

Appendix 2: Articles

Shutler, R., **Horry, R.E.** and Booth, C.A. (2022) Saving nemo and friends from the potential impacts of permitted building developments on the beaches of Jersey. In: Gorse, C., Booth, C.A., Scott, L., Dastbaz, M. & Drotleff, B.O. (Editors) *Sustainable Ecological Engineering Design*. Springer Nature, Chan, Switzerland. (in press).

Mundy, P., Henderson, E., **Horry, R.E.** and Booth, C.A. (2022) Building certification schemes: Are they driving or derailing sustainable development in the construction sector? In: Gorse, C., Booth, C.A., Scott, L., Dastbaz, M. & Drotleff, B.O. (Editors) *Sustainable Ecological Engineering Design*. Springer Nature, Chan, Switzerland, (in press).

Baranova, P., **Horry, R.E.** and Booth, C.A. (2022) To infinity and beyond the environmental impact minimisation paradigm. In: Gorse, C., Booth, C.A., Scott, L., Dastbaz, M. & Drotleff, B.O. (Editors) *Sustainable Ecological Engineering Design*. Springer Nature, Chan, Switzerland, (in press).

Horry, R.E., Booth, C.A., Mahamadu, M.J. and Ball, S. (2023) Benefits and barriers to the implementation of ISO 14001 in the Architecture, Engineering and Construction sectors: A systematic literature review - *Proceedings of the Institution of Civil Engineers – Engineering Sustainability*, <https://doi.org/10.1680/jensu.23.00038>

Bailey, M., Booth, C.A., **Horry, R.E.**, Vidalakis, C., Mahamadu, A.M. and Baffour Awuah, K.G. (2021) Opinions of small and medium UK construction companies on environmental management systems. *Proceedings of the Institution of Civil Engineers – Management Procurement and Law*, 174, pp. 23-34.

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Beck-Schildt, J.C., Booth, C.A., **Horry, R.E.** and Wiejak-Roy, G. (2023) Stakeholder opinions of implementing environmental management systems in the construction sector of the USA. *Buildings*. 13, pp. 1241.

Horry, R.E., Booth, C.A. and Mahamadu, M.J. (2023) Towards a consensus of expert opinions on implementing ISO14001 in the architecture, engineering, and constructor sectors of the UK. *Sustainable Development & Planning XII*, WIT Press, Southampton, pp. 329–341.

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Horry, R.E., Booth, C.A., Mahamadu, A.M., Manu, P. and Georgakis, P. (2021) Environmental management systems in the architectural, engineering and construction sectors: A roadmap to aid the delivery of the sustainable development goals. *Environment, Development and Sustainability*, <https://doi.org/10.1007/s10668-021-01874-3>.

Horry, R.E., Booth, C.A. and Mahamadu, A.M. (2023) Contributions of environmental management systems (ISO 14001) towards the delivery of sustainable development goal 12. In: Opoku, A. (Editor) *Elgar Research Companion to the Built Environment and the Sustainable Development Goals (SDGs)*. Elgar Publications (accepted).

Article 1 (Book Chapter): Horry, R.E. and Booth, C.A. (2018) Use of environmental management systems to mitigate urban pollution. In: Charlesworth, S.M. & Booth, C.A. (Editors) *Urban Pollution: Science and Management*. Oxford: Wiley–Blackwells. pp. 293-302.

22.1 Introduction

An Environmental Management System (EMS) is an instrument that can help organisations to manage and positively improve their level of impact on the environment (Christini *et al.*, 2004; Oke, 2004). An EMS helps a company measure its environmental performance and provides the framework for the integration of sustainable development goals within the organisation's corporate plan (Ilinitich *et al.*, 1998; Jolevski, 2013; Owolana and Booth, 2016). Within organisations, environmental management should be treated as an integral part of any operation, alongside the option for Corporate Social Responsibility (CSR), to ensure they not only acknowledge the impacts of their operations but also that they have plans and strategies in place to minimise their harm to the environment and society. This is relevant to both their daily operations and also any resulting risk from an emergency situation (e.g. pollution events).

Typically, an EMS encompasses policies, goals, plans, regulatory requirements and is usually reflected in the company's annual reports. Christini *et al.* (2004) gives the following basic characteristics for an organisation's EMS: (i) goals, methods and a timeline for achieving environmental criteria; (ii) procedures for maintaining a paper trail in relation to those goals; (iii) a defined structure and a matrix of responsibilities, as well as allocated resources; (iv) corrective actions and emergency procedures; (v) employee training plan; and (vi) a plan for monitoring and auditing the organisation's performance in achieving the EMS goals (Owolana and Booth, 2016).

This chapter provides an overview of the importance for organisations to have an established EMS in place. It then employs a series of infamous case studies to highlight where an EMS could have served as a useful means of mitigating pollution events.

22.2 Why is Environmental Management Important?

When thinking about environmental management it is easy to immediately think about our own needs as being paramount and that we manage the environment for our own benefit. To some degree that probably is the case. However, there are an increasing number of companies who are not just preserving the environment for the resources they can then use, but also to promote a green company image, to prosper positive public relations, to attract better employees through their ethical performance/operations or, in some instances, because morally it is the right thing to do. After all, society (hereinafter referred to as 'we') lives on one planet and, as such, has a finite limit of resources. Thankfully, humans are immensely creative and, as technology improves, we seem to find ways to use resources more wisely (e.g. reduce, reuse, recycle). However, it is essential that we need to manage not just the resources we use but also the pollution we create and leave behind too.

There will of course always be those organisations who just want to make a profit and fail to appreciate the adverse legacy they leave behind for others or future generations to clear-up. Gratefully, this trend

is declining, as both people and organisations come to realise that the environment where they live and work does matter. Without doubt, we, or our future generations, will have to deal with the environmental and pollution issues created in the past or those still to be created.

Until recent times humans chose to concentrate their attention on progress and industrial achievement with minimal thought to the environment. Luckily there were a group of individuals who had the foresight to recognise potential problems caused by pollution and they fought for the introduction of environmental legislation (e.g. Alkali Act). In that respect, environmental management has a short history in terms of the human occupation of the planet, whereas most environmental issues are historic in creation. Many nations have long industrial heritages but, sadly, our predecessors were not always careful in respect to their environmental and pollution impacts. Nowadays, we appear to have greater awareness of our impacts, and while our knowledge is always improving, and with appropriate environmental management we seem to have better understanding and regulation of the perils we emit from our modern industrial and domestic processes.

22.3 Organisational Benefits And Barriers Of Implementing An EMS

As the number of organizations adopting a third party certifiable EMS linked to international standards (such as Eco-Management and Audit Scheme (EMAS) and ISO 14001) increases, the question that many organisations want answered is what are the benefits and barriers for them? An unpublished UK study has identified 'reduction of environmental risks' and 'contribution to environmental protection' as the main benefits; whilst a similar Nigerian study has recognised 'reduction of environment-related sickness and injuries' and 'contribution to environmental protection' as the main benefits (Owolana and Booth, 2016) and 'Cost saving due to the reduction of fines associated with convictions' and 'Improving staff work environment, thus increasing their morale' are acknowledged as the main benefits from a study in Hong Kong (Shen and Tan, 2002). The unpublished UK study also acclaims 'lack of technological support within organisation' and 'Lack of government legal enforcement' as the main barriers, the Nigerian study is similar and highlights 'Lack of government legal enforcement' and 'lack of technological support within organisation' as the main barriers, whereas the Hong Kong study commends 'Change of existing practice of company structure and policy' and 'Lack of government legal enforcement' as the main barriers against the uptake of EMS. Stakeholder perceptions of the main benefits and the main barriers towards adopting an EMS are clearly different for different nations but the assortment of advantages and challenges is diverse (Table 22.1 and 22.2).

