor on QMS execution in the case study project by reporting that: *"Qualified staff is a big one that affects the QMS implementation because there are competing demands for our human resources"*. $P_{B2}$ continued that there was currently still an existing challenge facing the project team of the case study to obtain the required number of staff members for QMS implementation. This problem is partially attributable to the reduced support of the local TAFE, but also to the decrease in regional training facilities essential to upskill a sufficient number of the workforce ($P_{B1}$). Consequently, the project team intends to try and make a balanced workforce based on the current experienced staff and the new inexperienced employees. It is hoped that this balance, once attained, can become a foundation for further development that will allow for constant growth and integration of experience that is required to fill current gaps in the workforce resources ($P_{B2}$ & $P_{B3}$).

*Quality Manager and Assistant Staff*

Evidence of research data gathered from respondents and documents notably highlighted the critical role of a **quality manager and assistant staff** to execute a robust QMS in the case study project of Organisation B. $P_{B3}$ noted that: *"We lack a quality manager essential for implementing a robust QMS, we don't have a quality manager in our project or even a nominated person looking after QMS requirements"*. This lack of a project quality manager is clearly highlighted by the relevant section of the PQP, which shows the quality manager positioned out of the project and operating at a national level, as illustrated in Figure 6.2 below.

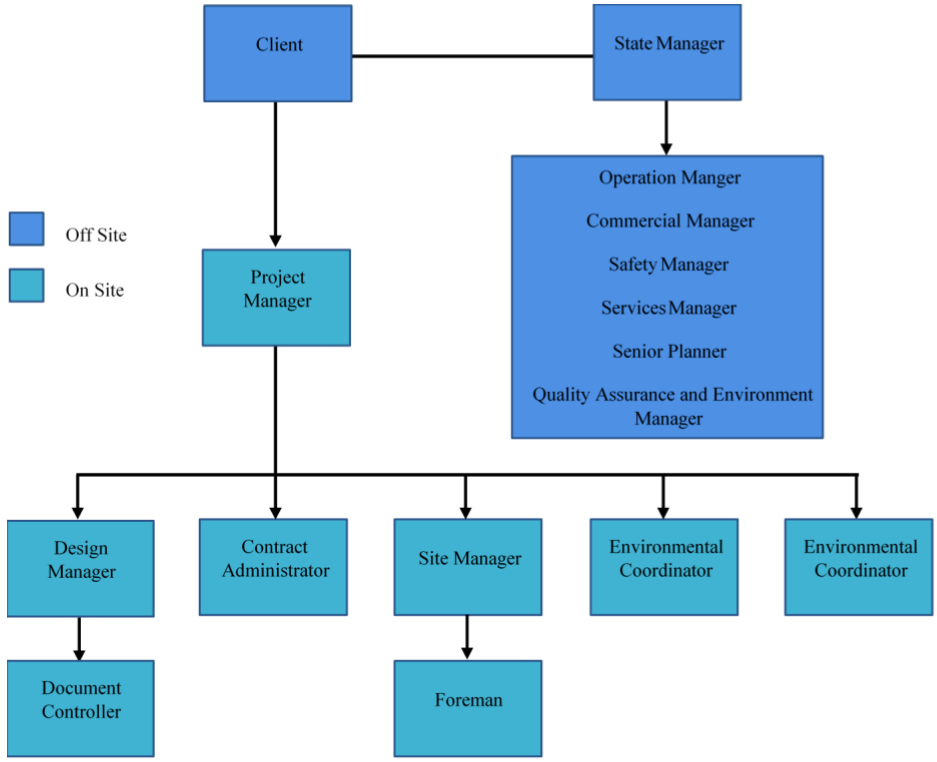


Figure 6.2: Project team organisation chart of Organisation B (PQP, p8)

This lack of the influence of a dedicated project quality manager was also corroborated by PB1, the State Quality Manager who acknowledged that:

> "I don't have any direct influence over the teams, and I'll show you what this sort of looks like, but basically if you've got the project team and you've got the operation manager, then I sort of report to him. I can't say, "You must do this." Essentially, I'm saying, "I think you should do this and this", as this is what our procedures say. Likewise, I might also say, "Here's an issue - I'll leave it up to the team to work out how they are going to solve it"".

However, on the Case Study 2 project, according to PQP, the main responsibilities for managing the QMS are allocated to the project manager along with other management tasks required to achieve the level of quality specified by the contract. For example, according to the PQP, p.9, the project manager should be responsible to:

- Review, implement and maintain the QMS;
- Identify, prepare and implement technical procedures of QMS;
- Provide guidance and resources to accomplish the requirements of QMS, and;
- Seek updates to the Project Quality Plan.

Thus, there is a clear need to acquire a quality manager and assistant staff to help achieve quality requirements in the examined project to rectify this serious barrier to deploying a rigorous QMS.

*Retention of Skilled Staff*

The influence of **retention of skilled staff** on the robust deployment of QMS was strongly corroborated by all of the respondents. Related to this, $P_{B1}$ explained the complicated facets of this factor stating that: *"The retention of skilled staff is very important for us to assure good level of QMS implementation because if skilled staff leave, all their knowledge and training moves out of the door, and you've got to bring someone in and also spend time really training them about our QM".* $P_{B2}$ also acknowledged that staff retention is one of the most significant factors that impacts the process of the QMS deployment in the project. On the other hand, retention of skilled staff became another major barrier confronting the project team because losing experienced staff knowledgeable about the requirements of QMS deployment created a distinct need to spend extra time and cost to train and upskill a brand-new workforce ($P_{B3}$ & $P_{B1}$). This issue was primarily associated with the competitiveness of the workforce market at the time of the interviews; in Queensland in the mining sector for example, many competitive opportunities are offered to, and attract, workers with better pay and working conditions ($P_{B2}$).

***Legislation and Regulations***

Respondents agreed that **legislation and regulations** impacted in a positive way on driving the rigorous adoption of QMS in the examined project. $P_{B2}$ recognised this impact by explaining that:

> "Legislation and regulations are really just a driver to maintain the QMS. It's just a lever that we can use to continuously improve the supply chain of subcontractors. Also, they represent some kind of a framework and expectations for us just to make sure we're in the right way of implementing a QMS".

Additionally, legislation and regulations facilitate the provision of a more consistent environment within theCIBS that in turn helps somewhat to reduce the competitiveness and bias towards lowest prices ($P_{B2}$ & $P_{B1}$). To sum up, legislation and regulations are a driver on the case study project for facilitating the effective adoption of the QMS by using them as a set of benchmarks to ensure development of the necessary requirements of an effective QMS.

***Project Supply Chain***

The effect of **project supply chain** on the successful implementation of QMS is supported by participants and also underpinned by some evidence gathered from related documents. Respondents in the case study interviews expressed their views concerning the influence of this factor based upon the sub-factors identified previously, namely **quality of imported products**, and, **suppliers**.

*Quality of Imported Products*

Some respondents corroborated the impact of a **quality of imported products** on the rigorous deployment of QMS in the case study project. $P_{B2}$ thoroughly supported the significance of this influence by stating that:

> "Quality of imported products really takes you away from doing what you need to be doing regularly. When you've got those problems with those imported products, it's a resource drain on the project team of losses resolved, like if you're having to get materials supplied from overseas that can obviously impact on the QMS"

In this project, the quality of imported products resulted in encountering some defects associated with various imported materials installed in the executed works ($P_{B1}$). Hence, it was extremely difficult for the project team to assure compliance of such products with the requirements of QMS, owing mainly to deficiencies and lack of completeness of the various documents attached with these products required to assure compliance with Australian standards ($P_{B1}$& $P_{B3}$).

*Suppliers*

The effect of **suppliers** on the QMS implementation is completely supported by both responses of interviewees and related documents examined. $P_{B1}$ clearly explained the impact of suppliers on the case study project commenting: *" I'd say we don't have great visibility on what they do to quality assure their products. For the project right now, supplies are the most critical thing affecting the process of our QMS, and it's a big problem"*. Under those circumstances, it became critical for the project team to take the lead in quality assuring the procurement of appropriate materials to be used on the case study project. Within the QMS, a sound samples approval process and also quite a huge number of checklists were developed to assure procurement of required quality materials that were not expected to raise defects ($P_{B2}$). Hence, in the project (PQP), it was explicitly indicated that suppliers were liable for the quality of the products supplied to the project. The project team in the PQP underpinned the importance that all suppliers should strive to match, or exceed, the minimum requirements of QMS through complying with related standards. One of the main issues is the time spent to manage assurance of suppliers' compliance with the requirements of the QMS ($P_{B3}$ & $P_{B1}$) and notably this hinders successful deployment of QMS in the case study project.

***Weather***

The interviews revealed clearly the crucial influence of **weather** on the procedure of QMS implementation in the case study project. $P_{B2}$ explained the level of this impact stating that: *"Weather has some impacts on the process of QMS implementation. The impact of weather is to the rescheduling that occurs when there are unexpected impacts from weather. So, we need to maintain a QMS and where that equals delays, we need to limit it to the initial schedule"*. Thus, in the context of this project, weather does significantly impact on the process of QMS execution because various safety-related issues occur resulting in Trade Union intervention that clearly impedes the progress of QMS implementation/operation ($P_{B1}$). On the other hand, the excessive influence of weather on QMS deployment is associated with the time required to plan for potential contingencies due to changes in weather, as well as weather delays that hold-up other quality related work ($P_{B2}$ & $P_{B1}$).

### 6.4.3 CSFs for effective Implementation Of QMS

This section explains how on the case study project of Organisation B, the adoption of critical success factors (CSFs) assist greatly in assuring effective execution of the QMS in the case study project. The perspectives obtained from respondents, along with evidence gathered from the analysis of documents, strongly demonstrate the influence of CSFs on assuring the effective deployment of the QMS. The significance and influence of twenty-one CSFs are elucidated together with examining the impact of sub-factors associated with some of the main CSFs.

***Digital technology***

The significance of **digital technology** for QMS deployment in the case study project is corroborated by evidence gathered from the data collected. $P_{B2}$ recognised how adopting such factors assists in implementing a robust QMS stating that: *"Digital technology, like iPads or tablets helps in implementing an effective QMS. It saves us a lot of time when everyone uses it and when the technology is good enough to suit everyone"*. This view was substantiated by the other respondents who confirmed that digital technology not only saved a huge amount of time in ensuring that all documentation required by QMS was in place, but also facilitating the sharing of crucial information across all related stakeholders ($P_{B3}$ & $P_{B1}$). More importantly, because the QMS of this project is a paper-based system wherein many tests, forms and checklists are required to be filled in and signed, digital technology offers a virtually paperless QMS for the project team through creating a system allowing different stakeholders to sign on and constantly check the progress of documentation and update it when required ($P_{B2}$ & $P_{B3}$). In essence, adopting digital technology at project level greatly facilitates the deployment of the QMS in the project being examined.

***Attitude to Change***

The extent to which **attitude to change** helps in facilitating the implementation of QMS in the project of Organisation B was demonstrated by respondents. In this respect, $P_{B3}$ acknowledged that: *"Attitude to change is a big critical factor to QMS implementation. If people aren't open to a QMS and aren't open to change, then it's not going to apply, they're not going to take to it"*. Thus, attitude to change is essential to ensure that workforce quickly responds and adapts to the changes in QMS requirements. This adaptation to changes is significant because of the requirement for constant improvements to the QMS to reach the expectations of the client, and to comply with legislation and regulations requirements ($P_{B2}$). However, $P_{B1}$ acknowledged that attitude to change of the staff members is strongly associated with their different backgrounds and individual views and qualifications, such as the ability to use computers professionally ($P_{B2}$).

***Client Involvement***

All respondents agreed that **client involvement** was significant for effective deployment of the QMS. $P_{B1}$ clarified that: *"Client involvement is very important to adopting a good QMS and we apply that right now, because if they don't understand what they're getting, and the expectations are different to what the reality is, it can cause a lot of problems, and rework"*. In relation to the case-study project, $P_{B3}$ stressed that the importance of client involvement is associated with the criticality of understanding their expectations concerning quality; these were extremely significant to developing the requirements of the QMS adopted in this project. Hence, throughout the project, client involvement was facilitated by involving them within the regular project and design meetings to ensure that the project was meeting their requirements as well as sharing with them the main requirements of QMS implementation ($P_{B2}$). In brief, client involvement at project level notably assists in adopting/implementing a more rigorous QMS on the project.

***Communication and Coordination***

The interview responses and related document review, all corroborate the importance of **communication and coordination** for effective deployment of QMS in the investigated project. $P_{B2}$ demonstrated the impact of this factor explaining that: *"Communication and coordination affect the level of the QMS implementation in our project. Again, it comes back to that production line, that production line needs to be smooth, and with the appropriate level of communication and coordination, understanding your expectations"*. In addition, the project team utilises communication and coordination to perform efficient definition of roles and responsibilities, and to share constant changes in the QMS requirements ($P_{B1}$ & $P_{B3}$). This all leads to avoiding misinterpretation between different stakeholders regarding the responsibilities and requirements of QMS implementation ($P_{B3}$ & $P_{B1}$). However, $P_{B1}$ stipulated that communication in the context of Organisation B notably needs significant improvement to maintain more efficient communication between different levels of the company as sometimes there is a lack of on-time updates concerning the changes in the QMS requirements made at company level and required to be undertaken at project level.

Furthermore, in this project, efficient communication was achieved by carrying out regular face-to-face meetings and operating a good communication plan, using digital technology to facilitate communication, and all the requirements of the QMS were initially explained to all stakeholders to ensure that there were no misunderstandings about these ($P_{B2}$). Therefore, the project team adopted a Communication Flowchart developed by Organisation B to effectively manage and perform internal and external communications relating to the adopted QMS (QMSM, p22-24). This Flowchart is illustrated in Appendix F. Thus, utilising efficient communication and coordination at different levels of Organisation B greatly facilitated the implementation of QMS in the case-study project.

***Construction Site Planning***

The critical role of **construction site planning** for ensuring successful adoption of QMS in the examined project was addressed by all three respondents and was also evident in other examined documents. $P_{B1}$ explicitly emphasised the significance of such a factor, by stating that: *"Construction site planning is super-important for QMS implementation in our project. It's 100% about the efficiency of how the site runs in terms of the numbers needed, the number of cranes needed, and how occupied those cranes will be, and where they can reach"*. $P_{B3}$ & $P_{B2}$ reported that the project team undertook detailed construction site planning at the front-end of the project to ensure inclusion of the provision of long-term solutions for the project concerning the requirements of QMS implementation. With this intention in mind, the project team conducted a Project Start-Up Meeting to *"ensure that the Project Team are fully briefed and prepared for the requirements of the contract scope, documentation, and client"* (QMSM, p26). In summary, performing precise construction site planning especially during the early project stage helped in deploying an effective QMS throughout the implementation of examined project.

***Continuous Improvement***

The prime impact of **continuous improvement** for effective execution of QMS is thoroughly demonstrated by evidence gathered from participants and analysed from associated documents. $P_{B2}$ highlighted the impact of the factor explaining that: *"... continuous improvement is experienced by making sure that we are driving the QMS efficiently, effectively. Experience reduces the time frame that is spent on that and allows us to achieve QMS requirements more efficiently"*. In this project, continuous improvement for QMS was also necessary to keep addressing and resolving the issues encountered by the QMS implementation team, and eventually ensuring that the project team were still carrying out all of the requirements of the QMS ($P_{B1}$ & $P_{B3}$). Hence, continuous improvement is considered one of the main KPIs of the overall quality management system utilised to assess the performance of QMS implementation on the project, as illustrated in Table 6.2 below (PQP).

Table 6.2: KPIs of QMS performance (PQP, p7)

| Policy | Objective | Measurement Basis | Target | Responsibility |
|---|---|---|---|---|
| **Customer Satisfaction** | Deliver Project on time | As per the updated and approved Contract Programme | Project is completed on or before forecast date for Practical Completion | Project Manager |
| | Deliver Project on budget | Final figures are as per Contract Sum and approved variations. | Stated cost achieves completion and post-completion obligations to the satisfaction of the Client. | Project Manager |
| **Compliance** | Minimise deviation from company procedures | Internal audits conducted by Management. | No more than 10 Corrective Action items issued to the project resulting from internal audits. | Project Manager |
| | | | Zero Non-Conformances issued to a project as a result of not closing out CARs from an internal audit. | Project Manager |
| **Continuous Improvement** | Early identification of correct course towards a high-quality outcome | Internal audits conducted by Management. | All projects are internally audited within 6 months of being established on site. | Project Manager |

Although direct responsibility and accountability for many of the policy-driven aspects of the QMS are the responsibility of the project manager, all stakeholders of the project are responsible for deploying the QMS and contributing to its continual improvement to ensure meeting the requirements of the documented system (PQP, p6). This is critical as adopting continuous improvement as a CSF for effective deployment of QMS across different levels of Organisation B greatly assists in assuring robust implementation of the QMS in the case study project.

***Customer Satisfaction***

The absolute key role of **customer satisfaction** for effective implementation of the QMS is clearly supported by evidence gathered from the case-study project examined. In this respect, $P_{B3}$ emphasised the impact of customer satisfaction by explaining that: *"Customer satisfaction is the big reason why we do QMS because at the end of the day, we have to hand over the project to the standard that is expected from the customer"*. Thus, the team of the project adopts customer satisfaction as a CSF for effective deployment of QMS to meet the expectations of the client concerning quality, which leads ultimately to realising customer satisfaction ($P_{B2}$). For this reason, the organisation's PQP emphasises that: *"the aim of the QMS is to provide our clients with satisfaction with our work and the confidence that our construction* *projects and services meet or exceed their needs and expectations"*. According to P B1, a project team critically focuses on the expectations of clients to ensure that the requirements of the QMS are adequately tailored and developed to fulfil these expectations covered in the PQP. Ultimately, utilisation of customer satisfaction attainment as a major CSF for QMS deployment amongst different levels of Organisation B induces implementation of a highly robust and effective QMS in the investigated project.

***Definition of Roles and Responsibilities***

Data gathered from the case-study project underpins the critical inclusion of a **definition of roles and responsibilities** on the effective implementation of QMS as a major CSF. P B1 clearly explained its influence by stating that: *"Defining the roles and responsibilities of our project staff is a key factor for QMS implementation. So, they know it exists, they know it's important, and they know that we must attend to it, everyone knows what their role is and understands it"*. Thus, the definition of roles and responsibilities of the project team was completed throughout a pre-commencement of the project. Consequently, right from start-up, each team member had appropriate incentives to form a highly efficient team that could perform effective execution of the QMS throughout the project life cycle (P B3 & P B2). However, the roles and responsibilities of QMS implementation for the project are disseminated amongst different managerial levels, namely state quality manager (SQM), project manager (PM), along with quality coordinator (QC), as part of the latter's overall role (Note: evidenced by the PQP). On the other hand, during Project B visits, it was observed that the nominated quality coordinator who manages the main requirements of the QMS at the project level, in addition to undertaking other roles, was actually insufficiently qualified and experienced to carry out such responsibilities because the QC was a fresh cadet employee. The lack of a qualified quality coordinator was directly reflected on the level of undertaking the required documentation and other records associated with QMS requirements.

***Education and Training***

The crucial function of **education and training** for effective implementation of QMS in the case study project was clearly addressed by all of the respondents. P B3 reported that influence by explaining that:

> "Education and training are really important, and we need to have upfront training before the project begins, just to make sure everyone understands how the QMS works. So, the effective allocation I'm calling QMS is getting people to understand what the system is, how the system works and how they implement that system at work".

Moreover, to ensure that the QMS team is adequately qualified to achieve the expectations of system adoption, they were provided with several education and training sessions that focused on highlighting the significance of the QMS for delivering a quality project and clarifying the requirements of QMS deployment ($P_{B2}$, $P_{B3}$ & $P_{B1}$). Accordingly, $P_{B2}$ confirmed that training regarding QMS adoption is delivered via lessons learned reflections/discussions and workshops for staff. These sessions also concentrate on demonstrating those quality issues that may potentially occur and how to handle them ($P_{B1}$). All agreed that education and training are fundamental for implementing a successful QMS in the case-study project of Organisation B.

***Employee Empowerment***

**Employee empowerment** for assuring effective deployment of QMS in the examined project was recognised by all participants to be a crucial factor. $P_{B2}$ affirmed that: *"Employee empowerment is essential to give our staff that confidence to ensure that there's non-negotiable attitude to quality and the QMS"*. In the project being examined, employee empowerment was supported through providing the QMS team with complete access to the whole quality management system to enable them to understand the required procedures to implement that system ($P_{B1}$). However, $P_{B2}$ acknowledged that empowerment of QMS staff is probably still fairly limited due to the levels of delegation of administrative power under which any updates to, or alterations of, the QMS or its requirements must be approved before being used in that system. The extent to which projects are empowered is also restricted by regulations, and current legislation as well as dictated by the project client ($P_{B3}$). However, it is very clear that employee empowerment noticeably facilitates the deployment of the QMS in the investigated project.

***End-user Involvement***

The role of **end-user involvement** for QMS adoption in the examined project was discussed by all respondents. $P_{B2}$ explained the impact of end-user involvement by emphasising that: *"End-user involvement can facilitate our QMS implementation, especially if it's adopted at the upfront stage of project. We needed to know what the end-user wants to give us a good brief to work to. That way we can implement all of that information into our QMS"*. In addition, end-user involvement appears to be essential to acquiring the inclusive expectations of quality to be used along with the client expectations to develop precise requirements of the QMS adopted in order to fulfil these expectations ($P_{B1}$). However, unlike hospitals, schools, and other public projects, in residential or commercial projects, clients generally prefer not to involve end-users within actual project-level discussions. Hence, the end-user is not really involved in the QMS procedures of the project because the client is unwilling to involve them for commercial reasons ($P_{B3}$ & $P_{B2}$). Nonetheless, $P_{B2}$ affirmed that Organisation B, despite their 'distance', still needed to develop an effective strategy to figure out how to include and meet their expectations during development of QMS requirements. To summarise, adopting end-user involvement as a CSF for QMS implementation, whilst difficult in this case-study project, was considered highly necessary at a systemic level as it was believed that it would result in a more rigorous deployment of any QMS, although it is not adopted in this project.

***Internal Stakeholder's Engagement***

Respondents unanimously highlighted the significance of **internal stakeholder's engagement** for QMS implementation in the investigated project. $P_{B1}$ recognised that impact by clarifying that: *"Engagement with internal stakeholders is one of those things where we get much better and more efficient outcomes of QMS if we consult with people"*. Another crucial need for internal stakeholders' engagement is due to it being necessary for the case-study project to ensure successful implementation of QMS because of the involvement of many different external disciplines and stakeholders that tend to focus on their own very specific requirements and works during the project lifecycle ($P_{B3}$). Thus, internal stakeholder's engagement assists greatly in achieving QMS deployment, as it contributes to education and experience sharing, as well as providing a double-checking mechanism for assuring the requirements of QMS implementation are being met ($P_{B2}$).

***Industry Relations with Trades Unions***

The significance of maintaining healthy **industry relations with Trades Unions** for QMS deployment was strongly supported as critical by respondents. $P_{B2}$ clearly elucidated the impact of this factor by mentioning that: *"Industry relations with Trades Unions indirectly help in implementing a successful QMS. The trades unions probably speak directly with government with their own agenda. That can help mandate the expectations of the industry and set that level playing field for the market"*. In this project however, $P_{B3}$ emphasised that the focus was on assuring sensible relations with trades unions in order not to interfere with the QMS implementation. This was ultimately achieved through ensuring that the QMS, besides driving quality on the project, also facilitated the meeting of all requirements regarding safety. This required the constant focus of the project team on mitigating the intervention of trades unions whilst driving the QMS adoption, a complex trade-off ($P_{B2}$ & $P_{B3}$). The project team, therefore, maintained good relations with the relevant trades unions by providing an appropriate and safe environment for the workforce ($P_{B1}$).

***Leadership Support***

Respondents explicitly corroborated the significance of **leadership support** to ensure successful implementation of QMS in the case-study project of Organisation B. $P_{B1}$ explicitly highlighted the significant impact of this factor by explaining that: *"For us, leadership support is very important to implement a robust QMS in our project where we want leaders to be consultative"*. Thus, leaders push towards adopting a rigorous QMS and drive the required resources for implementation to ensure that such a system is properly executed within the project ($P_{B3}$ & $P_{B2}$). Additionally, leadership support must be performed via different levels of the management team, all the way down to the project team, in order to fully facilitate the deployment of a robust QMS ($P_{B1}$ & $P_{B3}$). In the case-study project, $P_{B2}$ acknowledged that leadership support was thoroughly practised throughout the project, especially in encouraging an inherent culture that espoused this support, thus allowing the team to exhibit their own commitment to implementing an effective QMS.

***Management Review and Feedback***

The prime role of **management review and feedback** for QMS implementation was distinctly evident in company documents examined, as based on the interviews with the case-study respondents. On this subject, $P_{B2}$ emphasised the influence of this factor within the project being examined by clarifying that: *"Management review is another set of eyes just having a quick look through how QMS is implemented, but their understanding of our project is important because they need to know where the* *risks lie within the QMS and if there is any value through the QMS"*. To supplement the effective and constant management reviews on the job, the project team was required to hold several meetings throughout the project lifecycle to assess the performance of the QMS. Namely, the project start-up meeting, site team meetings, internal team meetings, and project monthly reporting meetings (PQP, p21).

The PQP dictated that such meetings were to encompass all related staff on the project that were responsible for implementing QMS requirements, such as the project manager, contract administrator, and site manager as required; meeting agendas were to include (PQP, p21):

- Review of previous minutes, the Project Quality Plan (PQP), and quality audits;
- Review of customer complaints, non-conformances and corrective actions;
- Review of subcontractor/supplier performance concerning QMS;
- Review of client generated quality observations, and;
- Compliance to regulations including Codes and Standards.

More importantly, $P_{B2}$ affirmed that since the projects of Organisation B are often geographically separated, sharing the experience across different projects by means of management feedback is fundamental to ensuring successful execution of QMS in this project. In either case, management review and feedback are crucial CSF for the adoption of QMS in the project being examined.

***Quality Culture***

The impact and importance of **quality culture** on the effective deployment of QMS in the case study project was supported by all respondents. $P_{B1}$ recognised how quality culture assists in adopting a robust QMS in the investigated project by stating that:

> "The key thing for us here to implement a good QMS is quality culture. It's about how the operational manager sets the culture in the organisation and that is super positive like getting us to do more training. So, I think the culture of the organisation is probably the biggest driver to adopt a robust QMS in the project".

Thus, $P_{B2}$ acknowledged that if quality culture is established at the high level of Organisation B and then spread out to other levels, including the case-study project, the project team adapts, to various degrees, to that culture. The reason that staff members differently adapt to quality culture is based upon their personalities and backgrounds as well as their various education and experience levels ($P_{B3}$ & $P_{B2}$).

***Regular External QMS Audits***

The impact of **regular external QMS audits** on QMS adoption in the investigated project was discussed thus by respondents: $P_{B3}$ addressed the influence of this CSF stating that: *"Regular external QMS audit would be a huge effect on QMS implementation. It's always significant to have an external party come in, review and give advice. I think it's very important, it's going to help in driving improvement"*. Moreover, regular external QMS audits help in adopting a highly robust QMS through the knowledge sharing around practice, education, awareness and more importantly, imparting awareness of industry-wide information and experience between different projects and companies ($P_{B2}$). On this project, only two types of external audits were carried out on the QMS. One was a certification audit under the ISO 9001 certification, and another was an external audit conducted by a professional services firm for marketing purposes ($P_{B1}$). Thus, on the case study project, there were no regular external QMS audits performed to particularly assess the level of QMS deployment. This led to difficulty in assuring compliance of project stakeholders with QMS requirements and missing the benefits of sharing QMS experience across different organisations.

***Reputation of Company***

**Reputation of company** was considered by all respondents to be a significant factor impacting on QMS deployment in the examined project. $P_{B1}$ recognised this by explaining that:

> "Reputation is something that we do take extremely seriously in this project. Pretty much all of our decisions are made around how it will affect our reputation and that definitely affects our QMS in a good way because it means that we want our reputation to be the product of what we deliver, which is extremely good".

The team on the case-study project worked extremely hard to implement a successful QMS to ensure delivery of a high-quality project because they considered that the reputation of the company is ultimately defined by the quality of the project handed over to the client ($P_{B3}$ & $P_{B1}$). In this context, $P_{B2}$ emphasised that adopting the reputation of a company as a CSF for QMS deployment in this project is fundamental to ensuring customer satisfaction. Thus, adopting the reputation of the company as a CSF for QMS deployment in the case study project acted as a key incentive to assure a robust adoption of QMS.

***Resources***

The vital role of **resources** for adopting an effective QMS in the examined project was clearly supported amongst respondents based on the evidence gathered during interviews and from the related documents and direct observation. However, for clarity, the influence of this CSF on QMS deployment is expressed based upon the resources subfactors, namely **provision of resources of time and cost**, **recruitment of experienced quality managers** and **recruitment of qualified sub-contractors**. The significance of each individual factor is demonstrated below.

*Provision of Resources of Time and Cost*

Relating to the **provision of resources of time and cost** on QMS implementation, respondents unanimously agreed that there was a significant impact. $P_{B1}$ explained the factor's prime role, mentioning that: *"Getting enough resources of time and budget is extremely important to adopt a robust QMS in our project, because if we get a really tight budget, we probably won't resource correctly on projects"*. Moreover, these resources need to be well-balanced in order to maintain the quality of executed works whilst implementing a rigorous QMS ($P_{B2}$). That balance is also crucial for the QMS staff to carry out the requirements of QMS deployment, such as having adequate time to accurately complete related paperwork, records and other documentation ($P_{B1}$ & $P_{B3}$).

