ATTAINING ZERO DEFECTS WITHIN THE UK'S BUILDING SCHOOLS FOR THE FUTURE PROGRAMME: STAKEHOLDERS' PERCEPTIONS

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Until its demise in July 2010 The Building Schools for the Future (BSF) programme represented the biggest single UK government investment in school buildings for more than 50 years. One of its key goals was to ensure that pupils learn in high quality 21st-century facilities that are designed or redesigned to allow for educational transformation in historically underperforming schools whose pupils were often enmeshed in depravation and social exclusion. This represents a major challenge to those involved in the delivery of the new or refurbished schools. This paper explores the extent to which schools completed under the umbrella of BSF lived up to the UK government's ideology of 'value for money' a key parameter of which is the delivery of high quality buildings. Drawing on an embedded case study methodology based around one local authority that completed nine secondary schools under the BSF funding model between 2006 and 2010 the findings portray the many challenges faced by constructors in the pursuit of zero defect construction. Critical to this, the authors argue, is the approach used by stakeholders to define and measure the presence of a 'defect'. Analysis of exploratory interviews undertaken with four key project stakeholders give evidence of the very different views each professional holds of both quality and what constitutes a defect. By highlighting a lack of consensus between industry stakeholders as to what constitutes a 'defect', how that is to be measured and at what point in the project this should be formally recorded, the research findings raise important questions about the construction industry's ability to deliver projects free from defects.

Keywords: building defect, quality, Schools for the Future

INTRODUCTION

In 2003 the UK government launched the Building Schools for the future (BSF) programme with the aim of renewing all 3,500 English secondary schools over a fifteen year period with an initial estimated public spend of £52 to £55 billion subject to future public spending decisions. The initial plan was to rebuild half the schools, structurally remodel 35% and refurbish the remainder. The scheme's key aspiration was to ensure that pupils learn in high quantity 21st-century facilities, designed or redesigned to allow for 'educational transformation' in historically underperforming

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schools, where pupils are often enmeshed in depravation and social exclusion. The first schools BSF contract commenced in 2005; however in July 2010 the BSF programme, which represented the biggest single UK government investment in school buildings for more than 50 years, met its demise as austerity measures were introduced.

As part of a wider study, which sought to explore the extent to which schools completed under the umbrella of BSF lived up to the UK government's ideology of 'value for money', a key parameter of which is the delivery of high quality buildings, the research reported in this paper aimed to explore how key project stakeholders' define, manage and importantly, assess quality during the construction phase of a BSF project. Literature relating to construction quality and the use of 'defects' or 'snagging' as a proxy for quality management is explored before the results are reported of semi-structured interviews with key project stakeholders that explore how quality is interpreted, managed and measured. The findings suggest that whilst the 'defect' remains an important measure of success on construction projects, in reality it is merely a gauge of standards of workmanship and the contractor's ability to comply with the base level specification rather than an indictor of quality. Invariably quality is a highly subjective concept that is strongly influenced by the client's overall satisfaction with the finished product. The paper concludes by proposing that further research be undertaken to evaluate how the construction project team can more effectively manage the client's expectations throughout the project life cycle to enhance satisfaction and therefore improve the perceived quality of finished buildings.

THE LITERATURE

Theory of Quality

Following World War II and his ground-breaking work in Japan Deming (1986) in his seminal text 'out of a crisis' produced a fourteen point plan which is considered to be a 'complete philosophy of management', which can be 'applied to small or large organisations in the public, private or service sectors' (Institute for Manufacturing 2009). Deming (1986) suggested that quality can only be defined in terms of customer satisfaction, management is key and quality can be achieved through continuous improvement. Deming differed from Juran (1989), who placed great importance and responsibility on statistical process control, with 'quality through continuous improvement'. Deming (1986) also believed that management is responsible for 94% of quality issues. Deming had a major influence in changing the way Japan controlled quality and told Japan's chief executives that, 'improving quality will reduce expenses while increasing productivity and market share' (Deming, 1986).

