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Manuscript title: Opinions of Small and Medium UK Construction Companies on Environmental Management Systems

Authors: Matthew Bailey[1], Colin A. Booth[2], Rosemary Horry[3], Christos Vidalakis[4], Abdul-Majeed Mahamadu[2], Kwasi Gyau Baffour Awuah[5]

Affiliations: [1]Speller Metcalfe Malvern Ltd., Malvern, UK. [2]University of the West of England, Bristol, UK. [3]University of Derby, Derby, UK. [4]Oxford Brooks University, Oxford, UK. [5]University of Salford, Manchester, UK.

Corresponding author: Rosemary Horry, College of Life and Natural Sciences, University of Derby, Kedleston Road, Derby DE22 1GB, UK. Tel.: 01332 591738

E-mail: r.e.horry@derby.ac.uk

Abstract

Pressure to reduce the environmental impact of construction activities has increased, such that a paradigm shift is required. This paper presents stakeholder opinions of environmental management systems as a means for the construction industry to respond to these issues. Using a previous approach (Shen and Tam, 2002) the views of small and medium construction companies were sought, using questionnaires to ask respondents to reveal their perceived benefits and barriers of implementing the ISO 14000 suite of environmental management standards in the UK. Detailed statistical analysis showed environmental management systems can sometimes produce quantifiable benefits to organisations in terms of cost reduction. However, from a contractors' view, the greatest benefit was a reduction in environmental impact outweighing financial benefits. Findings also demonstrated numerous barriers, both internal and external, to an organisation exist regarding adoption and use of environment management systems. The most critical barrier was that cost savings do not always balance with the expense of implementation. Furthermore, waste minimisation at design stage is viewed as most important. In general, the opinions gauged in this study indicated short-term profits are normally considered more imperative than long-term gains. Therefore, despite a need to focus on developing strategies for removing or reducing the challenges of environmental management systems, the reality is that they may not be the panacea to sustainable development, as is often touted.

Notation

$ASSi$	represents the average significance score to the factor i
α	denotes the grade assumed to 1-5
η_{ij}	denotes the number of respondents who give the factor i for the grade α
x	represents the number of overall respondents
$SIVi$	represents the significance index value to the factor i
Beniv	indicates the coefficient of variation of the beneficial factor i
Bariv	indicates the coefficient of variation of the barrier factor i
δ	denotes the standard deviation of the significant score for factor i

1. Introduction

The late 1980s witnessed the beginning of the sustainability revolution following the promulgation of the Brundtland Commission report of the United Nations in 1987. This resulted in a drastic re-modelling of business strategy particular for major firms. There are now, more than ever before, heightened expectations on business enterprises and public service institutions to conduct their business or trade in a socially responsible manner.

The arguable point, nonetheless, pertains to what the social responsibility of business enterprises ought to be and how they are expected to bring this about. Economist tends to hold the view that business exists to make profit. In 1962 for instance, Milton Friedman, a Nobel laureate in economics argued that 'there is one and only one social responsibility of business--to use its resources and engage in activities designed to increase its profits so long as it stays within the rules of the game, which is to say, engages in open and free competition without deception or fraud.'

Drucker (1954) puts it as 'a business management has failed if it does not produce economic results'. This presupposes that it will be an act of irresponsibility for managers to apply the resources of the firm to ends other than the financial success of the business. The financial success of the business is how the performance of the manager is often measured. A manager who achieves significant social goals but fails to make profit may quickly be removed from the role by the shareholders of the business. However, economic theory does not have to preclude businesses from showing concern for the pressing ills of society and contributing towards their attenuation.

Business enterprises have evolved to improve the overall wellbeing of society; however, they also contribute to the ills and, hence, cannot escape the challenges that confront society. For instance, if businesses cause environmental degradation, destruction of biodiversity, climate change they need to make amends. Managerial innovations have led to a situation where environmental management systems (EMS), such as ISO 14001 and eco-management and audit scheme (EMAS), are recognised modes for organisations to improve environmentally practices (Morrow and Rondinelli 2002; Poksinska *et al*. 2003; Link and Naveh 2006; Testa *et al*. 2014). These environmental management systems also help organisations and businesses to demonstrate their business compliance with current legislation and the procedures in relation to policy, planning, implementation, operation, management review and eco-auditing (Weaver, 1996; Jackson, 1997; Kein *et al.*, 1999; Ball, 2002; Morrow and Rondinelli, 2002; Griffith and Bhutto, 2008, Rebelo *et al.,* 2014).

Recent studies have revealed increasing levels of uptake mainly in fields of electrical engineering, metal fabrication, machinery, construction and retail trade (Neumayer and Perkins, 2004; Maier and Vanstone, 200; Altin and Altin, 2014). However, Marimon and Bernardo (2011) suggests the construction sector has been certifying to ISO 14001 at the highest rate when compared to all other sectors. This can be explained by the widely reported benefits associated with the implementation of EMSs (Sroufe, 2003). However, it may be that the value of EMSs is rather subjective depending on personal perceptions of business success and social responsibility. EMS in this study gauges the perceived benefits and barriers of the UK construction sector aligns with those of other nations. The objectives of this paper are to gain

an understanding of how stakeholders perceive the benefits and barriers of EMS within the SME construction sector. These barriers and benefits may be internal or external to the organisations.