22.4 What Can Companies Do In Relation To Their Environmental Impacts?

All businesses face a challenge in terms of their environmental impacts; environmental work is not just a concern for multinational organisations, which is sometimes how it is viewed. Small and medium sized enterprises (SMEs) form an important part of all economies, accounting for 99% of businesses in the UK (Revel and Blackburn, 2007). They are a major part of society; providing jobs and contributing financially to the economy. But there is an issue here in that in any environmental work there are always issues of limited resources, including cash flows versus customer demands and this can be a particular issue for the standard SME, (Hudson *et al.*, 2001) where staff capacity and cash are not always readily available. So in the case of many organisations the focus can be on current performance rather than taking a strategic approach, this in conjunction with their size contributes to them having what is

termed a flat organisational structure (Hudson *et al.*, 2001). It can also result in them being unsure of the tangible business benefits of environmental management (Hillary, 2000; Revel and Blackburn, 2007). As with any organisation whether they be multinationals or SMEs they will have both positive and negative impacts within society. However, while we always think of the multinationals being the pollution kings of the world, SMEs have been linked to approximately 60% of the carbon dioxide emissions (Marshall Report, 1998; Revell and Blackburn, 2007) and on the global scale it has been suggested they are responsible for 70% of all pollution (Revell *et al.*, 2010). However, this is a problem with a solution in the form of an EMS as high adopters of such systems are more likely to report increased recycling and reductions in air emissions, solid waste, and energy usage (Florida and Davidson, 2001). Organisations just need to be able to see the benefits of a system and have the confidence to work towards being more environmentally sound. The ISO 14001 system is not about being perfect, it is about making continual improvements in your environmental performance.

Implementation of an EMS not only provides improved environmental performance but also economic benefits. Research into the performance of some Italian firms operating an EMS identified economically quantifiable benefits, including raw material conservation, improved productivity, energy conservation, smoother production processes, waste reduction, improved access to government regulatory incentives and reduced insurance costs (Alberti *et al.*, 2000). Benefits, which are less easily quantifiable, are those such as risk reduction and improved company image (Alberti *et al.*, 2000). However, we are currently witnessing an increasing importance in these in terms of the opportunity for improved customer perception and even the recruitment of better more productive staff.

An ISO 14001 enables companies to focus strategically on their environmental performance and it has been suggested that companies who adopt such a system improved their environmental performance more significantly than non-adopters (Potoski and Prakash, 2005). However, it must be remembered that organisations need to have the correct management support in place to deliver an EMS, plus the financial ability involved in implementing and certifying such systems (Carraro and Leveque, 1999). There needs to be a commitment and support to make the potential a reality, the system will not fix the problem, it can only ever provide a mechanism to work towards a solution.

We are living in a changing world where companies face the immediacy of social media in terms of their operations; so if they are linked with an environmental incident it is global in a matter of hours. Panapanaan *et al.* (2003) suggested that Corporate Social Responsibility (CSR) and environmental management had become increasingly important as a result of the operation of all organisations impacting on the wider communities in which they exist. This is increasingly the case; companies need to be seen as responsible and sustainable. We have moved to a situation where the major companies now aim to implement their environmental systems through the supply chain to ensure that they, the major players, are seen to be acting in a socially responsible manner (Roberts, 2003; Enderle, 2004). These larger companies are in a position, which enables them to encourage such socially responsible behaviour within their supply chain (Lepoutre and Heene, 2006). How they do this can be via compliance with mandatory requirements or capacity building. The compliance approach sets standards for suppliers and tries to prevent non-compliance by a strict monitoring programme, which is time intensive (Lepoutre and Heene, 2006). If a non-compliance is discovered, then the customer

can terminate the contract or cease trading with the SME until corrective action is taken. Capacity building is more supportive in helping build the supplier's own capacity of handling CSR issues (Lepoutre and Heene, 2006) but tends to be more resource intensive for the customer. If this process involves SMEs in developing countries, the larger companies are also obligated to take responsibility for the well-being and performance of upstream producers that work in those countries (Wolters, 2003). Therefore, it is clear that any supply chain work potentially has significant cost implications for the larger organisations who sit at the top of the supply chain.

Larger organisations in the past 30 years have increasingly adopted environmental management but opportunities still exist for some of them and for many SMEs to boost their environmental performance through the provision of practical, easy-to-understand knowledge (Shearlock *et al.*, 2000). Another issue for some and SMEs, in particular, is that they are '*vulnerably compliant*', being unaware of existing, particularly environmental, and legislation (CEC 2002). This highlights a need within organisations, particularly SMEs, to have assistance in relation to their environmental impacts and legislative compliance.

Currently a situation exists where those organisations at the top of the supply chain are trying to manage their suppliers many of whom are disparate. The easiest method would be to insist that all suppliers must have or be working towards an EMS, such as ISO 14001, which is a voluntary standard. However, research suggests that voluntary standards such as ISO 14001 and Acorn, which are self-management and industry-driven approaches are not effective in promoting environmental management in SMEs due to lack of take up (e.g. Masurel, 2007; Revell and Blackburn, 2007). So, what are the reasons for and against organisations engaging with ISO 14001 (Figure 22.1)?

If an EMS were to be implemented, the resulting actions could bring about a stronger, more dedicated and productive workforce, which would be more outwardly focused. This could result in attention to the customers' requirements and leading to a better working relationship within the supply chain.

It is not just about environmental matters there has been considerable discussion over the last decade around the topic of CSR (Polonsky and Jevons, 2009), which again is implemented through the supply chain to create the idea of the major companies being seen as acting in a socially responsible manner. All organisations will impact on their local environment, therefore, they should consider their CSR as no organisation can operate within a vacuum (Roberts, 2003; Enderle, 2004) and traditionally some of these impacts were mitigated through the use of legislation, but what if companies governed themselves? Or is this just not possible due to the nature of the species?

22.5 What Happens When Things Go Wrong?

The next section details some of the better known pollution incidents and how they were managed. While reading these consider if we have actually learned from these events, or if the same situation could still occur again today somewhere in the world.



Love Canal – this has to be one of the worst environmental pollution incidents in the history of the

USA, not just in relation to the incident but also the consequences. William T Love had a dream of creating a short canal between the upper and lower Niagara Rivers to produce cheap hydro electric power for industry and homes. Unfortunately, Nikola Tesla had just made the momentous discovery of how to transmit electricity over vast distances at a rate which made it economically viable and there was an economic downturn. So, in 1910 construction of the canal ceased. The canal in the 1920s started to be used as a municipal and industrial chemical dump. Finally, in 1953 the dump was sealed and sold to the city for 1 dollar. A school and housing was subsequently built on the site. No one really understood the issues or that residents were living on a toxic waste dump thought to contain 82 different compounds (11 being suspected carcinogens). In 1978 unprecedented rainfall resulted in the leaching of chemicals from the site. Children and pets were getting chemical burns and there was an unusually high rate of miscarriages in the area. It had also been noted that patients were experiencing high white blood cell counts, which is potentially linked to Leukaemia. Residents had to be evacuated from their homes and the state had to purchase the land and property. Now we are more aware of the need to manage landfill sites. In the UK they have regulations that prevent the mixing of different types of hazardous waste and have processes in place to ensure that the required geology is present to contain the materials. However, in 1920 there was no such knowledge and it is in fact through events such as Love Canal that we have come to realise the necessity of environmental management to ensure that landfills are safe.

But how many other sites exist that we are just not aware of? How many companies have buried chemicals or materials in the past and now the records of that location have been lost? We cannot know, however, what we can do is to stop this happening in the future by the effective management of our impacts enabling us to reduce the potential damage.

We now try to ensure that we manage chemicals safely, with legislation such as REACH. We also ensure that at the time of their disposal they go to places where they can be managed safely by ensuring that landfill sites are appropriately licensed for all the wastes taken in the UK. However, what about other countries of the world?

Of course, licensing and legislation does not prevent accidents and there is still that historic pollution that can cause problems for ours or future generations. This is where environmental management is so helpful in ensuring that we are not only aware of the issues but that there are operational procedures in place to contain any incidents and that the organisations consider their operations and reduce the risks where possible and mitigate against others.

In the case of historic sites there is a problem. If, for example, a foundry was on a site and the owners sold it to another foundry, how could it be established who caused the pollution? If one of the companies ceases to exist or both, someone else is potentially left with the bill for clean up. In the case of water pollution that someone is the Environment Agency but that means that in effect the tax payer is paying. So there are still issues to be considered and worked through but we are now at least thinking about them.

