The Impact of quality management systems on construction performance in the North West of England

Mark Kennan, School of Built Environment, Liverpool John Moores University, UK

Ali Rostami, School of Built Environment, Liverpool John Moores University, UK

Abstract

Purpose - As the total construction output in the North West of England (NWE) is forecast to rise by an average of 2.5% over the next five years. It is imperative for organisations in the region to improve their overall construction performance, particularly if they are to hit the targets presented by UK Government in the construction 2025 report. Despite the known benefits of quality management systems (QMS) its implementation in relation to construction performance is very limited, particularly in the UK. Therefore, the purpose of this paper is to examine whether QMS can affect construction performance in the NWE.

Design/methodology/approach - A pragmatic mixed method approach of sequential explanatory strategy was adopted to conduct this research. This initially involved a quantitative approach of questionnaire surveys to gain opinions and views of a representative sample of industry professionals based in the NWE. The quantitative results were analysed to discover relationships in the data and further formulate the questions for the qualitative interviews. Three interviews with leading industry professionals were then conducted and the data was analysed using a thematic approach. The themes identified in the interviews were then cross-referenced with the data discovered in the questionnaire survey and literature review.

Findings - The findings provide a clear indication that the implementation of a QMS has a positive effect on construction performance in the NWE. Immediate improvements in efficiency of a construction organisation when implementing a QMS were discovered, including greater managerial control, and the recording and reduction in defects. Long term effects of changing company attitude by setting out company requirements and responsibilities through highlighting the significance of quality, and furthermore encouraging a culture of co-operation and teamwork, were also proven to increase construction performance as time progresses.

Research limitations/implications - To further enhance this research the focus could be on the whole of the UK. However, a greater amount of time would be required to gain the required representative sample. Furthermore, although the questionnaire survey was distributed equally

within the selected sample, a greater number of respondents working for contractors responded. Therefore, the respondents of the questionnaire survey were not equal in terms of organisation (client, contractor, sub-contractor, project manager).

Originality/value - According to the best knowledge of the authors and through searching many sources, there are no specific studies examining QMS and their effect on construction performance in the UK and particularly in the NWE. Therefore, it is believed the study is the first of its kind. The study discovered many findings that can be considered as a contribution to practice and theory. Moreover, it can be considered as a fundamental base for future studies in this research area.

Introduction

The construction industry has been criticised for decades regarding the industry's poor performance in relation to other industries (Almusharraf and Whyte, 2016). Many of the management practices that are used to support the construction industry are being challenged (Hoonaker et al, 2010). Clients demand improved service quality, faster buildings and new innovations and technology (Mydin, 2014). Wolstenholme (2009) suggests that clients are demanding more units of construction for less units of expenditure, as clients become more sophisticated and insist on better value for money. Moreover, quality has been identified as one of the main factors in the success of construction projects and one of the fundamental needs of clients (Mane and Patil, 2015; Ali, 2014). Thomas et al. (2012) suggests that in order to reduce the possible dangers and risk factors associated with quality of construction factors, some careful clients prefer to employ contractors with a quality management system (QMS).

Leong et al. (2014) describes quality as the totality of features required by a product or service to satisfy a given need or fitness for purpose. Quality in the construction industry emphasises the competence to discover requirements with conformance to a quality standard (Leong et al, 2014). Furthermore, Mane and Patil (2015) determine that quality on construction projects, as well as project success, can be regarded as the fulfilment of expectations of the project participants, and that it is one of the main factors in construction project success. While Mane and Patil (2015) also define a QMS as all activities of the overall management function that determine the quality policy, objectives, and responsibilities, implemented through mechanisms such as quality planning, quality control, quality assurance and quality improvement within the quality system. Therefore, QMS are designed to deliver quality

products to ultimately meet the needs of the customer and improve construction performance (Leong et al., 2014).

In 2013, the UK government set out ambitious national targets for the UK construction industry in the Construction 2025 report, including 33% reduction in costs, 50% faster delivery, 50% lower emissions, and 50% improvement in exports (HM Government, 2013). As the total construction output for the North West of England (NWE) is forecast to rise annually by an average of 2.5% over the next five years, which is above the UK average of 1.7% and the third highest growth rate compared with other regions and devolved nations (CITB, 2017). The region must improve its overall construction performance in order to hit the Construction 2025 report's targets (CITB, 2017; Dadhich et al, 2015), although, there is no strategy on how those targets will be achieved (Dadhich et al, 2015).

The construction industry's undesirable image

For the past number of decades, the construction industry has been increasingly criticised for its poor performance and productivity in relation to other industries (Almusharraf and Whyte, 2016; Hoonaker et al, 2010; and Mills, 2009). The criticism of the UK construction industry carried out in early 1930s by Bossom (1934), and followed with Simon (1944), and Banwell (1964). Following those studies, a number of government reports were considered to assess the UK construction industries performance (see table 1).