Prior to the introduction of quality assurance, quality was predominantly measured by the finished product. Other than Deming only a few quality champions have advanced this theory. Juran (1989), believed to be of significant importance, looked further into quality linking it to value and the end user. Juran further defined quality as the 'fitness for use' and suggested that this could be linked to value management where unnecessary costs and products are removed. Juran's theory brought the development of the quality trilogy: quality planning, quality control and quality improvement as a result of Deming's work and further development of Pareto's principle, that 80% of the problem is caused by 20% of the causes. It is widely acknowledged and understood that the main aim for quality management is to provide customer satisfaction for all stakeholders. Harris and McCaffer (2006) suggest that this can only be achieved if all stakeholders directly contribute to achieving the objectives.

Quality management might be defined as 'the culture of an organisation committed to customer satisfaction through continuous improvement' (CIOB 2011). Its principles should be the same for all industries, although quality management is evidently more successful in the car industry than in other industries such as construction, which can be attributed to the early implementation of Deming's methods. This may be (and the evidence supports this discussion) due to the inherent differences in the nature of the two industries.

Quality in Construction

Latham's (1994) and Egan's (1998) seminal reviews of the 1990s collectively challenged UK construction to place a greater focus on the quality of the assets it delivers. The authors collectively suggested improvements in quality would foster improvements in the levels of client satisfaction achieved. Key strategies in the attainment of this ambitious target included Latham's (1994) assertion that existing tendering procedures required significant transformation throughout the supply chain and Egan's (1998: 22) call for continuous quality improvements through the targeted reduction and eventual eradication of primary building defects within five years.

Whilst Egan does not advocate the adoption of the 'defect' as a singular measure of quality, it is nonetheless important to establish its suitability as an indicator of quality within construction projects. In his review of progress since the Egan report, on behalf of Constructing Excellence, Wolstenholme (2010) acknowledges that industry has achieved its 20% year-on-year target for reducing the number of recorded defects since Egan first set the target in 1998. A critical part of the sectors continuing attainment of this target must be its commitment to identifying the principle causes of construction defects. Yet as Auchterlounie (2009) opines defects have continued to plague construction projects across the full spectrum of projects raising important questions as to their underlying causes. Atkinson (1999) suggests there is a wide spread belief within the construction industry that defects are merely the result of human error and a general lack of work ethic leading to poor workmanship standards. Yet counter to this view, Atkinson (1999) also suggests that the situation is often quite complex, with different active and latent errors interacting and eventually leading to human error and the occurrence of a visible defect (Douglas and Ransom, 2007). Either way it is clearly in the interests of the construction industry to identify and combat the root causes of defects.

Josephson and Hammarlund (1999) attempted to identify these underlying causes in their four-year research study based on the detailed observation of seven Swedish construction projects over a four to six month period. They identified that defects could not be attributed to either a single stakeholder or phase in the project but to the overall motivation of the project's organisational team. This suggests that improvements in the motivation of the construction team would lead to a reduced occurrence of construction defects. Love et al (1999) used a system dynamics framework to evaluate two Australian projects, from commencement of the construction phase, to the end of the defects liability period; the first was a residential tower block, and the second an industrial warehouse facility. They concluded that a paradigm shift in project management strategy was needed to reduce the occurrence of defects. At the centre of their calls for improvement, was the implementation of a collective, joined-up approach to project management with a single point of information and responsibility. In their ten-project study, consisting of 700 apartments' in multi-storey buildings, Kim et al (2008) proposed an Information

Communication Technology (ICT) solution for managing defects in large construction projects. They tested and suggested real-time data collection and processing of defects, and the study reported significant efficiency improvements. Hassan et al (2011) reviewed the occurrence of defects across four design and build hospital projects constructed for the Malaysian Department of Health. From their quantitative analysis of secondary defect data together with stakeholder interviews, their analysis of between 1343 and 5483 defects per hospital reaffirmed the earlier findings relating to the breakdowns in the project management. The researchers suggested that the management of project quality should be a continuous process, overseen by an independent third party organisation. Such approaches are already utilised in the UK construction industry but they do not appear to have led to a reduction in the occurrence of construction defects.

The research reviewed so far appears to advocate for a relatively project-focused approach to the causes of defects. Yet another body of evidence has argued the need for a more long term strategy for reducing construction defects, based around the theory of organisational learning. Schön, the leading organisational learning theorist, has argued that people and organizations should be flexible and incorporate their life experiences and lessons learnt throughout their life through a process of double–loop learning, in which the organisation adjusts its operations not only to keep pace with changing market conditions but also to create new and better ways of achieving its business goals (Fulmer 1994). A number of researchers have argued that such an approach would allow organisations proactively to reduce and eventually eliminate defects and improve the quality of their projects (Love et al 2000).