Bhopal – another notable environmental disaster was that of Bhopal where on the 3rd December 1984 a cloud of 40 tonnes of methyl isocyanate (MIC) gas was released from the Union Carbide Factory, which had become surrounded by a shanty town with a large population (Broughton, 2005). Four months after the incident the Indian Government reported that 1,430 people had died but in 1991 said the figure was more than 3,800 dead and many thousands with resulting disabilities (Broughton, 2005). There is still debate on the cause, as some say that the plant had numerous safety issues, while the company is still saying that it was an act of sabotage. Whatever the cause there was a business risk be it that the safety systems were faulty or that someone had the opportunity to cause such sabotage which resulted in the deaths of nearly 4,000 people. So, were safety issues met? If not, then an effective EMS with procedures in place would have helped to ensure that safety systems were functioning and operating procedures followed. If it was sabotage, then procedures stating that on the MIC system two members of staff had to be in place during any work and that the system was secure at all other times would have reduced the risk and saved those lives lost and the suffering of those who are still subject to the health implications from such exposure.

Camelford – This is a small town in Cornwall that became the centre of very public water pollution incident in July 1988, when the drinking water supply was accidentally contaminated with 20 tonnes of aluminium sulphate, which raised the concentration of aluminium to 3,000 times permissible limits. The Lower Moor Works was originally a fully manned water treatment station. Later it was converted to operate automatically and was, therefore, unsupervised. Due to the geology of the area, the incoming water had a tendency to be acidic, so it had to go through a process where lime was added to neutralize it and then to remove the brown colouring and any remaining bacteria it was necessary to add Aluminium sulphate which was then itself removed by filtration. It may then be necessary to add more lime to ensure that the final pH is normal before the water reached the mains. On the fateful day, a different driver delivered the aluminium sulphate; the key he had fitted both the aluminium storage tank and the water tank but the tanks were not labelled and the driver put the aluminium in the wrong one. As the aluminium sulphate passed through the supply system its chemical structure broke down to produce several tonnes of sulphuric acid which stripped the pipe network causing leaching of the metals such as lead and copper. Over the years there have been numerous enquiries and court cases. However, while compensation has been paid out, we still do not know the real implications of this incident. Some people who were resident at the time have died of dementia. In 2012 at an inquest into the death of one of the victims it was stated by the coroner that South West Water had been "gambling with as many as 20,000 lives" due to their slowness in acknowledging the incident and by stating that there was no health risk when they had no certainty of this being the case. In 2013 a report was produced by the Lowermoor subgroup of the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment which concluded that exposure to the chemicals was unlikely to cause "*delayed or persistent harm*" and was also unlikely to cause future ill health. But if high levels of aluminium are in the body can we really be certain that no harm will be caused? Do we know enough about how our brains function to be sure that a huge dose of a chemical such as aluminium which has been found to have passed through the blood/brain barrier will not have severe implications for the people concerned? Also what of the environment, fish died in the river, farm animals suffered and had to be humanely destroyed. This is still used in many water purification processes and the debate over the health implications continues.

Camelford is an example of another incident which occurred as a result of a series of errors. The same lock on two very different unlabeled storage tanks, a new driver who did not know the site and the fact that it was an unmanned site. Hopefully we are more aware today and more likely to avoid such incidents. But are we? Do all the companies who deal with dangerous chemicals have safety procedures that are followed to the letter? Are there any companies that have no new staff or that if new staff arrive their induction happens on day one not several months later?

When we think of major environmental disasters probably one of the most frightening is that of a nuclear incident. It may be the severity of the potential impact or the fact that you cannot see the pollution and, therefore, avoid it. So when **Chernobyl** became news in 1986 on the 26th April suddenly the world was looking towards what is now Ukraine but formerly the USSR. Those affected included people involved in the emergency operations on the day of the incident (~600), those sent to the area in the period 1986–1989 to do decontamination work and of course the residents who lived within 30km of the site, around 116,000 people were evacuated from the area (Hatch *et al.*, 2005).

There was an explosion and fire at the site which released radioactive particles into the atmosphere which spread over much of what was then the USSR and Europe. This was the worst nuclear disaster due to not only the costs but also the casualties involved. It, along with Fukushima is one of the only two level 7 classifications for nuclear incidents. The cost implications to the Ukraine government as a result is estimated at USD 148 billion for the period 1986–2015 (Oughton *et al.*, 2009).

The accident caused 31 deaths but this does not include the long-term issues with the increase in cancers rates still being studied. Questions remain, what are the long term health implications? Was there significant long term environmental damage? Is the area really safe? Again, we think we are invincible sometimes, that nothing can possibly go wrong but how many times do we see incidents that could have been prevented? An EMS is not immediately perfect but with such a system corrective action is required and, therefore, any incidents would be carefully reviewed to ensure that they are not repeated. Potentially if organizations were to take information from other disasters, then their systems would be improved through the increased knowledge and risk awareness.

Sea Empress – On 15th February 1996, a single-hull oil tanker entered the Cleddau Estuary on route to Milford Haven heading for the Texaco Oil Refinery. Due to the nature of the port, there was a requirement for 2 experienced pilots from the port to bring it safely in. The cause of the incident was pilot error and miscalculation of the effects of the tides. Other contributory factors were found to include poor weather and tugs with insufficient pulling power. Due to strong currents the ship was pushed off course and hit the rocks resulting in the perforation of the single-hull and creation of the third largest oil spill to enter British waters killing many birds and polluting a large stretch of the Pembrokeshire coastline. If an EMS had been in place would it have been different? Potentially yes, if procedures had existed to ensure that pilots were sufficiently trained, accurate tidal information was utilized along with the allocation of tugs of sufficient capacity for the tasks required.

Have we learnt from these events? It appears not as on the evening of Saturday 10th December 2005,

there was a major incident at a tank at the Hertfordshire Oil Storage Limited (HOSL) part of the **Buncefield Oil Storage Facility**. At the site there were two forms of fill level control in place: a gauge that enabled the employees to monitor the filling operation; and an independent high-level switch (IHLS) which was designed to close down automatically if the tank was in danger of being overfilled. However, it appeared that the first gauge got stuck and the high-level switch was not working, resulting in the control room being unaware that the tank was being overfilled. As the tank overflowed the resulting vapour ignited and the resulting fire lasted for 5 days. It appears that the issues were a gauge which although serviced had stuck afterwards and no action had been taken to fix it. There was a requirement with the high-level switch for a padlock to secure it in the working position but the installer, maintenance and the site contractor were not aware of this; so no lock was fitted. As the petrol was overflowing the bund (secondary containment) should have been effective to contain the liquid. If not there was a system of drains (tertiary containment) to stop the fuel escaping into the environment. However, both failed due to inadequate design and maintenance. Is there a lesson to be learnt here? Buncefield had a management system in place and despite independent audits the system failed. So even with a system, things can still go wrong. Here we see a lack of control available to the staff in the control room and it is noted that the throughput had increased so the aspect of the operation had actually changed. It is easy to see how a change in events or operations can cause severe problems, but if these changes had been reviewed and discussed would the situation have happened?

22.6 Conclusions

It is always easy to be wise after the event, and all those involved with the incidents highlighted were doing what they thought to be the best at the time. There was no deliberate intent to damage or injure. However, when you consider these incidents it becomes clear that they all have the issues be they human error, lack of management control, lack of planning or increase in demand. We cannot control earthquakes but we can build facilities, which can withstand them. We cannot avoid using relief or new staff but we can make sure they have all the skills and information they need to do the job. We have to expand processes to fill demand but we can think of the risks involved and mitigate the potential for failures. Can we expect people to always get things right? Probably not! Can we put systems in place which can flag up issues and ensure that they are correct? Most definitely yes! There was human error and attempts to save money at the root of these incidents. We cannot stop companies taking short cuts except with the threat of the legal implications of course, however, we are more acutely aware of the issues of business and reputational risk now, and this may encourage more companies to take the route of environmental management to ensure that they are prepared in relation to environmental incidents.