*Recruitment of Experienced Quality Managers*

Organisation B respondents all related to the significance of **recruitment of an experienced quality manager** for implementing a successful QMS in the case study project. $P_{B3}$ explained the critical impact of this factor stating that: *"I think another CSF is a human resource one, especially to get a quality manager within the project, as we don't have enough resources in the project where our other people could fully focus on QMS"*. In this project, however, the allocated budget was insufficient to afford to recruit a quality manager. Hence, the responsibilities of QMS implementation were allocated to several members of staff and this resulted in a distinct lack of consistent deployment of the QMS ($P_{B1}$ & PQP, 9-11). As a result of this negative experience, $P_{B2}$ highlighted that there is a critical need to change the perception about how to manage the QMS on projects wherein the specific requirements of the QMS are assigned to qualified and experienced staff members as a part of their overall responsibilities in the project. When several individuals were attempting to manage fragmented parts of the system, this resulted in some serious issues on this project, a lot of documentation issues especially ($P_{B2}$ & $P_{A1}$). To sum up, while the significant need to recruit an experienced quality manager was well supported by respondents, this project lacks the influence of such a manager owing to limited budget allocated, in particular, for employing human resources for QMS deployment.

*Recruitment of Qualified Sub-contractors*

Evidence of research data clearly highlights the role of **recruitment of qualified subcontractors** for assuring a rigorous implementation of QMS in the project being investigated. In this respect, $P_{B1}$ explained the impact of this factor thus:

> "Qualified subcontractors are going to have a huge effect on QMS implementation. If we get people that we need to implement the QMS and they understand what they're doing, we make sure that engagement in doing the work is good too, and then you can trust them to do a good high-quality job".

This factor is also particularly critical to adoption of a rigorous QMS in the case-study project because more than 90% of the workforce belong to the subcontractors due to the majority of the works being performed by them ($P_{B2}$). Therefore, subcontractors have to ensure that their teams working at the project have the appropriate quality awareness trainings and are qualified adequately to carry out the requirements of QMS (PMSM, p10). In this respect, the project team has to request: *"evidence of subcontractor QMSs and practices and assess their consistency with the principles and requirements of ISO 9001"* (PQP, p12).

***Teamwork***

The significance of **teamwork** for QMS implementation in the case study project was highlighted and strongly justified by all respondents. $P_{B3}$ remarkedly explained the vital role of teamwork by stating that: *"Teamwork has a big effect on implementing the QMS in our project. I think safety, quality work hand-in-hand, design* *as well, and because like the construction team, with the right input, the right planning, everyone working together is going to mean good quality outcomes"*. In this project, teamwork helped substantially in implementing a robust QMS through reducing the pressure to maintain the high expectations of QMS outputs by spreading responsibilities appropriately around the project team as well as ensuring that there was efficient communication between all staff members to attain these expectations ($P_{B2}$). Teamwork was also certainly critical within the context of this project to ensure successful adoption of QMS, as there were limited resources in terms of personnel ($P_{B1}$ & $P_{B3}$).

***Top Management Commitment***

The prime role of **top management commitment** for adopting a rigorous QMS is notably corroborated by the data gathered from the project being examined. $P_{B3}$ described how this resulted in the successful deployment of the QMS, clarifying that: *"Top management commitment have a major effect on QMS implementation because if it's not driven from the top management, it's not going to happen. If top management isn't pushing or driving all the levels of company, it's not going to happen in this project"*. Also, to ensure commitment of the project team when implementing the QMS, top management visibly demonstrated their commitment towards significant QMS implementation throughout the various relevant levels of Organisation B ($P_{B2}$). Hence, the CMSM explicitly indicates that: *"The senior managers of [Organisation B] are committed to the development, implementation and continual improvement of the company's quality and environmental systems"* (CMSM, p5). Such commitment also requires provision of the essential resources, including human and financial, to ensure that the QMS is completely and effectively implemented (CMSM). Similarly, in order to highlight such commitment, the top management of Organisation B consents to holding full accountability in the following areas (CMSM, p6):

- ❖ The effectiveness of QMS and EMS (Environment Management System);
- ❖ Establishing quality and environment objectives;
- ❖ Provision of resources and direction of the deployment and maintenance of these systems;
- ❖ Promoting engagement in the improvement of such systems; and,

- Demonstrating client focus through assuring compliance with their requirements.

However, $P_{B1}$ acknowledged that, at the project level, it is fundamental to ensure a balance between top management commitment and empowerment of the QMS team essential to make decisions about the actions required to facilitate the deployment of the system. Thus, top management commitment markedly assists in adopting a successful QMS in the investigated project.

## 6.5 CASE STUDY (3)

### 6.5.1 Profile of Company

This section explains the background of the company being examined in Case study (3). In this study, the abbreviation "**Organisation C**" has been employed to refer to this organisation. Organisation C was established in 1983 in Adelaide, delivering commercial and industrial construction projects across a range of sectors: education, aged care, residential, food and beverage, health and retail. Also, its projects are implemented in different locations across Australia, including Adelaide, Brisbane, Maroochydore and Perth. With a total of approximately 200 employees, Organisation C is classified as a Tier Two construction company, according to ABS, 2014 (as cited in Industry, 2015).

Furthermore, Organisation C is certified under ISO 9001:2008 QMS and in this regard, $P_{C1}$ stated that: *"We have a system accredited to the ISO 900 international standard. It's a QMS… integrated with certain aspects of safety and environmental control. But it's a QMS that provides value and guidance to the end user. So, it's my bible of policies, procedures and instructions on use"*. Organisation C has developed its own comprehensive quality manual to be adopted for use on its own projects to *"apply the principles adopted in the company's Quality Policy Statement, located on the Intranet. To help us achieve our policy goals, the Quality Manual is one component of our Project documents, which also includes our Safety and Environmental Manuals"*.

To carry out this case study, various data collection techniques were performed in order to obtain the requisite data from the project being examined, including in-depth interviews, document analysis along with direct observation. In sum, four participants were interviewed in this case to acquire a deeper insight on the level of

QMS implementation in the investigated project. These participants included the Quality Safety and Environmental (QSE) Manager ($P_{C1}$), Group Operations Manager ($P_{C2}$), Project Manager ($P_{C3}$) and Construction Manager ($P_{C4}$). Along with these interviews, various types of documents associated with the procedures and requirements of QMS implementation were provided by the project team to assist this researcher to obtain a comprehensive perception regarding the deployment of the QMS in the context of case study project.

### 6.5.2 External Factors Affecting QMS Implementation

This section demonstrates the influences of external factors on the successful deployment of QMS within the case-study project of Organisation C. All four respondents generally supported the significant impacts of external factors on the effective execution of a QMS. However, these informants independently explain the effect of each factor on the process of QMS implementation during the life cycle of the project being examined. In addition to the evidence gained by interviews, the documents provided by the project team during the case study were also used to gain further evidence demonstrating the impacts of these factors together with evidence gathered by direct observations carried out by the researcher on the case-study project. The influence of each factor from the total of twelve identified external factors along with the impact of sub-factors on QMS deployment are discussed in detail below.

***Client Attraction for the Lowest Price***

The influence of **client attraction for the lowest price** on the effective implementation of QMS was clearly explained by $P_{C1}$ stating that: *"Client attraction for the lowest price significantly affects the implementation of QMS. I think they don't understand the fact that investing in good quality products upfront will give them more life on the end product"*. Moreover, $P_{C2}$ acknowledged that this factor influences heavily on the adoption of a rigorous QMS because all activities implemented in this project are ultimately financially driven. Hence, the level of quality expectations is completely driven by the client based solely upon budget considerations and this directly impacts on the project team’s ability to obtain quality products. Consequently, this budget-driven approach impacts negatively on the process of recruiting and nominating subcontractors, specifying appropriate materials essential to assure project quality outcomes and also ensuring the required level of human resources provided to implement the QMS on the ongoing project ($P_{C1}$ & $P_{C2}$).

*Client Awareness towards QMS Significance*

Evidence from the interviews clearly corroborates and demonstrates the influence of **client awareness towards QMS significance** on the rigorous implementation of QMS. $P_{C3}$ reported the impact of that factor by stating that:

> "It is a driver because our client is obviously looking for that certification, the ISO 9001. The client wanted to see some sort of certified QMSs in place during the tender process. So, we obviously had to produce a QMS plan for this job because the client wanted slightly different requirements, which defines how we're going to do, how we're going to split the lots up".

Thus, client awareness about the significance of the QMS drives the procedures of system implementation through, by developing clear expectations concerning the quality. In Organisation C this induced the project team to establish and resource where possible advance requirements of the QMS to meet these expectations ($P_{C4}$). However, $P_{C1}$ acknowledged that the client of the case study project already had some experience of QMS requirements, such as ISO 9000, but in general the level of client awareness across all projects about QMS importance varies based upon the quality, experience and focus of those clients. In contrast, other clients just focus on obtaining their projects within the desired budget and time and the QMS is of little concern ($P_{C2}$). Client awareness towards QMS significance was a distinct driver for adopting a QMS in the examined project.

*Design Process*

The respondents agreed that the influence of the **design process** had a significant impact on the rigorous deployment of the QMS in the case-project. $P_{C2}$ recognised the impact of design process noting that: *"For QMS implementation, it is critical to have a good design, that's by allowing the designers efficient time to complete their designs. I mean the way things are going, we are squeezing designers, we are squeezing the time-frames to complete designs, and with that can come quality eras"*. Hence, the design team of this project was encouraged to adopt Organisation C's own QMS throughout the design process to facilitate compliance of design documents with the requirements of the QMS ($P_{C3}$). However, in this case, the QMS team were involved in the review of the design to ensure its constructability and also to understand the critical nature of complying precisely with that design during the project execution ($P_{C3}$ & $P_{C1}$). Despite this agreement, some delay occurred owing to the specific details and techniques described in the design documentation provided to the project. This delay eventually adversely influenced the process of QMS implementation within the timeframe required, due to architects and consultants needing to resolve various issues by the revision of drawings ($P_{C1}$). On the case-study project, the design process was a serious challenge to successful deployment of the QMS.

***Different quality systems***

The influence of **different quality systems** on the effective deployment of QMS was discussed and the impacts were agreed to be significant by all respondents. $P_{C2}$ acknowledged that the adoption of different quality systems impacted seriously on the QMS being implemented on this project, not only due to the differences of the various QMSs adopted by different stakeholders, but also because of the difference between the QMS adopted at organisational level to meet the requirements of prevailing legislation and regulations, and the QMS being implemented at project level to achieve the expectations of the client concerning quality. The project team, from the kick-off of the project, had a strong intention to assure the compliance of the Inspection Test Plans (ITPs) adopted by external stakeholders with the requirements of the overall project QMS to ensure consistent implementation of all systems ($P_{C1}$ & $P_{C3}$). Related to this, $P_{C4}$ emphasised that to mitigate the complications of adopting different QMSs, the project team adopted a very flexible QMS that could incorporate/accommodate those different system variations within the processes and procedures of the prime QMS.

***Complexity of External Project Stakeholders' Involvement***

The evidence from this case-study demonstrates the impact of the **complexity of external project stakeholders' involvement** on the effective deployment of QMS. $P_{C2}$ declared that: *"One of our biggest challenges in adopting a robust QMS is the number of external stakeholders we deal with and the contradicting expectations of compliance of implementation…It's a massive barrier for our team to try and explain the implementation of the QMS"*. Also, the impact of these stakeholders was clearly identified by one respondent as causing deviation from the requirements and procedures of QMS execution in this examined project ($P_{C3}$). In addition, involving all of these external stakeholders represents a challenge for the project team owing to the time and effort needed to explain to them why the QMS is significant, and how departure from it can affect the project outcomes ($P_{C1}$ & $P_{C4}$). Thus, the complexity of external project stakeholders' involvement hinders QMS implementation in the case-study project being investigated.

***Government policies***

The influence of **government policies** on the processes and procedures of the QMS implementation was mentioned by all respondents. $P_{C1}$ recognised how government policies affected the process of implementing a rigorous QMS by highlighting that: *"For us, government policies are a significant barrier to implementing a robust QMS. Some of the government agencies that I am dealing with at the moment have been absolutely shocking…Some of the barriers that they put in the way have been awful for us recently"*. However, $P_{C4}$ stipulated that this factor influences the QMS at company rather than project level. Organisation C, therefore, intends to scale the expectations of these policies at an organisational level to mitigate their impact on QMS implementation in the project ($P_{C4}$). $P_{C3}$ felt that these policies do not provide very clear expectations in the form of explicit statements to guide and be considered by the project team during the QMS execution. In the combined view of $P_{C4}$ & $P_{C2}$ this issue was due to the fact that the government does not often consider the viewpoints of the construction companies and how they will deal with new statutory requirements when policies are introduced that are associated with QMS deployment.

***Interstate Working***

Most respondents felt that **interstate working** had a significant effect on the successful implementation of the QMS. $P_{C4}$ explained the impact of interstate working on the process of QMS execution by stating that: *"It's difficult and it is a real barrier to QMS implementation because there are plenty of ways to do work and what one government body in a state deems the correct way to do things might not agree with the other ones, and that all filters down"*. In the case study project, interstate working had affected the implementation of QMS in different ways, namely, establishing proper requirements, providing appropriate materials for the project, as well as recruiting the required workforce to fully engage with the QMS implementation ($P_{C3}$ & $P_{C1}$). However, $P_{C1}$ acknowledged that regardless of this negative impact, interstate working generally had helped to improve the overall experience of the project team because they were exposed to various QMS requirements and expectations.

***Intervention of Trades Unions due to safety***

The critical impact of **intervention of trades unions due to safety** on the effective deployment of QMS was clearly acknowledged by all respondents. For instance, $P_{C1}$ recognised that: *"Intervention of trades unions due to safety absolutely affects how we implement our QMS. The unions are continually trying to stop us from a safety point of view"*. Moreover, $P_{C2}$ acknowledged that, in this project, intervention of trades unions is a clear barrier to QMS deployment because that intervention makes the project team pay more attention to handling all safety issues rather than focusing on coping with QMS requirements. This rather unbalanced attention is attributed to the power and authority of the trades unions to suspend a project due to any potential safety issues, however large or small ($P_{C3}$). Also, the considerable amount of enforcement of, and expectations on, safety, especially by government, makes the implementation of the QMS a fluctuating target ($P_{C4}$ & $P_{C2}$). To sum up, intervention of trades unions due to their strong focus on anything related to project and worker safety seriously impedes the timely and successful implementation of the QMS in the case study project.

***Regular external QMS audits***

The impact of **regular external QMS audits** on the effective implementation QMS within the context of investigated project was corroborated by all respondents. $P_{C2}$ clearly emphasised that influence by mentioning that: *"external regular QMS audits is a barrier to our QMS implementation. We first summon the government projects, we have to do the PQC audits, which is safety, we get audited quite regularly on safety and bits and pieces, but we don't always get audited on any of our QMS stuff"*. This highlighted that in the case study project, the lack of the influence derived from the conducting of external audits hinders QMS deployment not only because such audits drive compliance with standards and the implementation of the QMS, but also because it is difficult to ensure that all related project team members are constantly following the prescribed processes and requirements of the QMS ($P_{C3}$ & $P_{C4}$).

On the one hand, the Project C Quality Manual (QM) explicitly indicates the need for conducting comprehensive regular internal QMS audits after two months from commencement of a case-study project to ensure that all quality policies and procedures are being complied with. Also, such audits are undertaken to ensure that the QMS *"comprehensively covers all project-related activities, and that project* *construction plans are being implemented and adhered to"* (QM, p10). On the other hand, *"the current internal audit process does not clearly review all components of the QMS"* according to the External Audit Report (EAR, 2017, p5). This means that the critical requirement to carry out external regular QMS audits, in addition to internal audits for assurance that an effective QMS was being executed, were not being followed (PC3).

***Skilled Human Resources***

The influence of **skilled human resources** on the successful implementation of QMS was explained and justified by the respondents, as well as being evidenced in other related documents from the case study project. As an illustration, PC2 addressed the impact of this factor by emphasising that:

> "In our project, skilled human resources are absolutely barrier to implementing a robust QMS. Until there's a clear expectation and regulatory body managing QMS, you're not going to have the industry make a change by way that they make an investment by having that sort of qualified quality manager per project like we do with that safety supervisor on all".

Further to this, case study respondents exclusively demonstrated their belief that the impact of this factor depended on the sub-factors associated with skilled human resources, namely **qualified staff**, **quality manager and assistant staff**, and **retention of skilled staff**, as detailed and explained below.

*Qualified Staff*

The case-study research data notably highlights the influence of **qualified staff** on executing a rigorous QMS. PC4 recognised how important this factor is by affirming that:

> "Qualified staff has a pretty nasty effect on our QMS, so it's definitely a barrier to implementing a robust QMS, it's terrible. We have something on the project that's more like a company that offers a service rather than a guy who's been to trade school and had training and gone through the whole thing".

Thus, any lack of qualified staff generally results in inconsistent implementation of the QMS as well as the absence of engagement of those staff managing the requirements and procedures of deploying such a system (PC3 & PC1). The issue of qualified staff deficiency in the project was largely due to the difficulties of obtaining an appropriate level of quality skilled workforce capable of implementing and managing a robust

QMS within the AustralianCIBS ($P_{C1}$). All this points to the inability to engage a qualified workforce for QMS deployment as being a clear barrier to executing a successful system in the examined project.

*Quality Manager and Assistant Staff*

The importance of engaging a **quality manager and assistant staff** for the effective implementation of QMS was fully corroborated by the respondents. $P_{C4}$ emphasised the criticality of the factor by confirming that: *"I think that's pretty obviously going to be a massive barrier for us to deliver QMS, if we haven't got anybody to implement it or anybody to monitor it, then we're not going to get any QMS done"*. In fact, there was no quality manager employed on the case-study project, nor was one planned to be employed throughout the remaining life of the project owing to the limited number of such qualified managers within the market in which Tier Two building organisations operate. Consequently, in this project, the requirements of the QMS implementation and operation were rolled-out in a highly fragmented manner as critical management and operational responsibilities were distributed amongst different staff members and made part of their main responsibilities ($P_{C3}$ & $P_{C2}$). In the end, in order to relieve this unacceptable situation, it was decided to upskill the project team to professionally implement a QMS rather than employing a dedicated quality manager on the project ($P_{C1}$ & $P_{C3}$). As shown above, the lack of a dedicated, experienced and qualified quality manager and related assistant staff was a crucial challenge confronting the robust implementation of a QMS in the case study project.

*Retention of Skilled Staff*

Evidence of research data distinctly corroborates the effect of **retention of skilled staff** on the successful implementation of QMS. $P_{C2}$ explicitly reported that impact by stating that: *"Retention of skilled staff is a certain barrier to QMS implementation because when our skilled staff leave, we lose the education value we're putting money into training them into the system. They become familiar with the implementation of the QMS and then we'll be losing them; it's a big challenge"*. Moreover, retention of skilled staff, in the examined project, affects the process of QMS deployment concerning the time required to train and upskill a new workforce, and cost of these programs. However, these resources of time and budget would be rather spent to recruit the right number of staff required for QMS deployment ($P_{C4}$ & $P_{C3}$). Nonetheless, the problem of skilled staff retention is either related to internal factors, such as employee satisfaction and empowerment, or associated with external factors, such as competitiveness of the construction industry market ($P_{C1}$ & $P_{C3}$). In summary, retention of skilled staff is evidently a clear barrier to adopting an effective QMS in the project of organisation C.

***Legislation and Regulations***

The influence of **legislation and regulations** on the rigorous deployment of QMS was agreed to be impactful by all respondents. $P_{C4}$ noted that: *"It's a driver for our QMS implementation because obviously the legislation and regulations is fairly accessible these days"*. Also, the project staff often utilise legislation and regulations as a benchmark against which to target the specified requirements for assuring the compliance of QMS requirements with ($P_{C3}$, $P_{C2}$ & $P_{C4}$). $P_{C1}$ specifically acknowledged that the project team struggled to obtain copies of, and comply with, Australian standards, because they are extremely expensive, not authorised to be copied and distributed, and often too sophisticated to be usable or understandable at the project level. For the most part, legislation and regulations are helpful to drive a successful implementation of the QMS, and as a benchmark to assure compliance with standards within the case study project. However, in this instance, Australian standards were not well understood or made available widely for project use.

***Project Supply Chain***

Broadly speaking, the impact of the **project supply Chain** on the successful implementation of QMS was considered to be significant by respondents, in the context of the case study project. However, respondents addressed the influence of this factor based on consideration of the subfactors identified previously during the exploratory study, including **quality of imported products** and **suppliers**.

*Quality of Imported Products*

The impact of **quality of imported products** on the successful adoption of QMS was mentioned by all respondents. $P_{C2}$ indicated the significant influence of this factor and emphasised that: *"I think recent the importation of poor-quality products is creating a lack of non-compliance, which is challenging the implementation of QMS in our project. It's a challenge that we are yet to really see the full implications of"*. More specifically, the quality of imported products critically affects the process of QMS execution due to the requirement for the compliance of such products with the QMS and Australian standards ($P_{C1}$ & $P_{C3}$). Whilst $P_{C1}$ acknowledged that the main contractor is responsible for ensuring compliance of such materials with standards, the materials themselves are often nominated by clients, specified by engineers, or stem from the architectural design. Hence, quality of imported products is a serious challenge facing the implementation of QMS in the project being examined. This issue can be attributed often to the deficiency or shortage of information related to the products; such missing or incomplete information becomes critical as it is utilised to ensure compliance of products, elements and components before installing them in the project (PC4 & PC1). Thus, the quality of imported products is clearly a barrier to implementing an effective QMS in the case-study project of Organisation C.

*Suppliers*

With regard to the influence of **suppliers** on the effective implementation of QMS, PC4 highlighted that: *"Suppliers affect our QMS, especially when we're supplying from a smaller company that we might not have dealt with before, that might be non-specified. So, they can certainly play a part in your QMS if they're not supplying what you're expecting"*. In this project, the client's own selection process was used to nominate suppliers. The main contractor then chose the most appropriate suppliers from the client's list that could cope with the QMS requirements, but the options based on this process were distinctly limited (PC2 & PC3). Thus, unless Organisation C can establish a more precise set of criteria to nominate and audit suppliers so as to better assure their perception and understanding of QMS requirements, it is difficult to adopt a robust QMS on the project (PC1). It was obvious from the responses of respondents interviewed that engagement of suitable suppliers represents a barrier to adopting a rigorous QMS on the case-study project of Organisation C.

***Weather***

As with most construction projects, the effects of **weather** can significantly impact on project works and this is certainly the case for the successful adoption of a QMS in the context of the project being investigated. PC1 explained the influence of weather stating that: *"Weather in general, significantly affects the level of QMS implementation. Sometimes, you might get extreme weather and that will significantly affect program from a quality aspect, so weather can significantly affect the QMS"*. Also, PC2 stressed that weather is a crucial challenge, which makes it hard to manage certain procedures of the QMS such as assuring compliance of poured concrete with

Australian standards owing to the difficulties of curing and finishing concrete during uncertain weather conditions. In the face of extreme weather conditions, such as heavy rain, high winds and soaring temperatures, which are dramatically changeable during the day in Queensland, especially in summer, it is almost impossible to comply to the schedule of a project, and perform all the required ITPs, such as those related to waterproofing work executed during humid weather ($P_{C2}$ & $P_{C4}$).

### 6.5.3 CSFs for effective Implementation Of QMS

This section demonstrates how general deployment and use of all of the CSFs investigated in this research, can facilitate and benefit the effective implementation of QMS in the case study project of Organisation C. Evidence collected was based on the viewpoints of respondents expressed during interviews, the evidence gained from the analysis of related documents, and through direct observation by the researcher whilst visiting the offices and sites of the case-study project organisations. Data obtained from these sources all elucidate the positive impact of adopting these CSFs on the outcomes necessary for successful execution of the QMS in the project being investigated. The importance and effect of twenty-one CSFs will be described in detail, in addition to addressing the influence of those sub-factors associated with some of the major CSFs; the significance and effect of each individual CSF is highlighted and manifested in detail below.

***Digital Technology***

The extent that **digital technology** assists in facilitating the deployment of QMS in the case study project was addressed by respondents. $P_{C1}$ clearly indicated the impact of such factor by clarifying that: *"It's a significant investment to facilitate QMS implementation; iPad or computer or mobile phone, apps sharing information within different stakeholders, are key to moving forward. That's efficiency and that's opening up communication. That's being given the opportunity to coordinate"*. In addition, the utilisation of a computer based QMS on the project, greatly assisted the training of staff about the QMS requirements, the sharing of these requirements amongst related stakeholders, and management of compliance of products essential to fulfilling the quality requirements ($P_{C2}$ & $P_{C3}$). Thus, the use of digital technology saves a considerable amount of time and cost throughout the whole QMS deployment ($P_{C1}$, $P_{C3}$ & $P_{C4}$). Adopting digital technology as a CSF for QMS deployment has facilitated the quality management system execution on the case study project.

### *Attitude to Change*

The **attitude to change** of project staff and the impact of this factor on the successful deployment of the QMS was clearly addressed by all respondents. $P_{C2}$ emphasised the critical function of attitude to change by affirming that:

> "Attitude to change is a huge CSF for QMS implementation because we need everyone from our staff to pay attention to it. At the lower level, the younger engineers probably see the paperwork as irrelevant, and all the effort that goes into managing QMS correctly is quite painful...So, it's a big effort to manage QMS correctly and ensure that you comply with all the requirements".

Moreover, $P_{C4}$ stressed that control of attitude to change should start from within the higher organisation level, i.e., top management team, wherein the criticality and benefits of adopting a QMS and being prepared to change 'the way things are done' are highlighted and espoused before flowing this thinking down to project team level. At the project level, however, the attitude to change and the benefits of changing where necessary for holding fast to processes and procedures, where that is more beneficial to the project, is stimulated by clearly indicating the significance of adopting an effective QMS, as well as emphasising the significance of changing attitude in order to facilitate the implementing of a robust QMS ($P_{C1}$ & $P_{C3}$). $P_{C3}$ acknowledged however, that attitude to change is different for each individual according to factors such as the differences in personalities, i.e., some individuals can adapt to change better than others. In either case, it is clear that examining and influencing attitude to change and deploying this as a CSF across different levels of a company, can notably assist in implementing an effective QMS in the case-study project.

### *Client Involvement*

The evidence gained from both interviewing respondents and analysing related documents underpins the significance of adopting **client involvement** as a CSF for the effective execution of the QMS. $P_{C3}$ highlighted the prime role of client involvement, noting that: *"we design our QMS around the client focus. In terms of them facilitating our QMS, their involvement is key when we need information from them and this needs to be transferred into our QMS"* Also, one of the main goals of Organisation C is to *"maintain a client focus in all building contracts with an adaptive reporting QMS reflective of the client's needs"* as stated in the Quality Policy Statement (QPS, p1). Accordingly, the project team sought to understand the expectations of the client at the early stage of the project in order to fully develop the precise requirements of the QMS essential to achieve these expectations ($P_{C3}$, $P_{C1}$ & $P_{C2}$). Therefore, $P_{C4}$ confirmed that reflecting these expectations in the procedures relating to QMS execution thoroughly facilitated involving and engaging the client fully in that process.

***Communication and Coordination***

The critical role of **communication and coordination** for assuring an effective adoption of QMS was specifically corroborated by two respondents and noted in other related documents. $P_{C4}$ recognised how communication and coordination impacted on QMS deployment by explaining that:

> "Without efficient communication and coordination, you set yourself up for failure in implementing a QMS. When I'm putting something together, in terms of a QMS plan, I want to communicate that with the site manager who's going to be implementing. I need to communicate that and coordinate that with the subcontractor, make sure he understands our expectations. It's definitely vital in delivering the QMS".

In the project being examined, good coordination was also necessary to ensure effective execution of the QMS due to the number of different stakeholders and subcontractors involved throughout the project lifecycle ($P_{C1}$). The criticality of communication was also recognised and strengthened by the project team through the conduct of regular site meetings to:

> "Keep all members/stakeholders up to date with progress of the project and to discuss matters relating to the project and assist subcontractors and management to communicate effectively and work as a team" (QM, p7). However, project team "could consider including details of internal communication (e.g. meetings) at a Business Unit level within the procedure, to enable a detailed review of the types of forums and their main objectives, to ensure efficient use of time and a return on the investment in the cost to holding the formal meetings" (extracted from External Audit Report, 2017, p5).

Thus, adopting communication and coordination as a CSF for QMS deployment substantially eases system execution in the case study project.

***Construction Site Planning***

The crucial function of **construction site planning** for ensuring a rigorous implementation of QMS was addressed and supported by respondents. $P_{C3}$ indicated the critical impact of this factor by explaining that: *"Construction site planning is key for robust implementation of QMS because what we do is look at the high-risk items from a quality point of view, whether it's particular products or a particular scope of work that has a high end"*. So, assessing these potential risks during a pre-commencement of the project enhances the confidence of the staff who are carrying out the QMS implementation based upon the precise requirements that have been developed ($P_{C1}$ & $P_{C2}$). However, $P_{C4}$ stipulated that meticulous construction site planning led to smooth coordination of all activities that could inhibit the effective execution of the overall QMS throughout the project lifecycle. That includes planning all construction-related facilities, such as workforce accommodation, work conditions, crane positions, and the like. It was clear from these responses that construction site planning plays a significant role to facilitate QMS deployment when adopted at the project level.