Table 1 – Government reports

Year	Author	Report
Early Reports		
1934	Bossom	Building to the Skies: The Romance of the
1944	Simon	Skyscraper
1964	Banwell	The placing and management of contracts for building and civil engineering work
Government Reports		
1994	Latham	Constructing the Team
1998	Egan	Rethinking Construction
2002	Egan	

2009 2013	Wolstenholme HM Government	Rethinking Construction 2002: Achievements, Next Steps, Getting Involved Never Waste a Good Crisis Construction 2025. Industry Strategy: Government and Industry in Partnership

An evaluation of the reports discovers key reoccurring themes of the agendas that affect UK construction performance and the perception of how it is being manged. The analysis of the reports demonstrate that a teamwork based culture of frameworks and partnerships to improve quality, as an alternative to the traditional procurement and relationships based on the cheapest price, is a consistent requirement. However, evidence suggests that insufficient effort and progress had been made (Wolstenholme, 2009). In addition to this, the industry is criticised for weak integration in the supply chain and insufficient investment and emphasis on training and research and development (Egan, 1998; Latham, 1994; and Wolstenholme, 2009). Contrary to this, the industry is also criticised for being over ambitious through setting unreachable targets (Dadhich et al, 2015). The reports list the wasteful, adversarial, and fragmented nature as common factor characteristics of the construction industry (Egan, 1998; Latham, 1994; and Wolstenholme, 2009). These common factor characteristics result in high rates of defects, none conformance, poor quality standards, excessive waste, and deficient performance of the construction industry that is frequently reported in the industry today.

Construction defects and quality deviations

According to Webster's Dictionary a defect is a lack of something necessary for completeness, or a shortcoming. It can also be described as a deficiency, fault, blemish, or imperfection (Ahzahar et al., 2011). Construction projects frequently contain construction defects and quality deviations that are typically tolerable if they are within the design and building code tolerance limits (Love et al, 2009). However, some deviations can lead to risky work in terms of cost, time, quality, and safety (Almusharraf and Whyte, 2016). Ahzahar et al. (2011) states that building defects can be the result of defective materials, a manufacturing flaw, error by the architect, a lack of observance to the design by the contractor, improper use of materials, or any combination of them.

It has become accepted by the construction industry that defects that are so severe that rectification is mandatory, are now part of the building process (Georgiou, 2010). These

deviations of such severity that continually need corrective action have been discovered to add substantial cost (Almusharraf and Whyte, 2016; and Love et al, 2009). According to studies by Almusharraf and Whyte (2016), and Love (et al, 2009) these manifest defects cause a 2-20% increase in the instant cost of construction projects. Construction defects can be related to internal factors associated with production or assembly, or they can be external causes related to issues outside of the organisation, environmental changes, or works related to different actors (Martin and Gatto, 2014). In addition to this, defects do not only have an impact on quality at handover, but also impacts the life cycle of the building (Jingmond and Argen, 2015).

Jingmond and Argen (2015) discovered that there are many different non-conformance issues identified in relation to defects in construction. The literature reviewed commonly highlights non-conformance issues causing defects such as insufficient knowledge, insufficient resources, motivation, minimal standardisation, lack of holistic approach, communication issues, inadequate construction, inaccurate design work, insufficient resources, differing opinions, risk allocation difficulties, and inappropriate operations (Almusharraf and Whyte, 2016; Jingmond and Argen, 2015; Ahzahar et al., 2011; Georgiou, 2010; and Love et al., 2009).

Quality in construction

There have been many different definitions for quality in the past, as it has a multifaceted meaning (Lai et al, 2016). For construction projects, its production process is complex, therefore companies must assess quality on each individual project separately, as it involves a high level of risk, it is affected by the quality of personnel, and the execution time is longer than other industries such as manufacturing (Lai et al, 2016). Leong (et al, 2014) believes that quality requirements are predefined by the clients in contract agreements and the requirements consist of the established characteristics of services, processes, and products. However, Mane and Patil (2015) suggest that although cost, time, and quality have been recognised as the three main factors concerning the client, for the majority of projects clients are more pre-occupied with cost and time parameters.

The crave for quality has been the predominant issue in the construction industry over recent times (Ali, 2014). Construction quality consists of service quality at project level, service quality at enterprise level, and product quality of the constructed facility (Lee et al, 2011). Almusharraf and Whyte (2016) suggest that contractors must take into consideration the nature of tasks applicable to a project, to overcome practical barriers that would otherwise result in cost and time overruns, poor quality, and would ultimately result in project failure and then use

this task reflection in order to combat it with a viable plan of execution. Furthermore, Rivera-Gomez et al. (2013) believe that quality can dictate a company's market survival. Gorman (2014) discovered that coordinating as a team, people accomplish more than they would working alone, and that shared knowledge has been linked to team effectiveness and improved quality. Leong et al. (2014) claims that in order to meet the client's quality expectations, all parties involved in the project must fully understand those requirements and expectations in order to achieve project success. Therefore, enterprises see the value in gaining control of quality planning, quality assurance, and quality control, and adopt a strategy of using a QMS (Mane and Patil, 2015; Ali, 2014; Leong et al, 2014; and Lee et al., 2011).

Quality management systems

Mukhtar et al. (2010) describes a QMS as a performance measurement towards continues improvement. While Lee et al. (2011) determines the target of QMS is the total quality management of all levels of business activities. The common theme in the definitions is the target to achieve decisive conformance through the implementation of continuous improvement via efficient and effective working (Mane and Patil, 2015; Lee et al, 2011; and Mukhtar, 2010).

Awny (2015) explains that ISO-9000 QMS has 3 layers including quality procedures, work instructions, and forms and reports. While Abdirad and Nazari (2015) advocate that QMS consist of a strategy of; quality planning, quality assurance, quality control, and quality improvement processes, which support setting up quality policies, providing and defining means, resources, and procedures to assess, improve, and maintain quality organisations. Thomas et al. (2012) discovered that a strategy targeting management responsibility, resource management, product reliability, and measurement analysis and improvement, as the four key areas improved satisfaction of the client in the region of 21-25% using a QMS.