So we have all these issues and problems, which can occur, be it through sabotage, human error or failure of equipment. But what can we do to prevent these events happening; one obvious route is through the use of an EMS. It may be that you want to use a recognized system, such as EMAS or ISO 14001, or you may just want to follow the route and apply the principles. Whatever you decide at least you will be looking at the risks and if you wish your organization to be responsible you will be able to address those risks.

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Figure 22.1: Lewin's forcefield analysis applied to environmental management.

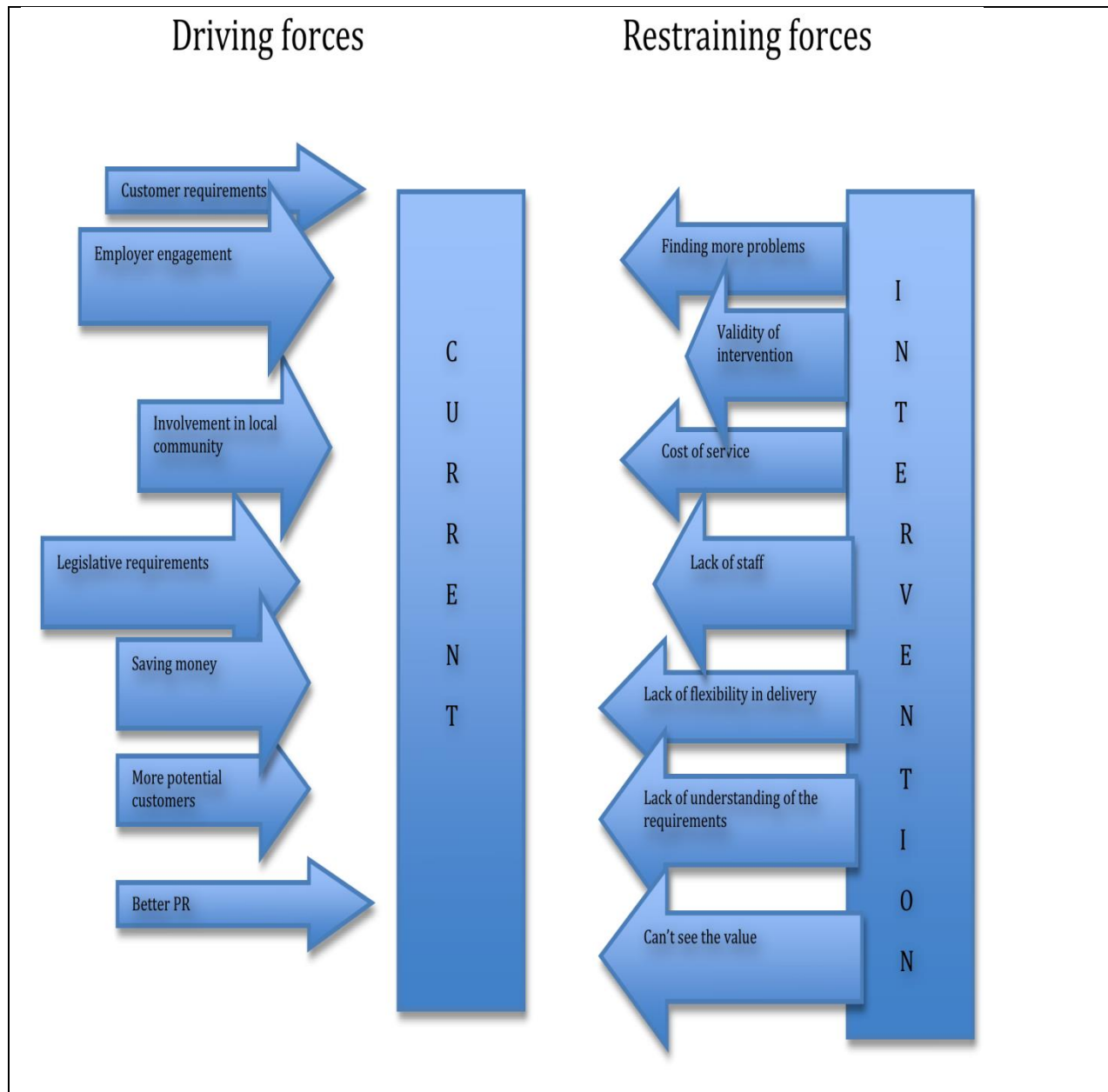


Table 22.1: Identified organisational benefits of implementing an EMS

EMS Benefits
Reduced liability through compliance
Attaining Enhanced relations with stakeholders
Integration with other management systems
Fulfilment of efficient resource management
Amplify financial operations and performance
Strengthen access to markets
Augment business competitiveness
Boost environmental, ethical and sustainable business operations
Reinforce business reputation
Encourage innovation to reduce business impacts
Facilitate agile business
Improve business operations
Be responsive to external pressures
Augment risk management and mitigation
Empower staff performance
Strengthens business strategy
Opportunities for collaboration within the supply chain

Table 22.2: Identified organisational barriers of implementing an EMS

EMS Barriers
Keeping pace with requirements
Lack of perceived value to the business, supply chain and wider stakeholders
Necessity for environmental expertise for implementation and training
Not a legal requirement
Inability to compare across business sectors
Environment not an issue acknowledged by the management and absent from the business strategy.
Viewed as superficial
Deemed irrelevant within the sector
Concern over accountability or liability through the required documents
Disincentive due to cost of implementation

Article 2 (Conference Paper and Book Chapter): Shutler, R., Horry, R.E. and Booth, C.A. (2024) Saving nemo and friends from the potential impacts of permitted building developments on the beaches of Jersey. In: Gorse, C., Booth, C.A., Scott, L., Dastbaz, M. and Drotleff, B.O. (Editors) *Sustainable Ecological Engineering Design*. Springer Nature, Cham, Switzerland. (In press).

Abstract

The impacts of cumulative permitted building developments can normally be registered in an Environmental Impact Assessment (EIA) report. However, on the Bailiwick of Jersey (the largest of the Channel Islands), ‘The Planning and Building (Environmental Impact) (Jersey) Order 2006’, appears to be exposed to shortfalls and oversights in this respect. Therefore, this study reviews Jersey’s EIA legislation, highlights when and where EIAs have been waived and considers the concomitant implications of cumulative impacts that small-scale permitted building developments could have on the island’s coastal environment. A sequential mixed methods strategy was utilized to address the aim, using a combination of public archive records and freedom of information requests, together with interviews of government officials. Results reveal there are concerning issues with the existing system, which could be exploited and open to abuse. The present process is subjective and relies heavily on decision makers: experience and judgement. Moreover, there is also potential for political pressure to be exerted, in that the Minister for the Environment, in particular circumstances, can overrule decisions made by planning officers in contradiction to the legislation. For instance, since the commencement of the order, twelve ministerial decisions have waived the requirement to produce an EIA. Worryingly, nine of these decisions were for developments in the intertidal zone (the area between high-tide and low-tide). Building structures on a foreshore/beach can change water, sediment, and nutrient flows around them; thus, disturbing important flora, fauna and feeding habitats. Similar studies have surmised that cumulative small-scale developments can have a collective impact on a site. Therefore, it is concluded that having a scoping opinion before a request to waive the requirement of an EIA would be a useful procedure, together with publicly available information on the island’s environmental benchmarks.

1. INTRODUCTION

The European Union (EU) Environmental Impact Assessment (EIA) Directive (85/337/EEC) was first introduced in 1985 (amended 1997, 2003, 2009) and has had a major impact on the decision-making practices of planners across its member states (Sheate, 2012; Bilgin, 2015). The fundamental intention of an EIA is to protect the environment by ensuring that the relevant planning authorities consider all potentially significant effects on the environment when deciding whether to grant planning permission for a development. It also enables all stakeholders (including the general public) an opportunity to participate in the decision-making procedure (Glasson & Therivel 2019; Roos *et al.*, 2020). While some planning decisions have been, and will continue to be, sometimes controversial and face legal challenges (e.g., Thames Tideway Tunnel, Battersea Power Station, Hinkley Point and HS2) (Humphries *et al.*, 2018)), the EIA process does enable environmental issues to be appropriately considered within the realms of the planning procedures (Richardson and Cashmore, 2011).