2. Literature review

2.1 Benefits from implementation of EMSs

Organisations adopt ISO14001 for a variety of reasons. King *et al.,* (2005) found increasingly firms implement International Organization for Standardization (ISO) management standards as a strategic initiative to remain competitive; a theory supported by Altin and Altin (2014) who suggest the aim is not to increase market share but to develop sustainably. Therefore, as Rondinelli and Vastag (2000, p.499) state ISO 14001 could serve as a 'panacea' or comprehensive structure for large improvements in overall performance within a firm where there are minimal or no existing systems in place. This concurs with research that has shown ISO 14001 can be used as an active tool for radical organisation change, which leads to enhanced sustainability practices and improved business (Sebhatu and Enquist, 2007; Altin and Altin, 2014).

Watson *et al.* (2004) reminds us of the traditional view, regarding environmental management, that costs are minimised when all necessary regulations are satisfied and any betterment beyond this point will only incur additional cost. There is, however, evidence that there are additional benefits from implementing EMS into construction activities. These can produce quantifiable financial savings, such as the reduction of production of wastes, reduction in the use of materials, less activities causing damage to the environment and a reduction in the

number of fines imposed from the breach of environmental legislation (Shen and Tam, 2002; Sroufe, 2003; O'Laoire and Welford, 2016). Indeed, a UK survey by Thakore *et al* (2012) shows evidence of significant returns on investment post ISO 14001 certification.

A review of the existing literature enabled Shen and Tam (2002) to identify a range of factors considered to promote or restrict the implementation of EMS within the Asian construction sector. It was perceived that 'contributing to environmental protection' and 'increase in management and operation costs' were the leading perceived benefit and barrier, respectively, to its uptake (Shen and Tam, 2002). This is further supported by Altin and Altin (2014) who found very few companies were motivated by profit when adopting ISO 14001; a view contradicting sharply with Friedman's purpose of business existence.

In relation to the implementation of ISO 14001, Tse (2001) indicates five main benefits on the business and bottom-line figures. They show significant savings can be produced from energy efficiency and waste minimisation. Tse (2001) argues that EMS implementation encourages competition as it gives another benchmark by which clients can differentiate between companies. This is supported by Edwards (2004), who stated that organisations should be ethical, economic, legal and commercial, today we are seeing more organisations seriously considering the ethical implications of their operations, as well as the operations of their supply chains. In addition, Lingard *et al*. (1998) argued the lowest cost at the start of a project does not always reflect the lowest cost on completion. Not only may the adverse impacts of poor techniques result in higher costs, but also those companies with an accreditation are more likely to provide a level of quality assurance. Thus, an EMS accreditation can increase a

company's competitive edge.

Tse (2001) argues further, that by its very nature, the process of obtaining accreditation improves the attention given to environmental issues within higher management levels of an organisation. The periodic review of environmental performance stimulates greater understanding and sparks debate in other areas, which in turn will improve the company as a whole. Indeed, the implementation of ISO 14001 is viewed as an appropriate time for implementation of ISO 9001, which is the international standard for quality management systems (QMS) and vice-versa (Hilary, 2004; Zeng *et al*. 2005).

Hilary's (2004) study indicated that benefits can be broken down into two categories – Internal and External, and each further divided into three areas: internally − organisational, financial and people benefits; and externally − commercial environmental and communication. Although in Hilary (2004) the focus was on small to medium enterprises (SME's) in Europe, the study highlighted similar benefits to Tse (2001), which can be viewed as an indicator of the international appeal of EMS. This has been supported by the fact that ISO 14001 has been adopted by over half the countries in the world (Delmas and Montes-Sancho, 2011).

2.2 Barriers to implementation of EMSs

In contrast to research purporting the benefits of EMS, studies in various parts of the world reveal that contractors feel there are significant barriers to the implementation of EMS; mainly far greater costs than benefits (Watson *et al*., 2004; Griffith and Bhutto, 2008; Pitt *et al*., 2009; Owolana and Booth, 2016). Shen and Tam's (2002) study revealed management costs, lack of trained staff, expertise and the failure of subcontractors to buy into the systems were major

barriers to implementation. Uncertainty exists in respect of EMS being too broad and about how activities would be assessed by auditors (Zutshi and Sohal, 2004).

Improvements in environmental performance are often seen as a cost burden to the business, which they must either absorb or pass onto the customer (Ball, 2002). Cassells *et al.* (2012) found some companies are still reluctant to implement ISO 14001 to increase the competitiveness of the company due to the cost of implementation. While the traditional environmentally friendly perspective purports that 'going green' is beneficial to society (Mackley, 2001; Tari et al., 2012). Businesses still are typically motivated to reduce, not social, but operating costs (Watson *et al*., 2004; Altin and Altin, 2014). As Griffiths (1994) notes, significant costs can be incurred from developing the system and procedures, producing documentation, implementation and monitoring, auditing and third-party assessment. This is an observation that is confirmed by numerous surveys with contractors being surprised by unexpected costs involved (Bansal and Bogner, 2002; Hanna *et al*., 2002; Ofori *et al*., 2002; Hilary, 2004; Davies, 2005; Owolana and Booth, 2016).

A survey undertaken in Singapore cited that the majority of contractors felt high costs and lack of tangible benefits were prime reasons for non-implementation (Ofori *et al.,* 2002). Similarly, Shen *et al.* (2010) indicated constraints on time and levels of costs investment, in order to properly implement measures for improving environmental performance, negatively affects contractor interest. Owolana and Booth (2016) also noted in the context of Nigerian construction that lack of technology can be a barrier.

