

# CASE STUDIES ON THE IMPLEMENTATION OF TQEM IN THE UK BUILDING CONTRACTORS

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To reduce the substantial contribution of the built environment, contractors have to comply with the increasing number of environmental regulations. Recent interest in the subject has resulted in global research initiatives that aspire to provide an understanding on Environmental Management (EM) and Total Quality Management (TQM). Total Quality Environmental Management (TQEM) has emerged, in the manufacturing sector, from integrating strategic EM into TQM holistic approach. This paper is part of a research that investigates TQEM impact on contractors' management, design, performance, and procurement. This paper presents three case studies on the impact of TQEM for contractors. The case companies are all main contractors, selected by local accessibility based on the assumption of a design-and-build procurement method. All the interviews, documentations analysis and site visits were carried out between October 2006 and March 2007 and were coded for analysis. The companies were categorised as 'two stars TQEM' and 'three stars TQEM' companies based on companies' experience with separate initiatives associated with TQEM. Results from the cross case examination indicated that contractors in the study had approached TQEM without the help of any specific management framework, but they had implemented numerous quality and environmental initiatives on a 'slice by slice' approach. Build-and-design procurement is recommended for controlling TQEM implementation and responsibilities among the design team, the construction team, the main contractor and the specialist subcontractors. It is suggested that TQEM needs to be supported by an implementation framework that considers the corporate-level TQEM (business and cultural aspects) and project-level TQEM (construction performance and procurement).

Keywords: case study, contractor, implementation, TQEM.

## INTRODUCTION

To reduce the substantial contribution of the built environment, construction companies have to comply with the increasing number of environmental regulations. Apart from the purely practical implications of compliance, there are some sounds prompting interesting questions concerning construction quality, environmental and sustainability's performance improvement through a management-based approach. Another question is; how could this management-based solution be linked to the procurement strategy? Recent interest in the subject has resulted in global research initiatives that aspire to provide an understanding on Environmental Management (EM) and Total Quality Management (TQM). Total Quality Environmental Management (TQEM) has emerged, in the manufacturing sector, from integrating EM into TQM holistic approach.

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TQEM was suggested by the Global Environmental Management Initiatives (GEMI), in 1991, and the Council of Great Lake Industries (CGLI) in 1993. TQEM is composed of four paradigms; (a) Total: involving the entire organisation, supply chain, and/or product life cycle; (b) Quality: with its usual 'zero defect' definitions, with all its complexities; (c) Environmental: strategic environmental management approach; and (d) Management: the system of managing with steps like Plan, Organise, Control, Lead, and Staff provisioning and organising as defined by the International Organisation for Standardisation.

TQEM is a philosophy and a business system that companies in general and construction firms in particular should adopt to achieve quality and environmental performance improvement towards sustainability (Hassan, 2006; Green and Lui, 2007). The adoption and implementation of quality and environmental initiatives have, in the main, been spearheaded by manufacturing; the construction sector has lagged behind. Various suggestions have been made to help construction companies implement quality management and environmental management separately. The management and benefits of quality and environmental management have a number of theoretical similarities (Angel and Klassen, 1999), suggesting that a TQEM could be applied by contractors. This paper begins with describing the methodology employed by this study. The presentation, in this paper, centres around three main areas of: (1) background of the case company; (2) major aspects of TQEM implementation; and (3) cross case examination.

## **METHODOLOGY**

Yin (1994) described two basic types of case study design (single case and multiple cases). The selection between single case and multiple cases design depends on the nature of the research questions and objectives, and the amount of resources available. Evidence from multiple cases is often more compelling, and the overall study can therefore be regarded as being more robust (Naoum, 2006; Wiley and Fellows, 2008). Conducting multiple case studies is described as being similar to replication or executing multiple experiments. For the application of this research, the research design employed multiple-cases.

Using the case study method is beneficial in this study. It will have a key role in addressing and uncovering the main issues of; a) How had the company implemented TQEM?; b) Why had the company chosen the particular approach?; and c) How can TQEM framework phases be linked to construction cycle and procurement system?. Three main contractors were selected based on location and interest in TQEM and willing to participate. The range of the separated TQEM related initiatives employed by the case contractors will be used to indicate 'how TQEM' the company is. A cross case examination will be conducted for further understanding on TQEM different practices. The following sections will present the case studies backgrounds, aspects of TQEM implementation, and cross case examination.