Impacts of cumulative permitted building developments can normally be registered in an EIA report (Cooper & Sheate, 2002). However, on the Bailiwick of Jersey (the largest of the Channel Islands), rather

than applying EIA regulations directly transcribed from the European Commission, they have adopted their own version via 'The Planning and Building (Environmental Impact) (Jersey) Order 2006', but this appears to be exposed to some oversights. The Island of Jersey is a British Crown dependency and is treated as its own jurisdiction outside of the EU. Yet treated within the European Community for the purposes of free trade in goods. Jersey has the power of self-determination and the Island does not have to adhere to the legislation that others do. Instead, Jersey has its own government (the Government of Jersey (GoJ)), judicial system and legislation.

Development in Jersey is controlled by the 'Infrastructure, Housing and Environment Department' of the Government of Jersey under 'Planning and Building Control', while the Development Control team have oversight of development with respect to environment. Planning and Building Control are overseen by the Minister for the Environment, an elected member of the States of Jersey, the Island's parliament. As well as its built environment, Jersey is responsible for four Ramsar sites; part of an intergovernmental treaty for the conservation and consideration of wetlands and their resources, one of which is on the southeast coast of the Island and corresponds to the most densely developed areas of the Island. However, in recent years, planning approval in this and other areas of the island has been granted for planning applications that have had the EIA waived by the Minister without any transparency behind the decisions and/or consideration of the cumulative impact of the collective decisions.

To date, there are no known previous academic or professional articles written about the planning processes of the Island of Jersey or any EIA articles either. Therefore, this is first study to explore these subject matters and their linkages. The study is important because, given the relatively small size of the country, environmental impacts could become prodigious for the island. Furthermore, by comparison to many other nations, Jersey's environmental impact legislation is immature and has not had chance to flourish so it is important that any potential issues and lessons-learned are reported – particularly where the impacts could affect the environmental and ecological sensitive parts of the island.

The aim of this study is to evaluate the significance of waiving the requirement for an EIA on small scale developments and to consider the cumulative impact those small-scale development may have on the natural environment in Jersey. In doing so, the study reviews Jersey's EIA legislation and explores how it relates to small scale developments and when legislation can be waived. Further, comparable legislation is also reviewed to give context, namely, the Guernsey Land Planning and Development (EIA) Ordinance 2007 (Ordinance), the UK Town and Country Planning (EIA) Regulations 2017 (Regulations) and the EIA Directive 2014/52/EU (Directive), for how small-scale developments are treated under this legislation and how/when the requirement for EIA is waived in comparison to the Order. Finally, by scrutinising other works and applying their results to developments in Jersey the study also examines how those developments determined as insignificant may still have a cumulative impact on the environment of Jersey.

2. BACKGROUND

The Island of Jersey is situated in the southern English Channel, near the Normandy coast of France and is approximately 120 square kilometres with an estimated 107,800 permanent residents and a rising population (Statistics Jersey, 2020). That equates to ~898 people per square kilometre. In comparison, the UK in 2017 had 272 people per square kilometre (Statistica, 2019). The Channel Islands, as a whole, are one of the most densely populated countries in the world (UNDESA, 2018). As well as a high population density there is an overall anticipated shortfall of 2,750 dwelling units in Jersey from 2019 to 2021 (Statistics Jersey, 2018). Alongside this, the Jersey House Price Index for March 2019 gives the average house price in the Island of £499,000 (Statistics Jersey, 2019). In comparison, the UK has an average house price of £227,000 (National Statistics, 2019). This is a significant difference and, therefore, may be an incentive for developers to invest in property development in Jersey.

Before determining the impact of waiving the requirement to produce an EIA it is necessary to review the environmental impact legislation, the Planning and Building (Environmental Impact) (Jersey) Order 2006 (Order) (GoJ, 2016). In particular, how the legislation relates to small scale development and when the legislation can be waived. To put Jersey's legislation into context, the Order is compared to Guernsey's Land Planning and Development (EIA) Ordinance 2007 (Ordinance). Guernsey is Jersey's nearest geographical neighbour and the jurisdiction mostly closely resembling it, that of a small, self-governing Island, outside of the EU but a British Crown dependency, with a high population and legislation that is not derived from the EU Directive 2014/52/EU (Directive). Jersey's other nearest geographical neighbours, the UK and France both have environmental impact legislation derived from the Directive, therefore the Order is also compared to the Directive and the Town and Country Planning (EIA) Regulations 2017 (Regulations) in concurrence. The Regulations is further chosen as the UK is the more closely tied to Jersey politically, socially, and economically than France. It should be noted that the Order was first implemented in 2006 and has had one review in 2016 to change the power under certain Articles from the Minister to the Chief Officer (Planning and Building (Environmental Impact) (Jersey) Order, 2006). In comparison there have been several updates since 2006 to the European EIA Directive (European Commission, 2017). Similarly, the UK Regulations have had two new iterations, in direct consequence of the Directive updates, and several amendments since 2006 (Legislation.gov.uk, 2019). The Ordinance, like the Order, has not been fully updated since its commencement in 2007, this is an interesting reflection and could imply the reason why it has not been updated are similar for both Islands. This supports using the Ordinance as a comparable legislation, more so than the Directive and Regulations, that have seen more changes in this time.

When compared like for like, the Order has a number of things missing that are found in the other legislation. Schedule 1 of the Order corresponds to Schedule 2 of the Regulations and Annex II of the Directive but there is no direct counterpart to Annex I and Schedule 1 of the Directive and the Regulations, respectively. While the Ordinance has two schedules, there are fewer types of development under each. The Ordinance covers similar types of development to the Order, the difference being that those developments are broken down into developments considered to necessitate an EIA and those that are subjective. The lack of Annex I developments within the Order, and the Ordinance, may correspond to the type and size of the developments covered therein, both Islands are small and densely populated, the scale of some of these developments, even the types of developments, would not be appropriate for them. For example, Jersey has no railway network and no

motorways, nor is there any capacity to build these. There is currently a dual carriageway along the length of St Aubin's Bay, to widen this would require reclaiming a substantial amount of land from the sea or buying many private properties for redevelopment, neither of which is economically viable for a road that fits on an Island 14.5km long. Furthermore, Article IIA and Article III of the Directive have no direct counterpart in the Order, these Articles refer to the information to be provided on developments in Annex II and the criteria to determine whether Annex II developments should be subject to an EIA, respectively. Both the Regulations (Schedule 3) and the Ordinance (Schedule 4) have equivalents in place but as the Order's prescribed development Schedule corresponds directly to Annex II the lack of a counterpart to Article IIA and III is obvious. In counterpoint, Annex IIA and Annex III are both dependent on Annex II developments being subjective, Schedule 1 of the Order is not subjective, it follows Annex I in that all developments that fall under Schedule 1 always require an EIA and, therefore, Annex IIA and Annex III are superfluous.

In real terms, the Ordinance, the Directive, and the Regulations all have a built-in method to exempt small scale developments through Schedule 4, Annex III and Schedule 3, respectively. This becomes particularly relevant to this study under Schedule 1, Section 11, Part (12) of the Order '*Any development on land covered or, in the normal course of tides, from time to time covered by sea water.*' The wording is clear, any development, there are no exemptions built into this beyond the definition of development, which is defined in the Planning and Building (Jersey) Law 2002 as to undertaking a building, engineering, mining or other operation in, on, over or under the land or to make a material change in the use of the land or a building on the land (Planning and Building (Jersey) Law 2002, Part 3, Chapter 1, 5 (1)). There is no direct equivalent to this Part in the other legislation, the nearest equivalent is in the Ordinance, Schedule 2 (e) '*any project on, or which may affect, a Ramsar site.*' Jersey also has a number of Ramsar sites, and this may be one of the contributing factors behind the development of this area of the Order. Otherwise, the Ordinance Schedule 2 (c) and Regulations under Schedule 2, Section 10, Part (m) are concerned with coastal defences or works that may alter the coastline, the Ordinance specifying new and reconstructing existing structures and the Regulations specifying that maintenance and repair is exempt.