Hilary's (1999) review article indicates internal organisational barriers where more

important than external ones for EMS implementation. Despite positive personal stances within organisations there was a real difficulty in translating those into actions. Indeed, within SME's, many held the view that their organisations had minimal environmental impact and, as such, it was not necessary to make the subject a core business issue, especially as costs would be rapid, and benefits, if possible, would only be recognised in the long-term. A later study showed opinions had still not changed (Hilary 2004), which is supported by several authors (Latham, 1994; Egan, 1998; Love *et al*., 2000; Egan, 2002) who proffer that changes are not well received within the UK construction industry, suggesting artificial barriers may be created, which dissuade individuals and organisations from implementing new policies and procedures. In conjunction to the idea that smaller construction companies may be unable to afford the initial investment required in to implement an EMS (Windapo and Jegede, 2013).

It has been demonstrated that privately owned companies are two to six times less likely to adopt EMS than publicly traded companies, due their comparative lack of resources to implement policy (Darnell and Edwards, 2006). In relation to construction companies, this is considered most significant in the UK, as 99% are privately owned and employ less than 80 people (DBERR, 2007). In fact, a survey by Revell and Blackburn (2004) found UK owner-managers claimed pressures from competitors, who could enter the market easily with no barriers and could compete with very low profits invariably, meant cost and speed of build were the priorities, and environmental management was a negligible concern.

3. Methodology

3.1 Methodological approach

The study adopted a primarily explanatory approach to investigate and explain stakeholder opinions of the benefits and barriers of EMS in the UK construction industry. As EMS implementation is well researched and previous literature provides sufficient evidence to hypothesise potential benefits and barriers of EMS, a quantitative questionnaire survey strategy was adopted following the approach of previous researchers (Denzin, 1978., Oppenheim,2001., Teddlie, 2009 and Kelley *et al.* 2003) who suggest the usefulness of investigating opinions, seeking explanation and providing data for hypothesis testing.

3.2 Data collection

Data collection was carried out by using an online questionnaire to ensure anonymity and eliminate unnecessary use of resources. This was supported by conducting six interviews with contractors supporting the development of the questionnaire. A pilot questionnaire was produced and presented to a small number of individuals for their critical appraisal. As the vast majority of the questionnaires were to be completed at distance, it was extremely important the questionnaire was easy to complete, understandable and effective in generating the required data (Jobber and O'Reilly, 1996; Bryman, 2008).

The questionnaire was divided into three sections with questions relating to participant details, plus the benefits and barriers to EMS implementation in construction. The benefits section comprised of 12 statements (Table 1) cited in a random order to avoid any preference.

The statements were formulated with a view to attempt to encapsulate all the different benefits previously identified. Similarly, the barriers section comprised of 16 statements (Table 2) presented in the same format and with no bias. Participants were asked to rank the significance of each statement using Likert scale from 1 to 5 ranging from 1= least significant to 5= most significant.

3.3 Research sampling

The questionnaires were distributed to 626 construction companies sourced from the National Federation of Builders, Scottish National Federation of Builders and Federation of Master Builders. The questionnaires were sent out to randomly selected companies with a view to obtaining the widest geographical spread of potential respondents from across the UK. Out of the 626 questionnaires sent out, 49 were returned completed giving a response rate of 8.3%. Jackson (2011) suggests that the typical response rate for on-line surveys is in the range of 10−20%. However, many other published articles indicate a response rate well below this level with Holbrook *et al.,* (2007) indicating response rates as low as 5%. Therefore, the response rate for this survey was judged satisfactory.

According Denscombe (2010), sampling and sample size adequacy can be determined based on precedence. Thus, the 49 responses recorded in this study is statistically significant when compared to previous built environment studies of similar nature. Owolana and Booth (2016) relied on 40 responses and applied similar analysis techniques, while, Ahadzie (2007) relied on 59 responses for multi-variant statistical analysis. Overall, survey sample sizes above 45 are deemed statistically significant based on estimations of UK construction industry

population with assumed 20% margin of error as well as confidence intervals of 95% (See Creative Research Systems, 2003; Survey Monkey 2019).

3.4 Data analysis method

To examine the relative levels of significance it was necessary to undertake data analysis using the approach of calculating the average significance score (ASS) between the number of responses to each factor. The following weighted model was used:

$$ASS_i = \frac{\sum_{j=1}^{5} \alpha_j \eta_{ij}}{x}$$

where ASS*i* represents the average significance score to the factor *i;* α denotes the grade assumed to 1-5, η_{ij} denotes the number of respondents who give the factor *i* for the grade α. x represents the number of overall respondents.

While it is possible to directly use the values given by this formula model to rank the data, the inherent weakness of this method is that it does not consider the level of variances between the responses (Shen and Tam 2002). For example, it may be the case that 50% of respondents gave a rank of 1 indicating low significance and 50% gave a 5 indicating a high significance – in this case the model would not show a spread of results and would indicate the same as all the respondents giving a response of 2.5. For a more accurate picture the responses with smaller variation between individual responses will give high quality to the weighted average, with it being the case that when two factors have the same or similar average value the factor with the lowest variation in responses should be given the highest rank (Shen and Tam, 2002). The coefficient of variation is found by dividing the weighted average by the standard deviation.

This figure can then be used to adjust the average weighted results and reduce the impact of extreme results on the data. The combined value of the weighted average and the coefficient of variation can be then used to rank the significance among all factors using the revised model to calculate the significance index value (Beniv and Bariv)

$$SIV_i = ASS_i + \frac{ASS_i}{\delta_i}$$

where ASS_i denotes the average significance score previously obtained; Beniv and $Bariv_i$ indicates the coefficient of variation of the beneficial or barrier factor *i;* δ denotes the standard deviation of the significant score for factor *i*. Data analysis was performed in MS Excel.