In later research, Love et al (2002) examined the extent to which change management processes or their potential lack within the project management system affected the overall quality levels attained. The research again adopted a case study approach, collecting data through both observation and stakeholder interviews. The research identified that instances of change had a significant impact on the project management, and led inevitably to an increase in the number of observable defects. As a result, the researchers concluded that achieving a reduction in defect occurrences required project managers to learn from and develop mechanisms proactively to anticipate project change, and to deal with its effects when it occurred.

Yet as Lundkvist et al (2010) quantitative survey of forty-one Swedish project and site managers suggested the calls of Love et al (2000) for the adoption of organisational learning strategies as a part of enhanced quality management have been largely ignored. The survey revealed that although the majority of respondents understood the benefits associated with the detailed analysis of defect data from past projects, in practice very few had tried to use it for the purpose of experience feedback and continuous improvement. The majority did little more than correct the defects. However evidence from Laing O'Rourke (2009) and Bovis Lend Lease (Labbad 2010), two of the UK's largest contactors suggests that this lack of reflection or organisational learning may be a symptom of the construction team's eagerness to move on to its next challenge. This is a problem that Peach (2010) belives must be addressed if overall quality is to improve and the industry is to come close to achieving zero defects.

If Auchterlounie (2009) is to be believed, the findings of these studies have thus far failed to identify the principal root causes of construction defects. This raises the question, is achieving zero defects truly a Sisyphean task? Deming (1986), the world

authority on quality, appears to suggest this to be the case, arguing that attempting to remove all defects would be an excessive waste of time and money. Instead, he asserts that clients and manufacturers should establish an acceptable level of defects for a project prior to its commencement. Looking to the literature, Aagaard et al (2010) have developed a theoretical framework based around the economic theory of optimisation for identifying the optimal level of defects. The model suggests that it is possible to identify an acceptable number of defects based on their associated economic cost-fundamentally, the model suggests that any decision to attempt to deliver a zero defect building is principally an economic one. The fewer defects the client is willing to accept, the more the project will cost, whereas the more defects the client can accept the less it will cost. Yet the complexity of construction procurement would appear to suggest that the model is overly simplistic, especially given the excessive use of price based competition (Wolstenholme 2010). In reality, the costs of defects are borne by the contractor, who has little prospect of transferring these back to the client in the form of additional transaction costs. Bovis Lend Lease (Labbad 2010) suggests that, defects can amount to 1.7% of a projects total value. On an £80million project, this would translate to an additional expense of £1.4million wasted on the correction of poor workmanship. However, Fagbenle's (2010) recent large scale quantitative survey of more than eight hundred Nigerian construction firms suggests that these costs and the total number of defects could be reduced significantly if contractors manage their supply chain proactively. Analysis of the questionnaire data revealed a strong positive correlation between the time and quality performance of labour only subcontractors, suggesting that such subcontractors compromised on quality to complete the work in the quickest time possible.

The literature reveals that although defects are costing contractors nearly 2% of the project value to put right Bovis Lend Lease (Labbad 2010), significant progress has not been made against Egan's fifteen year old target of delivering defect free construction. The literature evidences that whilst defects are the result of human error, a highly complex interrelated set of factors lay behind this. Yet the sector's major contractors appear to be dismissive of the academic models that have been developed, suggesting instead that the main reason for the number of defects recorded at handover is simply the low priority assigned by construction management professionals to the rectifying sub-standard work immediately prior to the critical hand over stage of the project. Even so none of the academic or practice led research undertaken to date has explored the possible influence different stakeholders perceptions and understanding of both 'quality' and 'defects' has on the number of defects recorded.

RESEARCH APPROACH

The research reported in this paper sought to explore to what extent key stakeholder's associated with the Building Schools for the Future programme felt it had achieved its principle aim of 'constructing high quality buildings'. In order to achieve this objective, the authors sought to explore (i) how key stakeholders perceived and defined quality (ii) how this definition of quality was communicated and managed during the construction phase of the project and finally (iii) how the quality of the finished scheme had been evaluated, with particular focus on the use of the 'defect' as an aid for measuring quality.