One of the greatest differences between the Order and the other legislation is the depth of detail in the latter legislation outside of the prescribed developments. The Ordinance, like the Regulations, clearly sets out the procedure relating to planning permission, how to prepare an EIS, and how a decision will be communicated. The Regulations go further to include how the information produced under the Regulations should be published and how impacts that are transboundary should be dealt with. In comparison to the detail in the other legislation, the Articles of the Order are brief, general statements. For example, Article 4 states '*A person minded to apply for planning permission where the applicant must provide the Chief Officer with an environmental impact statement (EIS), may request the Chief Officer to indicate the information to be provided in the statement*'.

An important aspect of this study is that of cumulative impact to the environment. Schedule 2 of the Order sets out what an EIS must contain, there are two Parts within this Schedule that are defined by Article 1. Part 1 is the information that can be reasonably expected to be found in an EIA submitted for consideration, while Part 2 is the minimum required information that will be accepted. Cumulative impact is in Part 1 but not Part 2. No reasoning is given for separating Schedule 2 into two parts, no

such division is found in the other legislation and the inclusion of Part 2 seems to undermine the inclusion of Part 1.

The part of the Order that particularly highlights where there have been updates to the Directive and correspondingly the Regulations is under Schedule 2 of the Order – what an EIS must contain. Both the Directive and the Regulations have a greater breadth of information that must be included in EIS's including an environmental baseline study, a section on the risk to human health, and cultural heritage, the impact on the climate, what technologies will be used and the risk of significant impact on the environment due to accidents and disasters. The Regulations also refer to the lifetime of the development, not only the initial development.

In regard to exemption under the different legislation the Order has no explicit exemptions, all developments that fall under Schedule 1 of the Order always require an EIA in the first instance. Instead there are two Articles that can be applied, Article 2 (4) refers to how the Minister can determine that a development will not be considered prescribed development under the terms of the Order and, therefore, not fall within Schedule 1 and; Article 3 (c) states that applicants can ask the Chief Officer if an EIA is required due to *'the nature, size or location of the proposed development'* (Planning and Building (EI) (Jersey) Order 2006, Article 3 (c)) and, hence, not have to submit such.

The Directive does not make explicit exemptions but rather highlights circumstances where exemptions may be appropriate for member States to exempt, in particular developments associated with military installations and civil emergencies. The Regulations do follow this advice regarding military developments but not for civil emergencies. In this case Jersey does not have any large or sensitive military installations that would require such an exemption though in the case of civil emergencies the wording of Article 3 (c) of the Order is subjective enough, with the use of 'or' rather than 'and' that the Chief Officer can exempt almost anything with sufficient justification. The Directive clearly states under Article 2 (b) 4 that exemptions should otherwise only be considered in exceptional circumstances, only when the provisions of the Directive adversely affect the proposed purpose of the project and even then, only when the principles of the Directive are still fulfilled. This is mirrored within the Regulations.

Another way to determine if a proposed development will have a significant impact on the environment is through screening and scoping. Screening and scoping are a way for the environmental impact of a proposed development to be assessed before an EIA is written. Article 4 of the Order gives a single sentence with regards to scoping, with additional information about what to provide for a scoping opinion in Article 5, the same information to be provided when requesting a waive. The Ordinance is the only piece of legislation that produces a scoping opinion in every circumstance involving a development that falls under the Ordinance and a screening opinion for every development that falls under Schedule 2 of the Ordinance.

There is another significant difference between the different legislation, particularly to this study; how information around EIA's is publicised. There is no provision within the Order to publish information in relation to an EIA. The only place publishing is considered is in the Planning and Building (Jersey) Law 2002, under Article 11 (2) that states that *'an application for planning permission shall be taken to*

include any EIS relating to the application'. Because only the statement is included the Government of Jersey does not need to publish any other information related to EIA, this is contrary to the other legislation that all have a publishing provision embedded in them. This is also at odds with a drive towards greater transparency and clarity in decision making within the Government of Jersey.

3. RESEARCH DESIGN AND METHODOLOGY

Aligned to the study's aim, the research design follows inductive reasoning and applies a sequential mixed method of archival and qualitative research strategies.

3.1 Archival Research Strategy

A review of government public records was proposed on EIAs carried out for small scale developments in Jersey. There is minimal information available to the public about how decisions related to EIA are made by the Government of Jersey. The government has a public register of all legal decisions that are made by the Ministers, the elected representatives in Jersey's parliament. These are known as Ministerial Decisions (MD) and cover a wide range of legal functions the Ministers are responsible for, including the decision to waive the requirement to submit an EIA under the Order. An MD gives a summary of the purpose, the decision, and a brief description of the reasons for the decision. If a written report was produced for consideration this is also included with the MD. The MD is then published to the Government of Jersey website. Once available, documentation was reviewed and Freedom of Information requests were submitted to the Government of Jersey to gain access to further information that was relevant to the study, including documents that have been submitted and issued to waive the requirement for an EIA.

3.2 Qualitative Research Strategy

The decision to waive the requirement for an EIA is not an open or transparent process in Jersey, the only detail is set out in the Order and refers to the information that is required with such a request. The sole part that is publicly available is a Ministerial Decision, which is issued after the decision is made. However, since the power changed to the Chief Officer in 2016, this decision may no longer be published. As such, a request for interview was emailed to all Government of Jersey officials involved in the decision-making process, which includes the Planning Officers, the Chief Officer and the Minister. Three persons from this group agreed to be anonymously interviewed. The themes of the questions asked in all the interviews (Table 1) were derived from the issues raised earlier in this document.

Table 1: General themes of the questions posed to the interviewees

	Themes included in the questioning
1	An explanation of the process of waiving an EIA and the basis for making ministerial decisions
2	Exclusion of public involvement in the decision-making and information being unavailable to the public
3	Description of the consultation process and an absence of an appeals process
4	Opportunities and obstacles of existing legislation and any changes they would recommend.
5	Whether internal processes could be open to abuse

4.3 Research Ethics

Ethics and moral standards are integral to research studies. Therefore, before consenting to participate, all interviewees were informed their involvement was voluntary and their responses would remain anonymous. Interviewees were also informed that they could withdraw their responses up to two-months after the interviews had taken place. The study was conducted in accordance with the ethics regulations at the University of Derby.

4. RESULTS

This section reports the archival and Freedom of Information findings from a review of MDs on developments (Sections 4.1 and 4.2) and the insights gained from interviews with government officials who were interrogated about the processes behind the decisions to waive the requirement for an EIA (Section 4.3).

4.1 Archival Information Findings to Support the Review of Ministerial Decisions

Scoping and screening opinions are not published by the Government of Jersey, the only publicly available information about EIAs, other than the EIAs themselves, is through MDs. As such the public register was searched for any MDs that waive the requirement to produce an EIA under the Order. Twelve such MDs were found since the commencement of the Order in 2006, an average of one per year, taking into consideration that this is not the number of requests received by the Department, only those requests that were approved by MD (Table 2). Two further MDs were found, between 2009 and 2010, where a request for reconsideration, of the requirement to produce an EIA, was refused following a screening opinion. Nine of the twelve MDs found were for development that fall under Schedule 1, Section 11, Part (12) of the Order; any development in the intertidal zone. These nine developments can be further broken down into two groups with similar potential impacts on the environment.

Table 2: Summary details of the twelve building applications that have not required an EIA (between 2006 and 2018).