4. Results and discussion

4.1 An analysis of benefits to EMS implementation

Table 3 details the responses for the benefits to implementation section of the questionnaire survey. The ranking profile is indicated, based upon the Beniv data. From the analysis, the benefits of EMS implementation are discussed in two subsections: most significant benefits (Beniv ≥7.5); and least significant benefits (Beniv < 7.5) (Table 4).

4.1.1 Most significant benefits of EMS implementation

Figure 1 provides empirical evidence of the ranked benefits perceived from implementing an EMS. ‘Reduction of environmental risks – polluted air, land and water’ is perceived to be the most significant benefit, followed by ‘Contribution to levels of environmental protection generally within society’.

In terms of the spread of the answers - ‘Reduction of environmental risks’ was considered

highly significant when compared to the other responses. From the α value given in Table 3 it is interesting to note that the statement not only had the overall highest score at 20% higher than the average of 159, only one contractor gave it a score of 1. Furthermore, it had the highest mean response of 3.90. The next two highest responses were – 'Contribution to levels of environmental protection generally within society' and 'Contribution to environmental standards of the construction industry as a whole' are viewed by contractors as extremely significant in terms of being beneficial factors of EMS implementation.

'Reduction of Environmental Risk' when viewed in the context of the previous studies (Tse , 2001 and Hilary, 2004) would not have been the most popular response and those responses which considered financial matters such as saving the organisation money, would have been anticipated to be most beneficial. However, when this result is compared to the study of Shen and Tam (2002) they similarly indicated that this was the most important benefit to be gained from implementation of an EMS. The finding here also concurs with the study by Raines (2002), which indicated profit is not the primary motivation of adopting ISO 14001. It is difficult to identify whether the perceived contractor's altruism with regard to environmental matters, rather than financial gain stems from the individual who is completing the questionnaire or it is a key facet of company policy. However, this gives an indication that generally contractors feel that actually improving the way they work to minimise their impact and create a 'better' environment for all is a positive way to proceed. Despite societies often negative view of the construction industry (Dammann and Elle, 2006), these responses give an indication that it is not necessarily justified and that those contractors questioned can see the

benefits from implementation. It shows that they recognise the need to satisfy the requirements that society imposes upon them to take care of the environment in which they work.

One of the key benefits identified in implementing an EMS is being able to fulfil the requirements of prequalification questionnaires before tenders (Tse, 2001). In terms of these results, this benefit was identified as important and has a direct financial advantage to the organization (Table 4). As the primary function of any commercial operation is to generate profit, it is interesting to note that this did not feature in the top three responses. It is, however, rated significantly higher when viewed in the context of the other results, with this statement scoring 0.5 points higher than the next response on the SIV scale. Furthermore, the basic α figure for this factor is actually 5 points higher than that of contribution to 'Environmental standards as whole' and has the same median score as the top three responses but is ranked lower potentially as a result of skew in responses.

4.1.2 Least significant benefits of EMS implementation

The next highly ranked group of responses can also be collectively attributed to financial benefits: 'Segregation of waste resulting in cost neutral or cost positive disposal'; 'Minimising production costs through more efficient ordering and waste minimisation' and 'Improved corporate image increasing overall business competitiveness'. These results are comparable with other studies (Jackson, 1997; Rondinelli and Vastag, 2000; Morrow and Rondinelli, 2002 and Davies, 2005) that indicated compliance can have considerable financial benefits, as a direct result of improvements in operational and managerial procedures leading to a better controlled organisation. This in turn will not only reduce costs and make the business more

competitive but is more appealing to clients as well. The latter can potentially result in higher prices which, although difficult to estimate, might be reasonable for the emerging generation of 'green' customers who are willing to pay higher prices for environmentally friendly products (Lyon and Maxwell, 2007; 2008). More research is needed to ascertain why cost positive benefits are not viewed as the most important when compared to factors that do not directly affect the profitability of the business.

In the study of Shen and Tam (2002) the factors of waste disposal and efficient ordering where not raised so no comparisons can be made here, although in their study 'Increasing overall business competitiveness' was one of the lowest ranked statements. Their summary of that situation was that contractors did not view EMS implementation as bringing any financial benefits. In this study, it is interesting to note that contractors have identified benefits albeit with a neutral attitude. The rational for this is likely three-fold. Firstly, in the years since they undertook their survey general awareness of the supposed benefits has increased (Weiβ and Bentlage, 2006). Secondly, the mechanisms by which the construction industry operates have changed; contractors are now viewed in terms of the environmental accreditations and performance (Constructing Excellence, 2014). Thirdly, facilities to make savings through waste segregation and supply chain management are now in place or more easily obtainable (Kassolis, 2007).

The next lowest ranked benefit was that of 'Reduced travel costs through managed travel strategy'. Opinion, however, divided on this with 32.6% of contractors rating with either 4 or 5 points, eight scored with a 5 showing that for some organisations managing transport

effectively is an extremely important benefit. This could be related to the adopted performance measurement systems since there is indeed a number of project-based key performance indicators (KPIs), put forward (BRE, 2003, DBERR, 2007; BERR, 2007;), which have highlighted the need for minimising travel distances and vehicle movements as means for reducing fuel consumption and costs from transportation (Vidalakis and Sommerville, 2013). It would appear the majority of contractors implementing an EMS would not have a direct impact on reducing transport costs.