***Continuous Improvement***

The prime role of adopting **continuous improvement** as a CSF for effective implementation of QMS was explicitly addressed by the evidence seen in the research data gathered from the case study project. $P_{C1}$ recognised how continuous improvement is essential for deploying a robust QMS positing that:

> "Continuous improvements supports the implementation of the QMS very much so. We have a business improvement process, I shared that business improvement whether that be something that saves us two minutes in time or saves us thousands of dollars, we want peoples' ideas because again, that creates a culture around continuous improvement of QMS".

In the project being investigated, continuous improvement is performed by sharing lessons learned amongst the project staff and involved personnel and by continually seeking out learnings off other projects drawn from across the whole of Organisation C; this eventually results in developing a more effective QMS ($P_{C4}$ & $P_{C3}$). Hence, achievement of efficient continuous improvement in the project QMS and thus project outcomes requires undertaking effective management reviews and utilising the results of these to gain a direct feedback from QMS-related staff that can indicate the positives and negatives of QMS implementation (PC3 & PC2).

That can be performed by conducting regular meetings amongst project managers in conjunction with feedback sought from clients and consultants. Besides these reviews, the project team also uses feedback gathered from the client and consultants to make necessary changes or introduce new processes and procedures to facilitate continuous improvement of the QMS. All of this feedback provides valuable and meaningful insights about the performance of the QMS and accords with the documented Client Satisfaction Survey Procedure (CSSP, p1). Additionally, there is an annual meeting that encompasses the Group QSE Manger, the Chief Executive and the Group Operations Manager, which is specifically held to review the QMS of Organisation C and undertake any necessary improvements and changes to the QMS, as stated by Quality Targets Objectives (QTO, p1) document. And so, adopting continuous improvement amongst various levels of Organisation C as a CSF for QMS implementation, is more likely to assure effective deployment of that system in the case-study project.

***Customer Satisfaction***

The critical function of **customer satisfaction** for ensuring an effective deployment of QMS within the examined project was strongly supported by all respondents. PC3 addressed the influence of the factor mentioning that: *"Customer satisfaction is a key for our QMS implementation. At the end of the day if the client is not satisfied with the quality of building that we've built for him, then that could be detrimental to our brand"*. Moreover, it was clear from interviewees PC4 & PC2, that the project team seeks to achieve the delivery of a high-quality project to the client through implementing a robust QMS. Accordingly, to ensure that the requirements of QMS deployment are constantly aligned with client expectations, the project team obtains and acts on constructive feedback from the client about the performance of QMS (PC1). This feedback is obtained through a Client Satisfaction Survey (CSS), an example of which is illustrated in Appendix G. Evidence collected shows clearly that obtaining and adopting customer satisfaction as a CSF for QMS implementation results in deploying a more rigorous system in the case-study project.

***Definition of Roles and Responsibilities***

The crucial role of **definition of roles and responsibilities** for effective implementation of QMS was addressed by all participants and evidence found in the related documents of the case study project that were examined. In this context, $P_{C3}$ addressed the significance of this factor stating that:

> "Definition of roles and responsibilities is absolutely important to QMS implementation. It provides organisation within your team, so everyone's got a role to play and who's responsible for executing them…from a QMS point of view, you don't want the same one person doing the same thing as the guy next to him in the desk".

In this project, a clear and well disseminated definition of roles and responsibilities ensures that all of the project team members are involved in implementing QMS; they are all aware of what is required to be attained and can identify the related staff needed to comply with the requirements of QMS ($P_{C2}$). However, it was essential to achieve definition of these roles during pre-commencement of the project, in order to assure the effective deployment of QMS throughout the project lifecycle ($P_{C1}$, $P_{C2}$ & $P_{C4}$). For this reason, specific documentation of Organisation C explicitly outlines: *"…the responsibilities of all employees within the Company, with detailed roles and responsibilities being communicated on a number of levels, including during the onboarding process, through position descriptions and through the performance review process"* (extracted from External Audit Report, 2017, p8).

***Education and Training***

Evidence from the research data clearly highlights the criticality of **education and training** for implementing an effective QMS in the examined project. $P_{C1}$ addressed the impact of this factor clarifying that: *"Training and education are key for QMS implementation moving forward, because if we can't educate people, why do we have a QMS? One thing we target and fight on is basically training on the QMS"*. Also, $P_{C4}$ & $P_{C2}$ explained that the QMS-related team are internally educated and trained during the early stages of the project, about the requirements and expectations of QMS implementation. Hence, $P_{C2}$ stressed that, in this project, education and training are performed first, through dissemination of information, and providing of critical learning associated with the QMS, and second, by sharing the basic information about the expectations of the QMS. Additionally, Organisation C *"systematically and* *strategically analyses the training and development needs of each employee and arranges internal and external programs to ensure that people have the competency skill they need to do their jobs"* (extracted from External Audit Report, 2017, p9).

***Employee Empowerment***

The crucial role of **employee empowerment** for successful implementation of QMS was underpinned by all of the respondents. $P_{C2}$ affirmed the impact of such factors by explaining that: *"employee empowerment in the process of QMS implementation is definitely key for QMS implementation because if the QMS becomes one man's role, it all falls apart. So, everybody's got to be involved in it".* In the view of $P_{C4}$ & $P_{C3}$, the QMS-related team were adequately empowered to make the required decisions about the system implementation because such empowerment was deemed essential for building their confidence to perform the full QMS deployment. From a different perspective, $P_{C1}$ acknowledged that empowering the project team helps in relation to the retention of QMS staff because such empowerment assured a level of equality for the team, where each member obtains an opportunity to manage their portion of the QMS. Ultimately, adopting employee empowerment as a CSF for QMS execution at project level leads to implementing a more rigorous system on the case-study project.

***End-user Involvement***

The respondents supported the significance of **end-user involvement for** ensuring an effective implementation of the QMS in the investigated project. $P_{C2}$ emphasised the role of this factor by stating that: *"Definitely elements of end-user familiarisation certainly are requirements, so we need to make sure we are complying with their needs that could affect our QMS implementation in the future"*. Additionally, $P_{C3}$ & $P_{C1}$ confirmed that pre-engagement of end-users was performed during the project design stage, in order to gain the expectations that were necessary to produce an inclusive design that could be fully accommodated into QMS planning. This strongly facilitates the implementation of the QMS by preventing interruption to QMS procedures caused by incomplete design ($P_{C3}$ & $P_{C1}$). However, $P_{C4}$ opined that the main contractor does not actually control the involvement of end-users throughout any of the project phases; that depended mainly on the client, who may want to, or not want to, involve them. However, from the responses obtained it is clear that adopting end-user involvement as a CSF for QMS deployment at the project level, significantly assists in adopting a successful system during the project lifecycle.

***Internal Stakeholders Engagement***

The prime role of **internal stakeholders' engagement** for rigorous deployment of QMS was addressed by all respondents during interviews. $P_{C1}$ indicated the factor's significance, positing that: *" Internal stakeholders' engagement really affects the implementation of our QMS. If staff aren't engaged, we are not going to provide a building that I know we can provide. Internally, staff must be engaged in what we are trying to achieve by implementing a QMS"*. Moreover, in the case study project, one respondent opined that assuring the engagement of internal stakeholders supported QMS adoption through conducting all the required actions essential for implementation, such as providing all required records and documentation ($P_{C4}$). $P_{C3}$ emphasised that internal stakeholders' engagement also enhances continuous improvement of the QMS by obtaining the knowledge and experience from different internal stakeholders and using these as 'lessons learned'. Ultimately, internal stakeholders' engagement as a CSF for QMS execution noticeably facilitates implementation of a rigorous system in the case-study project being investigated.

***Industry Relations with Trades Unions***

Respondents supported that the role of **industry relations with trades unions** was a critical factor for effective implementation of the QMS in the project being examined. $P_{C1}$ underpinned the significance of this factor by stressing that: *"If we build healthy environment or relationships with trades unions, that would be utopia for QMS implementation…If we could, as an industry engage with those unions, that would be a major factor to help us in implementing a robust QMS"*. Both $P_{C4}$ & $P_{C2}$ mentioned the fact that the project team worked to initially prepare all of the documents associated with setting down the requirements for safety and environmental controls for the workforce of the project, in order to maintain a positive relationship with various trades unions throughout the project lifecycle. As a consequence, the healthy relationships formed helped mitigate trade union intervention, which may have hindered the QMS implementation ($P_{C4}$ & $P_{C2}$).

***Leadership Support***

The crucial function of **leadership support** for QMS implementation was collaborated by all respondents. $P_{C4}$ clearly recognised the impact of this factor within the context of the case-study project, stating that: *"Leadership support from up above at a management level or at a business level is an essential support to implement a robust QMS. We're not experts at everything, so we need that support because we don't always build the same box"*. Moreover, in the case study project, leadership support was actually strongly obtained through management providing adequate resources necessary for QMS implementation, maintaining an efficient management review process, and sharing essential information about QMS throughout the project team ($P_{C2}$ & $P_{C1}$). Leadership support in this project was therefore utilised to provide the right message to the project team and lead-workers about the criticality of adopting a rigorous QMS on the project. That message became a firm commitment amongst all QMS-related staff, towards deploying an effective system on this project ($P_{C3}$ & $P_{C2}$).

***Management Review and Feedback***

The significance of **management review and feedback** for assuring an effective deployment of QMS was addressed and justified by all respondents during the case-study project interviews. $P_{C4}$ clarified the crucial role of this factor stating that *"If we weren't getting any feedback, we'd be probably less inclined to implement the QMS as strictly here. We want these guys to give us feedback, tell us that the QMS plan that we're putting in this project is correct, or have you thought about this, have you thought about that "*. $P_{C3}$ observed that continual management review provides the QMS-team with different options to comply with the requirements of QMS, as well as offering them various ways to achieve these requirements by discussing and using the shared experiences gained from other projects. Thus, the sharing of knowledge and dissemination of lessons learned across different projects helped in addressing some of the challenges confronting the project staff during the implementation of the QMS in the case study project ($P_{C2}$ & $P_{C1}$).

In this context, management review was constantly undertaken and QMS updated through holding regular site meetings to *"keep all members/stakeholders up to date with progress of the project and to discuss matters relating to the project"* (QM). Also, the project team had to *"…record any nonconformities identified through client inspections or issues or findings raised by 2nd or 3rd parties"* (extracted from

External Audit Report, Date p5). These items were then captured and actioned through management review and feedback to keep the QMS effective throughout the project lifecycle. Thus, the evidence is clear from respondents that adopting rigorous and regular management review and feedback as a CSF for QMS execution is fundamental to ensuring a rigorous deployment of the system in the case-study project.

***Quality Culture***

The important role of **quality culture** on the adoption of an effective QMS in the case study project was agreed by respondents. $P_{C3}$ highlighted the significance of quality culture by stating that: *"The most important thing which I've seen here, positive effects are quality culture, so for getting the staff to understand the QMS is the key to obviously get that culture for them to buy in and obviously implement it out on site"*. In this project, quality culture was adopted to gain staff commitment to adopting the requirements of the QMS and deploying the same throughout the project life cycle ($P_{C1}$). Specifically, an appropriate quality culture was developed and maintained through highlighting the potential positive outcomes to be obtained from implementing such system, and by providing positive motivation that induced the project team to more rigorously comply with the requirements of the QMS ($P_{C2}$ & $P_{C1}$).

***Regular External QMS Audits***

**Regular external QMS audits** greatly facilitated an effective deployment of QMS in the case-study project of Organisation C according to all respondents. $P_{C1}$ highlighted the significant impact of external audits stating that: *"Regular external QMS auditing would be a really healthy thing to drive a robust QMS by sharing knowledge amongst different companies"*. Moreover, $P_{C2}$ argued that although conducting a regular external QMS audit would certainly improve the level of QMS adoption, by expanding the knowledge shared from project to project by describing and discussing both positives and negatives across various projects. However, that being said, the only external QMS audits performed in this project were those yearly surveillance and re-certification audits carried out by the independent certifying organisation every three years to renew ISO 9000 certification. But in this context, most respondents acknowledged that without external QMS audits being undertaken, concentration on internally checking the level of compliance with the requirements of QMS according to precise criteria, was very difficult in order to ensure the effective deployment of the overall system operating on this project ($P_{C3}$, $P_{C1}$ & $P_{C4}$). In brief, according to respondents and documents examined, regular external QMS audits were inadequate in the case-study project regardless of the project team views about the positive significance of implementing this to facilitate adopting and implementing the quality management system.

***Reputation of Company***

The vital role of the **reputation of company** for ensuring an effective implementation of QMS in the project being examined was addressed and supported by all respondents. $P_{C1}$ clearly indicated that this factor was essential for the QMS implementation emphasising that: *"The reputation of our company is key to pushing the QMS implementation in our project because we want to provide a good quality product to our client. we don't want to continually tender for work in a pool of principal contractors that are all struggling to go and work"*. In this case-study according to one respondent, the project team struggled to adopt a robust QMS, which reflected directly upon the quality of the final product delivered to the client ($P_{C4}$). Great project outcomes are absolutely necessary to achieve full customer satisfaction and it is this that maintains the reputation of company ($P_{C4}$). Hence, $P_{C4}$ affirmed that the reputation of company is upheld by highlighting the criticality of this factor for the current and future business of the company to all staff involved in adopting/implementing the QMS. $P_{C3}$ agreed that this represents a significant incentive to encourage the QMS-team to operate an effective system.

***Resources***

The evidence from the interviews and from the examined documentation highlights the significance of **resources** for implementing an effective QMS in the case-study project of Organisation C. By way of an example, $P_{C1}$ explained the significance of resources stating that: *"Resourcing and resource in this project accordingly is a must for assuring a robust QMS. We did that at the planning stage, we also have to keep going back and reviewing that resource because the scope of works, the staff changes"*.

Furthermore, the impact of resources on QMS deployment was demonstrated through the consideration of the various relevant subfactors associated with the 'resources' main factor, including **provision of resources of time and cost**, **recruitment of experienced quality managers** and **recruitment of qualified sub-**

**contractors**. The prime role of each individual factor for adopting a successful QMS is detailed below.

*Provision of Resources of Time and Cost*

Respondents all agreed that the **provision of resources of time and cost** was critical in implementing a successful QMS in the project being investigated. $P_{C3}$ emphasised that:

> " Provision of the resources of time and costs has heaps of effect on QMS implementation. We need people to invest in it, so that's time and then obviously whether it's updating technology or providing an individual, so you pay that person. It's very important, it just filters down into the recruitment of qualified staff and recruitment of qualified subcontractors".

$P_{C4}$ supported this view noting that in this project, provision of the necessary required time and budget was critical to ensure the proper setting-up of the applicable requirements of the QMS to be implemented throughout the project life. However, acquisition of these crucial resources is highly associated with the level of the expectations of the client regarding the preferred quality of the executed works ($P_{C4}$). Hence, because the project client was intent upon achieving a final high-quality product, more resources in terms of time and budget were dedicated to ensuring the implementation of a rigorous QMS in this project, compared to previous projects of Organisation C ($P_{C2}$ & $P_{C1}$). According to $P_{C4}$ & $P_{C3}$, the project team efficiently utilised these resources by identifying risks around the project budget to enable redesign of some of the project items to save budget, and by adopting innovative strategies to maximise the adjusted cost of works.

*Recruitment of Experienced Quality Manager*

Respondents all acknowledged the critical role of **a quality manager** for the implementation of QMS in the project being investigated. $P_{C4}$ opined that: *"What I think is important is training the guys on site to get to that quality management space to be a quality manager and to be able to identify that stuff. If we're all quality managers, some will be better at it than others"*. In addition, $P_{C1}$ stipulated that unless quality managers could be engaged who could fully comply with the values of this project, including teamwork, integrity, continuous improvement, client focus and accountability, then adoption of a fully successful QMS would be a great challenge for the project team. There was explicit agreement amongst all respondents that a clear imbalance existed between the perception of what a good quality manager would undertake and provide, and the lack of such managers within the arena of Tier Two construction companies; additionally, the budget required to employ a quality manager in the project was not provided ($P_{C3}$ & $P_{C1}$).

*Recruitment of Qualified Sub-contractors*

The crucial role of **recruitment of qualified subcontractors** for implementing a rigorous QMS in the examined project was acknowledged by all respondents. $P_{C1}$ confirmed the importance of this factor stating that: *"Qualified subcontractors are massively important to the implementation of QMS…We had to find the time to plan and to assess our subcontractors. That means dealing with subcontractors making sure they're qualified in what they are going to do"*. Thus, the project team identified and managed the risk of criticality of subcontractors at an early project stage so as to determine the required level and extent of training needed regarding QMS requirements essential to upskill nominated subcontractors ($P_{C2}$ & $P_{C4}$). Initial assessment of subcontractors was, therefore, fundamental to identifying the existing levels of qualification and required training needs concerning the QMS, ($P_{C1}$). Consequently, recruitment of qualified subcontractors was key to implementing the QMS in the project being examined owing to the wide roles that subcontractors were expected to perform within the works to be executed ($P_{C4}$ & $P_{C3}$).

***Teamwork***

The significance of the factor of **teamwork** for implementing a rigorous QMS was supported by respondents. $P_{C1}$ recognised how teamwork impacts by clarifying that *"Teamwork is a key factor for QMS implementation. If we've got the right people that are around us, that are positive, that's going to make a significant difference to the level of QMS implementation in this project"*. In addition, $P_{C4}$ emphasised that to ensure a successful adoption of QMS in the project, the case-study project team struggled to engage in effective teamwork, not just amongst their own project staff, but also amongst the wider workforce of subcontractors on the project. Because of this issue, teamwork was promoted and utilised as a technique to upskill the QMS-staff by means of getting an experienced member to train and upskill less experienced workers who were less familiar with the requirements of QMS implementation ($P_{C3}$ & $P_{C2}$). Based on the interview responses, respondents clearly demonstrated that teamwork plays a crucial role for ensuring an effective deployment of QMS in the project being examined.

***Top Management Commitment***

**Top management commitment** towards implementing a QMS was considered a significant factor by all respondents, and this was supported by project/company documents reviewed and analysed. In this context $P_{C4}$ stated that *"Top management commitment certainly helps in QMS implementation. I mean, if we're not getting much commitment from above, then why would you do it? Why would you put the time in? They need to, as a business, be committed to implementing the QMSs"*. Also, in this project, the deployment of the QMS was driven by the top management downwards based on their vision of how the project team needed to undertake implementing a QMS at the project level ($P_{C2}$ & $P_{C1}$). These respondents opined that consequently, the top management played an integral part in encouraging the sharing of information related to the adoption and implementation of the QMS with site-based staff ($P_{C2}$ & $P_{C1}$) and this was finally achieved by *"conducting regular visits to the site and through undertaking formal and informal communication with the project team"* (extracted from External Audit Report, 2017, p.8). In the investigated project, top management commitment was also observed in an underlining exercise conducted to ascertain the cost of potential quality defects, emphasising the critical nature of the QMS for maintaining the business of the company, and also stressing the significance of QMS for managing the resources of the case-study project more effectively ($P_{C2}$ & $P_{C3}$). In this regard, $P_{C3}$ stressed that the implementation of QMS starts at top management level, wherein the significance of the QMS is highlighted through a clear vision filtered down to the project team. In brief, top management commitment notably facilitates the execution of the QMS in the investigated project.

## 6.6 SUMMARY

This chapter has presented a within-case analysis based on three different organisations' case-study projects. This analysis provides inclusive insights about each individual case and discloses how each organisation coped with the various factors related to QMS implementation within its examined project. Significantly, the within-case analysis has demonstrated the influences and importance of external factors impacting on the successful implementation of QMS in the context of each case. More specifically, the analysis provides more detailed explanation concerning the real influence of the various factors in the project of each case, by revealing which patterns underpin, refute or expand on the initial propositions established in the previous chapter. This analysis emphasises and validates the impact of each external factor initially identified by an exploratory study on QMS implementation in Chapter 5. In particular, the analysis confirms that these factors do affect QMS deployment, either acting as drivers or barriers to the implementation. Furthermore, this within-case analysis has strongly corroborated the significance of CSFs identified by the previous exploratory study in Chapter 5 and also viewed in the critical analysis of the literature in Chapter 2 and Chapter 3. The analysis has also emphasised the relevance and the most suitability of each CSF to be adopted at, i.e., organisational, project, or both levels of building organisation. The next chapter will cover the description of the procedures used to perform a cross-case analysis and the results of a cross-case analysis undertaken to reveal the major similarities and differences between the investigated case studies.

# Chapter 7: Cross-Case Analysis

## 7.1 INTRODUCTION

The preceding chapter explained and validated the influence of external factors on Quality Management System (QMS) implementation together with identifying the significance of adopting Critical Success Factors (CSFs) for assurance rigorous deployment of QMS in building organisations. This chapter presents the results of a cross-case analysis performed to uncover the main similarities and differences between the investigated case studies. The procedures used to carry out cross-case analysis are also described in this chapter. For clarity, the chapter has been arranged into two main sections. The first section explains how the external factors influence the successful deployment of QMS across investigated cases. The second section focuses on how the CSFs can facilitate the effective implementation of QMS in the context of studied cases.

## 7.2 CROSS-CASE ANALYSIS PROCEDURES

A cross-case analysis was performed providing more rigorous and accurate outcomes to the research questions, thus further strengthening the results of the research. To perform the cross-case analysis, a replication logic or pattern matching technique was followed, examining the data gathered from the three cases simultaneously. The procedures for performing a pattern matching technique are illustrated in Figure 7.1 below. Hence, a comparison was carried out between concepts that derived from the analysis of the data of each individual case and the preceding theoretical constructs that had emerged from the literature review and the exploratory study. This comparison was iteratively performed to verify both the commonalities and variances revealed amongst the cases confirmed, or to refute the initial propositions derived in the preceding chapter. In this regard, an explanation building technique was utilised to rationalise the discordance and prevent the emergence of premature or imprecise conclusions from the cross-case analysis whenever concepts across the cases did refute the propositions. Therefore, to perform the related queries, QSR International NVivo 11 software was intensively used to carry out a text search, coding, numeral counts, matrices, and memos. The main distinctions and commonalities from the case studies resulted in the development of tables that depicted the data associated with the common perception of the occurring influence of external factors and CSFs on the effective deployment of QMS.

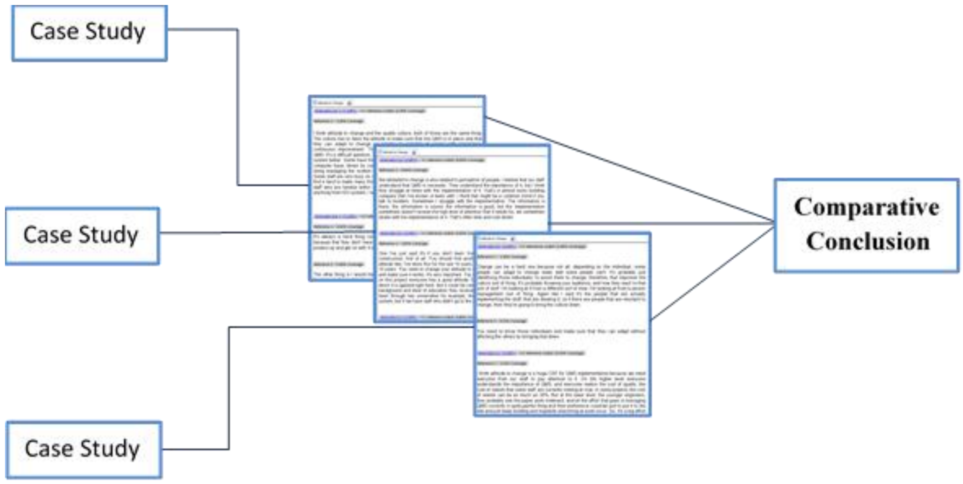


Figure 7.1: The procedures of performing Pattern Matching Technique

### 7.3 THE INFLUENCE OF EXTERNAL FACTORS

This section presents the synthesis of the analysis from Case Studies (1), (2), and (3). This synthesis results in an inclusive answer to RQ3: *How do the external factors and the CSFs affect the successful adoption of a QMS in real-world building projects of the CIBS*, although RQ3 was partially answered by conducting the within-case analysis. Moreover, synthesising the analysis of these cases leads to answering RQ4: *How can the external factors be categorised based upon their impacts on the effective deployment of a QMS in real-world building projects of the CIBS*, in addition to adding further insights gained from the within-case analysis.

The earlier literature review revealed a holistic impact of internal factors affecting QMS implementation in terms of barriers to QMS deployment. These factors were indicated as internal factors because most of them were either generated by construction organisations or associated with the the hierarchical systems of these organisations. Therefore, the exploratory study was performed to identify the external factors in the context of building organisations. It is emphasised that the deployment of QMS is exceedingly affected by many external factors surrounding the industry, ranging from governmental impact to external stakeholders' impact. However, these identified external factors were examined in the context of three case studies (building organisations) to verify the effect of the identified factors by the exploratory study and to obtain further explanation of their influence in the context of building projects.

### 7.3.1 Developing Assertions of External Factors

This section describes the results of a comparative cross-case analysis of the data collected from the three cases. To analyse the data generated from the case studies, the techniques explained previously in Chapter 4 were utilised, namely rating the utility of each case for each external factor, constructing a matrix of queries that generate theme-based assertions from all cases, and ultimately developing tentative assertions derived from comparative analysis of findings of case studies. Rating the utility of cases for each external factor illustrated in Table 7.1. discloses that Case Study 1 is the most useful case for explaining the external factors affecting QMS deployment as it shows higher utility for developing most of these factors. Case 3, however, has the less utility for building an explanation of external factors because it has lower utility compared with Case 2. Notwithstanding this, most of the utilities of cases were generally of a high scale. Thus, it is clear that all cases significantly contribute to developing the knowledge about the impact of external factors on QMS implementation in theCIBS.

Table 7.1: Ratings of the utility of each case for each external factor

| | | Utility of Cases | | |
|---|---|---|---|---|
| **No. of Factor** | **External factors** | **Case (1)** | **Case (2)** | **Case (3)** |
| **1** | Client Attraction for the Lowest Price | **H** | **M** | **H** |
| **2** | Client awareness towards QMS significance | **M** | **H** | **H** |
| **3** | Design Process | **H** | **L** | **H** |
| **4** | Different quality systems | **H** | **H** | **L** |
| **5** | Complexity of external project stakeholders' involvement | **H** | **L** | **M** |
| **6** | Government Policies | **H** | **M** | **H** |
| **7** | Interstate Working | **L** | **H** | **M** |
| **8** | Intervention of Trades Unions Due to Safety | **H** | **H** | **H** |
| **9** | External audit of QMS | **M** | **H** | **H** |
| **10** | Skilled Human Resources | **H** | **H** | **M** |
| **11** | Legislation and regulations | **H** | **M** | **L** |
| **12** | Project Supply Chain | **H** | **M** | **H** |
| **13** | Weather | **H** | **H** | **L** |

**H= high utility** **M= medium utility** **L= low utility**

On the one hand, the research data from case studies collected through interviews, document analysis, and direct observation, highlights distinct views on the levels of impact of external factors on the successful deployment of QMS. However, such data generally provides strong evidence that these external factors affect the implementation of QMS in different ways. Some of these external factors have the potential to induce and drive implementation of a rigorous QMS whilst other factors hinder the implementation of these systems. Therefore, in order to emphasise the findings from each case and create a basis for the resultant tentative assertions, a matrix for generating theme-based assertions was developed for each case study. Table 7.2 below illustrates the main findings derived from Case Study 1 related to the impact of external factors on QMS implementation.

After rating each finding of Case Study 1 according to its importance for understanding QMS deployment through a specific external factor, parentheses were used around the external factors that obtained high utility from Case Study 1, as depicted in Table 7.2. below. Using the parentheses assists in transferring the utility information exhibited in Table 7.1, as well as indicating the most important external factors to be used in establishing case assertions. This process indicates some external factors as having a high prominence in that particular case. These external factors were given extra (double) parentheses to indicate that they should carry further weight in drafting related assertions, such as Design Process, Different quality systems, Government Policies, and Skilled Human Resources.

Table 7.2: A matrix for generating theme-based assertions from Case 1 findings rated importance of external factors

| Case 1 | External Factors | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Findings** | ***(1)** | **2** | **((3))** | **((4))** | **(5)** | **((6))** | **7** | **(8)** | **(9)** | **((10))** | **((11))** | **((12))** | **(13)** |
| **Finding I:** Attraction for lowest price is a barrier to QMS implementation | ● | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ● | ◌ |
| **Finding II:** Client awareness about QMS significance hinders the QMS deployment | ● | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding III:** Design process is a serious challenge to implement a rigorous QMS | ◌ | ◌ | ● | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding IV:** Different quality systems are an obvious barrier confronting QMS adoption | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding V:** External stakeholders of project hinder a successful implementation of QMS | ◌ | ○ | ○ | ○ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding VI:** Government policies distinctly drive an effective deployment of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding VII:** Interstate working is a clear barrier to QMS adoption | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding VIII:** Intervention of trades unions impede a rigorous deployment of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding IX:** External audit of QMS is a notable barrier to implementing a rigorous QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ● | ◌ | ◌ |
| **Finding X:** Skilled human resources are notably a barrier to implementing a successful QMS | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ● | ◌ | ◌ | ◌ |
| **Finding XI:** Legislation and regulations are clear driver for successful deployment of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ● | ○ | ◌ | ● | ● | ◌ |
| **Finding XII:** Project supply chain noticeably hinders successful implementation of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ |
| **Finding XIII:** Weather clearly impedes an effective adoption of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● |

**●= high importance ○= medium importance ◌= low importance**
*** = Parentheses around a Theme number implies that it should carry extra weight in drafting an Assertion.**

A matrix of generating theme-based assertions from Case Study 2 findings is presented in Table 7.3 below. Whilst the Table indicates the important external factors of Case Study 2 that will be used, in conjunction with the significant factors of other cases, to create the tentative assertions, it also emphasised the most significant factors for deriving the tentative assertions, such as Client awareness about QMS significance, and Regular external audit of QMS. Thus, these external factors significantly and prominently demonstrate the QMS deployment because of the remarks related to these factors. These factors, therefore, carry extra weight in creating the tentative assertions.