## **CASE STUDIES FINDINGS**

### **Results from case study A**

#### *Company background*

The first case company is located in Nottingham. It is a family business with 30 years experience in the infrastructure sector. The National Rail appears to be a major client. The first impression of the company was that it was well maintained with clear signs for visitors and an overall pleasant atmosphere. The company has 150 employees,

divided into full-time and hourly paid employees and a system manager responsible for quality, environmental, and health and safety assurance. With a few number of employees engaged in the quality and environmental functions, the inspection work has been left to either the construction and inspection operators or consultancy.

Since 2002, the company has had maintained the environmental system BS EN ISO 14000 and the quality assurance system BS EN ISO 9000. Even though the company's assurance policies were formed in 2002, the company gaining network rail acceptance for its assurance case and investing in people, clearly demonstrates the maturity that has been achieved in terms of quality and environmental implementation. The company quality, environmental and safety plans include a range of initiatives to ensure providing adequate resources, responsibilities and time frames for achievement. The implementation of these plans demonstrate the company commitment to the railway group safety plan, network rail safety and environment plan and the safety plans of their major clients.

#### *Major aspects of TQEM implementation*

The company board involves in making policies, creating visions, and planning for quality, environment and safety. The core group consists of the managing director, quality, safety and environmental manager/director, and the production and sales managers. Their main responsibility is to make policies for running the business smoothly, winning more contracts and to ensuring continuous business improvement. There is certainly total commitment by management towards quality and environment. The company is committed to the prevention of pollution in all its activities. The company's environmental objectives are mainly related to waste minimisation, recycling where possible and energy efficiency design aspects. The related decision making criteria relays on a few performance indicators in a form of both feedback from the clients and internal economic indicators.

The environmental director has access to a budget appropriate to solve the problems and achieve the tasks of ISO 9000 audits in accordance with the quality manual, and for environmental audits (workplace evaluations, safety precautions, sufficient knowledge, near-accidents reported, adequate instructions and training, manuals for machinery, etc.). One person here plan, manage, and coordinate the quality, environmental, safety and health programme and activities.

### **Results from case study B**

#### *Company background*

The second case company was established in 1852. It is a big subsidiary of a larger group. The company operates across all construction sectors. The company strategy involves in sustainability issues, renewable energy, life cycle costs and project team integration. It has many offices all over UK and Ireland but has centralised its quality, environmental and sustainability departments in Birmingham. Out of this branch's 700 employees, nearly 20 are involved in developing quality and environmental specifications. This indicates that much of the inspection work is already delegated to the operatives on site. The company has embarked on various quality initiatives including ISO 9002 quality certification.

The company has three champions in quality, environment and sustainability. The quality steering committee at company level comprises senior management, and a few selected members including project managers, supervisors and team leaders. Their main responsibilities are annual reviews of quality policy, monthly reviews of

procedures, and review of work instructions, examining audit results, and QS 9000 training of employees.

#### *Major aspects of TQEM implementation*

The company recognises that its operations have a direct impact on the natural and human environment. Therefore, the environmental concerns are addressed separate from the quality ones and are referred to through environmental key performance indicators. The company claims to consider any environmental implications of all its activities and services. The aims are: to minimise adverse impacts as far as practicable, to undertake all operations on a more sustainable basis and to promote beneficial effects of their activities. To achieve these aims the company seeks the co-operation of clients, sub contractors and suppliers and employees. The main Environmental Management System in place is the ISO 14001:2004.

A continuous improvement structure exists in the company since it is a requirement of QS 9000. Other forms of performance improvement activities are in the form of weekly meetings to resolve problems and find better ways of performing tasks. This contractor has some pro-active activities toward the environment and i.e. it ensures that the ground works vehicles ran on recycled fuel. Improvements to the process layout have been carried out through work-study methods to achieve a lean construction environment. The environmental champion mentioned that the company centralised “champions” for quality, environment and sustainability try to keep updated with individual projects activities.