According to Shen and Tam (2002) the nature of construction is diverse and it is unlikely that operatives are based for long periods in one location and as such they have to go where the work is rather than being moved to suit the shortest distance to travel from where individuals live. In the case of the medium sized organisations where they do have vast labour pools is it difficult to tailor the workforce to location. Furthermore, in terms of main contractors a large amount of their workload is likely to be carried out by subcontractors whose operations as identified by Shen and Tam (2002) and Zeng *et al* (2005) cannot be easily managed nor have a visible direct financial implication on the main contractors' organisation.

'Reduction of Environmental Complaints' was ranked the next lowest statement with a low SIV score and a mean rating of less than 3 indicating that it was considered of low importance. This result is generally in line with the study by Shen and Tam (2002), which shows the item to be 'neutral'. This result appears to show that in both countries contractors do not experience a large number of complaints with regard to how they treat the environment.

The next lowest ranked statement was 'improving staff work environmental improving

moral'. The low score given to this item is consistent with findings in Shen and Tam (2002). Implementation of an EMS in the construction industry brings minimal change to the actually how comfortable the work environment is. Although it is interesting to note that nine contractors ranked this item 'significant' and five contractors 'very significant'.

The two lowest ranked statements were 'Reduction of environmental related sickness and injury' and 'Reduction in level of fines from convictions'. The lowest mean average ranking and Beniv value was the 'Reduction in fines' but the lowest median and modal scores were for 'reduction of sickness and injury' which shows a tighter grouping of low responses for that statement than any other. These results are generally aligned with those of Shen and Tam (2002), which show these items to be viewed by the majority of contractors as insignificant benefits to the implementation of an EMS. Thus, the least important benefits were, 'Reduced transport costs through travel management strategy', 'reduction of environmental complaints', 'reduction of environmental-related sickness and injuries' and 'reduction of fines associated with convictions'

4.2 Analysis of barriers to implementation of EMS responses

Table 5 details the responses for the barriers to the implementation section of questionnaire. From the analysis, the barriers to EMS implementation are discussed in two subsections: most significant barriers (*Beniv* ≥7.5); and least significant barriers (*Beniv* < 7.5).

4.2.1 Most significant barriers to EMS implementation

From the data as shown in Figure 2, respondents felt that the most significant barrier to the

implementation of environmental management systems in the construction industry was a 'lack of subcontractor co-operation' with a Bariv score of 8.35. Unlike the responses to EMS benefits, the most significant three statements on the Bariv scale are extremely closely ranked especially when the α and mean values are considered. The cumulative response values for the second most highly ranked statement on the Bariv scale 'Cost savings do not balance against expense of thoroughly implementing management strategies' actually obtained a greater α value by two points. Similarly, the statement ranked third on the Bariv scale 'Increase in management and operational costs' obtained a higher α value by 1 point. None of the four highest ranked statements on the Bariv scale received a '1' indicating they were unimportant in contrast to the even the top benefit that had at least one contractor who considered it so.

'Lack of sub-contractor co-operation' was highlighted as a significant barrier in the study of Shen and Tam (2002) and was also considered a key barrier with both the questionnaire they undertook showing this but also interviews revealing that controlling their environment performance is extremely difficult and time-consuming.

From the findings in Shen and Tam (2002), increases in management and operational costs was the most highly ranked statement, which is comparable with this study. Shen and Tam (2002) refer to business culture of Hong-Kong being one of short-term consideration, additional time and resources are not viewed as an investment for future profitability. In the case of this study, we cannot be completely sure as to the rational behind the high scoring of 'increase of management costs'.

The factor ranked second 'Cost savings do not balance against expense' indicates that the

contractors felt that despite initial investments they were or would not get any significant returns. It would therefore appear that the purported benefits of cost reductions from implementation of an EMS where not be realised and that any investment was a fruitless exercise in terms of reducing real costs and adding monetary value to the organisation. While it has been recognised that the EMS gives value in terms of environmental improvement and protection, the immediate issues of cash-flow and survival are more important.

The factor ranked third was 'Increase in management and operational costs'. This is directly correlated with the second that the increase in costs is not directly reflected in the level of savings to be made elsewhere in the organisation. Virtually all the papers reviewed showed increases in management costs are a key barrier to implementation. This includes Shen and Tam (2002) whose study ranked this item as the most important by a large margin. Whilst it is evident that this is an important issue it is not clear whether this is largely a true or perceived situation, which is manifesting itself in the views of the respondents. Further research is required in this area to attempt to quantify whether the costs or value are accurately measured when it comes to EMS.

4.2.2 Least significant barriers to EMS

The fourth ranked statement is 'Lack of client support'. If clients are not supporting environmental measures, then the attitude amongst contractors is likely to be 'why should I bother?' This finding does concur with that of Revell and Blackburn (2004) who found that lip service is being paid to environment issues and that economic concerns are of greater importance. This is particularly true in a single stage tender; whereby lowest cost is likely to be

the deciding factor for the placement of an order. What the survey does not indicate however is what type of clients those surveyed are working for – whether they are domestic, governmental or commercial. It may be that whilst a particular type of client such as domestic are not interested or aware of EMS requirements and are driven by cost alone, other organisations such as large corporate bodies or charities may take their environmental credentials seriously.