To meet the objectives of the study, a qualitative research approach was adopted with semi-structured interviews used to collect data from key stakeholders. This approach

reflected an interpretivist philosophical position that made use of an inductive research strategy and a qualitative methodology. Creswell (2009) attest that the adoption of a qualitative research approach is considered an effective method when collecting data that occurs in a natural setting as it enables the researcher to develop a level of detail from involvement in practice.

To ensure that data collection was as reliable as possible the interview sample was selected using 'discriminate sampling' which maximises the chances of collecting relevant data from a small sample. In total of seven key stakeholders were identified, all of whom were associated with wave one of a recent £250 million pound BSF secondary school replacement programme completed in North West England between 2006 and 2010. Emails were then sent out to those stakeholders identified outlining the purpose and context of the study before they were finally invited to participate. In total (4) individuals agreed to participate in the study (see Table 1).

Each participant was invited to take part in a 30 - 45 minute face to face interview, held at their offices between January and April 2013. The interviews were transcribed before being thematically analysed using Nvivo qualitative software. Nvivo allows the researcher to arrange the data using a hierarchical tree structure. The central phenomena (quality management) formed the root of the tree, from which sub-categories or nodes were generated based on a theoretical framework developed from the researchers' previous analysis of programme level defect data (Boothman et al 2012). The analysis used open coding to identify the various sub-categories associated with the two central themes.

Table 1: Interview Participant Profile

Respondent	Role	Type of organisation
A	Designer	Designer (contractor appointed practice)
B	Construction Manager	Main contractor
C	Project Manager	Special Purpose Vehicle (client)
D	Commercial Manager	Main contractor

STAKEHOLDERS' PERCEPTIONS OF QUALITY

Defects: A Proxy for Quality?

The first area explored during the interviews sought to ascertain how stakeholders view and define defects. The interviews revealed a consensus in respect of what a defect is. The interviewees opined that a defect is fundamentally (i) poor quality of workmanship

"Workmanship below the agreed standard, Construction not to agreed design or specification, Structure or item unfit for purpose, Material or colour not as per agreed specification, damaged items or structure". (Project Manager)

"Screws missing in the hinge or not the same gap around the door" (Construction Manager)

Or (ii) the contractor's failure to comply with the specification outlined in the contract documentation often resulting from the overeager drive to reduce costs through the application of value engineering.

"Any fault in the works which does not comply with the output specification and/or deem that particular asset unavailable or not fit for purpose" (Construction Manager)

"The component that you are trying to achieve that doesn't widely meet the standard(s)" (Designer).

Nevertheless the Designer reluctantly acknowledged that contractor instigated value engineering is often a necessary compromise if the client is to retain control of the overall bottom line cost of the project.

"Value engineering - you can loose the value of the scheme design and don't always save that much money, if you try to avoid value engineering you can pay a lot of money on partnership contract" (Designer).

Understanding and Managing of Quality in Construction

The second area explored during the interviews sought to ascertain the stakeholders' understanding of quality in construction projects. Once again the data revealed a consensus of opinion on how quality is defined, interpreted and understood. The data suggests that all four respondents demonstrated a sufficient understanding of the concepts of quality. All the project stakeholders agreed that the contract included minimum standards in respect of the design, specification and standard of workmanship. Taken together, these formed the minimum quality standard for the project.

The Construction Manager fully supported the use of a pre-agreed minimum quality standard for the project, and argued that quality was:

"The acceptable and agreed standard in relation to the design, material, finish and workmanship as per the contract agreement, Quality should not be subjective as a personal level of acceptance can differ" (Construction Manager).

Yet the designer, whilst having responsibility for the production of quality related documentation including material and workmanship specifications suggested that actual attainment of quality is

"Incredibly subjective as it's down to the client perspective". (Designer)

At the same time, they recognised the contractor's commercial needs, observing that approaches such as value engineering are often a necessary compromise if cost is to be controlled

"Value engineering - you can loose the value of the scheme design and don't always save that much money, if you try to avoid value engineering you can pay a lot of money on partnership contract". (Designer)

This would suggest that the clients perception of acceptability often drives the minimum quality standard although how this is defined and measured remains obscure. Yet as the Project Manager attested early promises made by the contractor to secure the contract can often lead to higher quality demands:

"I believe that the hype of the first phase actually caused more damage than good as expectations were so much higher than the real thing". (Project Manager)

In part, this view is supported by the projects commercial manager who agreed quality is a subjective area which is positively correlated to the overall customer experience. As such the commercial manager for the program views quality as a:

"bit of a compromise sometimes but it's about keeping the relationship going without letting them take the piss" (Commercial Manager).