Table 7.3: A matrix for generating theme-based assertions from case 2 findings rated importance of external factors

| Case 2 | External Factors | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Findings** | **1** | **((2))** | **3** | **((4))** | **5** | **6** | **(7)** | **(8)** | **((9))** | **((10))** | **11** | **12** | **(13)** |
| **Finding I:** Client attraction for the lowest price is a challenge confronting implementing a successful QMS | ● | ● | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ● | ● | ◌ | ◌ |
| **Finding II:** Client awareness about QMS significance is a notable driver for adopting a rigorous QMS | ● | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding III:** Design process is a clear barrier to QMS implementation | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ |
| **Finding VI:** Different system impedes successful deployment of QMS | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding V:** Difficulty of developing a unique QMS is associated with the various requirements of each project and the variant external stakeholders of each project | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding VI:** Number of external stakeholders is a clear barrier facing implementing a successful QMS | ◌ | ○ | ○ | ○ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding VII:** Government policies drives successful deployment of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding VIII:** Interstate working hinders an effective deployment of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding IX:** Intervention of trades unions is an obvious barrier to QMS implementation | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ○ |
| **Finding X:** External audit of QMS impedes an effective adoption of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ |
| **Finding XI:** Skilled human resources are a distinct barrier to implementing a rigorous QMS | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ |
| **Finding XII:** Legislation and regulations are a clear driver for deploying a robust QMS | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ○ | ◌ | ○ | ● | ◌ | ◌ |
| **Finding XIII:** Project supply chain hinders successful implementation of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ |
| **Finding XIV:** Weather is a clear barrier to QMS deployment | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● |

Furthermore, Table 7.4 below illustrates a matrix for generating theme-based assertions from Case Study 3 findings and underpins the prime findings of this Case respecting the external factors affecting QMS adoption. It also underlines the most important factors that will used along with the main factors of other studies, to derive the tentative assertions of the findings. Amongst the external factors, some more significantly and prominently explain QMS deployment because of the knowledge associated with these factors, such as Client Attraction for the Lowest Price, and Government Policies. As a consequence, owing to their prominence, these factors carry extra weight throughout developing the tentative assertions.

Table 7.4: A matrix for generating theme-based assertions from Case 3 findings rated importance of external factors

| **Case 3** | **External Factors** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Findings** | **((1))** | **(2)** | **((3))** | **4** | **5** | **((6))** | **7** | **(8)** | **((9))** | **(10)** | **(11)** | **(12)** | **13** |
| **Finding I:** Client attraction for the lowest price is a clear barrier to implementing a robust QMS | ● | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding II:** Client awareness about QMS significance is a distinct driver for QMS implementation | ○ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ |
| **Finding III:** Design process is a serious challenge facing the implementation of QMS | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding IV:** Different system is a clear barrier to implementing a robust QMS | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding V:** External stakeholders are a barrier to deploying a successful QMS | ◌ | ◌ | ◌ | ○ | ● | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding VI:** Government policies is a clear barrier to a QMS adoption | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding VII:** Interstate working notably impedes a successful deployment of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding VIII:** Intervention of trades unions hinders an effective adoption of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ○ |
| **Finding IX:** Lacking an external audit of a QMS is a clear barrier facing a successful adoption of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ |
| **Finding X:** Skilled human resources | ● | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ |
| **Finding XI:** Legislation and regulations are a key driver for implementing a rigorous a QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ○ | ● | ○ | ○ | ● | ● | ◌ |
| **Finding XII:** Project supply chain are a barrier to adopting a robust QMS | ● | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ○ | ● | ◌ |
| **Finding XIII:** Weather is a big challenge confronting a QMS deployment | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● |

The preceding technical procedures are evaluated using ratings of utility, significance, prominence, and ordinariness of external factors, to develop a matrix for generating theme-based assertions from all three cases. By combining and comparing the analyses from Case Studies 1, 2, and 3, the way in which the external factors affect the adoption of QMS, as well as how these factors should be categorised in accordance with that effect, are demonstrated. Thus, tentative assertions based on the findings of cases, and the significance and prominence of the external factors illustrated in Tables 7.2, 7.3, and 7.4, can be made. These assertions are derived based upon evidence gained from more than one case (almost all cases) to underpin these assertions. Therefore, they have a single or common focus, and a contribution concerning understanding QMS deployment. Nonetheless, it is obvious that amongst the three cases, Case Study 1 offers more contribution to draft tentative assertions compared with the other two cases because approximately half of its external factors show high weighting to such assertions.

Furthermore, to introduce final assertions, tentative assertions were thoroughly reviewed to recognise if there is any overlap, the need for rewriting them, or an immediate requirement for re-arranging their order. Accordingly, tentative assertions were repeatedly reordered in accordance with the criteria exhibited in Table 7.5 below and clarified in Chapter 4. That process requires the demotion of some assertions that have the least significance and minimal evidence underpinning them.

Table 7.5: Criteria of reordering tentative assertions of external factors

| Reordering Stages | Reordering Criterion | Case No. | External Factors | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Primary Ordering** | **Ordering obtained from within-case analysis** | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** |
| | **Weight of Factor for Drafting Assertion** | **1** | ▣ | □ | ■ | ■ | ▣ | ■ | □ | ▣ | ▣ | ■ | ▣ | ■ | ▣ |
| | | **2** | □ | ■ | □ | ■ | □ | □ | ▣ | ▣ | ■ | ■ | □ | □ | ▣ |
| | | **3** | ■ | ▣ | ■ | □ | □ | ■ | □ | ▣ | ■ | ▣ | ▣ | ▣ | □ |
| **Second Reordering** | **Significance of Factors Used to Draft Assertion** | | 3 | 3 | 2 | 2 | 6 | 2 | 6 | 4 | 1 | 1 | 5 | 3 | 5 |
| **Third Reordering** | **Remarks Support Assertion** | | 8 | 6 | 4 | 5 | 13 | 3 | 12 | 9 | 2 | 1 | **10** | 7 | **10** |
| **Final Reordering** | **Uniqueness of Assertion** | | 8 | 6 | 4 | 5 | 13 | 3 | 12 | 9 | 2 | 1 | 10 | 7 | 11 |

■ **= high weight** ▣ **= medium weight** □ **= low weight**

The final assertions were ranked in descending orders in which the first external factor is the most significant external factor impacting the adoption of QMS. The abbreviation (**E**) in conjunction with the number of external factor sequences used to refer to the orders of final assertions drawn across the findings of cases as illustrated in Table 7.6 below. According to these assertions, the most significant external factor that impacts the QMS deployment in theCIBS is 'skilled human resources' since it is corroborated by 10 **remarks** across all cases and its assertion was created based upon the most significant knowledge gathered across all cases. However, the complexity of external project stakeholder's factor is the least important external factor because it is only supported by 5 **remarks** and its assertion was created depending on the less significant knowledge compared with other factors

Furthermore, the final assertions explicitly highlight the impact of external factors on the effective implementation of QMS in building projects and that impact is clearly split in two distinct ways. On the one hand, data gathered by interviews during the exploratory study addresses distinct viewpoints on the level to which the external factors influence the effective deployment of QMS. However, the strong evidence gained by cross-case analysis indicates that these external influences were deploying a rigorous QMS as either a **driver** for the implementation of a QMS, or **barrier** to the adoption of that system. Many of these external factors are indicated as barriers to effective implementation of QMS, such as **complexity of external project stakeholders' involvement** and **project supply chain**. On the contrary, a lack of skilled human resources is the most significant barrier to QMS implementation. Only two external factors are, however, shown as drivers for deploying a rigorous QMS, namely **client awareness towards QMS significance** and **legislation and regulations**.

Table 7.6: Cross-case assertions of the external factors impacting QMS implementation

| No. | Assertions | External Factor | Evidence, Persuasions |
|---|---|---|---|
| **E1** | Skilled human resources are a considerable challenge confronting the deployment of rigorous QMS in theCIBS. This issue is attributable to the dearth of qualified staff essential for QMS implementation within the construction industry market, the lack of quality manager and assistant staff in building projects because of the perception about their importance amongst building organisations context and financial resources for recruiting them, and the issue of skilled staff retention in theCIBS. | **Skilled Human Resources** | PA2, PQMP, PA1, PA3, PB2, PB3, PQP, PB1, PC4, and PC2 |
| **E2** | External audit of a QMS is a clear barrier to adopting a successful QMS since lacking such audit results in a dearth of instructions concerning how to deploy a robust QMS, insufficiency of shared information and experience across various organisations essential for continuous improvement as well as difficulty for building organisations to assure compliance of related staff with QMS requirements. | **Regular external audit of a QMS** | PB1, PB3, PB2, PC2, PC3, PC4, EAR, and PA3 |
| **E3** | Government policies are a challenge facing a robust deployment of a QMS because of the contradiction between the requirements of clients and governments concerning QMS that complicates the efforts of contractors to adhere to these policies, a difficulty to comply with these policies is associated with insufficient documents concerning supplied materials as well as not considering the perspectives of construction organisations prior to establishing new policies regarding QMS adoption requirements. | **Government Policies** | PC1, PC3, PC2, PC4, PA1, PA3, PA2, and PB3 |
| **E4** | Design process is a barrier to deploying a robust QMS in the building projects because obtaining inclusive design is a huge challenge confronting QMS deployment due to required time for responding and revising experience issues related to incomplete design, which eventually affects the procedure of QMS deployment and compliance with the requirements of such systems. | **Design Process** | PC3, PC1, PC2, PA3, PA1, PQMP, and PB1 |
| **E5** | Different quality systems are a notable barrier to implementing a rigorous QMS that confronts developing a unique QMS usable by all stakeholders of project and applicable across different types of projects. This issue is attributable to the difference between the QMS adopted at organisation level to meet requirements of legislation and regulations and the QMS essential to reach the expectations of clients regarding quality at project level as well as different QMSs adopted by subcontractors who are expert in these systems. | **Different quality systems** | PA3, PA1, PA2, PB1, PB2, and PC2 |
| **E6** | Client awareness towards QMS significance, on most occasions, drives the successful deployment of QMS by providing contractors some resources required for QMS implementation, such as lesson learned, and distinct expectations of quality essential for developing QMS requirements, although the level of clients' perception varies according to the quality of clients. | **Client awareness towards QMS Significance** | PB1, PB3, PB2, PC4, PC1, PA1, PA2 and PA3 |

| | | | |
|---|---|---|---|
| **E7** | Project supply chain is an obvious barrier to adopting a successful QMS in building projects due to the difficulty of assuring compliance of imported products with the requirements of QMS and Australian standards, and suppliers who either intend to deviate from the requirements of QMS or conform to client's trend by saving more money through supplying cheaper products. | **Project Supply Chain** | $P_{A1}$, $P_{A3}$, $P_{A2}$, $P_{C2}$, $P_{C1}$, $P_{C3}$, and $P_{B1}$ |
| **E8** | Client attraction for the lowest price is a challenge impeding adoption of an effective QMS in projects of building organisations due to the fact that the construction industry, in general, is a financially driven sector in which the level of quality expectations is affected by the budget dedicated by client for acquiring quality products and that eventually affects the level of QMS adoption essential to achieve expected quality. | **Client Attraction for the Lowest Price** | $P_{C1}$, $P_{C2}$, $P_{C4}$, $P_{A1}$, $P_{A3}$, and $P_{B1}$ |
| **E9** | Intervention of trades unions due to safety hinders implementing a successful QMS in building projects owing to the authority of these unions to suspend a project because of any potential safety risk. This excessive focus on safety and its implications make building organisations concentrate on complying with safety requirements while deploying robust QMS, notably lags behind safety in theCIBS. | **Intervention of Trades Unions** | $P_{B1}$, $P_{B3}$, $P_{A2}$, $P_{A3}$, and $P_{C2}$ |
| **E10** | Legislation and regulations are a key driver for implementing a successful QMS in theCIBS because these can be utilised as guidelines, expectations or benchmarks to assure compliance of QMS requirements with these legislation and regulations. | **Legislation and Regulations** | $P_{A2}$, NcDP, $P_{A3}$, $P_{C4}$, $P_{C3}$, and $P_{B2}$ |
| **E11** | Weather, on most occasions, hinders a rigours deployment of QMS owing to unpredictable nature of weather in some regions of Australia. Weather impact leads to intervention of trades unions if some safety issues emerge, and a need for extra time to plan for potential contingencies concerning unexpected change in weather. | **Weather** | $P_{B2}$, $P_{B1}$, $P_{A3}$, $P_{A2}$, $P_{A1}$, and $P_{C2}$ |
| **E12** | Interstate working impedes an effective implementation of QMS due to the various requirements of states concerning deployment of that system, different state specific QMSs, time required to ensure perception of related staff about these new requirements, and essential amendments to the QMS in accordance to different expectations of states. | **Interstate Working** | $P_{B1}$, $P_{B2}$, $P_{B3}$, $P_{A2}$, $P_{A3}$, $P_{C4}$, and $P_{C3}$ |
| **E13** | Complexity of external project stakeholders' involvement more probably hinder the successful adoption of QMS owing to the various focus and interests of these stakeholders within the project as well as contradicting expectations of compliance with QMS requirements that lead to deviation from these requirements. | **Complexity of external project stakeholders' involvement** | $P_{A3}$, $P_{A2}$, $P_{C2}$, $P_{C3}$, and $P_{B3}$ |

Generally, there was a high level of similarity between the findings of the data obtained from the three cases (Organisations A, B and C) resulting from the cross-case analysis. On the other hand, some differences between these findings were also indicated. Also, the final assertions on external factors' impact on QMS deployment address some refutable statements to the propositions of the exploratory study. For instance, whilst the analysis notably emphasised that client awareness towards QMS is a driver for adopting a rigorous QMS in building projects, this factor was subsequently clearly indicated as a barrier to QMS implementation by some interviewees within the exploratory study. The difference between these findings is rationalised to some attributions. It is possible that some participants of the exploratory study were confused between the concept of the impact of client awareness about QMS significance, and the influence of engaging such a client in QMS adoption, which is clearly the responsibility of a project team.

As an illustration, some informants stressed that promoting a QMS amongst clients is a challenge facing building organisations, owing to the ability of organisations to attract clients' focus about QMS criticality for fulfilling quality expectations ($P_{13}$, $P_{2}$, and $P_{3}$). It obvious that this viewpoint is associated with the capability of organisations to engage their clients within the process of QMS adoption rather than indicating any implications around client awareness of QMS importance. This notwithstanding, evidence gained from the cross-case analysis noticeably corroborated the impact of client awareness towards QMS significance as a driver for implementing a robust QMS in the building organisations being investigated ($P_{B1}$, $P_{B3}$, $P_{B2}$, $P_{C4}$, $P_{C1}$, $P_{A1}$, $P_{A2}$ and $P_{A3}$). These informants focused on the implications of client awareness about QMS significance and how that perception can either drive or impede QMS deployment; this leads to a view that the findings drawn across the three case studies significantly indicated that such a factor is a driver for QMS implementation as stated by assertion E6.

Furthermore, it is clear that there was a level of correspondence between the different views of participants across all three case studies concerning the impact of design process on the QMS deployment and its criticality for ensuring an effective adoption of that system ($P_{C2}$, $P_{C3}$, $P_{C1}$, $P_{A2}$, $P_{A1}$, and $P_{B1}$). Furthermore, participants of Case Studies 2 and 3 (Organisation B and Organisation C) all focused on the implication that the design process was hindering rigorous deployment of A QMS ($P_{B2}$,

$P_{B1}$, $P_{C4}$, $P_{C3}$ and $P_{C1}$). However, it appeared that there was only a slight focus observed on the issues associated with design process by participants of Case Study 1 (Organisation A), and most evidence gained from this case study was concentrated upon the process followed by Organisation A to assure acquiring a comprehensive design at an early stage of a project ($P_{A3}$, $P_{A1}$, and PQMP). This specific focus is attributable to the robust system of reviewing design documentation adopted by Case Study 1, and the human resources allocated to perform that review, such as using experts from various fields ($P_{A3}$ and $P_{A1}$).

It is noteworthy that both Organisations A and B are Tier One building organisations, and they implement very similar scales and kinds of building projects. However, it is clear that the Organisation A manages the requirements of QMS deployment, such as design documentation review, more professionally than Organisation B, owing to the allocation of suitable strength of human resources for that purpose, and their experience as an international company. However, there was no evidence that emerged from the exploratory study to either support or refute the impact of the design process external factor since that factor was initially suggested by the informants of Case Study 1 to add such a factor to the list of external factors.

## 7.4 CSFS FOR EFFECTIVE IMPLEMENTATION OF QMS

This section combines the analysis from Case Studies 1, 2 and 3. This, in combination with the initial answer obtained by performing within-case analysis, leads to the merging of the ideas, beliefs, and perspectives gained from the different cases in order to inclusively answer RQ3: *How do the external factors and the CSFs affect the successful adoption of a QMS within the construction sector*? This research has focused on identifying a holistic list of CSFs for QMS implementation, particularly at the project level and on finding out how these CSFs facilitate the deployment of a QMS within the context of three selected case studies. The exploratory study analysis identified a set of CSFs for QMS adoption within theCIBS. These CSFs, along with others identified from the literature review, were examined in the context of three case studies to verify their significance and also to gain additional insight into their impact on QMS deployment within the context of building projects. This section, therefore, highlights a cross-case analysis that performs a comparative analysis of the data gathered by three cases.

### 7.4.1 Developing Assertions of CSFs

The utility of cases for developing each CSF were rated as illustrated in Table 7.7 below. The table discloses that Case Study 1 is the most beneficial for demonstrating the impact of adopting the CSFs for assuring the effective implementation of QMS, because it exhibits high utility for developing most of the CSFs. On the contrary, Case Study 3 provides the least utility for explaining the influence of adopting the CSFs, since generally most of its utilities were either medium or low compared with Case Studies 1 and 2. Nonetheless, all cases significantly contributed in developing the knowledge regarding the influence of adopting the CSFs on QMS deployment in building organisations, and eventually this has contributed to development of the tentative assertions.

Table 7.7: Ratings of the utility of each Case for each CSF

| No. of Factor | CSFs for QMS Implementation | Utility of Cases | | |
|---|---|---|---|---|
| | | Case (1) | Case (2) | Case (3) |
| 1 | Digital Technology | M | H | M |
| 2 | Attitude to Change | H | M | H |
| 3 | Client Involvement | L | H | L |
| 4 | Communication & Coordination | H | H | H |
| 5 | Construction Site Planning | H | M | L |
| 6 | Continuous Improvement | H | H | H |
| 7 | Customer Satisfaction | H | H | H |
| 8 | Definition of Roles & Responsibilities | M | H | M |
| 9 | Education & Training | H | H | M |
| 10 | Employee Empowerment | M | H | H |
| 11 | End-user Involvement | H | M | M |
| 12 | Internal Stakeholders Engagement | H | H | M |
| 13 | Industry Relations with Trades Unions | M | H | H |
| 14 | Leadership Support | M | H | M |
| 15 | Management Review & Feedback | H | H | H |
| 16 | Quality Culture | H | L | M |
| 17 | Regular external audit of QMS | M | L | H |
| 18 | Reputation of Company | H | M | L |
| 19 | Resources | H | M | H |
| 20 | Teamwork | H | M | M |
| 21 | Top Management Commitment | H | H | H |

**H= high utility    M= medium utility    L= low utility**

The data gathered from the cases provides robust evidence of a link between the implementation of effective QMS in the projects of building organisations and the adoption of many of the CSFs in such projects. This data revealed that there are three potential levels within which these CSFs should be utilised: organisation level, project level, or both levels. Therefore, in order to emphasise the findings from each case that highlight these levels and create a basis for the resultant tentative assertions, a matrix for generating theme-based assertions was developed for each case study. Table 7.8 below exhibits the main findings derived from Case Study 1 related to the impact of CSFs for effective adoption of QMS.

Parentheses were also used to indicate the CSFs that acquired high utility from Case Study 1, as illustrated in Table 7.8 below. This process was utilised to transfer the utility information depicted in Table 7.7, and to address the most important CSFs that will be used to create case assertions. The most significant and prominent CSFs were indicated in Table 7.8, as having a high prominence in the Case 1. These external factors were provided in extra (double) parentheses to indicate that they should carry further weight in drafting CSFs assertions, such as Attitude to Change, Customer Satisfaction, and Teamwork.

Table 7.8: A matrix for generating theme-based assertions from Case 1 findings rated importance of CSFs

| Case 1 | CSFs for Effective Implementation of QMS | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Findings** | **1** | ***((2))** | **3** | **((4))** | **((5))** | **((6))** | **((7))** | **(8)** | **((9))** | **(10)** | **(11)** | **(12)** | **13** | **(14)** | **((15))** | **(16)** | **(17)** | **(18)** | **((19))** | **((20))** | **(21)** |
| **Finding I:** Digital technology as a CSF at project level notably facilitates the implementation of QMS | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding II:** Attitude to change is a significant CSF to be adopted at project level to facilitate deploying a rigorous QMS | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding III:** Adopting client involvement as a CSF at project level evidently helps in deploying a rigorous QMS | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding IV:** Utilising communication and coordination as a CSF results in an effective adoption of QMS | ● | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ● | ◌ |
| **Finding V:** Construction site planning is a key CSF to be adopted at project level to assure successful deployment of QMS | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ |
| **Finding VI:** Adopting continuous improvement as a CSF is essential to implement a robust QMS | ◌ | ○ | ○ | ● | ◌ | ● | ◌ | ◌ | ○ | ◌ | ○ | ◌ | ◌ | ○ | ● | ◌ | ● | ◌ | ◌ | ◌ | ◌ |
| **Finding VII:** Using customer satisfaction as a CSF leads to implementing a successful QMS | ◌ | ◌ | ◌ | ○ | ◌ | ○ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ○ | ◌ | ○ | ◌ | ◌ | ◌ |
| **Finding VIII:** Definition of roles and responsibility is a crucial CSF that ensures a robust deployment of QMS | ◌ | ◌ | ◌ | ○ | ● | ◌ | ◌ | ● | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ |
| **Finding IX:** Adopting education and training as a CSF at project level notably results in implementing an effective QMS | ◌ | ○ | ○ | ● | ◌ | ● | ◌ | ◌ | ● | ○ | ◌ | ○ | ◌ | ○ | ● | ◌ | ◌ | ◌ | ● | ○ | ◌ |
| **Finding X:** Employee empowerment at project level facilitates implementing a rigorous QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ● | ◌ | ○ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ |
| **Finding XI:** Adopting end-user involvement as a CSF at project level is fundamental to deploying a successful QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ |

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| **Finding XII:** Internal stakeholders' engagement is a key CSF at project level that helps in adopting an effective QMS | ○ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ○ | ◌ | ● | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding XIII:** Utilising industry relations with trades unions as a CSF at project level is essential to facilitate QMS deployment | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding XIV:** Leadership support is a prime CSF to be adopted at company level to assure implementing a successful QMS | ○ | ◌ | ◌ | ○ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ○ | ◌ | ◌ | ● | ◌ | ◌ |
| **Finding XV:** Adopting management review and feedback as a CSF helps in implementing a robust QMS | ◌ | ◌ | ◌ | ● | ○ | ○ | ● | ○ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ● | ○ | ◌ | ◌ | ● | ◌ | ◌ |
| **Finding XVI:** Quality culture is a key CSF that facilitates adopting an effective QMS | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ○ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ○ |
| **Finding XVII:** Using regular external audit of a QMS as a CSF at project level assures adopting a rigorous QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ |
| **Finding XVIII:** Reputation of company is a significant CSF that ensures a rigorous deployment of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ● | ◌ | ◌ | ◌ |
| **Finding XIX:** Resources is a crucial CSF to be adopted at project level to assure an effective implementation of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ |
| **Finding XX:** Adopting teamwork as a CSF at project level is essential to facilitate implementing a successful QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ● | ◌ |
| **Finding XXI:** Utilising top management commitment as a CSF at organisation level is fundamental to implementing an effective QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ● | ○ | ● |

**●= high importance ○= medium importance ◌= low importance**
*** = Parentheses around a Theme number implies that it should carry extra weight in drafting an Assertion.**

Table 7.9 below depicts the theme-based assertions matrix generated from the Case 2 findings and supports the key findings of such cases concerning the CSFs for effective implementation of a QMS. It also highlights the most significant CSFs and uses their utility to explain them. Hence, parentheses were utilised to indicate the CSFs that are supported by the high utility of Case Study 2. This process was performed to transfer the utility information exhibited in Table 7.7, and to indicate the most important CSFs that will be used to develop the case assertions. These significant CSFs will be utilised in conjunction with the major CSFs of other cases, to develop the tentative assertions of the findings. Amongst these CSFs, some more significantly and prominently describe QMS implementation based upon the knowledge related to these factors, such as Communication & Coordination, Education & Training, and Top Management Commitment. Accordingly, due to their prominence, they carry extra weight during developing tentative assertions.

Additionally, Table 7.10 below illustrates the theme-based assertions matrix derived from the Case 3 findings of CSFs for QMS implementation. It also underlines the most important CSFs and utilises their utility to elucidate them. To transfer the utility information displayed in Table 7.7, and to highlight the most important CSFs that will be used to develop the case assertions, the parentheses process was performed to indicate the CSFs that are corroborated by high utility of Case Study 3. These significant CSFs will be used in combination with the main CSFs of other cases to develop the tentative assertions of the findings. These results indicate some more significant and prominent CSFs that explain QMS deployment depending upon the knowledge associated with these factors. These factors are, for example, Attitude to Change, Customer Satisfaction, and Regular external audit of QMS. These prominent CSFs will significantly contribute to deriving the tentative assertions.