Mane and Patil (2015) believe that to ensure continual improvement of QMS, it is imperative that top management give their full commitment and support particularly to the implementation and development of construction projects. QMS that are implemented effectively and efficiently have proven to be important in improving organisation performance (Leong et al., 2014). Both Lee et al. (2011) and Leong et al. (2014) suggest that treating QMS as a task will create a greater number of non-conformance. Furthermore, Rezaei et al. (2011) discovered that the construction industry still holds a lack of enthusiasm for the correct implementation of a QMS, and that the industry view QMS as a task rather than a strategy. However, Mane and

Patil (2015) state that the implementation of a QMS is a key tool in consistently and reliably managing the goal of client satisfaction, and can be implemented at both project level and organisational level.

From the literature reviewed it is clear that a QMS is a strategy of managing quality on site, with a clear theme of continual improvement. The system is applied by top management and must be adopted throughout the rest of the quality cycle and the rest of the organisation correctly in order to employ its full potential (Abdirad and Nazari, 2015; Mane and Patil, 2015; Leong et al., 2014; Patil et al., 2012; Lee et al., 2011; and Mukhtar, 2010).

Both Leong et al. (2014) and Aichouni et al. (2014) discovered that if QMS are too complicated the system cannot be implemented successfully, as it results in a poor degree of knowledge and application for the organisation. Therefore, a good structure is imperative for the QMS to be implemented effectively and efficiently.

Organisational and project quality management systems

The list of practically applied QMS documentation is large and includes staff job descriptions, policies, plans, organisation flowcharts, labour regulations, structural departments and committees' provisions, instructions, standards, requirements, procedures, service specifications, and sub-process descriptions (Šaulinskas et al., 2013). In general, when implementing a QMS there is a possibility to decide the extent of the documentation required; however, Hernada and Gayab (2013) reveal that according to the standard ISO organisations must have at least a quality manual, procedures manual, general and specific procedures, records, quality plans, and specifications.

According to the most recent research studies (Saulinskas et al, 2013; Kuei et al., 2013; Pabedinskaitė and Vitkauskas, 2011; and Breja et al., 2011), there are four levels of QMS documents. The first level documentation consists of organisational structure, quality manual, quality policy, division of duties and powers. This level is where the general principals and documentation structure are set. The second level documentation includes processes and procedures, which state the specification of how the activities are performed. The third level consists of labour manuals, operating manuals, and specifications. The fourth level contains various forms and records.

Further to organisational QMS, many construction companies adopt project QMS and a quality manager (Jraisat et al., 2015). As most defects in construction projects consist of roof leaks, building structure, foundation movements, drainage deficiencies, plumbing internal leaks,

infrastructure, doors, windows etc, quality checks will be carried out on projects reported to the quality manager (Rajendran, 2012). Therefore, the aim of a project QMS is to prevent construction defects, minimise punch lists and rework during the project, ensure work conforms to the contract documents and functional performance requirements, and preserve warranties (Rajendran, 2012). To perform these requirements the QMS requirements are to verify that all materials delivered meet project requirements, carefully inspect initial work activities to ensure crews are following instructions properly from the outset, perform timely inspections and tests, conduct a pre-closure inspection.

Rajendran (2012) believes that health and safety professionals would be able to perform the QMS requirements of a quality manager. However, Parmet (2013) disagrees with this, and states only after extensive training would a health and safety professional be able to carry out the role of the quality manager.

How the benefits of quality impact performance

A number of studies have examined the effects and benefit of implementing QMS in the construction industry, and evidence suggests that it can improve communication problems, minimise material wastage, reworks, mistakes, and have greater control over suppliers and subcontractors (Mane and Patil, 2015; Leong et al., 2014; and Lee et al., 2011). As researches also demonstrate that quality could assist firms to obtain a competitive advantage by delivering quality products to the marketplace in order to meet customer needs (Leong et al., 2014).

The relationship between QMS and performance can be related to quality assurance and quality control of the system, as this consists of measuring achieved outputs tasks against predicted output tasks (Chiarini, 2011). The literature advocates that large successful companies benefit from quality management in relation to performance through reduction in the amount of non-conformance, rework, and wastage, as well as an improvement in their goodwill. (Thomas et al., 2012)

The benefits of adopting a QMS to increase performance levels is widely recognised (Mane and Patil, 2015; Lee et al., 2011). There is debate as to the effect of QMS in relation to performance, as some literature states it has minimal effect, and others state if implemented correctly can produce significant effect (Thomas et al., 2012). Therefore, it could be argued that the method of the measured outcome, could have an impact on the results of its overall effectiveness (Kotane, 2015). Consequently, the literature examined could not provide a consistent outcome. Therefore, the subject topic will be further investigated with the collection and examination of data.

Research approach and methodology

The research will follow a pragmatic approach to produce a constructive and comparative opinion based research on solid information and data. A pragmatic approach is often associated with a mixed method research, as it is an approach were the researcher does not focus on methods but rather uses any angle they can in order to understand the problem (Creswell, 2009). As both performance and quality are subjective ideas and therefore concept variables to provide conclusive data, retain adequate context, and connect with the subject, a pragmatic mixed method approach is the necessary methodology for this task (Saunders, 2012; Creswell, 2009; and Potter, 2006).