'Increase in documentation workload' ranked fifth is intrinsically linked to the statement regarding increased management costs as it is logical that an increase in time spent implementing EMS will increase the amount of documentation associated with it. Statistically, this is the first response to receive a single response from a contractor of 1, which indicates that it is not considered a barrier to implementation, although overall the median score remains at four indicating that is considered of high importance. In the study by Shen and Tam (2002) this statement was ranked ninth out of 13 statements indicating that for participants it was considered of relatively low importance. In discussions with contractors it was felt that recently 'more and more paperwork was being generated to tick boxes' and the difference could be explained that in the last few years the amount of information processed generally has increased dramatically.

'Time consumed for improving environmental performance' ranked sixth is also linked to increases in management time and associated costs. In the study by Shen and Tam (2002) it received a similar rank in fifth place showing that despite the time-lag between studies and cultural differences similar problems persist.

Ranked seventh was the statement 'Difficult co-ordination of environmental performance

of multi-tier subcontractors'. As lack of subcontractor co-operation is ranked first it is to be expected that those subcontractors who subcontract work out to a firm with whom the main contractor has no direct link would be particularly difficult to manage. Whilst there are generally procedures in place for the overrunning of a project, which would result in cost penalties – it was not highlighted in the literature review of penalties being imposed by main contractors on subcontractors for the non-performance in terms of environmental requirements. This does not discount however that on certain projects there are levels of environmental management required as part of the specification failure of which would generally be dealt with using the standard procedures for non-compliance.

'Lack of trained staff and expertise' is ranked eighth and is the first statement whose median response score drops to a level of 3 indicating that it is considered of medium significance. In Shen and Tam's (2002) survey this was considered the second important barrier to implementation. The difference is quite marked and whilst further research would be required to account for this dissimilarity, potentially, it can be attributed to increased knowledge amongst management level staff (O'Laoire and Welford 2016). It is likely that whilst environmentalism in the construction sector has not been wholly embraced, the levels of management capability and understanding to deal with such issues have increased since 2002 especially amongst those entering the industry more recently who will have encountered environmental consideration during their education as part of the core syllabus.

Ranked ninth out of the 16 statements was that of 'Ambiguous or absent governmental targets for the Construction Sector'. This statement has a mean of 3.41, which indicates that it

is still considered a significant difficulty in undertaking EMS. It is interesting that this factor is still ranked quite so highly considering the relative availability of KPI's and other governmental benchmarks now available to the construction industry (Chan and Chan 2004). Shen and Tam (2002) did not consider this statement in their study and it was entered into this study as a factor after discussions with contractors prior to the survey formulation.

The tenth most highly ranked factor was that of 'Lack of support from working staff'. In the discussions with contractors it was noted that whilst the company objectives may be towards EMS, employees' engagement was challenging as they saw it is an 'inconvenience' and 'a distraction' from their normal duties. As the statement regarding the increase in staff moral from the implementation of an EMS was ranked as a fringe benefit of little significance: we can see a correlation between that result and this. Whilst problematical for the employer this result was the first where the overall mean response dropped below 3 signifying that this was not generally considered to be significant. In Shen and Tam's (2002) survey the statement was ranked of similar magnitude.

'Lack of supplier co-operation' was ranked eleventh although it had a higher overall α value and a higher mean than the previous statement due to the SIV giving greater significance to spread of the results rather than the overall scoring. Shen and Tam (2002) also found this to be of medium significance with the same modal score of three occurring in their survey.

The next set of results overall SIVs drop significantly indicating that they are not perceived to be significant barriers to implementation. 'Lack of tailor-made training on environmental management', 'Waste Management companies do not offer services that suit our

needs', 'Change of existing practice of company structure and policy', 'Lack of government legal enforcement' followed. 'Lack of technological support within the organisation' was ranked the lowest at 1sixth indicating that it is viewed as generally as largely insignificant. Nevertheless, each of the statements received were ranked in the highest position by between 2 and 6 contractors indicating that to some organisations these fringe barriers were still viewed as highly significant.

The factor ranked twelfth, 'Change of existing practice, company structure and policy' is most interesting as this reflects the importance that contractors put on their existing setup and business model. It indicates that they view change as a problem rather than an opportunity. From views purported when discussing the research with members of various organisations it was perceived that change for the sake of the environment is 'a waste of time'. As previously noted (Latham 1994; Egan 1998; Love *et al* 2000; Egan 2002), change is often un-welcome within the UK construction industry, a view that this survey appears to substantiate. The low-level ranking of this item however indicates change is not as big a barrier as it may be perceived to be. This concurs with Shen and Tam's (2002) survey that ranked this statement of low importance, showing it to be the most insignificant barrier.

The four lowest ranked statements in Shen and Tam's (2002) study are matched with those found here, albeit in a different order. This indicates that despite the time and cultural differences these marginal barriers are the same. There is also parity between the two studies on highest ranked and lowest ranked barriers for both studies and this seems to suggest that despite changes in policy, greater awareness and indeed levels of implementation the same

issues have yet to be resolved.

Overall this study corroborates a number of findings that have previously been highlighted in construction management and EMS studies. Effective communication across the supply chain helps in alleviating misconceptions, thus providing construction companies with rounded view of EMS impact (Zhang et al., 2000). This is substantiated by the findings from this study and concurs with the submissions in Owolana and Booth (2016).