Table 7.9: A matrix for generating theme-base assertions from Case 2 findings rated importance of CSFs

| Case 2 | CSFs for Effective Implementation of QMS | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Findings** | **((1))** | **2** | **((3))** | **((4))** | **(5)** | **(6)** | **((7))** | **(8)** | **((9))** | **(10)** | **11** | **((12))** | **(13)** | **(14)** | **((15))** | **(16)** | **17** | **18** | **(19)** | **20** | **((21))** |
| **Finding I:** Digital technology as a CSF at project level leads to implementing a rigorous QMS | ● | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding II:** Attitude to change is a key CSF to be utilised at project level to implement an effective QMS | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding III:** Adopting client involvement as a CSF at project level is fundamental to ensuring successful deployment of QMS | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding VI:** Using communication and coordination as a CSF results in implementing a robust QMS | ● | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ○ | ○ | ○ | ◌ | ● | ◌ | ◌ | ◌ | ● | ◌ |
| **Finding V:** Construction site planning is a crucial CSF to be adopted at project level to assure a successful implementation of QMS | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding VI:** Adopting continuous improvement helps in deploying an effective QMS | ○ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ○ | ◌ | ○ | ● | ● | ◌ | ◌ | ◌ | ○ |
| **Finding VII:** Utilising customer satisfaction as a CSF leads to implementing a robust QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ● | ○ | ◌ | ● | ◌ | ◌ | ○ |
| **Finding VIII:** Definition of roles and responsibilities is a crucial CSF that facilitates implementing a successful QMS | ◌ | ◌ | ◌ | ● | ● | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ |
| **Finding IX:** Adopting education and training as a CSF at project level results in deploying a successful QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ○ | ○ | ◌ | ● | ◌ | ◌ |
| **Finding X:** Employee empowerment is a key CSF to be adopted at project level to assure an effective implementation of QMS | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ● |
| **Finding XI:** Utilising end-user involvement as a CSF at project level helps in implementing a rigorous QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |

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| **Finding XII:**<br>Internal stakeholder's engagement is a key CSF to be utilised at project level to facilitate implementing a robust QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ |
| **Finding XIII:**<br>Adopting industry relations with trades unions as a CSF at project level results in implementing an effective QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding XIV:**<br>Leadership support is a prime CSF to be utilised at organisation level to ease deploying a rigorous QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ |
| **Finding XV:**<br>Using management review and feedback as a CSF results in implementing an effective QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ○ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ○ | ◌ | ◌ |
| **Finding XVI:**<br>Quality culture is a prime CSF that helps in adopting a robust QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ● | ◌ | ◌ | ● | ◌ | ● |
| **Findings XVII:**<br>Utilising regular external audit is a CSF at project level | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ |
| **Finding XVIII:**<br>Reputation of company is a key CSF to be adopted at project level to assure implementing a rigorous QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ○ | ◌ | ◌ |
| **Finding XIX:**<br>Resources is a considerable CSF to be utilised at project level to implement an effective QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ● | ● | ● |
| **Finding XX:**<br>Adopting teamwork as a CSF at project level facilitates deploying a successful QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ● | ◌ |
| **Finding XXI:**<br>Top management commitment is an essential CSF to be utilised at company level to assure an effective deployment of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ○ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ● | ◌ | ● |

Table 7.10: A matrix for generating theme-based assertions from Case 3 findings rated importance of CSFs

| Case 3 | CSFs for Effective Implementation of QMS | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Findings** | **(1)** | **(2)** | **(3)** | **(4)** | **5** | **((6))** | **(7)** | **(8)** | **9** | **(10)** | **(11)** | **12** | **(13)** | **14** | **((15))** | **16** | **(17)** | **18** | **(19)** | **20** | **(21)** |
| **Finding I:** Digital technology as a CSF at project level leads to deploying an effective QMS | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding II:** Attitude to change is a prime CSF to be adopted at project level to ensure a rigorous implementation of QMS | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding III:** Utilising client involvement as a CSF at project level is fundamental to implementing a successful QMS | ◌ | ◌ | ● | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ |
| **Finding IV:** Communication and coordination are key CSFs that facilitate the efficient deployment of QMS | ○ | ◌ | ◌ | ● | ◌ | ◌ | ○ | ◌ | ● | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ○ |
| **Finding V:** Construction site planning is a significant CSF to be used at project level to assure a robust implementation of QMS | ◌ | ◌ | ○ | ◌ | ● | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ● | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ |
| **Finding VI:** Continuous improvement is a crucial CSF that helps in adopting a successful QMS | ◌ | ◌ | ◌ | ○ | ◌ | ● | ○ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ● | ◌ | ● | ◌ | ◌ | ◌ | ◌ |
| **Finding VII:** Adopting customer satisfaction as a CSF results in implementing an effective QMS | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ● | ◌ | ◌ | ◌ |
| **Finding VIII:** Definition of roles and responsibilities is a considerable CSF that assures successful deployment of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **Finding IX:** Utilising education and training as a CSF at project level facilitate implementing a rigorous QMS | ○ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ○ | ◌ |
| **Finding X:** Employee empowerment is a significant CSF to be adopted at project level to deploy an effective QMS | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ○ | ◌ | ◌ | ○ | ○ | ◌ | ◌ | ◌ | ○ | ◌ |
| **Finding XI:** Adopting end-user involvement as a CSF at project level assists in facilitating the effective implementation of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |

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| **Finding XII:**<br>Internal stakeholder's engagement is fundamental CSF adopted at project level to ensure a rigorous deployment of QMS | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ● | ◌ | ● | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ |
| **Finding XIII:**<br>Utilising industry relations with trades unions as a CSF at project level facilitates implementing an effective QMS | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ |
| **XIV:**<br>Leadership support is a key CSF utilised at organisation level to assure a rigorous deployment of QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ● | ○ | ○ | ◌ | ◌ | ○ | ◌ | ◌ |
| **Finding XV:**<br>Adopting management review and feedback as a CSF is fundamental to deploying an effective QMS | ◌ | ◌ | ○ | ○ | ○ | ● | ○ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ○ | ● | ◌ | ◌ | ◌ | ● | ◌ | ◌ |
| **Finding XVI:**<br>Quality culture is a significant CSF that assists in implementing a robust QMS | ◌ | ● | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ● |
| **Finding XVII:**<br>Utilising regular external audits as a CSF at project level results in implementing a rigorous QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ |
| **Finding XVIII:**<br>Reputation of company is a key CSF that leads to adoption of an effective QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ |
| **Finding XIX:**<br>Resources is a considerable CSF adopted at project level to assure a successful deployment of QMS | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ○ |
| **Finding XX:**<br>Adopting teamwork as a CSF at project level is essential in deploying a rigorous QMS | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ● | ◌ |
| **Finding XXI:**<br>Using top management commitment as a CSF at organisation level is fundamental to implementing an effective QMS | ◌ | ● | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ◌ | ◌ | ◌ | ◌ | ○ | ◌ | ● | ● | ◌ | ● |

As previously mentioned, ratings of utility, importance, prominence, and ordinariness of the CSFs provide the basis for a technical process to create a matrix for generating theme-based assertions of these factors. In this section, the analyses from Case Studies 1, 2, and 3 are combined and compared, in order to explain how the CSFs facilitate deployment of a QMS and at which level of an organisation they should be adopted to ensure best outcomes. Tentative assertions are therefore formed according to the findings from the case studies, and the significance and prominence of CSFs that were depicted in Tables 7.8, 7.9, and 7.10. These composite tentative assertions offer a single or common focus and a major contribution to the research findings facilitating better comprehension of the nature and drivers of QMS adoption.

Additionally, to develop finalised assertions, the tentative assertions were thoroughly examined in order to identify any overlap, essential rewriting, or a prompt arrangement of their order. The tentative assertions were frequently reordered based upon the criteria illustrated in Table 7.11 below. Thus, the assertions that have lowest significance and provide the least evidence to support them were demoted, depending on established reordering criteria. The final assertions were ranked in descending orders, in which the first CSF is the most significant factor for effective adoption of QMS. The abbreviation (**C**) in combination with the number of CSF sequence is used to indicate the orders of final assertions, as illustrated in Table 7.12.

The final assertions clearly address the most important CSF for QMS adoption as being 'management review and feedback', since this factor was supported by 9 **remarks** across the cases and its assertions were derived according to the most significant factors of three cases. Moreover, the interviews performed during exploratory study provided key perspectives on the levels of CSFs impact on the robust adoption of a QMS. These perspectives were strongly supported by the within-case analyses findings drawn based upon the context of each case. Further, the prime evidence emerged from the cross-case analyses, along with the final assertions of the CSFs derived from the findings of different cases that all emphasise the impact of CSFs on QMS adoption and on a rigorous deployment of such systems within the context of building organisations. However, it is also emphasised that these CSFs can be adopted at different levels of an organisation, including at company or project level. In fact, some of these CSFs can be utilised across both levels of organisations to gain the most significant outcomes of QMS implementation.

Table 7.11: The criteria of reordering tentative assertions of CSFs

| Reordering Stages | Reordering Criterion | Case No. | CSFs for QMS Deployment | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Primary Reordering** | **Ordering obtained from within-case analysis** | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** |
| | **Weight of Factor for Drafting Assertion** | **1** | ▣ | ■ | □ | ■ | ■ | ■ | ■ | ▣ | ▣ | ▣ | ▣ | ▣ | □ | ▣ | ■ | ▣ | ▣ | ▣ | ■ | ■ | ▣ |
| | | **2** | ■ | □ | ▣ | ■ | ▣ | ▣ | ■ | ▣ | ■ | ▣ | □ | ■ | ▣ | ▣ | ■ | □ | □ | □ | ▣ | □ | ■ |
| | | **3** | ▣ | ▣ | ▣ | ▣ | □ | ■ | ▣ | ▣ | □ | ▣ | □ | □ | ▣ | □ | ■ | □ | ▣ | □ | ▣ | □ | ▣ |
| **Second Reordering** | **Significance of Factors Used to Draft Assertion** | | 3 | 4 | 7 | 2 | 4 | 2 | 2 | 5 | 4 | 5 | 8 | 4 | 7 | 7 | 1 | 8 | 7 | 8 | 3 | 6 | 3 |
| **Third Reordering** | **Remarks Support Assertion** | | **6** | 8 | 12 | 4 | 7 | 2 | 3 | **11** | **9** | **11** | **16** | **9** | **14** | **14** | 1 | 15 | 13 | **16** | 5 | 10 | **6** |
| **Final Reordering** | **Uniqueness of Assertion** | | 6 | 9 | 15 | 4 | 8 | 2 | 3 | 13 | 11 | 14 | 21 | 10 | 18 | 17 | 1 | 19 | 16 | 20 | 5 | 12 | 7 |

■ = **high weight** ▣ = **medium weight** □ = **low weight**

Table 7.12: Cross-case assertions of CSFs for effective implementation of QMS

| No. | Assertions | CSFs for QMS Implementation | Evidence & Persuasions |
|---|---|---|---|
| **C1** | Adopting management review and feedback as a CSF for implementing a successful QMS facilitates the execution of such system in building projects by indicating during regular meetings held monthly or six-weekly anticipated quality risks or issues, number of experienced defects along with analysing significant positive achievements, and through sharing management feedback amongst different projects to tackle the same issues or to avoid occurrence of them. | **Management Review and Feedback** | PA1, PA2, PQMP, PC2, PC1, QM, PB3, PB2, and PQP |
| **C2** | Continuous improvement is a key CSF for adopting a robust QMS performed through constant review of QMS requirements to undertake any necessary amendment for them, and by sharing lessons learned across different projects that indicate the experienced issues confront a QMS team during the preceding projects. | **Continuous Improvement** | PA1, PA2, PQMP, PA3, PB2, PQP, PB1, PB3, CMSM, PC3, PC2, and CSSP |
| **C3** | Utilising customer satisfaction as a CSF is crucial to ensure rigorous deployment of QMS in building projects due to the fact that client expectations and needs concerning quality are fulfilled through implementing a robust QMS to ensure competitiveness of building organisation and maintaining reputation of company, and these expectations represent a guideline for organisations to establish QMS requirements. | **Customer Satisfaction** | PA2, PQMP, PA3, PA1, PB3, PB2, PQP, PB1, PC4, and PC2 |
| **C4** | Adopting communication and coordination as a CSF is fundamental to assuring rigorous implementation of QMS in building projects since this factor is essential to perform efficient definition of roles and responsibilities, to ensure effective training for staff through dissemination of lessons learned, to share constant changes of QMS requirements amongst related stakeholders. | **Communication and Coordination** | PA3, PDP, PA1, PA2, PB2, PB1, PB3, CMSM, PC1, and QM |
| **C5** | Resources is the most significant CSF for adopting an effective QMS in theCIBS owing to the direct impact of that factor on the capability of an organisation to carry out the requirements of QMS. This CSF is performed through providing adequate resources of time and cost essential for QMS deployment, recruiting a quality manager in each project, ensuring recruitment of qualified subcontractors by conducting appropriate measures to assess their capability to comply with QMS requirements. | **Resources** | PA1, PA3, PQMP, PC1, PC3, PC4, PB3, PB1, PB2, PMSM, and PQP |
| **C6** | Digital technology is a key CSF for rigorous implementation of QMS at project level that facilitates adoption of such a system through saving considerable time spent for documentation, sharing the requirements of QMS amongst all related stakeholders, creating a virtual lab for different stakeholders to sign on and to regularly check the progress of documentation and update it, managing compliance of materials and executed work essential to meet QMS requirements. | **Digital technology** | PB2, PB3, PB1, PC1, PC3, PC2, PA1, and PA2 |

| | | | |
|---|---|---|---|
| **C7** | Top management commitment is a prime CSF adopted at organisation level to implement an effective QMS by presenting their commitment towards quality and QMS amongst different levels of company, indicating the commitment about providing required resources of QMS deployment, promoting internal stakeholder's engagement, assuring compliance with client expectations by establishing precise requirements and objectives of QMS. | **Top Management Commitment** | $P_{B3}$, $P_{B2}$, CMSM, $P_{B1}$, EAR, $P_{C2}$, $P_{C3}$, and $P_{A3}$ |
| **C8** | Utilising construction site planning as a CSF for QMS deployment at project level is significant to assure recruitment of required resources for QMS adoption, enhancing perception of a QMS team about system requirements, precisely assigning the roles and responsibilities of staff, as well as ensuring provision of required facilities for project teams that facilitate QMS adoption throughout a project cycle. | **Construction Site Planning** | $P_{A3}$, PRP, PQSW, $P_{A1}$, $P_{A2}$, $P_{B1}$, $P_{B3}$, $P_{B2}$, QMSM, and $P_{C4}$ |
| **C9** | Utilising attitude to change as a CSF at project level noticeably facilitates implementing an effective QMS in the building organisations owing to the criticality of perception of workforce towards QMS significance for adopting a robust system. However, ability of staff to adapt to changes is associated with level of qualifications, background and personality of team members, and level of education and training acquired. | **Attitude to Change** | $P_{A3}$, $P_{A1}$, $P_{A2}$, $P_{C2}$, $P_{C1}$, $P_{C3}$, and $P_{B2}$ |
| **C10** | Internal stakeholder's engagement is a key CSF for QMS adoption at project level that assists in sharing the experience of these stakeholders across the project team, ensuring perception of many staff members in respect to quality and the significance of QMS requirements to fulfil quality expectations as well as assuring double check of compliance with QMS requirements. | **Internal stakeholders' engagement** | $P_{B1}$, $P_{B2}$, $P_{B3}$, $P_{A2}$, $P_{A1}$, and $P_{C4}$ |
| **C11** | Education and training are a key CSF at project level to ensure an effective implementation of QMS by exposing team of QMS to intensive programs of lessons learned, workshops, as well as available online resources to assure reaching a satisfactory level of qualification essential to implement a rigorous QMS. | **Education and Training** | $P_{B3}$, $P_{B1}$, $P_{B2}$, $P_{A1}$, $P_{A3}$, and $P_{C2}$ |
| **C12** | Teamwork is a key CSF for implementing an effective QMS at project level, which is exclusively appropriate to the context of building projects because of the limited number of workforces of them. Teamwork also facilitates QMS deployment by using this factor as a strategy to upskill QMS teams in which experienced staff is induced to upskill less-qualified staff by sharing their knowledge about QMS requirements through maintaining efficient communication between project teams. | **Teamwork** | $P_{A1}$, $P_{A2}$, $P_{A3}$, $P_{B3}$, $P_{B1}$, $P_{C3}$ and $P_{C2}$ |
| **C13** | Adopting definition of roles and responsibilities as a CSF for QMS implementation is crucial to assure successful deployment of such a system, especially if it is performed prior to announcing a project to enable the QMS team to effectively cope with the implementation of QMS throughout the project life so as to provide such a team adequate incentives to create the most efficient teamwork. | **Definition of Roles and Responsibilities** | $P_{A1}$, PRP, $P_{A3}$, $P_{B3}$, $P_{B2}$, $P_{C2}$, $P_{C1}$, and $P_{C4}$ |
| **C14** | Employee empowerment is a key CSF for implementing a robust QMS at project level if this empowerment is not tightly constrained by administrative power and dictation of client in project to make required decisions, and if QMS team are | **Employee Empowerment** | $P_{B2}$, $P_{B1}$, $P_{B3}$, $P_{C2}$, $P_{C4}$, $P_{C3}$, $P_{A2}$, and $P_{A1}$ |

| | | | |
|---|---|---|---|
| | provided a complete excess to the system and its requirements. Employee empowerment also requires distinct definition of roles and responsibilities and sufficient qualifications of project team to accomplish allocated roles. | | |
| **C15** | Client involvement is a crucial CSF at project level because of the importance of early perception of the expectations of clients about quality for establishing precise requirements of QMS. Client involvement, in addition, assists in QMS deployment through assuring consistent adoption of QMS, maintaining clients' focus by reflecting their needs in the QMS requirements, and eventually saving a huge amount of time through facilitating the process of implementing that system. | **Client Involvement** | $P_{B1}$, $P_{B3}$, $P_{B2}$, $P_{C3}$, $P_{C1}$, $P_{C4}$, QPS, and $P_{A2}$ |
| **C16** | Adopting regular external audit of QMS as a CSF for QMS implementation at project level is significant to ensure the compliance of related team with the requirements of such a system by expanding a knowledge-share basis of project to project through sharing positives and negatives amongst the projects of different organisations, and to gain the feedback of external audits fundamental to assure producing relevant and applicable requirements of QMS. | **Regular external audit of QMS** | $P_{A1}$, $P_{A3}$, $P_{A2}$, PQMP, $P_{C1}$, $P_{C2}$, and $P_{B2}$ |
| **C17** | Leadership support is a key CSF for QMS adoption at company level that facilitates the implementation of such a system by providing the required resources of QMS deployment, granting a QMS team the essential power for making decisions, providing QMS team adequate motivations to commit to implement a robust QMS, maintaining an efficient management review as well as constant share of lesson learned about experienced quality issues and challenges. | **Leadership Support** | $P_{A1}$, $P_{A3}$, $P_{A2}$, $P_{B3}$, PB2, and $P_{C1}$ |
| **C18** | Utilising industry relations with trades unions as a CSF for QMS deployment at project level is more likely to facilitate the implementation of such a system during the project cycle because such a factor mitigates the implications of intervention of these unions through developing accurate requirements before announcing the project, ensuring meeting these requirements during project execution, and providing appropriate and safe environments for project teams. | **Industry Relation with Trades Unions** | $P_{B2}$, $P_{B3}$, $P_{B1}$, $P_{C4}$, $P_{C2}$, and $P_{A2}$ |
| **C19** | Quality culture is a crucial CSF for deploying a rigorous QMS in theCIBS that assures gaining staff commitment and focus concerning implementing the requirements of QMS although responding to quality culture is associated with level of organisation's focus on quality, background and education level of staff, and personality of team members. | **Quality Culture** | $P_{A3}$, $P_{A1}$, $P_{A2}$, $P_{B1}$, $P_{B2}$, $P_{B3}$, $P_{C3}$, $P_{C1}$, and $P_{C4}$ |
| **C20** | Reputation of company is a key CSF for QMS adoption in building projects essential to maintain competitiveness of company in the construction industry market and to ensure gaining customer satisfaction because reputation of company is directly reflected by the quality of products delivered to client. | **Reputation of Company** | $P_{A3}$, $P_{A2}$, $P_{B3}$, $P_{B1}$, and $P_{C4}$ |
| **C21** | Adopting end-user involvement as a CSF for QMS deployment at project level is essential to ensure that their expectations and requirements regarding quality are considered during developing the QMS requirements, especially if they are involved within the early stages of a project, such as the design stage. | **End-user Involvement** | $P_{A2}$, $P_{A1}$, $P_{B2}$, $P_{B1}$, and $P_{C3}$ |

More than half of the CSFs are found to be suitable for adoption at project level to ensure implementation of an effective QMS. These consist of **digital technology**, **attitude to change**, **construction site planning**, **internal stakeholder's engagement**, **education and training**, **teamwork**, **employee empowerment**, **client involvement**, **regular external audit of QMS**, **industry relations with trades unions**, and **end-user involvement**. However, the most significant factor of the project level is digital technology because this factor is supported by eight remarks from different cases and its assertion is developed based upon the significant factors of all cases. On the other hand, only two CSFs are found to be utilisable at an organisational level, namely **leadership support** and **top management commitment**. However, some CSFs are indicated as being adoptable at both organisational and project levels, including **management review & feedback**, **continuous improvement**, **customer satisfaction**, **communication & coordination**, **resources**, **definition of roles & responsibilities**, **quality culture**, and **reputation of company**. Management review and feedback is shown to be the most significant CSF of that level, as previously justified.

Furthermore, a cross-case analysis of the data gathered from the three organisations (Organisation 1, 2 and 3) indicates high similarity levels between the findings of the three cases. However, there are some differences between these findings attributable for different reasons. For instance, although the client involvement CSF was corroborated by participants of different cases ($P_{B1}$, $P_{B3}$, $P_{B2}$, $P_{C3}$, $P_{C1}$, $P_{C4}$, and $P_{A2}$), most respondents from Organisation A associated the significance of the QMS adoption factor with the client sector wherein a project is implemented. According to some respondents, this factor is more important for adopting a robust QMS in specific sectors, such as health, defence, education, and public projects ($P_{A1}$ and $P_{A3}$). This perspective was also corroborated by informants in the exploratory study because, in certain sectors, clients represent a key determinant as to whether building companies implement a robust QMS or not, based on them applying high and distinct expectations regarding the quality levels essential to develop precise requirements of QMS implementation ($P_{10}$, $P_1$, $P_7$, and $P_6$). However, there is a correlation between the assertion of client involvement and Proposition 17 related to this CSF, since both support the key role of client involvement for adopting a successful QMS.

Similarly, the impact of the resources CSF on adopting an effective QMS was strongly supported by both participant interviews and documents examined in the different cases, especially regarding recruitment of an experienced quality manager (PA1, PA3, PQMP, PC1, PC3, PC4, PB3, PB1, PB2, PMSM, and PQP). In contrast, there was distinct disagreement, or uncertainty of agreement, with the significance of recruiting a quality manger as a part of the resources CSF. This was indicated by participants from Organisation C (case 3) (PC4, PC1, and PC3). Participants reinforced this view based upon the common perception in the construction sector that quality is a responsibility of everyone within a project team. Thus, PC4 for example, stipulated that building organisations should concentrate on upskilling and training their project teams to become sufficiently skilled and qualified to fill a position of quality manager.

However, it is possible that this viewpoint is attributable to the dearth of quality managers within the context of Tier 2 building organisations compared to Tier 1 companies, and to several financial issues that confront these organisations preventing them from dedicating the required level of budget to recruit quality managers (PC1 and PC3). The direct impact of budget on the recruitment of quality managers was also corroborated by data gathered from the exploratory study (P9, P3, and P5). On the one hand, dedicating sufficient budget to employ required human resources for QMS deployment is directly associated with clients' expectations concerning quality, and the perception of them about QMS significance for achieving these expectations; however, this will have no traction unless clients shift their mindset regarding the necessity of providing sufficient budget essential to employing the requisite human resources for QMS implementation, especially within Tier two or three organisations. This is a huge challenge for these organisations wishing to recruit a quality manager for each project (P10, P5 and P11).

## 7.5 SUMMARY

This chapter presented the findings gained from performing a cross-case analysis, which was aimed at explaining how external factors impact on the level of QMS deployment on building projects, and eventually how these factors may be categorised in accordance with their influence. The cross-case analysis also sought to demonstrate the impact of adopting CSFs amongst different levels of organisations when implementing, or attempting to implement, a rigorous QMS on building projects. A comparative analysis of the findings of three cases indicated high similarities between them that represented building organisations from across different Tiers of construction companies. However, there were some differences highlighted by the cross-case analysis that were distinctly attributable to the available resources dedicated by these organisations for QMS deployment and to meet quality expectations. Consequently, explanation building was applied to address the rationales lying behind these differences indicated across the three cases. In addition, this chapter introduces the main assertions of external factors derived from developed matrices for generating theme-based assertions for all cases. Importantly, final assertions were ordered according to the significance of the impact of external factors on the implementation of QMS. However, these external factors were categorised into two groups as being either drivers or barriers, based upon their influence on QMS deployment. Moreover, derived assertions regarding CSFs stressed the effect of adopting these to facilitate implementation of an effective QMS in building projects. In contrast, to assure obtaining key outcomes from adopting these CSFs, it was clear that these factors can be utilised within different levels of organisations, namely company level, project level, or both levels.

# Chapter 8: Discussion

## 8.1 INTRODUCTION

Chapter 7 presented the results obtained from three case studies, performed within building organisations from different tiers of the industry, to answer RQ4. Two main sections were carried out to investigate each case study, observing the phenomenon of QMS deployment within the context of building organisations. The chapter ended with a summary of the main outcomes obtained from these cases. This chapter now discusses the insights from, and meaning of, the results from the analysis of the research data gathered during the preceding phases of the research, as described in Chapters 5, 6, and 7. The examination of these results points to a correlation between the conclusions drawn within each phase of data analysis and raised as the primary research problem; through these findings and results, the following research questions are answered:

1) What are the main external factors influencing the effective adoption of a QMS in the CIBS?
2) What are the crucial CSFs necessary for an effective QMS implementation in the CIBS?
3) How do the external factors and the CSFs affect the successful adoption of a QMS in real-world building projects of the CIBS?
4) How can the external factors be categorised based upon their impacts on the effective deployment of a QMS in real-world building projects of the CIBS?

By integrating and triangulating the study findings, conclusions are drawn that explain the relevance of these findings in approaching the overall research problem. Scholarly and practical implications of the study are indicated throughout the detailed discussion presented in this chapter.

## 8.2 EXTERNAL FACTORS AFFECTING QMS IMPLEMENTATION

The results of data analysis from the exploratory study interviews strongly indicate that the successful implementation of a QMS in CIBS organisations is affected by the external factors surrounding the industry and the sector. Almost all informants confirmed, to a significant degree, the impact of these factors on the anticipated outcomes of QMS deployment. Following on from this analysis, the data from the three case studies performed was examined using within-case and cross-case analysis, and the results from these further emphasised the impact of external factors and the level of the impact of each external factor, on the adoption of a rigorous QMS. Examining the results of all of the analyses reveals that external factors affect QMS implementation in two different ways, namely as a **driver,** or as a **barrier**. The following section addresses the factors considering each of the two types of impact and discusses how they influence the deployment of a robust QMS in the CIBS. The factors of each type are explained in accordance with the significance of their impact on QMS.

### 8.2.1 External Drivers for an Effective Deployment of QMS

Results demonstrated in Chapter 7 addressed two drivers for implementing an effective QMS in building projects, namely **client awareness towards QMS significance** and **legislation and regulations**. The impact of these drivers was supported by evidence gathered from different stages of data collection, namely the exploratory study and case studies. This impact was particularly emphasised during the cross-case analyses performed, based upon findings from the three different cases that led to derive the assertions of these factors. This section discusses how the existence of these drivers facilitates the adoption of QMS in building projects and helps to acquire robust outcomes that positively reflect on the quality of delivered projects.

**Client awareness towards QMS significance** was revealed by the exploratory study interviews to be one of the external factors affecting QMS deployment in theCIBS. Clients are arguably the most significant external stakeholders of the construction industry, owing to their prime role of originating and funding projects (Cox, Ireland, & Townsend, 2006; Lopes M., 2011). Thus, clients are considered a positive driving force that guides the process of construction by exerting pressure within that sector through their knowledge, skills, and behaviour (Blayse & Manley, 2004; Kamara, Spencer, Anumba, & Evbuomwan, 2002; Ryd, 2014). Despite studies such as these that highlight the key role of client perception and power, there is a clear lack of research concerning the impact of client awareness regarding their understanding of QMS significance in construction organisations. The significance of client awareness is closely associated with their prime roles in construction projects, which affects implementation of a successful QMS, including providing accurate expectations about quality essential to develop QMS requirements, dedicating an adequate budget for adopting that system, as well as providing resources necessary for continuous improvement, such as lessons learned.

Alternatively, data analysis indicates that the awareness of clients varies based upon the sector, e.g., residential, retail, hospital, or education, and the quality awareness of such clients in these particular sectors, who may range from residential homeowners to international superfund organisations. As an illustration of this, the overall data from the exploratory study and the case studies emphasises that clients of Federal and State government projects are distinctly aware of the significance of adopting QMSs within their projects to facilitate them to acquire an expected level of quality. As a consequence, it is emphasised that client awareness towards QMS significance, in most instances, drives the successful deployment of QMS by providing contractors with the essential resources required for QMS implementation **(Assertion E6)**. This assertion explicitly emphasises the positive implications of such factors on implementation of a robust QMS in building projects, thus providing distinct expectations of quality that are utilised to develop a set of precise requirements of a QMS to specifically fulfil these expectations.

Furthermore, the analysis reveals that **legislation and regulations** are an external factor that affects QMS implementation in theCIBS. It was found that legislation and regulations have a key impact on QMS processes because this factor is directly associated with proprietary standards that guide how a QMS should be implemented. Further, because legislation and regulations are more likely to established by various governmental or non-governmental authorities, such as federal government or councils, this range of legislative bodies provides building organisations with several options that facilitate the compliance of their QMSs with requirements. However, the cross-case analysis suggests that establishment of consistent legislation and regulations requires taking into consideration the perspectives of building organisations. Because this factor represents a key benchmark to guiding and ensuring conformance of the QMS elements with it, legislation and regulations are a key external driver for adopting a successful QMS in theCIBS (**Assertion 10**). However, the findings from Case Study 3 indicated that to ensure efficient accessibility and usability of legislation and regulations, they are required to be non-sophisticated and financially affordable by different users belonging to different building company tiers.

### 8.2.2 External Barriers for an Effective Deployment of QMS

One of the main objectives of this research was to investigate the external factors that impact the robust deployment of QMS in construction sector building organisations, and to categorise these factors in accordance with their impact as either a driver or barrier. Furthermore, data analysis led to the classifying of most of the identified external factors as barriers to QMS implementation, as illustrated in Chapters 6 and 7. However, the cross-case analysis emphasised the impact of these barriers and resulted in ordering them based upon their significance of influence on the successful deployment of QMS. This section, therefore, discusses the impact of these barriers starting with the most significant barrier through to the least significant one.

The data analysis reveals that **skilled human resources** is the most significant barrier confronting an effective deployment of QMS in theCIBS. Successful management of QMS is inextricably associated with appropriate and sufficient human resources being allocated to implement such a system, and limitation of these resources is emphasised as one of human-related issues that inhibits the implementation of that system (Fotopoulos & Psomas, 2009; Keng & Kamil, 2016). Despite this, there is a lack of studies conducted specifically to explore the implications of the lack of human resources on QMS adoption, especially when due to external causes. In this research, however, the analysis of exploratory study interviews disclosed skilled human resources as one of the external factors impacting QMS deployment. It is stressed that theCIBS lacks adequate human resources essential to adopt an effective QMS owing to the competitiveness of the construction industry in general, as well as the level of qualifications of the current potential workforce graduated from universities. It should be noted that the impact of skilled human resources was addressed by the participants of interviews and case studies related mainly to the sub-factors associated with that factor, namely **qualified staff**, **skilled quality manger**, and **retention of skilled staff**.

The exploratory study shows that the sub-factor of *qualified staff* is a barrier to QMS implementation since the industry lacks an adequate employed workforce essential to achieve the quality expectations needed when adopting a robust QMS.