Both quantitative and qualitative approaches were adopted in this study using a sequential explanatory strategy (Saunders, 2012). This involved initially a quantitative approach offering the capability to measure the opinions and views of a selected sample (Creswell, 2009). In addition, it allowed the measurement of variables and to conclude the important relationships such as knowledge and awareness of QMS implantation, and understanding QMS against industry performance. Furthermore, a quantitative approach developed the shared thoughts of a population in percentage wise (Saunders, 2012). It helped to statically determine the use of QMS in the North West of England. However, as a 'follow up explanations model' of sequential explanatory strategy was employed, the quantitative results discovered relationships between the data in order for the qualitative questions to be formulated (Creswell, 2009).

The survey questions were formed through the topics discovered in the literature review. As the target audience are busy industry professionals the questionnaire was divided into three sections with a total of 13 questions, with the aim to get as many responses as possible to allow quick responses and furthermore providing the questionnaire with greater appeal. The questionnaire survey was disseminated through an electronic link that was password protected in order for only the participants to gain access and was distributed via electronic email directly to the intended recipient. The survey involved a total of three sections. The first section of the survey was designed to discover the participants background such as their professional position, age range, working experience, and whether they believe there are a high level of defects in the industry. The second section is designed to assess the performance in the NWE construction industry. Moreover, to assess construction performance, and discover common factors that affect construction performance the NWE. The final section of the survey aimed to examine the use of QMS in the construction industry. Additionally, it attempted to measure

whether QMS affect construction performance, including quality on site, financial gain, and other benefits.

For the questionnaire survey section of the study a random sampling method was adopted. Professionals were selected randomly from a given population which are a group of professionals working in the NWE construction industry. Each subject had the same probability for selection in the survey including contractors, clients, sub-contractors, and project managers in both the private and public sector. The population was obtained from different resources such as tendering portals in the NWE including The Chest, Constructionline, Due North, Pro-Contract, and Contracts Finder. The researcher was also in a fortunate position where they had been working in the NWE construction industry for over ten years and had access to a number of different portals and professional contacts. The representative sample were only contacted electronically with a covering email and the questionnaire password protected. This avoided unlimited and uncontrolled spread of the survey, as only the respondent sample had access to the questionnaire survey. Though this method may lower the number of participant responses, it is believed that this method will ensure that only construction professionals in the NWE will participate in this survey. A pilot study was conducted were the research questionnaire was evaluated by two academic and two industry professionals before distributing to the participants, which in turn provided helpful feedback to improve the quality of the questionnaire.

The data collected from the 83 participants was analysed through SPSS 23. The data was then proofread and checked randomly through the SPSS software to identify if any errors had occurred. A univariate analysis of all 13 questions was carried out, displaying frequency, standard deviation, and the modal answer of each individual question.

The second stage of the sequential explanatory strategy is to conduct qualitative research. An interview method was adopted for this part of the study (Naoum, 2007). Within the explanatory stage, a pilot study with two academic professionals was carried out to examine the feasibility of the method. The interviews were conducted and based to support the results discovered in the questionnaire. The method aimed to expand the investigation through in depth discussion with industry professionals of some specific findings. The results from the pilot study helped to consider sixteen questions within the interviews, with the questions aimed at factors affecting construction performance, QMS factors, and whether QMS affect construction performance. The questions were designed to gain a greater understanding of the answers

produced in the questionnaire survey, and to further investigate the aim and objectives of the study.

Once the data had been analysed from the questionnaire survey, the characteristics of the interview respondents could be specified. The targeted population for the questionnaire survey was construction industry professionals (Naoum, 2007). However, as the majority of professional respondents to the questionnaire were employed by a contractor, and furthermore utilise a project QMS as well as an organisational QMS. It became clear that the characteristics of the three respondents were to be industry leaders employed by a contractor. Implementing a selected sample approach, the interview sample was selected on their experience and their contractor organisation category. Consequently, the researcher selected three participants that represent three different contractor organisation categories including a medium size building contractor, a large building contractor, and a large civil engineering contractor. Furthermore, the sample was chosen on their professional working experience, were the respondents had to have worked for a minimum of ten years in the construction field.

Data analysis of questionnaire survey

The respondents to the survey demonstrated a respectable level of experience, with professionals with over 10 years' experience in the industry representing 40% of the survey, and respondents with 7-10 years of experience representing 20% of the sample population. (Table 2)

Table 2: Questionnaire response

	Ranking					**Standard Deviation**
	1	**2**	**3**	**4**	**5**	
Organisation	Contractor (69%)	Client (18%)	Project Manager (9%)	Sub-contractor (2%)	Other (2%)	0.963
Age	31-40 (36%)	41+ (34%)	26-30 (22%)	18-25 (8%)		0.949

Experience	Over 10 (40%)	4-6 (21%)	7-10 (20%)	1-3 (19%)		1.170
Do you believe there are a high level of defects?	Mostly (48%)	Strongly (30%)	Disagree (16%)	Not sure (5%)	Strongly disagree (1%)	1.043
Are targets set too high?	Disagree (64%)	Mostly (18%)	Strongly disagree (8%)	Not sure (6%)	Strongly (4%)	1.003
Are quality standards underperforming?	Mostly (42%)	Disagree (39%)	Strongly (11%)	Not sure (6%)	Strongly Disagree (2%)	1.145
What affects construction performance?	Lack of collaboration (29%)	Industry being resistant to change (23%)	Lack of skills (15%)	Economic (15%)	Bad culture (13%)	
Performance productivity of workplace?	Above average (46%)	Good (25%)	Average (24%)	Below average (4%)	Poor (1%)	0.864
Do you operate under a QMS?	Yes (95%)	No (5%)				0.215
Do you understand and find your QMS beneficial?	Understand and find it beneficial (48%)	Understand clearly and find very beneficial (35%)	Understand the system but do not find the benefits (12%)	Do not understand the system and do not see any benefits (5%)		0.808