#	Subject of the Planning Application	Decision Reference	Application Reason(s)/Decision(s)
1	Demolition of existing garage and storage...[to] construct 3 self-catering units	MD-PE-2009-0144	An EIA is not required...by virtue of the nature, size and location of the proposed development, it would be unlikely, if carried out, to have a significant effect on the environment, in accordance with Article 2(4) of the Planning and Building (Environmental Impact) (Jersey) Order 2006.
2	Change of use from a meat processing facility to a scrap metal recovery business.	MD-PE-2012-0047	The Minister is satisfied that by virtue of factors such as nature, size or location of the development, it is unlikely to have a significant effect on the environment...and confirms that no Environmental Impact Statement is required.
3	Construct new LPG/Air gas production plant.	MD-PE-2012-0074	Given the minor nature, small size and location...it is unlikely that this proposal will have a significant effect on the environment...the Minister therefore decided that an EIA is not required to support the application to construct a new LPG/Air gas production plant.
4	Install timber staircase from apartments to the beach.	MD-PE-2013-0131	The minister decided that the proposal did not require an EIA, as would be otherwise required under Schedule 1, 11(12) (Article 2(1)) of the Planning and Building (Environmental Impact) (Jersey) Order, 2006.
5	Repair existing steps in harbour wall.	MD-PE-2014-0038	The minister decided not [to] require an EIA, as would be otherwise required under Schedule 1 (Article 2(1)) 11(12) of the Planning and Building (Environmental Impact) (Jersey) Order, 2006.
6	Provision of steps from the site to the beach.	MD-PE-2016-0166	The Minister considers that an Environmental Impact Statement is not required...in accordance with Article 2(3) of the Planning and Building (Environmental Impact) (Jersey) Order 2006.
7	Provision of steps from the site to the beach.	MD-PE-2017-0001	The Minister considered that an Environmental Impact Statement is not required...in accordance with Article 2(3) of the Planning and Building (Environmental Impact) (Jersey) Order 2006.

8	Replacement access ladder to seaward side of a breakwater.	MD-PE-2017-0029	The minister decided an EIA (Article 2(4) of the Planning (Environmental Impact) (Jersey) Order 2006) is not required as would be otherwise required under Schedule 1, Article 2(1), 11(12) of that order.
9	Underpinning and repairs to a bunker within the sea wall.	MD-PE-2017-0054	The minister decided an EIA (Article 2(4) of the Planning (Environmental Impact) (Jersey) Order 2006) is not required as would be otherwise required under Schedule 1, Article 2(1), 11(12) of that order.
10	Relocation of a beach kiosk and store.	MD-PE-2017-0094	The minister decided that an environmental impact statement was not required.....in accordance with of Article 2(3) of the Planning and Building (Environmental Impact) (Jersey) Act 2006.
11	Provision of steps from the site to the beach.	MD-PE-2018-0007	The minister decided that an environmental impact statement was not required.....in accordance with of Article 2(3) of the Planning and Building (Environmental Impact) (Jersey) Act 2006.
12	Construction of an extension and decking to an existing beach café.	MD-PE-2018-0024	The minister decided that an environmental impact statement was not required.....in accordance with of Article 2(3) of the Planning and Building (Environmental Impact) (Jersey) Act 2006.

The last group (Table 2 (#10–12)) includes steps, food kiosks and decking on the beach that all form a barrier over areas that previously were exposed to sunlight. It is important to highlight that when they are positioned on the beach themselves, or are supported by a structure on the beach, these new features could influence and change the flow of water around them. Thus, altering the movement of sediments and nutrients, which are fundamental to the ecosystem of the foreshore or even undermine and weaken coastal defence structures. This scenario is supported by other studies that investigated the cumulative impact of small-scale developments on coastal and estuary environments and have concluded that small scale developments can have a direct impact on the marine environment that can be multiplied by cumulative small-scale developments. Therefore, whilst the number of small-scale developments that have been officially built without an EIA in Jersey is minimal, it is entirely feasible to assume that the cumulative environmental impact on the flora and fauna of Jersey's beaches could also be significant.

The second group (Table 2 (#4–9)) are repairs, underpinning and concrete footings that require engineering works of varying magnitudes, including the removal of existing ground. This is then followed up with the use of concrete, or a similar product. There is extensive research into concrete and concrete like material and how they interact with the environment. Of particular interest, in line with the repair and footing types of development that had EIAs waived, is how concretes, and concrete like materials, can impact on water quality. Studies have shown that leaching of organic and inorganic constituents of concrete can occur when the material is in permeant contact with water, and that fresh concrete, and early curing time lead to high alkaline leachates. It is noted that where concretes are used as part of large engineering projects the surrounding areas are often of ecological significance, in particular leaching may influence the surrounding ecosystem by exerting influence on the groundwater and surface water chemistry, which could lead to the loss of flora and fauna.

The first group waives (Table 2 (#1–3)) were for a change of use of a warehouse to a scrap metal yard, extending an approved holiday village to include three additional self-catering units and the construction of a new gas plant on the existing gas works site. The extension of the approved holiday village is the one that may have the greatest significance with regard to cumulative environmental impact. Another point to consider with the covering of land, not only in coastal areas, is the loss of wild growth. Recently there has been a drive in the Channel Islands to help the environment, by establishing areas of wildflowers called pollinator patches. Research suggests that global pollinators are in decline

due to a number of factors including loss of habitat and chemical use. The loss of pollinating insects is having a further impact on the eco-system with the decline in the number of birds. Small areas that were once left to grow wild, or even covered in gardens, are not necessarily seen as a loss to the environment when they are covered in hardstanding or small developments. The development may even be considered an improvement. These losses are much more likely to occur than developments onto the beach, and have no mention in the Order, and subsequently could have a larger cumulative impact overall.

Further review of the public register shows a change in the process to waive EIAs. It appears that, at the beginning, developments that came under the remit of the Order were issued a screening opinion from Development Control and that applicants then submitted a request for reconsideration to the Minister under Article 2 of the Order. The original screening opinions are not published so this cannot be confirmed and there have been no such requests for EIAs since 2012, which may correspond to a change in the legislation on how appeals are dealt with by Planning and Building Control.

4.2 Freedom of Information Findings to Support the Review of Ministerial Decisions

After reviewing the publicly available documentation, a Freedom of Information request was submitted to the Government of Jersey requesting *'all available documentation, advice, and/or information that the Minister for the Environment used to inform their decisions to waive the need for an EIS'*. However, the response received was that the request was exempt under the Freedom of Information Law, as the information was accessible by other means. Article 5 of the Order states a location plan, and a description of the proposed development is required to request a waiver under Article 3, yet these were not included with the MDs on the public register. Neither of these documents are available to members of the public by any means other than through a Freedom of Information request. The response went on to say that all decisions to waive the requirement for an EIA are made by recorded MD and available to view on the Government's public register. This is misleading, while the Freedom of Information request only referred to decisions made by the Minister, the decision to waive an EIA can be made by the Chief Officer since 2016 and, therefore, does not require a MD. The response then refers to the fact that the majority of the decisions to waive the requirement for an EIA are made by the Minister after verbal advice from a Planning Officer, therefore there is no documentation or paperwork. While it is accepted that documentation of a verbal report may not be available, this does not circumvent the initial documentation that must be submitted under Article 5 of the Order to request the decision. It is also interesting that a decision is not justified or supported with some form of documentation, particularly in relation to the next point made in the response. *'The criteria for setting aside the requirement for an EIA is judged by the scale of the project. An EIA is not considered appropriate for very small projects... where the impacts are plainly negligible'*. This point shows that the process is subjective and implies that only the scale of the project is taken into consideration rather than the impact it may have on the environment. It makes a generalised statement about the impacts being plainly negligible but there is no evidence to support this claim.

A second Freedom of Information request was submitted later in the study asking for the number of requests to waive the requirement for an EIA, how many had been approved, who made the decision and what was the development involved. The second response was also unsuccessful. For the same

reason as the first but also due to the nature of the document management system used by Planning and Building Control, the information could not be extracted without a manual search taking place, one that would use excessive resources as determined under the Freedom of Information Law. The response went on to list the MDs that are available on the public register; while helpful, did not take into consideration any decisions made by the Chief Officer and, therefore, not on the public register. This was further explicated by the following point that states all decisions are made by the Minister, which may be true, even as the Order has removed that power from the Minister since 2016; MDs were still being signed by the Minister in 2018. This calls into question why the powers were changed.