Evidence gained from the case-studies attributes this issue to the decreased support by the local TAFE and regional training programs, to qualify sufficient numbers of trade workforce, high competitiveness of theCIBS market, as well as the mobility of building projects. Thus, balancing between current expert staff and new members of staff is fundamental to mitigating the implications of the limited numbers in the workforce, through maintaining constant growth of experience to fill this gap.

Moreover, the analysis of the exploratory study data indicates that employing a dedicated quality manager and assistant staff is still a challenge confronting the requirements for successful deployment of a QMS in the building projects. Thus, the responsibilities for managing a QMS are often additionally disseminated amongst different members of staff alongside their normal everyday roles. The lack of a quality manager and assistant staff within building projects, therefore, is emphasised to be a serious barrier to implementing a robust QMS, although many companies do have either a state (regional) quality manger, or a national quality manager. This issue is mainly associated with an inadequate number of such managers within theCIBS market, especially amongst Tier 2 companies, and the main perception of such building organisations is that quality is considered as a part of the overall role of every member of staff.

Furthermore, the retention of skilled staff is also indicated as a cause of the issue of skilled human resource deficiency in theCIBS. The analysis of exploratory study shows that the negative impact of this factor on the QMS implementation process is attributable to allocating the resources required for upskilling new staff; it is also the 'lost knowledge' about the instigated QMS that goes when staff leave a project. Leaving the workforce to their own jobs is associated with internal rationales such as tight programme of project, rigid dedicated budget, pressure of allocating too many responsibilities, and insufficient empowerment of staff. Besides this, the issue is also attributed to external causes, including location of project, personal circumstances, and competitiveness of theCIBS. The cross-case analysis clearly demonstrates that retention of skilled staff is a serious challenge facing the successful deployment of QMSs in theCIBS, and this issue is a result of the three subfactors explained above (**Assertion E1**).

Additionally, **external audit of QMS** was disclosed by the exploratory study analysis, to be an external factor that influences QMS adoption in building projects.

According to several studies, the effectiveness of audit directly impacts on the sustainability of a QMS deployment and represents a critical portion of project implementation (Prabhakar, 2018; Rajendran & Devadasan, 2005). Whilst such studies have been carried out, they largely have focused on the triggers of internal audit, or audit in general on QMS adoption (Keng & Kamil, 2016; Zeng, et al., 2007). However, the analysis of the research data from the exploratory findings highlights several new issues related to the lack of external auditing in theCIBS. These issues include dissipation of QMS team focus regarding compliance with QMS requirements, difficulty to ensure the following of these requirements constantly, and a dearth of formal instructions about how to implement a robust QMS. External audit of QMS, therefore, is a clear barrier to adopting a successful QMS in theCIBS (**Assertion E2**). On the other hand, the cross-case analysis stresses that a lack of this factor within the context of the building organisation may also be attributed to the deficiency of relevant legislation and regulations that enforces the need for theCIBS to carry out external audits compared to legislation governing other sectors, such as the engineering sector. Accordingly, lacking a comprehensive process of audit, be this internal or external, is more likely to adversely affect the achieving of the target of reducing the cost of poor quality.

Moreover, the analysis of interviews revealed **government policies** as an external factor that influences the adopting of a rigorous QMS in theCIBS. The findings of the exploratory study indicated that government policies have yet to meet building organisations' expectations in relation to QMS requirements or the expectations of required quality in the executed projects. This barrier, however, is associated with a difficulty to comply with these policies owing to insufficient documentation concerning supplied materials, as well as not considering the perspectives of construction organisations regarding the adoption of QMS-related policies (**Assertion E3**). According to the cross-case analysis, the difficulties of coping with these policies are attributed to the contradiction between the requirements of such policies and the expectations of clients. Thus, the relevance of introduced policies in relation to QMS undoubtedly depends upon the availability of a national body of knowledge essential to produce a policy that addresses clear expectations in the form of formal documentation and regulatory statements. Nonetheless, the cross-case analysis indicates that Tier 2 building organisations are more affected by this factor than companies belonging to Tier 1, This is due to Tier 1 companies allocating resources to particularly ensure conformance with these policies.

The various elements of design represent an integrated portion of the construction sector that impacts on all phases of projects from initial design through to handover; *quality of design* is the prime issue impacting on project success in general, and the construction phase in particular (Ezeldin & Abu Ghazala, 2007). The impact of **design process** on QMS adoption, however, has not specifically been explored previously within the context of the construction industry. *Design process* was suggested by participants of Case Study 1 as one of the external factors that most impacts on the adoption of QMS in building projects. The cross-case analysis supported this view by emphasising the criticality of acquiring comprehensive design development documents for ensuring consistent adoption of QMS. Thus, performing reviews and peer reviews of design documents is essential to ensure an effective deployment of QMS throughout the entire project lifecycle. However, design process is still a barrier to deploying a robust QMS in building projects because obtaining inclusive design information is a huge challenge confronting QMS deployment (**Assertion E4**). To mitigate the impact of such a factor on QMS deployment procedures, it is fundamental for the design team to itself adopt a QMS, to ensure primary compliance with the requirements of that system. Engagement between a QMS team and the design team is also necessary to assure the completeness and adequacy of design documentation and information prior to finalising them. These key procedures are necessary to avoid misinterpretation of the expectations of clients about quality, or issues that might lead to a need for major redesign or amendment to meet QMS requirements during project execution.

In addition, the analysis of the exploratory study data revealed that the **different quality systems** factor was an external factor impacting QMS deployment in theCIBS. The need for different quality systems is associated with the differences of each project's QMS requirements based upon expectations of individual clients concerning quality, and also the difference between the main QMS adopted by prime contractors and the QMSs of sub-contractors, suppliers and/or other stakeholders of a project. Thus, having several QMSs operating within a project results in several issues that impede implementing a rigorous QMS. The findings of the cross-case analysis stress that developing a unique QMS usable by different stakeholders of a project and appropriate to suit the specific QMS requirements of different projects, is a serious challenge facing building organisations.

**Assertion E5**, therefore, emphasises that different quality systems are a notable barrier to implementing a rigorous QMS that confronts developing a unique QMS usable by all stakeholders of project. This issue of different QMSs leads to lacking a consistent QMS essential to avoid deviation from the requirements of that system, as well as complicating the efforts of main contractors to assure compliance of these stakeholders with such requirements. Importantly, to mitigate the complications of different quality systems on the effectiveness of the main QMS, the cross-case findings suggest that a main contractor should develop checklists and guidelines to indicate the expectations that other stakeholders need to fulfil regarding QMS requirements.

Furthermore, the exploratory study disclosed that the **project supply chain** is one of the main external factors influencing a QMS adoption in building projects. The impact of this factor was apportioned across two different targets, namely, the quality of imported products, and quality of different suppliers based on the perspectives of the interview informants. According to the analysis of the exploratory study, the quality of imported products affects the procedure of QMS deployment, owing to the majority of materials of building projects being imported. This reliance on importation is a result of the procurement strategy of these companies, which aims at leaning upon the cheaper price of overseas materials to enable medium-sized companies to compete with larger organisations. The main issue that results from imported product quality, however, is often the difficulty in assuring compliance of these products with the regulatory standards and QMS requirements, mainly because of the inadequacy of required attached information and documents. Hence, the project supply chain is an obvious barrier to adopting a successful QMS in building projects (**Assertion E7**). On the other hand, the findings of Case Study 3 stress that this issue is associated with government shipping policies and related regulations, for which the liability for non-conformance of products is considered the responsibility of building companies.

Moreover, the analysis of exploratory study indicated the significant impact of suppliers on the successful adoption of QMSs. This impact is a result of the difficulty of ensuring compliance of supplied materials with the requirements of QMS. The difficulty is further supported by the results of the cross-case analysis that attributes this issue to the difference between the QMSs adopted by suppliers and the prime QMS of the main contractor. On the other hand, acquiring a supplier who is expected to comply with QMS requirements is difficult, especially for Tier 2 or 3 organisations because these suppliers are often nominated by a client selection process. Consequently, **Assertion E7** emphasises that the project supply chain is an obvious barrier to adopting a successful QMS in building projects because suppliers often intend deliberately and strategically to deviate from the requirements of a QMS. However, adopting more precise criteria for nominating and auditing suppliers throughout a project's lifecycle is more likely to alleviate the negative impacts of suppliers on the procedures of QMS implementation.

Furthermore, the findings of the exploratory study indicated **client attraction for the lowest price** as an external factor that has impacted on QMS deployment in theCIBS. Attraction for the lowest price can seriously impede adopting a rigorous QMS, because winning a project based on extremely tight margins directly affects the allocation of sufficient resources for undertaking QMS adoption, and this is ultimately reflected in the quality of delivered products. This issue, however, is associated with the level of client perception about the significance of QMS for reaching their expectations regarding a quality. Thus, attraction for the lowest price is often more associated with certain clients, such as those in the private sector. Notwithstanding this, the level of quality is driven by the client, based upon the budgets they dedicate to fulfilling the expectations of quality by promoting the implementation of a robust QMS. Eventually, it is difficult to meet quality expectations without developing precise requirements for QMS deployment. Hence, it is emphasised that client attraction for the lowest price is a barrier impeding adoption of a QMS in projects of building organisations (**Assertion E8**). By contrast, certain clients deliberately provide sufficient financial backing as a driver for implementing a successful QMS, and in this context, government-type clients often allocate some of their tender budget to be utilised in non-priced criteria including the budget required for a successful and effective QMS adoption.

The analysis of the exploratory study interviews disclosed that **intervention of trades unions due to safety** was an external factor that, according to interviewees, impacts the adoption of a QMS in building projects. Informants of exploratory study directly associated the negative impact of this factor with the time required by a project team to cope with the requirements of safety. According to the cross-case analysis, the intensive focus on safety requirements is primarily due to the authority of trades unions to suspend the work if any safety-related issue occurs. Thus, concentrating on coping with safety issues due to an intervention by trades unions, leads to a lack of essential focus on the requirements of QMS adoption, and even to significant deviation from these requirements. The findings from Case Study 2 emphasises that insufficient focus on QMS requirements by project teams results in a noticeable amount of quality defects appearing within the projects being examined. **Assertion E9**, therefore, stresses that intervention of trades unions due to safety issues, hinders implementing a successful QMS in building projects. However, the fluctuation in QMS implementation in the building projects is also attributable to the amount of expectations and enforcement introduced by governments and specifically concerning safety.

**Weather** is revealed by the findings of the exploratory study to be one of the external factors affecting the adoption of a QMS in the construction sector building industry. Analysis of the interviews indicated that inclement weather adversely impacts the adoption of a QMS in two different ways. Firstly, weather influences a QMS deployment from a time perspective as the weather causes unpredictable delays that can affect the procedures needed to implement such system. Secondly, extreme adverse weather also impacts the quality of executed works, which complicates ensuring compliance of such works with the requirements of a QMS and/or other related standards. However, the cross-case analysis asserts that adverse weather may also lead to increasing the impact of intervention of trades unions, owing to the potential occurrence of weather-related safety-related issues. Thus, weather, on most occasions, hinders a rigorous deployment of QMSs owing to the unpredictable nature of climatic conditions in some regions of Australia (**Assertion E11**). According to case-study respondents, this unpredictable weather also makes re-scheduling, as a potential contingency to deal with changes in climate, extremely difficult for project teams.

The findings from interviews also revealed that **interstate working** is an external factor that is seen as a serious challenge confronting QMS implementation. This is attributed to the complications of developing a broad QMS that can be adopted nationally, because of the difference in QMS requirements, and in regulations and standards across different states. On the other hand, the cross-cases analysis indicated that amendments to QMS requirements in accordance with the expectations of different states is difficult for building organisations to achieve. A major effect of this is on the time required to ensure perception of related staff about these new requirements. This is very likely to create ineffectiveness and inefficiency in attempting to follow the requirements of QMS during project lifecycle. **Assertion E12**, therefore, emphasises that interstate working impedes an effective implementation of QMS due to the various requirements of states affecting deployment of that system.

The exploratory study analysis further disclosed that **complexity of external project stakeholders' involvement** is one of the external factors that critically impacts QMS adoption on building projects. There are a wide range of influences from the external stakeholders based upon the type of a stakeholder and the stage of project that they are involved in. Such impacts result in the absence of consistency of adoption of QMSs owing to the differing focus and aspirations of external stakeholders, i.e., small groups of subcontractors and workers constituting the labour force. However, the cross-case analysis showed clearly that this factor impacts the QMS deployment because of the difference of quality expectations of these external stakeholders and the expectations of the main contractor. Such impact notably leads to these stakeholders deviating from the requirements needed for adoption of the prime QMS of the main contractor. Hence, the complexity of external project stakeholders' involvement hinders the successful adoption of QMS owing to the various foci and interests of these stakeholders within the project (**Assertion E13**). In order to counteract the effects of this factor, building organisations tend to try and accomplish the precise requirements of the prime QMS and share them with their various stakeholders at an early stage of project, according to findings from Case Study 2.

## 8.3 CSF FOR EFFECTIVE IMPLEMENTATION OF A QMS

This research has aimed at identifying an inclusive list of CSFs for the rigorous and robust adoption of QMSs in the building industry construction sector, and to explain the impact of these factors on the implementation of such quality management systems. This objective was fulfilled by conducting fifteen interviews during an exploratory study in order to identify all relevant CSFs by focusing at a project, rather than an organisational level. Following this, three case studies were undertaken to verify the impact of these 15 CSFs, and to gain deeper insights regarding adopting these factors in the projects being examined.

Following the analysis of the interviews, the case study data was then analysed in two phases. Firstly, a within-case analysis was conducted followed by a cross-case analysis, to clearly demonstrate the impact of the CSFs on QMS implementation in building projects. The cross-case analysis also clearly highlighted the levels at which the CSFs need to be adopted to gain best outcomes from QMS implementation in the context of building industry construction sector projects. This then identified three levels at which to adopt these CSFs, namely at the organisational, project, or both levels. The following section discusses the CSFs for each level and confirms how they impact on the adoption of a rigorous QMS in building projects. The CSFs of each level are elucidated in respect of their significance to QMS deployment in which the first factor is the most significant CSF of that level.

### 8.3.1 CSFs for Effective Deployment of a QMS at the Organisational level

The outcomes of the cross-case analysis presented Chapter 7 indicated that two specific CSFs need to be adopted at the organisational level of building companies for an effective deployment of a QMS. These factors are; **leadership support** and **top management commitment**. Although these CSFs were initially identified during the critical analysis of the extant literature, the impact of them was actually underpinned by the evidence from the results of the within-case analysis, and then more strongly confirmed by the cross-case analysis outcomes, in which were the final assertions of these factors. The following sub-sections discuss how adopting these CSFs at an organisational level facilitates the implementation of successful QMSs in building projects and assists in gaining better outcomes from deploying such QMSs.

**Top management commitment** was identified by the literature review as one of the major CSFs for effective implementation of QMS in the construction industry (Fening, 2012; Hietschold, et al., 2014; Hussain & Younis, 2015). According to Chin and Choi (2003), this factor plays a key role in effective QMS implementation through providing essential resources, making better decisions around problem-solving, and ensuring continuous improvement of the adopted system. This perspective is further corroborated by the evidence gained from case studies. These findings emphasise that top management commitment in particular should be practised in projects, highlighting the cost of potential quality defects, underlining the significance of a QMS for maintaining the business of company, as well as stressing the role of QMS adoption for managing the resources of a project more effectively.

Therefore, **Assertion C7** emphasises that a prime CSF adopted at organisational level to implement an effective QMS is top management commitment towards quality and QMS throughout different levels of a company. Hence, promoting and achieving effective commitment concerning QMS importance requires the clear vision of top management to be filtered down to project team level. This finding corresponds with the assumption of Rashed and Othman (2015), who stressed that top management should provide sufficient motivation and resources for successful implementation of QMS, in order to induce and acquire project team commitment concerning the implementation of QMS.

Furthermore, **leadership support** is addressed by literature analysis as a CSF for QMS adoption in the construction sector (Abdullah, et al., 2015; Fening, 2012; Ismyrlis & Moscgudus, 2015). To achieve high quality in the construction process, leadership from the management level is essential to promote quality and ensure successful adoption of QMS (Arumugam, et al., 2008; Gunaydin & Arditi, 1998). The analysis of the three case studies corroborates the importance of the impact of leadership support on QMS deployment, which should be carried out at the different levels of management, all the way down to the project team, who actually implement the requirements of QMS. However, one of the most important supporting roles of leadership is to constantly share lessons learned concerning quality issues experienced or challenges faced during QMS adoption on ongoing projects. It is, therefore, emphasised that leadership support is a key CSF for QMS deployment at company level that facilitates the system implementation (**Assertion C17**). Leadership support also requires the provision of essential resources to facilitate effective QMS deployment, granting the QMS team the necessary empowerment for making decisions, and encouraging the team with adequate motivation to implement a robust QMS. Toor and Ogunlana (2009), on the other hand, argue that the effectiveness of leadership in construction projects is affected by negative personal attributes of managers, such as unfair use of power, and insufficient ability to manage complex circumstances. However, the cross-case findings stress that as long as leaders at the top level indicate their distinct expectations of quality and QMS adoption outcomes, this positively and significantly assists in acquiring the necessary commitment of a project team to implement a rigorous QMS.

### 8.3.2 CSFs for Effective Deployment of a QMS of project level

The cross-case analysis illustrated in the preceding Chapter 7, the CSFs at the project level that are adopted in order to drive rigorous outcomes of QMS implementation in building projects. Whilst some of these CSFs were identified from a critical analysis of the extant literature, some factors were identified by analysing the data from the exploratory study. However, all of these CSFs were also examined within the case studies, to verify their impact on QMS adoption within actual operating building projects. The impact of the CSFs was precisely demonstrated by the findings of these case studies, and then significantly emphasised by the cross-case analysis, resulting in creating a set of assertions regarding these factors, in accordance with the findings from the three cases. This analysis addressed **digital technology** as the most significant CSF at a project level, whilst **end-user involvement** was the least important CSF for QMS adoption at a project level. This section now discusses how the adoption of these CSFs at project level assists in implementing a robust QMS in building projects.

Analysis of results from the exploratory study confirmed that **Adopting digital technology** one of the CSFs impacting QMS adoption in building projects. The findings of the exploratory study emphasised the significance of the factor and the positive benefits accrued owing to cutting down on the considerable amount of paperwork associated with QMS requirements, and the amount of communication with a large number of external stakeholders of projects. Hence, adopting a digital technology-based system, such as iPad, or mobile phone, facilitates QMS deployment by saving a considerable amount of time required to achieve distribution of the former volume of documentation and paperwork. Besides, adopting digital technology improves the internal and external communications with, and between, different stakeholders of a project, which in turn enhances the efficiency of QMS adoption.

The cross-case analysis, however, also indicates that adopting digital technology assists in creating a relatively paperless QMS for related stakeholders to perform their own system documentation, and to regularly check the progress of required documentation and update it whenever necessary. Thus, **Assertion C6** posits that adopting digital technology is a key CSF for rigorous implementation of a QMS at project level, which facilitates system adoption through various beneficial means. However, it was found that this factor is most exclusively appropriate to building projects because of the mobility of the sector, where, in most cases, the project location is geographically separate from the main office or headquarters of the parent organisation. Despite this, the cross-case analysis suggests that this factor can effectively be used to manage compliance with QMS requirements by facilitating more effective reporting of information from projects such as identified defects across related stakeholders.

The exploratory study interviews further revealed **construction site planning** to be one of the critical CSFs for effective deployment of a QMS in the projects of building organisations. It was emphasised that establishment of effective construction site planning, before projects commence, facilitates the successful adoption of a QMS that continues to be effective throughout the project cycle, especially in respect to providing a safe environment for workforce. This encompasses planning for all required equipment on the project, such as cranes, accommodation of the project offices, stored materials, access to the site, and parking. The cross-case analysis, therefore, stresses that construction site planning is key in adopting a robust QMS because it provides long-term solutions for the project ensuring that the site planning requirements are fully covered, controlled and monitored as part of the QMS deployment. As a result, **Assertion C8** emphasises that construction site planning as a CSF for QMS deployment at project level is significant to ensure the provision of required facilities for project teams that facilitates QMS adoption throughout the project cycle. Hence, efficient planning requires the formulation of strategies, planning, controls, and processes that have been developed to successfully deliver projects. Well-organised planning assures that project teams are thoroughly prepared and briefed about the requirements of QMS deployment.

Furthermore, **attitude to change** was identified as a CSF for QMS adoption from the literature analysis (Abdullah, et al., 2015; Chin & Choi, 2003; Tan & Abdul Rahman, 2011). Previous research asserts that there is a clear correlation between attitude to change and implementing a successful QMS, which is supported by effective participation of employees throughout the implementation (Dargahi & Rezaiian, 2007). This assumption was well-supported by the case study analysis, which indicated that the attitude to change of project teams is fundamental to ensure quick and precise adaptation to any changes in the QMS requirements, due primarily to the continuous improvement of systems. However, the perception of project teams concerning QMS significance, along with their capability to implement the system, is essential to instilling a positive attitude to change.

The cross-case analysis, in contrast, stressed that the project team’s attitude to change is distinctly associated with their levels of education, qualifications, background, and individual ability to adapt to changes. This perspective corresponds with the views of Dargahi and Rezaiian (2007), who argued that attitude to change increases more positively amongst employees who have a higher level of education compared with less-qualified staff.  Notwithstanding, it is true to say that the CSF of attitude to change noticeably facilitates implementing an effective QMS in building organisations owing to the criticality of workforce perception towards QMS significance, and to adopting a robust system (**Assertion C9**). However, to ensure that an effective attitude to change is encouraged, it is necessary for a high level of management team to highlight the significance and benefits of adopting a rigorous QMS in the project.

I**nternal stakeholders’ engagement** was revealed as a CSF for QMS adoption in building projects by the exploratory study findings. The significance of this factor is attributed to the positive implications of involving internal stakeholders in the procedures of QMS adoption. These implications include the sharing and improving of processes and procedures based on lessons learned, and thus ensuring involvement of a widespread range of staff, enhancing continuous improvement, and obtaining the widest acceptance of the QMS amongst project team members. The findings of the cross-case analysis strongly support the significance of internal stakeholder's engagement owing to the numbers of external stakeholders typical in most construction projects and the various disciplines involved in the project cycle. As a consequence, ensuring of compliance of these external parties with QMS requirements requires effective engagement of internal stakeholders in order for them to perform different roles associated with QMS adoption.

Thus, internal stakeholders’ engagement is a key CSF for QMS adoption at project level. This CSF assists in a sharing of the experience of these stakeholders across the project team roles, ensuring the critical perception of a wide range of staff members in respect of quality and understanding the significance of QMS requirements to fulfil quality expectations (**Assertion C10**). However, it is important that any involvement of internal stakeholders into QMS improvement activities should be overseen by management teams, through ensuring the understanding and later the meeting of, their desired goals of continuous improvement (Chin & Choi, 2003; Hussain & Younis, 2015). The cross-case analysis suggests that to ensure efficient internal stakeholder engagement, the adopted QMS should be easily understood, followed, and implemented.

Intensive analysis of the literature revealed that **education and training** is also an important CSF for QMS adoption in the construction industry (Patil, et al., 2012; Rashed & Othman, 2015; Rodríguez-Antón & Alonso-Almeida, 2011). According to Rashed and Othman (2015), education and training programs aim at enhancing the familiarity of project teams concerning QMS benefits and requirements, in order to facilitate their participation in adopting the system. This perspective is corroborated by evidence from the case studies, where the main focus of these education and training programs is to ensure, at an early stage of projects, that the project team are fully conversant with the QMS requirements and fully understand how these requirements are to be implemented during the project cycle.

Additionally, the analysis of Case Study 2 indicates that respondents on that project thought that education and training concentrates on demonstrating the significance of QMS adoption for maintaining the reputation of company, gaining customer satisfaction, as well as explaining the potential quality issues that may occur and advising how to settle them. **Assertion C11**, therefore, emphasised that education and training is a key CSF adopted at project level to ensure the effective implementation of a QMS by exposing the QMS team to intensive training programs. According to the cross-case analysis, these programs are based on understanding lessons learned, and are delivered through workshops as well as via online resources provided by companies. Consequently, a well-qualified workforce can effectively implement QMS requirements and efficiently participate in a culture of continuous improvement (Hietschold, et al., 2014; Patil, et al., 2012). However, the Case Study 1 analysis indicates that the delivery of efficient programs of education and training is sometimes a challenge owing to the uncertain, and often over time, changeable requirements of QMSs in the building projects.

The analysis of the literature disclosed **teamwork** as a CSF for adopting a successful QMS in the construction industry (Abdullah, et al., 2015; Gunaydin & Arditi, 1998; Stonehouse, 2011). According to Gunaydin and Arditi (1998), teamwork is primarily aimed at ensuring effective involvement of project team members into the process of QMS implementation and continuous improvement. The cross-case analysis, on the other hand, attributes the need to adopt teamwork CSF to the limited number of project teams in theCIBS in general. Therefore, teamwork can also be used as a strategy for upskilling of new members of staff concerning QMS deployment, by inducing the more experienced members of staff to share their knowledge and experience with them.

Consequently, the assurance of effective teamwork requires its adoption not only across the project team, but also throughout the external stakeholders in the workforce who will be involved throughout the project cycle. This finding is consistent with those of Abdullah, et al. (2015), who argued that teamwork should encompass all of the relevant construction parties, such as customers, consultants and subcontractors, in order to fulfil the overall goal of QMS adoption. Thus, **Assertion 25** emphasised that teamwork is a key CSF for implementing an effective QMS at project level, which is exclusively appropriate to the context of building projects because of the relatively limited numbers in the workforce. The analysis of Case Study 3 indicates that if teamwork is effectively planned prior to announcing the project, it significantly facilitates more effective QMS implementation during project execution.

From the literature analysis, **employee empowerment** was identified as one of the CSFs for effective deployment of QMS (Abdullah, et al., 2015; Ghosh, 2013; Poksinska, 2010). This factor is stimulated by ensuring that project teams react to quality-related issues and by providing them with the authority required to contribute to the decision-making processes around continuous improvement of a QMS (Ismyrlis, et al., 2015; Poksinska, 2010). This assumption is consistent with findings from the cross-case analysis that emphasised the necessity for strong employee empowerment needed to enhance the confidence of project teams and incentivise them to implement a robust QMS. On the other hand, the analysis of Case Study 3 recognises that employee empowerment also assists greatly in ensuring retention of those qualified staff essential to assuring the consistent deployment of a QMS. Therefore, **Assertion C14** posits that employee empowerment is a key CSF for implementing a robust QMS at project level, unless this empowerment is too tightly constrained by administrative power and dictation of the project client to make those required decisions. Thus, facilitative employee empowerment is provided by allocating QMS staff complete access to the system in order to enable them to perceive the requirements of implementation, and by permitting them to make essential decisions to undertake the deployment of the system. This not only improves positively the overall performance of a QMS, but also stimulates the development and maturity of employees to implement and operate the systems, by enhancing their feelings of being important, valued, and significant in decision-making (Poksinska, 2010). The finding from Case Study 1 further suggests that effective empowerment of staff requires a precise definition of their responsibilities, and assurance that such staff are suitably qualified to actually attain the requirements of the QMS.

Analysis of the exploratory study revealed that **client involvement** is one of the CSFs for effective deployment of a QMS in theCIBS, and that this factor is significant because clients represent the key determinant for building companies to implement, or not to implement, a robust QMS. The cross-case analysis assigns this significance to the criticality of fully understanding client expectations regarding quality, in order for project teams to develop the precise requirements of the QMS. On the other hand, client involvement is also key to obtaining the essential resources that will assist in improving the level of QMS deployment; amongst these resources are lessons learned that address the previous experiences of clients concerning QMS adoption. Consequently, the analysis of Case Study 2 corroborates that a thorough involvement of clients assists in saving considerable time throughout the implementation process of a QMS and ensures that there is a consistent deployment of a QMS throughout the project cycle. Client involvement is, therefore, a crucial CSF at project level, due to the importance of an early perception of the expectations of clients about quality, so that precise requirements of a QMS can be properly established (**Assertion C15**). Drilling down, the cross-case analysis indicates that an effective involvement of clients is achieved by involving them in design meetings to ensure the meeting of their expectations in the design produced, regular project meetings and sharing with project teams the requirements of QMS deployment. However, according to the exploratory study findings, effective involvement of client requires efficient communication to be maintained with them.

**Regular external audit of QMS** was identified as one of the CSFs for effective adoption of QMS in theCIBS, in the exploratory study data analysis. Several of the interviewees stressed that regular external audit of QMS is essential not only to understand how project teams cope with QMS requirements, but also to obtain the persistent feedback reinforcement needed to deliver a successful QMS. The cross-case analysis, however, indicates that such audits are crucial to expanding the shared knowledge base by creating a widespread understanding of the positives and negatives regarding QMS deployment across different projects. Consequently, performing a regular external audit of a QMS assists in developing the precise requirements of that QMS by highlighting the obligations of companies required to effectively implement such a system. Thus, **Assertion C16** recognises that the adopting of regular external audits of QMSs is an important CSF for QMS implementation at project level. It is a significant factor to ensure the compliance of related teams with the requirements of such a system. On the other hand, the within-case analysis indicates an overall dearth amongst the case study projects in conducting such audits, and a variance in the levels of performing external audits within these projects. The most frequent external audits occurred in the Case Study 1 project, which was being undertaken by a Tier 1 company. The analysis of the exploratory study, however, attributes carrying out a regular external audit of QMS to the size of organisations, types of clients of projects, as well as the perception of such organisations concerning the significance of external audit impacts/affects.