Do QMS systems help maintain quality on site?	Mostly (60%)	Strongly (27%)	Not sure (8%)	Disagree (4%)	Strongly disagree (1%)	0.777
Do QMS increase chance for financial gain?	Mostly (47%)	Strongly (27%)	Not sure (19%)	Disagree (7%)		0.866
Advantages and gains from QMS implementation ?	Improved efficiency (56%)	Greater managerial control (25%)	Inferior number of defects (17%)	Other (2%)		0.799

Within the quantitative analysis, the standard deviation measured to find out how concentrated data are around the mean. Although the standard deviation of 1.043 represents a moderate to large spread of responses, it can be established through examining the results that the majority of the representative spread either agree or mostly agree (78%) with the statement that there are a high level of defects in the industry. Although 72% of the populated sample believe this is not down to targets being set too high, as they either disagree or strongly disagree with the statement.

An analysis of the data provides a modal answer of mostly (42%) believe that quality standards as a whole are underperforming in the industry. With a lack of collaboration (29%) as the highest scoring factor, and the industry being resistant to change (23%) as the next highest scoring answer. Following this, a lack of skills and economic factors both scored 15%, with bad culture representing 13% of the representative sample.

In addition to this, 71% of professionals believe their organisations to be either above average or good, when relating their work place to performance productivity. With 83% understanding their QMS and finding it either beneficial or very beneficial in the workplace.

87% of the participants either mostly or strongly agree with the statement that QMS help maintain quality on site. Additionaly 74% of the participants either mostly or strongly agree that there is a link between QMS and financial gain in the industry. Analysis of the results indicate that 56% of the professionals surveyed believe QMS improves efficiency. 25% believe QMS provides greater managerial control, and 17% believe it helps create an inferior number

of defects. The other option was selected twice and both answers suggested a 'requirement for tendering' (2%).

Data analysis of interviews

Transcripts from the three face-to-face interviews were analysed to highlight key statements using NVivo11. A total of 116 passages across the three interviews were highlighted and deemed to be related to the subject area. The three main high level themes were discussed during the face-to-face interviews. A thematic analysis has been produced to demonstrate the parent child relationship between the subjects and the lower level nodes creating a parent child relationship (see figure 1).

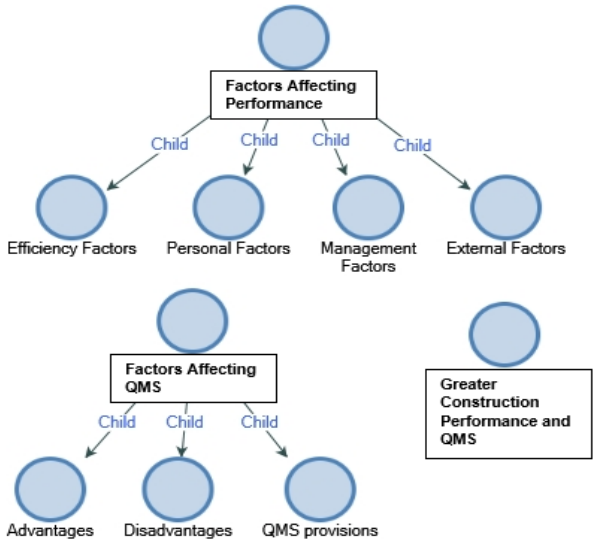

Figure 1 - High level themes

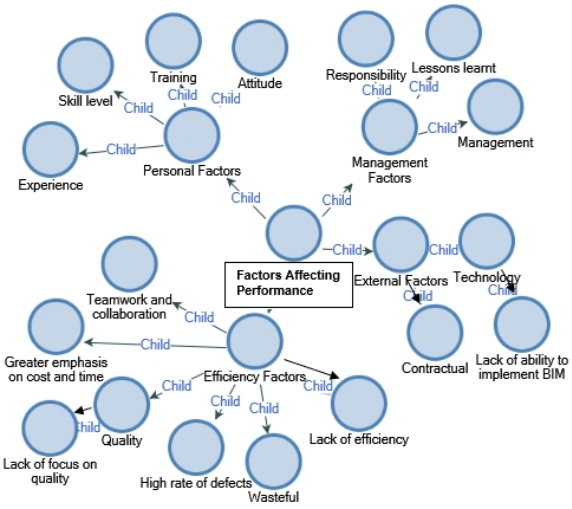

Figure 2 - Factors affecting performance

Factors that affect performance in the construction industry is the first theme discussed (see figure 2). A number of 38 passages were related to this theme. The theme was further grouped into 4 mid tiers and 15 lower tier sub themes.

Efficiency factors are factors that affect performance in the construction industry directly. The factors can be split up into a further 6 lower level themes including teamwork and collaboration (3 passages), greater emphasis on cost and time (3 passages), quality (5 passages), high rate of defects (3 passages), wastefulness (1 passage), and a lack of efficiency (2 passages). The interviewees perception is that an "open and co-operative style of management were all parties

work together" is the best style of management to improve performance. All interviewees believe there to be a greater emphasis on cost and time where the opinion is that "contractors would rather offer practical completion on time and within budget with 1000 snags than miss a deadline and financial target". This in turn impacts not only quality but also cost and time as "a lack of quality impacts performance of projects through re-works and missing key deadlines as a result". A total of 5 passages related quality as a main factor affecting performance, with 2 of the interviewees highlighting it as the biggest key factor. A pessimistic view on defects is perceived when asked if there is a high rate of defects, as the opinions of "everything goes wrong in construction all the time" and "massively" are provided. Finally, the belief that construction is "currently a wasteful industry" and lacks the general efficiency compared to other production driven environments, is also having a major impact on performance.