In moving towards a TQEM organisation, various systems have been already implemented by the company. Examples include installing a quality assurance (QA) system, a training system, and an information and data collection system (mainly computerised now to deal with the company centralised structure). The company business plan outlines its continuous improvement strategy, its people (human resource development) and its customer aspects, as well as its action plans to achieve both in the short (one year) and long (five years) term objectives. The way in which the company identified customer needs was through a detailed customer satisfaction index, measuring areas such as quality performance, logistics, delivery, etc.

The system manager addressed the need for more training and skills development system. The champion's limited availability was overcome by upgrading the team leaders' skills. Those team leaders' training was supported by the local Training and Enterprise Council (TEC). The company has a variety of initiatives in place but, at the time of conducting this research, had not yet reach its goal of achieving TQEM towards sustainability.

### **Results from case study C**

#### *Company background*

The third company is one of the major UK construction contractors with branches all over the UK and Ireland. The company construction activities vary from civil engineering, infrastructure and housing sectors. It is an international engineering and construction group with a reputation for technical excellence founded on more than 140 years of experience. The company major clients currently are the NHS and Sainsbury. The first impression of the project's site was quite displeasing. There was no evidence of a visitor's car park, reception was poorly marked and receptionist did not sound to recognise the quality manager who the researcher was meant to meet there. The interview with the quality manager was held on one of the company sites which was not really conducive.

Interestingly, waste management appears to be the company fastest growing sector. To them, the Government's multi-billion pound programme to cut landfill means that there is huge demand for civil engineering and investment expertise. The company aims for a head start in this emerging market. Again, the structure of the quality function was similar to the previous company studied. Quality was no longer the responsibility of the quality department but of the people actually involved in production or manufacturing.

#### *Major aspects of TQEM implementation*

The company operates an environmental management system that complies with BS EN ISO 14001 in 1999 in all its civil engineering and construction, contracting and project management activities. The company operates a quality management system that complies with the ISO 9000 since 1995 with the scope of; the management of the design and construction of all forms of building and civil engineering as a sole contractor construction, QS 9000 in 1997 and the environmental management standard, ISO 14001 in 1998.

In addition to their QS 9000 and ISO 14001 systems, the company has conducted detailed process of EME and has implemented KPI to ensure that parts are produced as per the customer specification. This is especially so when the component in question is safety-related. On the question of identifying customer needs, it has a customer complaints and customer concern system in place. As has been stated before its main customer is headquarters and so all the requirements come from there. The implementation of the various quality initiatives have led to changes in the way in which the company is managed. The midland QA manager feels that "it will take the company another two or more years to see the true benefits" of any TQEM framework re-structuring exercise. He also pointed out that customer expectations are very demanding and this was particularly evident within the civil engineering projects. Zero defects today means virtually no defects. However, for each project the main three responsibilities are divided among; Bid Manager – Bid/Tender Stage; Project Manager – on winning work; Office/Facilities manager- regular review; and Advisor – to provide advice when required at all stages. The scope of the procedure covers instructions for identifying and evaluating significant environmental aspects at all stages of a project.

### **CROSS CASE EXAMINATION**

The cross case examination pointed out two main areas. The first is related to the technical or hard aspects of TQEM, including the various quality tools and techniques. The other is related more to the soft/motivational or human and cultural issues for transforming the company to a TQEM organisation.

The findings presented in this paper are the key factors that are used for developing the TQEM framework for contractors. The research finding presents the key factors for integrating TQEM, the benefits that may occur and the barriers. The three case studies uncover the main issues of; How could the company implement TQEM?; Why had the company chosen the particular approach to quality and environmental issues in design, performance, tendering documents?; and How can the framework management phases be linked to construction procurement?.

A wide range of initiatives has been implemented in the case companies. Some initiatives are quite newly implemented (in response to the new environmental regulations and taxation) while others have been applied for up to 20 years (driven by

the market demand). With regard to the results achieved, company B stated that it had achieved a 20% cost reduction based on energy efficiency plan, while company C had managed to reduce its defective parts from 5,000ppm to less than 500ppm. Company A did not provide any figures. This indicates the diverse experiences contractors possessed. Both companies B and C are quite advanced in their application of quality planning tools, KPI and a QA system, compared to company A. Self-assessment has only been performed by companies B and C. Both of these companies can be considered “three stars TQEM” towards sustainability while “two stars TQEM” could be given to company A.