According to Shen and Tam (2002) construction practice is typically characterized by traditional methods that contractors are more accustomed to, thus making the adoption of new approaches challenging. In relation to EMS, contractors often choose these traditional approaches as a result of the economies of scale presented due to years of use and familiarity. However, effective environmental practices require Modern Methods of Construction (MMC), including offsite methods which are generally viewed as more capital intensive and offering less short-term benefits to contractors. Related to this is the perception that, the adoption of these methods have associated higher costs that may affect profitability (Zhang et al., 2000). The current study however debunks these assertions, highlighting relatively less concern about the cost of implementation in the view of construction practitioners. Furthermore, institutional promotion of MMCs including, the UK construction strategy, 2025 present opportunities for mainstreaming construction methodologies that lend themselves to more effective EMS practice (DBIS, 2013)

5. Validity of findings

In this study, replication is adopted in testing validity of the findings and research design. This is

an external validity approach used to ascertain reliability of research findings (Rosenthal and Rosnow 1991). When using 'replication', research process is repeated to ascertain whether there is consistency in findings or reasonable variations due to context. This can be achieved through adoption of the same survey instruments, research design and analysis techniques although applying them in a new context or time horizon. In this study, survey instruments used by Shen and Tam (2002), Hong Kong, as well as Owolana and Booth (2016), Nigeria, was adopted and repeated in different context (i.e. UK). The findings highlighted many areas of congruence between these studies and is outlined in the 'discussion' section.

6. Conclusions

The significance of various benefits and barriers to EMS in the UK construction industry have been investigated. Whilst benefits can be achieved there are also detrimental effects to organisations in pursuing those goals. In this study, the key benefits perceived to be associated with EMS systems in construction are: (i) Reduction of environmental risks – polluted air, land and water; (ii) Contribution to levels of environmental protection generally within society; (iii) Contribution to the environmental standards of the construction industry as a whole. These altruistic statements demonstrate that construction companies view the implementation of EMS as bringing about changes that will benefit the wider society. They perceive a rising of standards and public perceptions of the industry as a positive and see that EMS actually can make a difference to the environment and it is not solely about looking good or ticking the right boxes.

Aside the benefits, there is also an acknowledgement that EMS implementation is

sometimes fraught by barriers. The perceived key barriers identified in this study were: (i) Lack of sub-contractor co-operation; (ii) Cost savings do not balance against expense of thoroughly implementing management strategies; (iii) Increase in management and operational costs. Whilst it has been shown that real tangible benefits can be achieved by organisations that are committed to their EMS and that those benefits can serve the dual purpose of improving the businesses operational status and profitability while also reducing the impact of that organisation upon physical and biological environments. It has been noted that there is a great deal of evidence to support the idea that implementation is costly and a poorly implemented system can have a myriad of negative impacts on a business including reductions of profitability and the wasteful use of company resources.

The effectiveness of the EMS relies upon all areas of construction working together although this is not the case in practice. Indeed, there is a long road to travel, before the prerequisites of sustainable development are achieved. EMS can have negative aspects, which run counter to the goals of the organisations and those need to be addressed before implementation can be viewed as a solely beneficial pursuit to a contractor. However, global society is becoming more aware of the need for sustainable development and this paper demonstrates that the greening of the construction industry has a huge part to play in this journey, while acknowledging the barriers which exist. As society moves towards a more sustainable world those barriers should become easier to negotiate and the benefits become more significant as the demand for environmental impacts to be reduced increases.

From the findings it is recommended that future research takes cognisance of the fact that

despite reported benefits EMS might not be the panacea for sustainable construction practices and overall sustainable development. But this could facilitate the identification of potential solutions, which could help the industry improve. This research relied on mainly on a quantitative design thus in order to explore the underlying reasons for the findings, qualitative studies should be conducted in the future.

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Table 1. Beneficial factors from EMS implementation

Code	Benefit Factors
BEN-a	Reduction of fines associated with convictions
BEN-b	Improved corporate image to increase overall business competitiveness
BEN-c	Contribution to the environmental standards of the construction industry as a whole
BEN-d	Contribution to levels of environmental protection generally within society
BEN-e	Reduction of environmental complaints
BEN-f	Improving staff work environment, thus increasing their morale
BEN-g	Reduction of environment-related sickness and injuries
BEN-h	Reduction of environmental risks - polluted air, land and water
BEN-i	Compliance with employers prequalification requirements
BEN-j	Segregation of waste resulting in cost neutral or cost positive disposal
BEN-k	Minimising production costs through more efficient ordering and waste minimisation
BEN-l	Reduced transport costs through managed travel strategy

Table 2. Barrier factors to implementation of EMS

Code	Barrier Factors
BAR-a	Lack of government legal enforcement
BAR-b	Increase in management and operational costs
BAR-c	Lack of trained staff and expertise
BAR-d	Lack of client support
BAR-e	Lack of sub-contractor co-operation
BAR-f	Lack of supplier co-operation
BAR-g	Difficult co-ordination of environmental performance among multi-tier subcontractors
BAR-h	Lack of support from working staff
BAR-i	Time-consumed for improving environmental performance
BAR-j	Change of existing practice of company structure and policy
BAR-k	Increase in documentation workload
BAR-l	Lack of tailor-made training on environmental management
BAR-m	Lack of technological support within organisation
BAR-n	Cost savings do not balance against expense of thoroughly implementing management strategies
BAR-o	Ambiguous or absent government targets for the construction sector
BAR-p	Waste Management companies do not offer services that suit our needs

Table 3. Survey responses and calculation of parameter values to beneficial factors