The four components attached to the theme 'personal factors' consisted of experience (4 passages), attitude (1 passage), skill level (5 passages), and training (4 passages). The interviewees all referred to "the loss of experienced workers within the industry" with one of the interviewees "struggling to find the right site managers" as a major effect. This is further demonstrated by the current lack of attitude which one interviewee refers to as "everyone is lazy". To further compound these views, 5 passages describe the skill shortage as a main factor affecting construction performance, including one interviewee stating it to be "the main factors affecting performance are skill shortages". As well as the loss of experienced workers there are 4 passages related to training. Therefore, a lack of experience, poor attitude, combined with inadequate training are resulting in an insufficient skill level of the industry, providing a damaging effect on construction performance.

Responsibility (1 passage), lessons learnt (2 passages), and management (1 passage) are the three sub themes connected with management factors. Responsibility refers to an interviewee believing that "someone needs to take ultimate responsibility because as soon as it starts going from manager to manager it gets messy and doesn't work", referring to management responsibility at project level. Furthermore, the industry as a whole and in particular management are perceived not to be learning from previous experiences, as "the non-existence of lessons learnt in this area of production results in repetition of mistakes". Finally, the role of management at project level has a great impact on performance, as different styles provide different impacts on performance with one interviewee believing that mangers should have an "open platform on a site level to share problems/issues and resolve them as a team". Therefore,

different management techniques and styles can have a great impact on construction performance.

External factors can be broken down into two sections technological (2 passages) and contractual (1 passage). One interviewee describes the construction industry as "revolutionising the way we build things, but I believe the understanding of the industry is lagging behind the vision". Another interviewee believes that this is due to "the limited take up of BIM in the industry especially above level 2 as per the government's requirements means the industry is missing out on potential efficiency and cost savings". Therefore, the industry could be seen as being resistant to change to implement this technological factor that could have a great impact on performance. "Contractual obligations not being understood" is a factor that also affects performance. As many contractual obligations often slow the whole construction process, with claims against either the contractor, subcontractor, or client meaning works cannot progress until the contractual disputes have been resolved.

The second high level theme deliberated in the face-to-face interviews was the factors affecting QMS. A number of 64 passages were related to this theme and it was examined in three sections including QMS provisions (12 passages), advantages (41 Passages), and disadvantages (11 Passages). (Figure 3)