Yet the Project Manager highlighted the dangers of such a client orientated approach to quality suggesting that those clients with Rolls Royce expectations would invariably deem the project a failure. Those clients, with lower level expectations would be more likely to see the finished project as a success.

Stakeholders' Reflections on Quality

The final area explored during the interviews revealed contrasting views between all the stakeholders. The Construction Manager clearly felt that the quality management process implemented on the project had achieved a career defining standard, stating:

"The client acknowledged that they considered the completed project of a good quality and sent a letter to the team thanking all for the finish jobs and effort to complete it early and defect free. Following this I won a silver medal" (Construction Manager).

Yet although the projects success was internal recognition, other stakeholders did not share this view. Indeed both the Designer and Project Manager strongly contested this view of the project. The Designer suggested, that despite the project's accolades:

"I don't think they delivered a good quality product" (Designer)

However the Designer did concede that the project was completed to 'a similar' level of quality to that achieved by comparable organisations confirming

"The quality of the work was comparable with other contractors of a similar size and skill level" (Designer).

The client's representative agreed with the Designer in this view. However, he identified three principle factors which he deemed to be fundamental to the low quality achieved. These included (i) design failing, and specifically failings in the communication of important design information; (ii) failings in the selection and procurement of sub contractors, with cost taking precedence over other aspects of past performance; (iii) the contractor failing to deliver against the expectations of the client, which had in part been artificially inflated by the contractor during the bidding phase of the scheme which in turn led to severe time and cost management issues.

DISCUSSION OF RESULTS

Over the last two decades the construction industry has become obsessed with the attainment of quality through the measurement and use of defects as a proxy. In part this ideology stems from Egan's (1998) seminal review of the construction industry which inter alia called for continuous quality improvements through the targeted reduction and eventual eradication of primary building defects within five years. As Wolstenholme (2010) acknowledges, in the long term, this target became interlinked with sector wide key performance indicators and a year on year target for 20% reduction in the number of recorded defects. The exploratory interviews revealed that although they are important, defects are not a substitute for quality, and participants expressed a far wider view of construction quality. Instead they opined that quality is achieved through the management of customer experience. This supports the views already expressed by both Harris and McCaffer (2006) and CIOB (2011) who advise that a commitment to customer satisfaction is fundamental to the quality of delivery.

The stakeholders interviewed instead identified defects to be more likely indicative of poor workmanship by craft operatives. This would support the earlier views articulated by Atkinson (1999) who's research identified a wide belief that defects are merely the result of human error and a general lack of work ethic amongst tradesmen on site. The second major cause of 'defects' on project completion related to non-compliance with component specifications. As Deming (1986) has asserted the establishment of an acceptable level of performance prior to commencement is fundamental to quality management. The interviewees in our study appear to support this view, with all of them agreeing that the specification documents set the principal quality benchmark for construction projects.

CONCLUSIONS

This paper raises a number of important questions about the use of 'defect' as a performance measurement for quality within the construction sector. The literature identifies poor management practices together with a disregard towards organisational learning as responsible for the adoption of a weak approach to the management of quality within the construction sector. The literature further identifies a number of contributory factors including (i) the lack of personal ownership of quality (ii) procurement driven by price not the wider parameters of value and (iii) construction teams eagerness to move on to the next project. This collectively prevents the sector from attaining the levels of quality that Egan (1998) observed in other industries.

The exploratory interviews suggest that whilst the 'defect' remains an important measure of success for construction projects, it is really only a gauge of standards of workmanship and the contractor's ability to comply with the base level specification. The conversations with stakeholders, suggest however, that quality is a far more subjective concept that is invariably influenced by the clients overall satisfaction with the finished product. If construction quality is to be improved the findings from this research would suggest that further work is needed to evaluate how construction professionals can effectively manage the expectations of their clients from the projects initial inception to its final handover and occupation.

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