Code	SD	D	N	A	SA	Total	BENIV	α	Rank
BEN-a	11	12	13	10	3	49	4.79	129	12
BEN-b	4	12	9	16	8	49	5.88	159	7
BEN-c	1	5	9	20	14	49	7.57	188	3
BEN-d	1	4	13	22	9	49	7.62	181	2
BEN-e	8	12	15	12	2	49	5.20	135	9
BEN-f	8	12	15	9	5	49	5.13	138	10
BEN-g	10	15	8	12	4	49	4.80	132	11
BEN-h	1	4	8	22	14	49	7.86	191	1
BEN-i	2	5	10	16	16	49	7.14	186	4
BEN-j	4	5	16	20	4	49	6.47	162	5
BEN-k	2	10	14	15	8	49	6.36	164	6
BEN-l	6	14	13	8	8	49	5.28	145	8

Table 4. List of beneficial factors in ranked order

Rank	Code	Benefit Factors
1	BEN-h	Reduction of environmental risks - polluted air, land and water
2	BEN-d	Contribution to levels of environmental protection generally within society
3	BEN-c	Contribution to the environmental standards of the construction industry as a whole
4	BEN-i	Compliance with employers prequalification requirements
5	BEN-j	Segregation of waste resulting in cost neutral or cost positive disposal
6	BEN-k	Minimising production costs through more efficient ordering and waste minimisation
7	BEN-b	Improved corporate image to increase overall business competitiveness
8	BEN-l	Reduced transport costs through managed travel strategy
9	BEN-e	Reduction of environmental complaints
10	BEN-f	Improving staff work environment, thus increasing their morale
11	BEN-g	Reduction of environment-related sickness and injuries
12	BEN-a	Reduction of fines associated with convictions

Table 5. Survey responses and calculation of parameter values to barrier factors

Code	SD	D	N	A	SA	Total	BARIV	α	Rank
BAR-a	9	8	21	6	5	49	5.15	137	15
BAR-b	0	5	12	17	15	49	7.80	189	3
BAR-c	2	6	18	16	7	49	6.75	167	8
BAR-d	0	6	13	19	11	49	7.59	182	4
BAR-e	0	3	13	22	11	49	8.35	188	1
BAR-f	3	11	15	14	6	49	6.05	156	11
BAR-g	2	6	13	17	11	49	6.86	176	7
BAR-h	3	10	22	13	1	49	6.29	146	10
BAR-i	2	7	9	19	12	49	6.89	179	6
BAR-j	7	15	16	9	2	49	5.18	131	14
BAR-k	1	6	14	14	14	49	7.10	181	5
BAR-l	5	10	22	6	6	49	5.61	145	12
BAR-m	10	12	15	9	3	49	4.90	130	16
BAR-n	0	4	12	19	14	49	8.06	190	2
BAR-o	3	7	17	11	11	49	6.32	167	9
BAR-p	7	10	16	7	9	49	5.35	148	13

Table 6. The ranking profile of responses given to statements of proposed barriers to the implementation of EMS

Rank	Code	Barrier Factors
1	BAR-e	Lack of sub-contractor co-operation
2	BAR-n	Cost savings do not balance against expense of thoroughly implementing management strategies
3	BAR-b	Increase in management and operational costs
4	BAR-d	Lack of client support
5	BAR-k	Increase in documentation workload
6	BAR-i	Time-consumed for improving environmental performance
7	BAR-g	Difficult co-ordination of environmental performance among multi-tier subcontractors
8	BAR-c	Lack of trained staff and expertise
9	BAR-o	Ambiguous or absent government targets for the construction sector
10	BAR-h	Lack of support from working staff
11	BAR-f	Lack of supplier co-operation
12	BAR-l	Lack of tailor-made training on environmental management
13	BAR-p	Waste Management companies do not offer services that suit our needs
14	BAR-j	Change of existing practice of company structure and policy
15	BAR-a	Lack of government legal enforcement
16	BAR-m	Lack of technological support within organisation

Figure 1. The ranking profile based on SIV data for responses given to statements on benefits to implementation of EMS

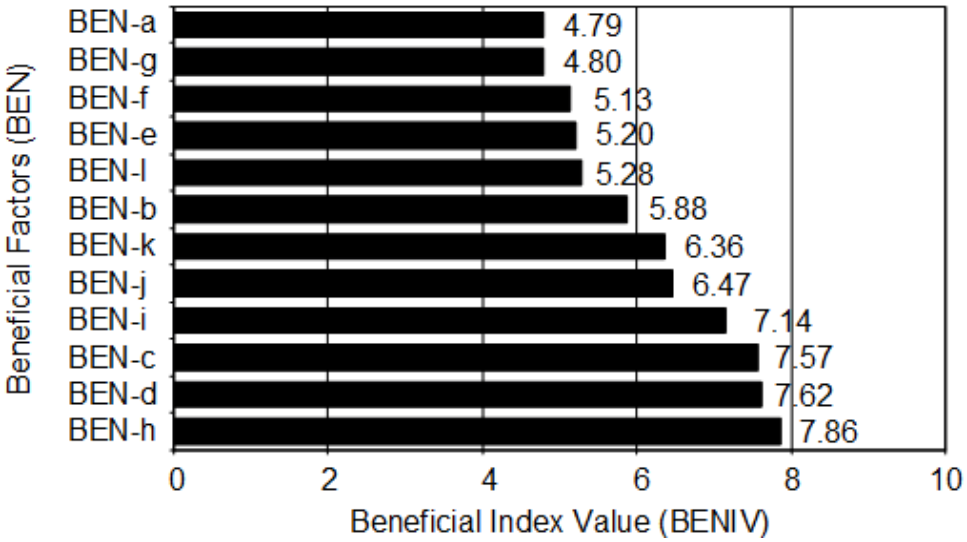

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Figure 2. The ranking profile based on SIV data for responses given to statements on barriers to implementation of EMS