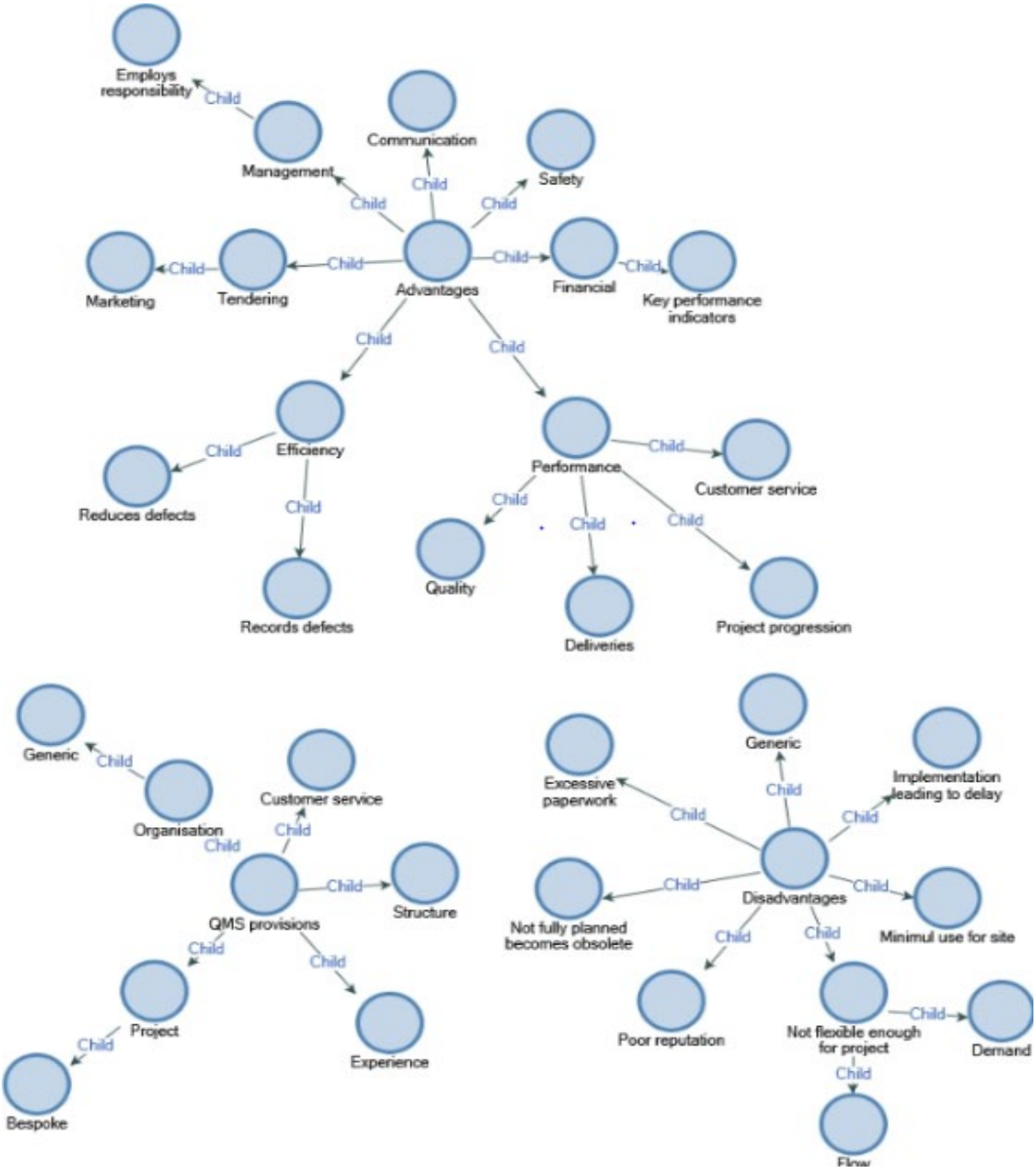

Figure 3: Factors affecting QMS

The three interviewees mentioned key provisions that should be adhered to when implementing a QMS. These themes consisted of project (3 passages), organisation (3 passages), customer service (2 passages), structure (3 passages), and experience (1 passage). There are many different quality management systems in the construction industry, however these can be grouped into two categories namely organisation QMS and project QMS. All three interviewees operate under a generic (3 passages) QMS for their organisation QMS, and a bespoke (3 passages) form of QMS for project QMS, and all believe this works best. This is further demonstrated by one interviewee stating that the bespoke QMS "involve a few changes

to individual sites". While the "overall systems such as customer service are more generic requirements". The importance of the structure of a QMS was also mentioned in 3 passages. Finally, the experience in implementing a QMS also became a key provision as one interviewee suggested that for "a QS for instance, a quality management system is important from the point of cost savings", and "for a sub agent like myself it helps reduce defects through quality checks." This further highlights the importance for the whole project team to understand the QMS.

The financial and non-financial indicators from literature review were used to analyse data in the advantages and gains from QMS implementation. The financial indicators included the fundamental tool in which financial performance of an organisation could be measured, and non-financial indicators delivered various other qualitative activity variables such as job satisfaction, time, and quality. Advantages and gains of QMS consisted of the highest amount of passages (41 passages) relating to it, reflecting the financial and non-financial indicators from the interviewees towards QMS. The theme consisted of several different lower level nodes. The interviewees frequently commented on the non-financial indicators such as the improved performance including quality (6 passages), project progression (4 passages), customer service (1 passage), and deliveries (1 passage). The interviewees believe it "brings quality to the job" and improves project progression as the implementation of a "check sheet" on the delivery of materials, means the project will not be in delay due to damaged or insufficient materials. Improved efficiency was mentioned a number of times (12 passages) by the interviewees, including recording defects (4 passages) and reducing defects (6 passages). All three interviewees believed the recording and reduction of defects within QMS improved project efficiency and performance with one interviewee suggesting that "it's perfect for defects", as "the paperwork ultimately tells you whether it's completed and who is responsible for the quality check".

Interviewees further suggested that QMS can improve financial performance (7 passages) including through the use of key performance indicators (KPI's) (3 passages). Results suggest that interviewees believe that financial gains can be generated from QMS "through KPI's, however they can also generate internal efficiencies and or savings". Furthermore, the interviews reviewed management (3 passages) as an advantage in utilising a QMS including employing responsibility (2 passages), as the system records "who is responsible for the quality check". Additionally, all three respondents mentioned QMS as a requirement for tendering (4

passages) including further marketing (2 passages) opportunities. Finally, both safety (2 passages) and communication (1 passage) were related to improvement with the adoption of a QMS.

Disadvantages of QMS consisted of 11 passages which included any negative aspects surrounding the process. Some of the lesser mentioned nodes were its poor reputation (1 passage) and excessive paperwork (1 passage), which commented on its "minimal use on site" (1 passage). Furthermore, if it is not fully planned it becomes obsolete (1 passage) and its implementation can lead to delay (2 passages), as QMS "can sometimes be viewed as a hindrance and delay rather than a benefit when not fully planned". In addition to this, QMS not being flexible enough for project (2 passages) as a disadvantage, as one interviewee believes that QMS are not "flexible enough to adapt to the demands of a project, in terms of flow and demand for production". However, the largest number of passages for disadvantages was for QMS being too generic (3 passages), as one interviewee believed when asked about QMS that "almost all quality management systems are generic", and "if you are technically minded, you find these generic and useless".

Table 3 - Comparison of advantages and disadvantages of QMS

Comparison of Advantages and Disadvantages of QMS				
Advantages	**Passages**		**Disadvantages**	**Passages**
Improved efficiency	12		Generic	3
Improved performance	12		Not being flexible enough for project	2
Financial	7		Implementation leading to delay	2
Management	3		Not fully planned becomes obsolete	1
Tendering	4		Poor reputation	1
Safety	2		Excessive paperwork	1
Communication	1		Minimal use on site	1
Total	41		Total	11

The link between greater construction performance and QMS was examined separately through the analysis of all three transcripts. Thus, identifying themes consisting of evidence linking greater construction performance and QMS. A total of 14 passages were highlighted.