The interviews conducted during the exploratory study disclosed that **industry relations with trades unions** is a CSF for effective adoption of a QMS in building projects. The findings from the exploratory study emphasised the significance of this factor based on the clear impact that trades unions can have during the implementation of a QMS. Whilst such impact is associated with ensuring compliance with safety requirements and issues, it also critically influences the procedures of QMS deployment in terms of the time required to cope with the system requirements, which can often cause the deviation of project teams from the requirements of the QMS. Hence, the cross-case analysis further emphasised that maintaining healthy relations with trades unions through meeting their expectations concerning safety, significantly enhances the essential focus of project teams on achieving the requirements that have to be met for effective QMS adoption. **Assertion C18**, therefore, states that utilising relations with trades unions as a CSF for QMS deployment at project level is more likely to facilitate the implementation of such systems during the project cycle. The findings from Case Study 3, however, suggests that healthy relations with trades unions requires an initial up-front preparation of safety and environmental requirements that satisfy the unions in order to mitigate any implications of their potential intervention throughout a project's execution.

Finally, **end-user involvement** is revealed by the analysis of exploratory study, as a CSF for effective adoption of QMS in the building industry. The findings from the interviews associates the need for end-user involvement in the process of QMS adoption, and the significance of end-user's expectations regarding quality. This is particularly true in certain projects, such as those of government, or publicly funded projects like hospitals and schools, where the clients intend to involve the end-users in the process of delivering a quality project through adopting an effective QMS. However, the cross-case analysis emphasises that the gaining of effective outcomes from the use of end-user involvement requires involving them in the early stages of projects, especially during the design stage, as it is at this stage that they can fully consider their requirements to be incorporated within the final design documentation. The findings from Case Study 1 show that the early involvement of end-users in QMS implementation, subsequently saves a huge amount of time and eventually results in closely fulfilling their expectations. Therefore, adopting end-user involvement as a CSF for QMS deployment at project level is essential to ensure that the expectations and requirements of such users are considered during developing the QMS requirements (**Assertion C21**). On the other hand, it is noted that building organisations do not usually control the involvement of the end-users in the project, and such involvement is clearly associated with the quality of the client of a project as well as the quality of the project itself.

### 8.3.3 CSFs for Effective implementation of QMS of both levels

The cross-case analysis presented in Chapter 7 has indicated a number of CSFs for QMS implementation that can be adopted in organisations, including at the organisational and project levels. **Management review & feedback** is indicated as the most significant CSF adopted across these levels and reputation **of company**, on the other hand, the least important CSF adopted at these levels. Some of these CSFs were identified by an intensive analysis of literature, and then the identified factors were subsequently examined within the context of the case study projects, in order to verify their impact and gain further explanation of their importance and impact. Other CSFs were identified from an analysis of the interviews of the exploratory study conducted prior to examining them within the case studies. As previously mentioned, the impact of the CSFs identified earlier was thoroughly explained by evidence gained from the analysis of case studies, and rigorously emphasised by the cross-case analysis outcomes. Assertions representing these CSFs were derived according to the findings from the three different case studies. The following section now discusses how utilising these CSFs across the levels of organisation facilitates the implementing of an effective QMS in construction sector building projects.

**Management review & feedback** were identified from the detailed literature analysis as a CSF for QMS implementation in the construction sector (Ab Wahid & Corner, 2009; Chin & Choi, 2003; Wu & Chen, 2006). Management review assists in ensuring that an adequate evaluation of QMS implementation is performed regularly (Abdullah, et al., 2015; Pheng L. & Omar F., 1997). The cross-case analysis, therefore, emphasises the significance of undertaking management review and providing feedback to ensure a robust deployment of QMS. Performing an effective management review requires analysing and evaluating positive achievements and records, and identifying nonconformities, or quality issues, during management meetings. This finding is consistent with assumption of Chin and Choi (2003), who recognised the main purpose of such review as ensuring the regular evaluation of adopted QMSs necessary to make practical decisions to assure the effectiveness of such QMSs.

According to ISO: 9001 (2015), an organisation should consider the outcomes obtained from the analysis and evaluation of management reviews, to determine if any of these require addressing as part of the continuous improvement of company outcomes or the QMS. **Assertion C1**, therefore, stresses that adopting management review and feedback as a CSF for implementing a successful QMS, facilitates the execution of the system in building projects. Thus, to acquire efficient and usable results from management review and feedback, it is essential to share the outcomes of such reviews across the different projects of an organisation by means of lessons learned, shared knowledge, or widespread feedback. On the other hand, the findings from Case Study 3 stress that management review and feedback is particularly significant to building projects due to the fact that they are often geographically separated.

The analysis of the literature identified **continuous improvement** as a CSF for QMS adoption in the construction industry (Abdullah, et al., 2015; Hussain & Younis, 2015; Pheng L. & Omar F., 1997). Continuous improvement primarily aims at gaining high levels of customer satisfaction through developing robust requirements of a QMS, which will be clearly reflected in the quality of delivered projects (Ilango & Shankar, 2017). According to the cross-case analysis, continuous improvement contributes to QMS implementation through constantly evaluating experienced issues that confront QMS adoption, so as to develop lessons learned, which are then shared across different projects to avoid the re-occurrence of the same issues. This finding also confirms the purpose of continuous improvement as indicated by ISO: 9000 (2015), which advises that such improvement should be performed to maintain current levels of organisational performance, as well as to stimulate changes in the internal and external environments of organisations.

However, assuring effective continuous improvement requires the production of, and referral to, documentation of issues or defects, as well as carrying out effective management reviews to regularly gain feedback from QMS-related staff and other stakeholders of project. Thus, **Assertion C2** affirms that continuous improvement is a key CSF for adopting a robust QMS and is performed through constant review of QMS requirements to undertake any necessary amendment of them. However, the analysis of Case Study 1 indicates that carrying out effective continuous improvement is often difficult owing to the uniqueness of each building project that results in particular and unique requirements for the QMS of that project.

**Customer satisfaction** was also identified literature review and subsequent analysis as one of the CSFs for QMS deployment in the construction industry (Delgado-Hernandez & Aspinwall, 2008; Hadidi, et al., 2017; Tan & Abdul Rahman, 2011). A QMS in construction projects is implemented in order to maintain the quality of executed works, in accordance with the required standards, to obtain customer satisfaction (Tan & Abdul Rahman, 2011). Thus, the result of the Case Study 1 analysis emphasises that the prime aim of adopting a QMS in building projects is to acquire customer satisfaction that eventually helps maintain the business of an organisation. This finding is consistent with the aim of QMS deployment contained in ISO: 9000 (2015), which indicates that a QMS aims at enhancing customer satisfaction by the effective adoption of the system. However, according to the cross-case analysis, customer satisfaction is attained mainly through fulfilling the expectations of the client regarding quality. Hence, **Assertion C3** emphasises that utilising customer satisfaction as a CSF is crucial to ensuring a more rigorous deployment of a QMS in building projects; this is due to the fact that client expectations and needs are fulfilled by implementing a robust system. This assertion is also corroborated by the assumption of Poksinska (2010), who stipulated that customer requirements are a primary motive that induce construction organisations to implement a QMS.

The analysis of literature review identified **communication and coordination** as a CSF for construction sector QMS implementation (Abdullah, et al., 2015; Gunaydin & Arditi, 1998; Ilango & Shankar, 2017). According to Hawrysz (2014), communication is one of the prime factors impacting on the effective adoption of a QMS regardless of the type of system being adopted by an organisation. Furthermore, effective coordination during the design phase may minimise those costly and negative factors, such as rework, constructability issues, and frequency of changes, during the construction phase (Arditi & Gunaydin, 1997). Supporting this finding, Case Study 1 recognises that effective coordination of all facets of communication and documentation ensures clarity and accuracy amongst project teams. The cross-case analysis also supports and emphasises that carrying out an efficient communication in the project is fundamental to keeping all related stakeholders up to date about QMS improvements. In this respect, Hawrysz (2014) stresses that there is a significant correlation between the effectiveness of QMS and the selected elements of communication, such as the official system of communication to exchange information between different parties within the organisation. Consequently, adopting communication and coordination as a CSF is fundamental to assuring rigorous implementation of QMS in building projects, according to **Assertion C4**. Thus, efficient communication is performed by conducting face-to-face meetings, using digital technology to facilitate communication, as well as maintaining constant contact between the management team and the project staff. On the contrary, performing an efficient communication primarily requires the determination of the essential internal and external communications concerning the QMS to be conducted (ISO: 9001, 2015).

**Resources** were disclosed by the interviews conducted during the exploratory study, as being a CSF for QMS implementation in theCIBS. However, the overall impact of such resources was addressed based explicitly upon explaining the contributory impact of some subfactors associated with resources. These subfactors are **provision of resources of time and cost**, **recruitment of experienced quality**

**mangers, and recruitment of qualified subcontractors**. The analysis from the exploratory study emphasised that the presence of these subfactors is necessary and significant to ensure the obtaining of effective resources for implementing a robust QMS in building projects. For example, implementing a successful QMS is strongly associated with the adequate provision of required time and budget, which is somewhat of a major challenge facing building projects since meeting the timeline of a project and delivering the project under the budget, are the main aims of most building companies, but are often hardest to achieve. The cross-case analysis revealed that providing these resources is fundamental to assure deployment of a successful QMS. Unless the essential budget for QMS adoption is allocated at an early stage of a project, it is clearly a difficult challenge to employ the necessary human resources to implement the system appropriately and/or adequately, and to develop the robust requirements necessary for robust system implementation. Provision of time, however, is also essential to fulfil these requirements and to produce all documentation and paperwork required by a QMS.

In addition, the results of exploratory study interviews also emphasised the critical need to employ a quality manager within building projects, to ensure achievement of the requirements of a QMS, as well as to effectively manage the available resources required to implement such a system. This finding is corroborated by evidence gained from the cross-case analysis, which further determines that recruiting a quality manager, essential to ensure consistent implementation of a QMS through the crucial role of managing system implementation, is handled by the quality manager instead of being distributed amongst several members of a project team. However, the exploratory study stresses that employing a quality manger within each project depends mostly upon the size of organisations, and the size of projects. As an illustration of this, the analysis of Case Study 3, which is a Tier 2 organisation, demonstrates that organisations of Tier 2 size tend to upskill project teams to undertake QMS adoption and implementation requirements rather than recruiting an exclusive quality manager. This was attributed to the larger scale of resources available on the projects of Tier 2 companies, and also the difficulty of acquiring such managers within the Tier 2 market as compared to their greater availability in the Tier 1 market.

Thus, ensuring a robust deployment of a QMS clearly depends upon recruiting qualified subcontractors, according to the exploratory study analysis. Therefore, building organisations need to adopt a precise strategy to assess their subcontractors in order to identify the most appropriate capable of accomplishing the requirements of the prescribed QMS. According to the cross-case analysis, the significance of recruiting qualified subcontractors is attributable to the wide-range of works executed by them in the project. Therefore, it is the responsibility of nominated subcontractors to ensure that their workforces are aware about the significance of the quality, and the nature of the project QMS, and are adequately qualified to meet the requirements of QMS adoption. Consequently, it is true to say that providing these subfactors is essential to assure the allocation of the required resources for QMS deployment, Thus, **Assertion C5** emphasises that resources CSF is one of the most significant CSFs for adopting an effective QMS in theCIBS, owing to the direct impact of that factor on the capability of an organisation to implement an effective QMS. The cross-case analysis, however, strongly indicates that obtaining these resources is highly associated with the dedicated budget for any QMS, which is in turn affected by the level of focus of clients on the significance of QMS deployment, and their expectations concerning achieving a high-quality project outcome.

Additionally, the analysis of the exploratory study unveiled **definition of roles & responsibilities** as a CSF for QMS adoption construction organisations. Precise and primary definition of roles and responsibilities of project team is key to implementing a rigorous QMS and avoiding any misinterpretation of these responsibilities. This finding is consistent with the general assumption identified by the cross-case analysis, which emphasises that initial definition of the roles and responsibilities of project team members requires to be confirmed prior to commencing the project, to enable the project team to effectively cope with and effectively implement the requirements of QMS deployment. According to the analysis of Case Study 1, the primary definition of these responsibilities is necessary to provide to a building project's staff, owing to the limited number of such staff that sees them often overloaded with many responsibilities. As a consequence, the CSF of adopting a clear definition of roles and responsibilities for QMS implementation is crucial to assuring successful deployment of such systems, especially if it is affected prior to commencing a project (**Assertion C13**). Also, facilitating the undertaking of efficient roles and responsibilities needs training programs to be developing that will qualify the staff of projects to efficiently achieve their dedicated responsibilities during QMS implementation. Despite this, the findings of Case Study 1 indicate the need for a regular review of these responsibilities to ensure that the perception of team members concerning their assigned roles remains constant.

The literature review and analysis indicated that **Quality culture** was a significant CSF for the effective implementation of a QMS (Abdullah, et al., 2015; Almeida, et al., 2014; Chin & Choi, 2003; Juanzon, 2017). According to the literature, there is a definite relationship between quality culture and quality in those construction projects where such culture is considered as being a major determining factor to the successful implementation of a QMS (Coffey, 2010; Koh & LOW, 2010; Willar, Trigunarsyah, & Coffey, 2016). Therefore, the cross-case analysis emphasises the necessity of indicating the significance of a quality culture amongst all staff levels of an organisation from the top management level down to the project team. This finding corroborates the work of Psomas, et al. (2013), who asserted that drawing attention to quality culture is key to creating a rigorous internal environment directed at achieving an effective QMS. **Assertion C19**, therefore, emphasises that quality culture is a crucial CSF for deploying a rigorous QMS in theCIBS, that also assures achieving a high level of staff commitment and focus concerning implementing the requirements of the QMS. According to the cross-case analysis, drawing attention to the quality culture is also reinforced by underlining the potential outcomes of QMS adoption, and providing positive motivation that induces a project team to comply with QMS requirements. Besides this, sharing with a project team the critical consequences of providing non-quality products and delivering poor quality outcomes, is also essential to enhancing their quality culture. On the other hand, the analysis of Case Studies 1 and 2 indicates that adapting to a particular quality culture is associated with the background of the company's team members, their levels of education and their qualifications.

**Reputation of company** was also revealed by the interviews of the exploratory study as being a significant CSF for effective adoption of a QMS in theCIBS. The reputation of the company is a key incentive to encourage building organisations to deploy a robust QMS, which significantly helps to maintain their reputation by delivering high quality products. The cross-case analysis attributes the significance of company reputation to the clear association between the quality of work delivered to client satisfaction and market reputation of the company. Therefore, the exploratory study findings indicate that organisations that already have an upstanding reputation in the construction market, have most likely adopted ‘reputation of company’ as a CSF and have maintained such a reputation by inducing the deployment of a rigorous QMS. Accordingly, the reputation of a company is a key CSF for QMS adoption on building projects and is essential to maintaining competitiveness of a company in the construction industry market, and to ensure obtaining customer satisfaction (**Assertion C21**). Hence, according to the analysis of Case Study 3, effectively adopting reputation of company requires underlining the criticality of the reputation to the business outcomes of a company and explaining how adopting and implementing an effective QMS can maintain such a reputation.

## 8.4 SUMMARY

This chapter has integrated the research questions and conclusions by assessing the findings of the study and explaining their practical implications. This chapter has primarily discussed the impact of external factors on QMS deployment in construction industry building organisations and explained how these factors affect the outcomes of QMS adoption. It has also discussed the influence of adopting the CSFs for QMS implementation on the level of QMS deployment, and then thoroughly discussed the potential of different levels of organisations to adopt these factors in order to acquire robust quality outcomes and client satisfaction from implementing a robust QMS in building projects. The last chapter that follows will present a summary of the main findings of this research along with research contribution and limitations. Finally, conclusions and recommendations will be provided for both the use of the construction industry and for further research into construction related QMS implementation.

# Chapter 9: Conclusions

## 9.1 INTRODUCTION

The key focus of this research was to investigate the current levels of Quality Management System (QMS) implementation in the CIBS in Australia. This focus of the research was aimed at developing a comprehensive framework for QMS adoption that assembles all of the relevant factors, including internal and external, impacting the implementation of such systems, as well as the levels of deployment. The research was conducted using a qualitative approach, namely interviews and case studies. Based on the findings explained in the preceding chapters, and the inclusive discussion elucidated in Chapter 8, this chapter now presents the final framework of QMS deployment developed based upon the findings of the within-case and cross-case analyses. The chapter also summarises the main findings of this research regarding the QMS implementation in the building organisations, and further presents the overall contributions of this study. The chapter also presents the conclusions that link the findings of this research with the extant literature of QMS deployment in the construction industry. It outlines the recommendations for industry going forwards to implement a robust QMS, epically in the building sector. The chapter finally explores the limitations of this research and the implications for future research studies.

## 9.2 SUMMARY OF THE RESEARCH PROCESS

This research has been conducted to investigate the impact of factors surrounding QMS deployment at the system implementation level. It has examined and identified (a) which external factors potentially influence the adoption of QMS; (b) which CSFs effectively impact the level of QMS implementation, particularly at project level; and, (c) how all of these either impede QMS adoption or improve the levels of deployment. For these reasons, the literature review set down in Chapters 2 and 3 examined the existing body of knowledge associated with QMS implementation in the construction industry, which resulted in identifying the gap to be investigated and answered in this research. It was found that there was a dearth of research that had been carried out to explore the impact of external factors on QMS deployment, meaning that there was a critical need to identify holistically the CSFs for QMS implementation, especially those at a project level.

Therefore, the research attempted to investigate the current levels of QMS deployment in the context of building organisations, in order to discover the major factors impacting such deployment, and also to explain their impact on typical building projects. The study also sought to identify a holistic categorised list of the CSFs for effective deployment of QMSs in theCIBS, by taking into account those factors that may impact on the adoption by different levels of building organisations, especially at a project level.

To achieve these objectives, a qualitative approach was adopted to collect the required data owing primarily to the exploratory and explanatory nature of this research as explained in Chapter 4. The exploratory study was performed not only to determine the external factors impacting upon QMS deployment in theCIBS, but also to identify an inclusive list of CSFs for implementing a robust QMS. Data analysis of the exploratory study led to development of a list of twelve external factors and ten major CSFs for QMS adoption, which significantly impact the implementation at a project level. During this stage, a series of propositions were created to be tested later within a series of case studies, after positioning the propositions as part of the components of the conceptual framework to either confirm or refute the impact of these identified factors.

Then, a series of three case studies were selected and conducted to examine and test the findings of the exploratory study. These cases represented Tier 1 and 2 building organisations as it was very difficult to acquire consent from Tier 3 organisations to participate in this research, as previously explained in Chapter 6. The case studies were aimed at explaining the impact of the identified external factors and the CSFs on the levels of QMSs in building projects. Therefore, the examination of the cases addressed either similar outcomes that literally replicated the preceding outcomes, or dissimilar results that produced a new predictive aspect for the theoretical replications, thus explaining more fully the impact of these factors on QMS deployment. Plausible conclusions were drawn from the different stages of the data analysis that led to a complete explanation of the precise impact of the external factors on QMS implementation; also, these impacts were classified dependant on their effect on QMS deployment in two different ways, namely as drivers, or barriers. The CSFs for QMS adoption were however, grouped into three different classes based upon the best level of QMS implementation achieved by adopting these factors, in order to gain robust outcomes from QMS deployment, including CSFs at company level, project level, or both.

The findings of the data analyses presented in Chapters 5, 6, and 7 were then discussed in Chapter 8, in order to triangulate the outcomes and compare them with the extant literature. This discussion then led to the provision of a rigorous basis to develop the final conceptual framework of QMS implementation, which is detailed in the next section of this chapter. The discussion also helped in summarising the major findings and implications of this research and assisted in drawing the final conclusions, as presented in this current chapter.

## 9.3 FINAL FRAMEWORK DEVELOPMENT

This section aims to develop the final version of a framework for QMS implementation in theCIBS, based upon the findings of the research. The main components of this proposed framework are dependent upon the development of a conceptual framework that was evolved over two stages of literature analysis and exploratory study outcomes. The initial framework was derived based upon the analysis of QMS literature to present the prime factors impacting QMS deployment and to address the key gaps identified in this research. This framework was then developed, in accordance with the outcomes of the exploratory study interviews summarised, by using derived propositions. These propositions were then examined during the case studies before further revising them during within-case analysis and finally testing them throughout the cross-case analysis. Subsequently, this new developed framework was constructed according to the key findings that this research acquired from different stages of data analyses, namely exploratory study analysis, with-in case analysis, and cross-case analysis.

This framework aims to enhance the levels of QMS deployment in theCIBS through addressing the main factors impacting such deployment levels and emphasising the significance of adopting the Critical Success Factors (CSFs) across different levels of an organisation for improving the levels of QMS implementation. Therefore, all of the factors, internal and external, related to the implementation of QMSs were taken into consideration in formulating the final developed framework. The final version of the developed framework is illustrated in Figure 9.1 below.

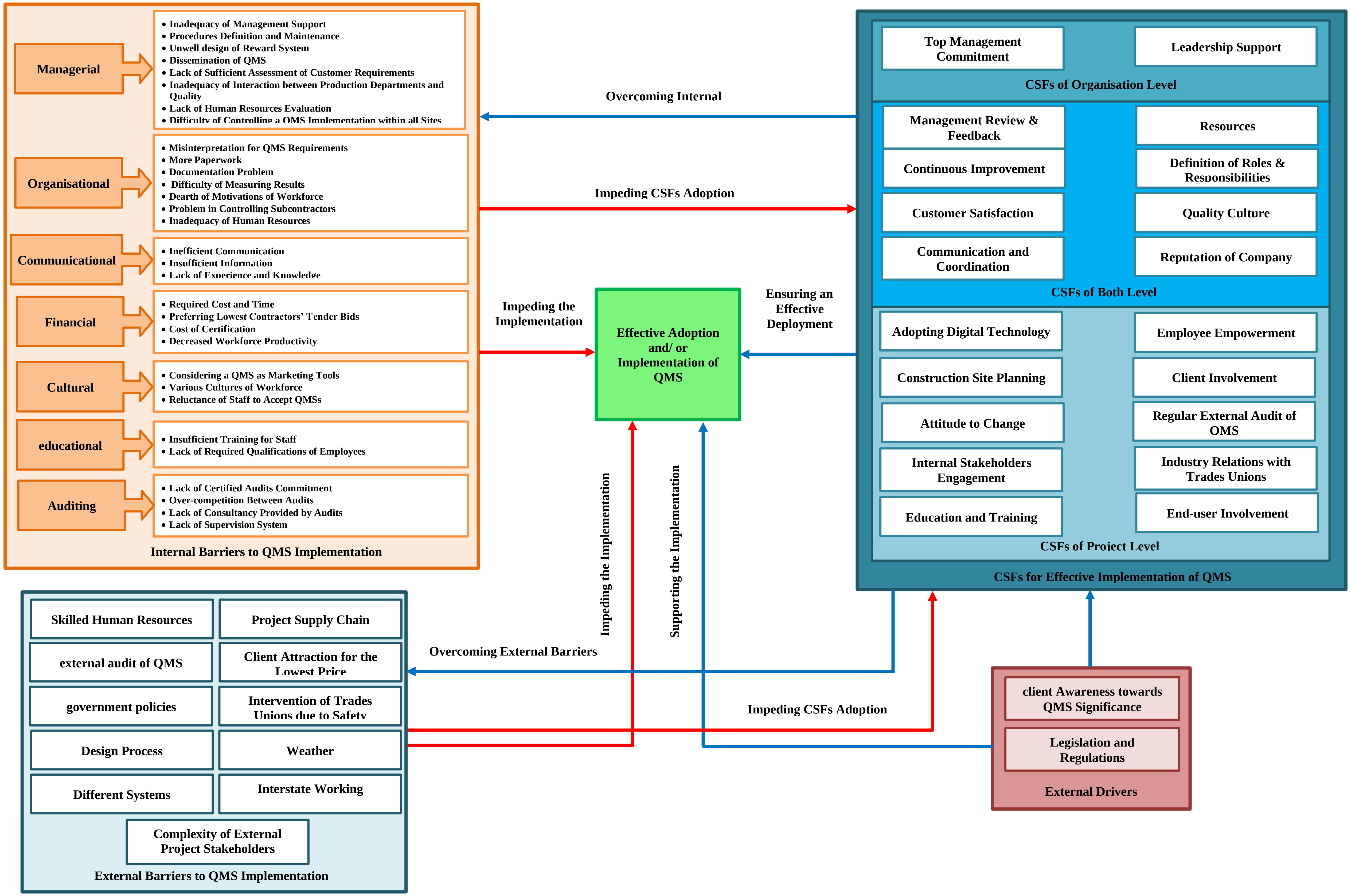


Figure 9.1: The developed framework for effective implementation of QMS in the CIBS

The new developed framework specifically addresses the impact that the different identified factors have on the effective deployment of QMS, including both positive and negative impacts. For instance, the framework illustrates the influence of the external barriers on the adoption of CSFs, but also depicts the impacts that the adoption of the CSFs has on overcoming the internal barriers, and the influence of implementing these CSFs on assuring an effective deployment of a QMS. Moreover, the new developed framework presents the main sources for identifying and generating all factors related to the implementation of a QMS. These consist of internal sources, which generate those factors generated by, or related to, building organisations, and are an example of the internal barriers and the CSFs at different levels of organisations. The final framework displays the external sources where generation of factors cannot be controlled by building companies themselves, although these factors do impact significantly on the process of implementing a QMS in these organisations, such as external drivers and external barriers to QMS deployment.

The new developed framework offers clear guidelines for building organisations to fully address the impact of all factors surrounding QMS implementation. Therefore, implementing such guidelines provides short-term and long-term benefits when adopting an effective QMS within construction industry building projects. However, it should be noted that gaining the full benefits of adopting the new developed framework is not expected to be accomplished over a short period of time. Consequently, in order for building organisations to acquire complete advantages of adopting this framework throughout the implementation of QMS, three major stages are required, namely pre-implementation stage, implementation stage, and continuous improvement (sustainability).

### 9.3.1 Pre-implementation Stage

Performing this stage effectively requires top management commitment and leadership support evidenced by allocating the required resources to adopt this framework. Thus, organisations need to commit to making the serious changes to their management philosophies around how to implement a QMS, create a management vision and mission, and eventually build an organisation culture to support the continued commitment to, and continuous improvement of, a robust QMS. Also, an effective adoption of the new framework needs to ensure that employees are involved and empowered at all levels of organisation, in conjunction with an effective involvement of all external stakeholders of the construction project in the process of QMS deployment. More importantly, the building project team, including the workforce of subcontractors, should acquire extensive training in QMS requirements, especially prior to commencing a project, or at the initial stage of such a project.

### 9.3.2 Implementation Stage

Conducting a pre-implementation stage will result in establishing distinct objectives of quality that can be accomplished by adopting the guidelines offered by the new developed framework. However, this also requires a clear identification of the requirements of deploying an effective QMS throughout different stages of a project. This can be effectively achieved by adopting the framework, wherein the impact of all potential factors surrounding the QMS implementation are clearly highlighted within the constructs of the framework. In addition, the framework also provides alternative pathways for project teams to follow during QMS implementation, that will facilitate acceleration of some stages of deployment, or delay others, based upon the available resources. On the other hand, the roles and responsibilities of a QMS-related team at all levels of an organisation should distinctly be defined to avoid any overlapping or duality of effort during this framework adoption. However, to ensure effective adoption of the framework throughout QMS deployment, effective teamwork should be maintained by performing efficient internal and external communications across all levels of organisations and their related stakeholders.

### 9.3.3 Continuous Improvement (Sustainability)

The developed framework from this research represents a new technical management approach that is expected to be accepted by theCIBS based on its suitability for different projects of the CIBS and the contribution that the framework provides to implementing a robust QMS. Therefore, going forwards, it is fundamental to perform continuous improvement to the framework, conducted in accordance with the feedback provided by subsequent management reviews, the feedback of clients, and the feedback provided by other stakeholders of the project, such as subcontractors.

## 9.4 OUTLINE OF THE MAIN FINDINGS

This research has fulfilled its overall aim and objectives throughout the two stages of data collection, i.e., the exploratory study interviews and case studies, and accordingly the research questions have been answered by performing the qualitative data analysis. The analysis of the exploratory study interviews provided an understanding of the weaknesses and strengths of the current levels of QMS adoption in the context of theCIBS. This analysis has clearly identified the main external factors impacting the QMS deployment in building organisations, as it addressed the holistic list of CSFs for QMS implementation by focusing specifically at the project level. It was revealed that those external factors are impacting the levels of QMS implementation in different ways. Some of these factors may potentially drive a QMS adoption, while other factors might impede the successful deployment of the system.

During the second stage of data collection, the practical approaches described or proposed by the informants of the case studies, provided a deeper understanding of how the external factors, and the CSFs, affect QMS deployment within the context of each specific project examined. The within-case analysis revealed a high similarity of general impact of the external factors across all three cases. However, the level of each factor's impact varied amongst the cases, largely due to the overall resources dedicated by organisations for QMS adoption, especially related to the available human resources allocated to manage the requirements of QMS implementation. The analysis of the data from the three case studies emphasised the impact of the CSFs on adoption of rigorous QMSs on building projects. On the other hand, it was noted that these factors are applicable to different levels of organisation, and by adopting these factors at the relevant levels results in the most robust outcomes of QMS deployment.