The case studies show that there are some similarities in the approaches adopted by the case companies. It can be looked at from four main areas: (1) people focus as the vehicle for cultural transformation; (2) QS 9001 and EN 14001 as the major systems for achieving quality and environmental improvement; (3) continuous and progressive implementation of initiatives based upon resource availability; and (4) performance measurement system based on a simple feed on client satisfaction.

The three case studies indicated that the TQEM framework requires increased iterations between the architectural design team and the construction team. The commercial concerns of clients were seen as a major barrier to this. The three companies are facing problem with clients ‘need to change their attitude [and] understand the need to bring in environmental consultants earlier’ despite the extra cost (case study: A). It is still the client’s perception ‘that sustainable building costs more (case study: B). The difference of constructing sustainable buildings and non sustainable buildings is decreasing’ (case study: C).

A preference was expressed by some for a two stage tender approach (case study: A). TQEM should become an integral part of tender documentation. ‘Two-stage tendering is the best where the contractors are brought on earlier and all the design team is novated. There are advantages as the project would be taken up to planning permission phase, then the contractors get bidding for the project. As the contractors participate in the rest of the process, the reason this works best is because the client wants to control the cost and the contractors are capable of delivering a project on cost and time, but the collaboration between designers, consultants and contractors can deliver quality (case study: A).

## **CONCLUSION**

This paper has reported on three case studies all of which have experienced several initiative of TQEM. A wide range of quality and environmental initiatives had been implemented by all of them. Some similarities were observed among the case companies with regard to their approaches towards quality and environmental management. Build-and-design procurement may allow main contractor controlling implementing TQEM.

TQEM impact on procurement practice: The common practice of ‘novating’ designers to Design-and-Build contractors is not only compatible with the regulatory developments, but is likely to be extended. The case studies indicated a preference for, and increased tendency to novate environmental performance assessors, such as M&E consultants, to the relevant specialist subcontractors. This is considered necessary to ensure continuity of responsibility for the TQEM in its as-built form for final compliance with environmental regulation, initiatives and clients requirement.

TQEM impact on tendering documents: unlike many management approaches for performance improvement, TQEM represents a structural organisational learning for contractors. Participants have already witnessed the emergence of a new pre-tender information document when building TQEM strategy and start by gathering the clients' requirements. This document will become indispensable, as in its absence, most contractors would decline invitations to bid. If the TQEM strategy fails to demonstrate compliance with the environmental regulations, contractors will consider such non-compliance in the design stage as a particularly unacceptable risk during the risk

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TQEM impact on post-tendering: contractors operating in a Design-and-Build environment will 'freeze' designs earlier, and, in order to avoid risks, forgo the potential for later value engineering which they see as significant. Finally, there has emerged a positive and welcome by-product of the new environmental legislations. This approach will prompt an increase in collaborative working between design and construction teams. TQEM for contractors requires much iteration at the design stage and, more than ever before, invites close collaboration between the various professionals involved. If, in line with present procurement trends, projects are commissioned on a Design-and-Build basis, it is imperative that the contractors are fully involved at the design stage if they wish to exercise TQEM: the opportunity to do so after the acceptance of the bid is severely limited by the technical complexities surrounding environmental compliance.

Overall, it appears likely that the environmental legislation, taxation and recognition are already having a profound effect on the contractors and procurement arrangements of UK construction projects. A number of interesting conclusions resulted from the study, some of which invited further examination. These included the impact of TQEM on: 1) different market segment of contractors; 2) different size contractors; 3) post-construction and post occupancy evaluation; and 4) collaborative working between the different parties involved in building a project. Despite the relatively recent introduction of the building environmental regulation and taxation, and the exploratory nature of the current research, capturing the feedback offers the opportunity to disseminate good practice and shortfalls to contractors. Further research is needed to develop TQEM implementation framework.

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