The fact that QMS "improves efficiency" was highlighted as a key factor in increasing construction performance, as one interviewee stated that "you can actually programme all your works if you are sure the works are going to be up to a quality standard". The interviewees believed that this reduces delays in "going back and sorting out defects, which cost money and adds pressure to the job". Furthermore, with the implementation of a defects record "the level of defects is slightly reduced" which encourages a culture of "Get It Right First Time approach to activities". This in turn is believed to "impact project progression, and also enhances a company's reputation, impacting on its ability to secure future works". The participants provided the impression that if QMS are implemented correctly it can reduce defects, which in turn provides the confidence to programme and secure works. In addition to this, an interviewee further proposed "it highlights the significance of quality on a project, clearly sets out the companies, clients and individuals requirements and responsibilities, aides in co-operation across the parties as most quality management systems on construction/civil are jointly client/contractor driven, and assists in reducing accidents". This further demonstrates the impact QMS has on greater construction performance.

In the qualitative part of the study, the reliability was gained through depth, richness, honesty and comprehensiveness of the collected data. The reliability of the analysis was considered according to the ability of a judge to code data the same way over time (Milne and Adler, 1999). The analysed and coded interviews by NVivo were recoded again in the same way over a period of time. The validity factor was also achieved under the interviewees' approaches and the extent of objectivity of the researchers.

Discussion of data analysis

The literature reviewed on construction research studies identified a weak and adversarial industry with a fragmented nature. This was resulting in a high rate of defects, none conformance, poor quality standards, excessive waste, and deficient performance. The results from this study similarly outlined a high rate of defects and substandard quality within the industry (Egan, 1998; Latham, 1994; and Wolstenholme, 2009). The questionnaires acknowledged the key factors that affect construction performance in the NWE as a lack of collaboration, industry being resistant to change, lack of skills, economic factors, and a bad culture. Correspondingly, the interview data expressed the requirement for training pathways, a greater focus on quality, an industry attitude change, and a more co-operative style of management were all parties work together. Performance limitations were identified as a lack of quality, a high rate of defects, poor attitude, skill level and experience, insufficient teamwork

and collaboration, a lack of efficiency, and a greater emphasis on cost and time than quality. In addition to this, the interview data identified that the lack of focus on quality is resulting in a high rate of defects, and therefore also affecting cost and time due to delays in reworks.

The literature reviewed discovered a number of studies advocating the implementation of a QMS, as it improves performance through improving communication problems, minimising wastage, reworks, mistakes, and having greater control over suppliers and subcontractors (Mane and Patil, 2015; Leong et al., 2014; and Lee et al., 2011). However, there is debate between scholars, as some literature stated that the implementation of a QMS has minimal effect on performance, and others stated if implemented correctly can produce significant effect (Mane and Patil, 2015; Thomas et al., 2012; and Lee et al., 2011). The questionnaire provided an overall positive attitude towards QMS, with the data displaying a link between increased quality on site and financial gain when implementing a QMS. Other advantages such as improved efficiency, greater managerial control, and inferior number of defects were identified. Equally, the interviews also provided an overall positive response towards QMS, including benefits such as quality improvements through quality checks and inspections on site, an increase in project progression, the recording and reduction of defects, and employing responsibility between project members. The most dominant incentives were that QMS increased performance and raised standards. Other incentives included an increase in customer service output, financial gains from the use of KPI's, an increase in internal efficiencies, and improved tendering and marketing opportunities.

The adaptation of the QMS increases performance levels were an organisation has no prior system in place (Leong et al, 2014). Researchers stated that it can produce significant effect if implemented correctly (Mane and Patil, 2015; Leong et al., 2014; and Lee et al., 2011). The questionnaire sample displayed that QMS was perceived to help maintain quality on site, and furthermore increase the chances for financial gain. In addition to this, the sample highlighted an improvement in efficiency, greater managerial control, and a reduction in the number of defects, as other perceived performance advantages of implementing a QMS.

The interviews similarly established the improvement of efficiency with the adoption of a QMS. As the perception was that if implemented correctly QMS can reduce defects, which in turn provides the confidence to programme and secure works. Furthermore, the belief that long term QMS sets out company requirements and responsibilities, highlights the significance of quality, aids in co-operation between different parties, and assists in reducing accidents further

demonstrates its impact on performance. Consequently, these findings advocate a decisive link between QMS and greater construction performance in the NWE construction industry.

Limitations of the study and future research

Due to the researchers' contacts and access to construction portals in the NWE and a limited time to complete the study, the focus of this study was based in the region of the NWE. To further enhance this research, the focus could be on the whole of the UK. Nevertheless, a greater amount of time would be required to gain the required representative sample. Secondly, the questionnaire was distributed equally within the selected sample, however a greater number of respondents working for contractors responded. Therefore, the respondents of the questionnaire survey were not equal in terms of organisation (client, contractor, sub-contractor, project manager). Following this, another limitation of the study was the interview questions were aimed at both project QMS and organisational QMS, and the greatest number of respondents of the survey were contractors. Therefore, the researchers decided to interview industry leaders employed by contractors for the three interviews conducted. This resulted in the interviews only representing one type of organisation.

Further studies should analyse which project QMS have a greater impact on performance, and further establish a framework for all future project QMS to work from. This would ensure that subcontractors working for different organisations could be fully implemented into their QMS with very minor training.

Conclusion

The main aim of the study was to examine whether quality management systems can affect construction performance in the North West of England (NWE). It was clear the implementation of a QMS has a positive effect on construction performance in the NWE. The primary reasoning for this descends from the improvement in efficiency of a construction organisation when implementing a QMS, including immediate affects such as the recording and reduction of defects. In addition to this, long term effects of changing company attitude by setting out company requirements and responsibilities through highlighting the significance of quality, and furthermore encouraging a culture of co-operation and teamwork, further increases construction performance as time progresses.

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