The cross-case analysis provided a strong basis for generalising the findings of the three case studies by drawing comparative conclusions across the findings from the cases. The results emphasised the various impacts of the external factors on the effective deployment of QMSs. It was found that only two of the external factors actually clearly drove the adoption of QMSs in building projects, whilst all other factors acted as barriers to implementing a rigorous QMS. The analysis shows that '**client awareness towards QMS significance**' and '**legislation and regulations**' are the main external drivers for implementing a vigorous QMS in theCIBS. Client awareness is fundamental to implement a successful QMS owing to the main resources that clients can, or do, dedicate, to improve the levels of implementation, such as 'lessons learned'. Also, clients who are fully aware of QMS significance are more likely to provide distinct expectations regarding quality, which are essential to developing precise requirements of, and for, QMS deployment. Legislation and regulations also drive QMS implementation, when building organisations utilise them as guidelines, expectations, or benchmarks to ensure compliance of QMS requirements with such legislation and regulations.

The cross-case analysis addressed the impact of external barriers on the effective adoption of QMSs. The results indicate that **'skilled human resources'** is the most significant external barrier that confronts the successful deployment of QMSs in the CIBS projects. This issue is a result of external influences, which include the dearth of qualified staff in the building workforce market necessary to deliver a robust QMS, and the high competitiveness of such a market that makes retention of an experienced workforce a serious challenge to implementing an effective QMS. Employing the required levels of human resources for QMS adoption is however, directly affected by the overall perception of the management of building organisations about the significance of recruiting adequate and essential staff for adopting a rigorous QMS. As a result, it would appear that building organisations are, in general, parsimonious towards investing in quality through allocating the levels of essential resources necessary for QMS implementation.

The results of the cross-case analysis also highlighted the impact of other external barriers on the levels of QMS adoption. However, these factors appear to be impacting on the deployment of QMS throughout the different stages of a project. In this context, it appears that the initial influence of some external factors is constantly reflected in the processes operating during the adoption of a QMS during the project execution. For instance, **'design process'**, which is often most concentrated in the primary stage of a project in order to accomplish design documentation, is more likely to impact QMS deployment during the construction stage. This results from production of incomplete design documents, or provision of non-constructible items that need to be designed later, i.e., during the implementation of a QMS. Therefore, to ensure effective adoption of QMS throughout a project cycle, it is fundamental to handle design issues at the early stage of projects before they become barriers to the QMS deployment process.

The analysis of the exploratory study clearly identified the CSFs for effective deployment of QMSs, especially those impacting on their implementation at project level. However, examining these identified CSFs, in conjunction with other CSFs identified by the literature review analysis within the case study projects, provided a deeper understanding about the impact of these factors. The cross-case analysis significantly corroborated the initially identified influence of the CSFs on QMS adoption addressed by the within-case and exploratory study analyses, particularly concerning the levels at which these factors needed to be implemented, in order to acquire the very best outcomes for QMS adoption. Three levels for implementation of the CSFs are indicated by these analyses, namely the organisation level, project level, and both levels. Notwithstanding, the overall CSFs were ranked in descending order to indicate the significance of these CSFs for adopting a vigorous QMS in building projects. The cross-case analysis shows that **'management review and feedback**' is the most significant CSF for effective adoption of QMS across all levels of adoption of these factors.

However, the cross-case analysis indicated that the CSFs at each level, based upon the anticipated outcomes of adopting these factors, assured a more effective deployment of a QMS. Only two CSFs were indicated as needing to be adopted specifically at organisational level, namely **'top management commitment**' and **'leadership support**'. Also, top management commitment is the most important factor at that level, due to the key role of such commitment for ensuring effective deployment of QMSs amongst different levels of organisations. Moreover, the results of the cross-case analysis emphasised that more than half of the CSFs are indicated as needing to be adopted at the project level to gain robust outcomes from QMS implementation.

**‘Digital technology**' is the most significant CSF at a project level because adopting this factor has many implications on the facilitation of implementing a vigorous QMS throughout the project life. Nonetheless, adopting the CSFs at the project level is more likely to address the potential barriers that confront QMS implementation during the whole project cycle. More specifically, some CSFs support QMS adoption if they are implemented during the pre-stages of projects, such as '**construction site planning**', **'end-user involvement**' and '**client involvement**'. As an illustration, the primary effective involvement of a client and end-user helps with the perception of their expectations regarding quality; this is essential to developing precise requirements for QMS deployment. Also, accomplishment of efficient construction site planning beforehand facilitates implementation of a robust QMS during the project execution stage, through the handling of potential issues related to safety, and resulting from poor planning concerning the clear definition of roles and responsibilities.

The analysis of data also highlights the CSFs specifically necessary for effective adoption of QMSs that can be adopted across both organisational and project levels. It has been noted that **'management review and feedback**' is the most significant CSF owing to the various benefits resulting from adopting the factor. Its adoption is emphasised as being crucial to facilitating QMS deployment by the provision of essential resources for implementing other CSFs. Management review, for instance, assists in developing lessons learned, which are essential to continuous improvement and education and training due to analysing, evaluating, and disseminating positive achievements, identified nonconformities, or quality issues, during regular management meetings. On the other hand, all other CSFs of this level have some impact on QMS adoption through either facilitating the process of implementation, or by tackling some of the barriers encountered during the adoption of such systems during the project execution.

Revealing the impact of the external factors on QMS deployment helps management teams of construction organisations to establish a strategic approach to managing the influence of these factors during the implementation. Addressing the external factors also assists construction companies to develop comprehensive requirements for a successful QMS implementation, taking into account the various impacts of these factors. Accordingly, establishing the precise requirements for an effective QMS deployment can result in a successful implementation of such a QMS by related stakeholders. Also, the identification of a comprehensive list of CSFs by focusing on the contribution of different organisational levels of implementing these factors is fundamental to assuring a vigorous deployment of QMS in building projects. This assists organisations to determine the essential required resources for adopting CSFs at different levels of company, or within project teams, prior to commencing a project. Consequently, adopting holistic CSFs for QMS implementation is essential to tackling the critical obstacles that have often confronted QMS deployment for a long time in the CIBS.

Overall, the findings of this research corroborated and emphasised the assumptions of the conceptual framework, which hypothesised that the implementation of QMS is affected by all identified surrounding factors, internal and external, and that the level of deployment can be improved by adopting holistic CSFs, especially those impacting at a project level. Also, these findings led to developing and validating the final framework of QMS deployment presented above in Figure 9.1. Adoption of this framework by building organisations can improve the performance of implementing a QMS in their projects, since it clearly indicates all of the potential barriers that are anticipated to occur, as well as explaining how to handle these when, and through, adopting the suggested CSFs.

## 9.5 RESEARCH CONTRIBUTION TO THE THEORY AND PRACTICE

The outcomes of this study provide a number of contributions to both academic knowledge, and for future benefits to be realised by the construction industry. The following section reports on the theoretical and practical contributions of this research.

### 9.5.1 Contribution to the Body of Knowledge

1. The main contribution of this study to the academic knowledge on QMS implementation is that it identifies the external factors affecting QMS adoption and provides a deeper understanding of how these factors impact on the QMS deployment by addressing both their negative and positive influences.
2. The research findings have addressed an inclusive list of the most important CSFs for QMS implementation in building projects, by focusing on those factors especially appropriate to be adopted at a project level.
3. The study clearly highlights the impact of these CSFs by ranking them in descending order to show the significance of each CSF for QMS adoption. It has also categorised these factors into three different levels in accordance with their suitability to be adopted at a specific level (organisational, project, or both).

4. The research establishes a new inclusive framework for QMS implementation that integrates all of the identified factors and provides clear insights into the influence of all of these upon QMS adoption, and also on the performance of implementing such systems. It also emphasises the relationships between these factors and how they potentially impact on QMS performance, or on each other.

### 9.5.2 Practical Contribution to be considered by the Construction Industry

A number of practical contributions are provided by the outcomes of this research for consideration by the construction industry, especially theCIBS:

1. This research has addressed a key gap in the context of QMS deployment in the AustralianCIBS, namely the absence of any comprehensive framework for QMS implementation, which encompasses all of the factors impacting the implementation. That can dissipate the efforts of building organisations to adopt a QMS at a similarly high level to other industries, such as manufacturing and services.

2. To handle this gap, the research investigated and identified all factors affecting QMS deployment, especially those external factors sitting outside the internal context of organisations in conjunction with the CSFs that had an influence, specifically at a project level.

3. The integrated holistic framework of QMS deployment established by this study will facilitate the construction sector, especially building organisations, in assuring a more rigorous implementation of QMSs in the future. This framework offers a clear set of guidelines for these organisations to apply throughout the adoption of a QMS by highlighting the different factors to be considered that may impact on the implantation.

4. The indication of the levels of the impact of different factors on QMS adoption and grouping of these factors into various categories facilitates managing their impacts and helps in allocating responsibilities for organisational staff at different levels, to effectively cope with applying and managing these factors.

5. The outcomes of this study also allow decision makers within building organisations to clearly identify any required improvements to their QMS requirements, especially where such improvements can assist in mitigating the impact of the framework elements on the implementation of QMSs.

## 9.6 RESEARCH LIMITATIONS

A number of limitations associated with the scope and design of the study are identified in the current research, as follows:

1. The research was limited to the QMS implementation in the organisations of the Australian CIBS. Hence, the data of research was primarily gathered from the Australian building organisations and most of the participants of this research were limited to theCIBS from Queensland, Australia.
2. Whilst the sample of the study was purposefully selected to be focused upon, involving the most relevant and experienced participants who cope with QMS adoption, the selection process also of necessity took into account the availability and proximity of participants.
3. The sample of selected case studies was limited to Tier 1 and 2 of building companies, although the researcher initially planned to involve all three Tiers of the sector. This limitation is due to the fact that Tier 3 encompasses small organisations of theCIBS, which overall have less than 20 employees at most. Thus, all Tier 3 companies invited to participate in the study either declined to participate or did not respond to the invitation.

## 9.7 RECOMMENDATIONS AND FUTURE RESEARCH

This research has provided some novel and valuable insights, and deeper understanding regarding QMS implementation in the AustralianCIBS context. The lessons provided here can also be used by other sectors that adopt similar QMSs to those in theCIBS, such as the civil sector. Based upon this, the following key recommendations are suggested to be considered for adoption by construction industry organisations and practitioners to assure an effective deployment of their QMSs. These recommendations are:

- ❖ Building organisations need to dedicate adequate resources to recruiting an essential workforce for QMS deployment, especially at the level of quality manager, and this requires a considerable change in the mindset of top management concerning the responsibilities for QMS implementation at project level.

- ❖ To ensure the effective implementation of a QMS throughout the project cycle, project teams should be exposed to intensive programs of training or engage frequently in workshops directed at delivering knowledge around QMS deployment requirements, so that they can meet a satisfactory level of qualification before the commencement of a project.
- ❖ Contractors should undertake a degree of transformational change in respect of the requirement for essential external audits of a QMS, which should regularly be performed in conjunction with internal audits to evaluate the levels and performance of QMS adoption.
- ❖ Building organisations belonging to Tiers 2 or 3 should nominate that their consultants/experts continually review changes to government policies, or regulations, in order to make the required amendments to adopted QMSs and develop clear benchmarks for future operation/implementation based upon these policies and regulations, to be used by project management staff to assure compliance with them in future.
- ❖ Project teams should undertake a regular involvement with external parties and stakeholders, especially with clients and end-users, in order to ensure meeting their expectations regarding quality throughout QMS implementation, and to conduct any required modifications to QMS requirements essential to fulfil these expectations.
- ❖ Building contractors should maintain effective and efficient internal and external communication amongst different project stakeholders to ensure effective sharing of management review outcomes across different projects, to assure effective involvement of external stakeholders in the process of QMS deployment, and to acquire effective feedback from these parties essential for continuous improvement.
- ❖ Senior management urgently need to immerse themselves in the process of QMS adoption at project level, to provide the required empowerment, support, and resources to assist and support QMS-related staff.

- To adopt all the previous recommendations, building companies should immediately begin to transform QMS requirements, especially essential documentation from soft copy to hard copy, and widely utilise digital technology to more effectively communicate across all levels of company and stakeholders.

Additionally, the limitations presented in the preceding section also identify some potential recommended future studies for consideration by researchers as follows:

- The main focus of this research was on investigating the QMS within the context of theCIBS. It is suggested that further research is required to examine the context of sectors other than the construction industry, such as the civil engineering sector, by adopting the results of this study to incorporate the methodologies and build on the findings by performing related research within the context of other sectors.
- The framework is established based upon the data gathered from selected projects in Queensland. Thus, further research may be carried out to test this framework in the Australia-wideCIBS, or globally.
- The outcomes of this study are mainly based upon the prime perspectives of the study participants, who represented different managerial levels. Future study may be undertaken to examine the impact of the identified factors depending on a wider basis of participants who are fully representative of the many different stakeholders of building projects, such as clients and subcontractors.
- The outcomes of this study are primarily focused on the adoption of QMSs in the CIBS. Future research might be carried out to examine the impact of factors identified by this study in the successful deployment of other management approaches, such as 'lean construction', which is considered as an effective and complementary strategy for quality management/continuous improvement in the construction industry.

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# Appendices

## Appendix A-Exploratory Interviews Questions

5) How would you define the term “quality” in the context of your organisation?
6) What is the current system for managing (Quality management system - QMS) adopted in your organisation?
7) Do you have a quality manual or other document detailing your QMS in your organisation?
8) How do your staff currently perceive your organisation’s QMS?
9) To what extent do you think that external factors affect (positively/ negatively) the successful adoption of QMS?
10) What are the main external factors influencing effective implementation of QMS? Can you prioritise them?
11) Do you think that these factors have more impact on a QMS before or after it has been adopted in an organisation? If ‘yes’ why? If ‘no’ why?
12) What are the overall critical success factors (CSFs) for effective implementation of the QMS adopted by your organisation? Can you specify them?
13) Do you think that there are any other CSFs that could be adopted to ensure successful implementation of QMS at project level rather than company level? If so, what are they?
14) In other words, what do you think need to be fixed to better delivery of project consistently?

# Appendix B -Case Study Protocol

This protocol is developed to define the instruments and procedures to follow in undertaking the case studies and to guide the investigator during data collection process.

## CASE STUDY OBJECTIVES

The main aim of the case study is to explore how the identified external factors impacting the successful implementation of QMS in the building organisations. Also, the case studies are utilised to explain the effect of adopting the CSFs for effective implementation of QMS on the deployment of such system in the projects of these companies.

## CONFIDENTIALITY

The data collected for this study will be treated as strictly confidential. All comments and perspectives will be kept anonymous.

## RECORDING AND STORING THE COLLECTED DATA

A digital audio recorder will be utilised to record the interviews to ensure that all the comments and perspectives expressed by interviewees are recorded. Also, all data collected will be stored in researcher's personal academic storage space by using a locked filing cabinet within Queensland University of Technology area only.

## INTERVIEW SESSIONS' TIMING

### Stage 1 - Beginning Phase: Introduction to the research (5 mins)

- Introduce the researcher and the study;
- Thank participants for consenting to conduct the interview and taking time off to do it;
- Introduce the main concepts of the research;
- Clarify the data collected confidentiality level for interviewees and provide them ethics consent form to sign;
- Ask for permission to record the interview

*"QUT has strict policy on ethics, and for this research to be carried, ethics had to be approved. That's why before we start the interview, I would like to ensure you that this interview is absolutely confidential, and in no way, it could be apparent that responses came from you. Could you please read and sign this consent form to confirm your agreement to participate in the study?"*

- Ask for permission to record the interview

**Stage 2 - Implementation Phase: Case Study Questions (40 mins)**

**INTERVIEW QUESTIONS:**

Current research case study questions are constructed to answer main research project objectives. These major questions were broken into several sub-questions to facilitate answering these questions with sufficient details. Then, a review of the questions was implemented and as the result more detailed questions, written in lay language, are designed as below:

**Demographic questions:**

1. How long have you been working for (organisation name)?
2. What is your current position, and your responsibilities in your organisation?
3. Are you directly responsible for implementing your organisation's QMS on your projects?
4. Do you have sufficient resources within your projects to implement your QMS effectively?
5. Can you show how the personnel responsible for implementing QMS within (Company name) integrates into your overall company? Can you describe the hierarchical structure of your QMS Team/Division/Personnel?

**To explain the effects of different external factors on the effective implementation of QMS:**

15) Does your organisation's QMS help to ensure high-level quality of your deliverable products?

16) Based on the list of external factors, (Interviewer will provide this to you), how do these external Factors affect either adoption or implementation of your organisation's applicable QMS?

17) Using the term '**Barrier**' or '**Driver**', how would you categorise these external factors related to their impacts on adopting or implementing effective QMS in your projects?

18) How do the external Barriers impact on the adoption of a robust QMS by organisation's decision makers and delivery of quality products that satisfy your customers?

19) How do the external drivers facilitate the implementation of a successful QMS by organisation's decision makers and delivery of quality products that satisfy your customers?

**To clarify the impact of adopting CSFs for QMS implementation on effective deployment of QMS:**

20) Based on the List of Critical Success Factors (CSFs) (Interviewer to provide), which of these are adopted by your organisation? Can you explain your choice?

21) Why these factors and not the others? Can you explain?

22) Do you think that these adopted CSFs can help the implementation of an effective QMS within your projects? If yes, could you explain how? If no, could you clarify why?

23) Do you think that adopting these CSFs can assist in tackling some of the barriers impeding effective implementation of QMS? How?

**Stage 3 - Closing Phase (2 mins)**

- Within this stage, the researcher will thank interviewees for their participation and ask them if there is a chance to contact them again to answer any new question released during the development of this stage.

**DATA COLLECTION PLAN AND PROCEDURE**

i. **Selection of cases of research:** This research focuses on exploring the level of QMSs implementation in building projects. Therefore, four building organization within Queensland State, and from various tiers will be chosen as main case studies for this research.

24) The ‘participant information sheet’ will be sent to the participants’ organizations prior to conducting the case studies. The nominated interviewees will be asked to sign the ‘consent’ form before the interviews can be undertaken.

ii. **Data collection methods:** As mentioned before, several data collection methods within case studies will be conducted to gather comprehensive knowledge about research phenomenon. Those methods consist of semi-structured interview as a prime method of data collection, direct observation, and documentations analysis.

iii. **Interview timeframe:** Case study interviews are planned to be conducted between August to December 2017.

iv. **Definition of terms used in interviews:** The interviewees are anticipated to be nominated from different managerial levels depending on their roles in implementing QMS within participated companies. Therefore, it is supposed that the interviewees will be to be familiar with many complicated terms around the research focus; however, the interview questions are formulated in a way that there is no specific term that needs to be defined for the participants.

v. **Preparation and ethical clearance:** This research received QUT ethical approval on the 8th of June 2017 to commence the data collection process.

## Appendix C-The Information Consent Form

| | |
|---|---|
| Queensland University of Technology Brisbane Australia | **CONSENT FORM FOR QUT RESEARCH PROJECT – Case Study –** |

**An Evaluation of Quality Management Systems (QMSs) Implementation in the Construction Industry**

**QUT Ethics Approval Number 1600000950**

**RESEARCH TEAM CONTACTS**

| | | |
|---|---|---|
| **Mohammed Ali Ahmed** | +61 412 698 206 | mohammedaliahmed.ahmed@hdr.qut.edu.au |
| **Vaughan Coffey** | +61 439 007 545 | v.coffey@qut.edu.au |

**STATEMENT OF CONSENT**

**By signing below, you are indicating that you:**

- Have read and understood the information document regarding this project.
- Have had any questions answered to your satisfaction.
- Understand that if you have any additional questions you can contact the research team.
- Understand that you are free to withdraw at any time, without comment or penalty.
- Understand that if you have concerns about the ethical conduct of the project you can contact the Research Ethics Advisory Team on +61 7 3138 5123 or email humanethics@qut.edu.au.
- Agree to participate in the project.

**Please tick the relevant box below:**

☐ I **agree** for the interview to be audio recorded.

☐ I **do not agree** for the interview to be audio recorded.

**Name** ______________________________

**Signature** ______________________________

**Date** ______________________________

**PLEASE RETURN THE SIGNED CONSENT FORM TO THE RESEARCHER.**

## Appendix D-Project Quality Start-Up Workshop

Date: Time:

Location:

Attendees:

| | | |
|---|---|---|
| | | Construction Manager |
| | | Project Engineer |
| | | Site Engineer |
| | | Qld Quality Manager |

| Item | Details | Action By | Closed Out |
|---|---|---|---|
| 1.0 | Project overview | | |
| | •Proposed site start date = approx. 3 July at this stage.<br>•This Workshop follows the Project Start-up Quality Procedure Issue 1. | Note | |
| 2.0 | Package Criticality Matrix | | |
| | •Initial review completed previously and is part of the Project Quality Plan.<br>•Will be developed further as specifications become AFC & Master Schedule is developed.<br>•Subcontractor audit schedule initial completion is part of the Matrix. | DM | |
| 3.0 | Project Contract Requirements & Deliverables | | |
| | •Have on file as part of PCP process.<br>•MW to provide for audit purposes latter. | LW | |
| 4.0 | Quality Master Schedule | | |
| | •Quality Master Schedule is to list all approvals, samples, shop drawings, inspections, tests, O&Ms, warranties, spares, training, etc. called up in the contract documents (specifically the specification.<br>•Needs to be updated as the job progresses.<br>•RS has Master Schedule well underway. Will be further developed as specifications become AFC. | RS | |
| 5.0 | Project Quality Rep | | |
| | •QA Rep at this stage = Devin Miller. | Note | |
| 6.0 | Quality Management Plan | | |
| | •QMP has been completed.<br>•CC has reviewed.<br>•As specifications & other documents including the master schedule are developed, section 9 of the QMP (Package Specific Quality Requirements) may need to be developed further. | Note | |

| | | | |
|---|---|---|---|
| | | | |
| 7.0 | Establish Project Quality Systems | | |
| | •Aconex is the collaboration system for the project.<br>•Aconex will also be used for completion documentation (O&M Manuals, etc), & Aconex Site Works will be used for Defect Management.<br>•In Aconex, there is a Mail type called Diary = an electronic diary system, which can be used. | Note | |
| 8.0 | Subcontractor Works to Proceed EHS & Quality Checklist | | |
| | •Ensure this document (attached) is used for all subcontractors to review their QA system before they start on site, in conjunction with the QA Master Schedule.<br>•Note in particular the review of ITPs is part of Subcontractor Quality Works to Proceed. | Note | |
| 9.0 | Audit Checklists | | |
| | •Attached are audit checklists (both Procurement and Project) for the Contract Manager & the Site Engineers to use to ensure they have all bases covered regarding Lendlease procedures. | Note | |
| 10.0 | Training | | |
| | •Note Site Engineers are expected to audit trade package subcontractors under their control & are to have internal audit training. Some staff will have already received this training late last year. CC will organise training in conjunction with the Corporate QA Manager's future visit latter in the year.<br>•There is a Lendlease requirement that those involved in supervising waterproofing & passive fire trades are to have undertaken CIDD training by Paul Langhorne. Several of the team received this training recently. Further training to be organised for other staff through the project. | CC | |

## Appendix E-Meetings and Reviews Performed by Project Management

| Activity | Responsibility | Frequency | Quality Review Activity | Proforma/ |
|---|---|---|---|---|
| **Pre-Construction Review Meeting** | PM/CM | Once. Before construction commencement | Approval of commencement of project works and confirmation of completion of quality planning, roles and responsibilities, risk assessment | Project Pre Construction – Agenda<br><br>Review minutes |
| **Risk and Opportunity at Design (ROADs) Workshop** | PM | Prior to proposed design solution | ROAD process is used to undertake reviews of all risks and opportunities of a project's proposed design solution including those relating to constructability. | Project ROAD Assessment Template |
| **[Organisation A] Project Team meetings** | CM | Weekly | Upcoming quality risk activities and surveillance requirements; effectiveness of system, non-conformances | Minutes of meeting |
| **Subcontractor Pre-award Meeting** | Project / Site Engineer | Once. Before contract is awarded | LLB Quality Requirements for subcontractors | Minutes of meeting |
| **Project Control Group (PCG) Meeting** | CM | As per contract requirements | Client Quality feedback | Minutes of meeting |
| **Project Reviews** | CM | 6 weekly | Quality section of project review report, quality performance metrics | Review report/actions arising from meeting |
| **End of Project Review** | CM | Within 1 month of project completion | Defect close outs, effectiveness of controls | End of Project Report |

**Appendix F-Flowchart of Performing internal and external communication**

## COMMUNICATION (Q&E)

### COMMITMENT

Q &E Manager

Provide a copy of the [Organisation B] HSEQ Policy and general information on the company's quality and environmental performance to all external parties upon request

Provide the Policy to external interested parties through public display at the various project sites and through tender submissions as required

Communicate with and respond to requests from Statutory Authorities, Local Government bodies and similar Agencies

Provide information of the company's QMS and EMS, and the quality and environmental performance in response to Expressions of Interest and Tenders

Provide Quality and Environment Reports to management as required

Periodically disseminate information on the company's quality and environmental performance to employees

Provide general information on the company's quality and environmental performance to Clients and external parties

Coordinate all correspondence with Statutory Authorities, Local Government and similar agencies as a result of quality and environmental incidents

### MEDIA INTERFACE

All Personnel

Direct all enquiries from the media, Green groups and like organisations concerning [Organisation B]'s quality and environmental management activities to the Corporate Affairs Manager.

[Organisation B]'s Managing Director or Corporate Affair Manager are the only people authorised to direct contact with the media.

The company will not communicate externally about its significant environmental aspects other than:

- The provision of information to subcontractors and visitors as part of Project inductions and tool-box meetings.
- The provision of information to external parties in compliance with Permit, legal, regulatory and other requirements.
- The provision of information to Clients, Principals and Superintendents in compliance with Contractual, legal, regulatory and other requirements.

Any requests to communicate our significant aspects externally must be directed to the State Manager and Corporate Affairs Manager for consideration

The HSEQ policy will be made available to the public by request.

### PROJECT COMMUNICATION

Project Manager

Advise the Construction Manager, State Manager and Quality and Environment Manager of all serious quality and environmental incidents and complaints

Work in partnership with the Q&E Manager to communicate with the Client, Statutory Authorities, Local Government bodies as a result of quality and environmental incidents

Report project quality and environmental information in Monthly Project Reports to management and Project Reports submitted to the Client

Site Manager

Display the Watpac HSEQ Policy at the project site

Discuss applicable quality and environmental items during project Toolbox Meetings

Report all serious incidents and complaints to the Project Manager and the QA&E Manager

Advise the QA&E Manager of all relevant quality and environmental communications from external sources, including the notification of all external audits and requests for information

# Appendix G-Client Satisfaction Survey

| | | | |
|---|---|---|---|
| PROJECT NAME | | | |
| COMPANY NAME | | SURVEY COMPLETED BY | |
| YOUR ROLE ON THE PROJECT | CLIENT | | |

| | |
|---|---|
| PROJECT/CLIENT SPECIFIC DISCUSSION | (Background information must be sought relating to the Client/Project specific requirements, from our prior knowledge of the Client, tender documents and information gained from the Client project start up meeting.) |
| | |

| Very Poor | Poor | Satisfactory | Good | Excellent |
|---|---|---|---|---|
| 1-2 | 3-4 | 5-6 | 7-8 | 9-10 |

| | | RATING | COMMENTS |
|---|---|---|---|
| INTEGRITY | Do you feel we did/are acting in a professional manner and have/are been honest, transparent and open in our communications and day to day actions? | | |
| | Would you classify [Organisation C] as a trusted advisor? | | |
| CLIENT FOCUS | Did/do we understand your business and respond to your unique requirements? | | |
| | Did/are we living up to our promises and your expectations? | | |
| | Are we meeting/exceeding your expectations and delivery the project and contract conditions? | | |
| | Do you believe we administer the contract in a fair and reasonable manner? | | |
| CONTINUOUS IMPROVEMENT | Did/are we providing the level of quality/service that you expected? | | |
| | Do/did we challenge assumptions to ensure that you are receiving best value for money? | | |
| | Did/has our team openly requested and provided feedback so that we can capture improvements and lessons learned? | | |
| | Did/have we adapted to and address the issues that arise during the progress of the works? | | |
| TEAMWORK | Did/are we working collaboratively with you and the key stakeholders/project team? | | |

| | | RATING | COMMENTS |
|---|---|---|---|
| ACCOUNTABILITY | How responsive was/is our team to deal with issues that arise? | | |
| | Do you believe [Organisation C]'s Senior Management are accessible and reasonable to deal with? | | |
| | Do you feel the project team was/is adequately supported by Senior Management? | | |
| | Did/are we taking responsibility for our performance on the project? | | |
| | Have we delivered the works in the spirit of the contract? | | |
| | Have we met your expectations for timely delivery? | | |
| | Have we met your expectations for value and cost? | | |
| | Have we met your expectations for quality? | | |
| | Did/do we successfully communicate our expectations? | | |
| | Did/do you believe [Organisation C] systems adequately cater for your requirements? | | |

| RATING | Not achieved<br>1 | To | Achieved<br>10 |
|---|---|---|---|

| | | RATING | COMMENTS |
|---|---|---|---|
| OUR VISION | It is [Organisation C]'s vision to be a Contractor of Choice for our staff, clients, consultants and subcontractors. Where would you rate BADGE on this journey? | | |

| Do we have permission to use any of your comments as a testimonial? | Yes / No |
|---|---|