Since the powers under the Order changed to the Chief Officer in 2016, MDs have continued to be issued when a decision is made to waive the requirement for an EIA. In fact, seven of the twelve MDs found on the register were issued after the power changed to the Chief Officer, furthermore five of those were in 2017. The timing of the request to waive the requirement for an EIA could be coincidental or there may not have been as many developments in the previous years that required an EIA or those who requested the Minister or Chief Officer to waive the requirement for an EIA were refused. This could also be evidence that the Order was not enforced properly and that the update to the Order in October 2016 increased the awareness of the Order. If it was a matter of reminding Planning Officers about the remit of the Order, the change in power to the Chief Officer should have also been realised and, therefore, no necessity to produce a MD. In this case there would no longer be any such MDs, the fact that there are more brings into question why the power was changed.

Another consideration, that is highlighted by this case, is that of Elizabeth Castle, a Grade 1 listed building. There are very limited permitted development rights for Listed Buildings and a Planning application would have been necessary for the works (Planning and Building (General Development) (Jersey) Order 2011). The requirement for an EIA may only have been realised because an application was already being submitted for the repair works. If the works had fallen under the scope of permitted development, as other, non-listed, developments will be, Planning and Building Control may not have known works in breach of the Order had taken place. That the Order is not properly enforced is supported by further investigation of the Planning register. While cross referencing planning application with the MDs, Elizabeth Castle had a MD to waive the requirement for an EIA for repairs to the harbour steps in 2014 and yet had another application to repair the breakwater, arguably a larger development and one that falls under the same type of prescribed development, in 2017, that had neither an EIA nor a MD to waive the requirements. Nor was there any published correspondence to say if one had been requested. This does not confirm that one was not requested, or that a waive was not given by the Chief Officer, only that such information is not published on the public register.

With limited documentation provided by both Freedom of Information requests, any additional information had to be searched for through the Planning register. Few of the MDs had Planning reference numbers included, but by using the address and the type of development, most of the MDs could be matched with a Planning application. Using this process two letters addressed to the Minister asking for the EIA to be waived were found published under the planning application documentation. One highlighted the fact that the proposed stairs onto the beach were a replacement of an existing stair and argues that would have an insignificant change to the existing conditions. The second letter

was for a new set of steps onto the beach and focused on the materials and aesthetic of the proposed development. The author discussed the environmental considerations as those of exposure to the elements, and the impact as how the materials would react to this exposure. This implies that the author did not understand the purpose of an EIA or the breadth of impacts that can be considered under the umbrella of an EIA. This is reinforced in the conclusion of the letter where the author states in their opinion there is no significant impact on the environment. No evidence of this was included, or how the author is qualified to make this conclusion.

The letter goes on to talk about a precedent, that previous applications have not needed an EIA and, how a neighbouring property was given a waiver on the requirement for an EIA, using this as a justifiable reason to waive their own requirement for an EIA. There is no evidence of a MD for the property mentioned and while a corresponding planning application was found there was no documentation included on the Planning register to support this claim. There is also nothing in the Order that states an EIA is exempt due to precedent, in fact the Order clearly states that changes to a development that is considered prescribed development under the Order also require an EIA to be submitted (Planning and Building (EI) (Jersey) Order 2006, Article 2 (3)). Interestingly, this second letter is for a large development that had a number of planning applications. A development that the Natural Environment Team were consulted on, and who repeatedly asked for more information in the form of an initial ecological report, before they could make an informed response. The application was eventually approved by the Planning Committee with the condition that work would not start until a full ecological assessment was submitted and approved by Development Control. While the final decision to waive an EIA is made by either the Minister or the Chief Officer, a Planning Officer recommends a decision to them. This recommendation can be made by any Planning Officer, from trainee up to the Director of Development Control, as shown on the various MDs, though the Director of Development Control is the most common Officer to give verbal reports to the Minister.

4.3 Interviews with Government of Jersey Officials

The interviews were conducted with the purpose of understanding the processes behind how a decision to waive the requirement for an EIA is made, but also to understand how the legislation is viewed by the decision-makers.

One of the first questions asked was about process and each person answered about their part in that process. Interviewee-A set out the process from the beginning, though he made it clear that the process Development Control follows is not written down anywhere. The first step is for an applicant to write to Development Control to ask for the requirement for an EIA to be waived. This should include setting out why they believe an EIA is not required, where the development is, and details of what the development is. This corresponds to the information asked for under Article 5 of the Order. Following the written request, a Planning Officer will consider it and using their experience, make a judgement call and put the recommendation before the Minister, or the Chief Officer, for the final decision. Once a final decision has been made, good practice suggests issuing the decision in writing and recording it against the property file. Interviewee-A also admitted that the decision-making process is entirely an internal one, it is not transparent or publicly accessible. He was also clear that just because an EIA is not required does not mean the environment is not being considered as part of the Planning

application. Interviewee–B spoke about an occasion when one of these decisions was brought to him as a senior official. He recalled it was essentially a description of the development and left to him to consider if it required an EIA or not. There was no clear process or guidelines. He admitted that the decision could suffer depending on how the decision maker ‘got out of bed in the morning’. Interviewee–C spoke about the process behind a MD and how they are used for a large range of things including legislation amendments, policy documents and awarding funds. There is a formal procedure, the person requesting the MD must also write it up. If the decision is a simple administrative one, the Minister will usually speak with a civil servant representative to discuss the issue and then sign it. Most MDs require a report setting out the arguments and what needs to be done, in these cases the Minister will meet the author of the report to discuss it before signing. MDs can be altered up to the point of signing; in fact, the current Minister has asked for alteration to be made to MDs before he will sign them. Ministers also have the power to refuse to sign a MD and can overrule the recommendations of civil servants.

All three interviewees discussed the role of screening and scoping as a process that should be used to determine if an EIA is required and how these opinions are not published. The decision to waive the requirement for an EIA is based on Planning Officers recommendations, this is reliant on the Officers experience and coming to a balanced conclusion rather than a step-by-step process. Interviewee–A was clear that these decisions were made by experienced Planning Officers, one’s used to consulting others when they are unsure. This does not correspond with the range of experience of those listed on the MDs as presenting the case, those showed that trainee Planners were making reports to the Minister. Interviewee–B agreed that it is a matter of Officers experience to decide, that trained Planning Officers know that environmental impact is an issue, one that must be considered. He went further to discuss how Officers gain this experience; requests of this nature are uncommon. This is supported by the review of the MDs, there is on average one a year, so the opportunity to experience them is limited. He also discussed how different Planning Officers approach continued professional development and EIAs in general, going so far as to say some Officers seemingly take account of perhaps a more traditional range of issues and using natural environment as an example of where consultation responses can be overlooked. Interviewee–C also has a view about the necessity for in–house skills and capabilities, to reach informed decisions around EIAs, and where there is no in–house expertise how there needs to be a provision for an independent review. His view is based on his personal experiences producing planning and environment legislation in one of the other Channel Islands.

Interviewee–A discussed the relative immaturity of the current legislation, of how it does not go into the same depth as the UK and European equivalent and that the Jersey Planning Department also do not have the same experience with it, this seems to contradict his earlier point about experienced Planning Officers making decisions regarding EIAs. He went on to talk about how the bigger developments that require EIAs in these countries are inappropriate for the size of the Island, using the example that Jersey is unlikely to have a nuclear power plant built. Interviewee–B also spoke of this and that it extends to the planning and environmental consultancy in Jersey; they are also relatively immature with regards to experience with the legislation. Both Interviewee–A and Interviewee–B discussed how this can translate into significant variations in the practice around EIAs by applicants submitting an EIA. Interviewee–B went on to clarify that the consultancy available in Jersey are mostly

architects who are good at designing buildings but not very good at wider strategy or making an argument for not requiring an EIA. Interviewee–A spoke about how the benefit of Jersey having its own legislation is that it can be tailored to the Island’s needs. That it is, mostly, fit for purpose. He then went on to admit that revision of the Order is long overdue and spoke about one of the drawbacks of Jersey being small is that the Government acts as both Local Authority and National Government, with the resources of a Local Authority. The people who draft the legislation are also the ones who do the operational work.

When asked about there being no form of appeal under the Order, particularly as there is also no option to comment during the process, each interviewee commented that just because there is no appeal function in the legislation that does not mean it cannot be challenged. Both Interviewee–A and Interviewee–B went into greater detail. Interviewee–A admitted that Development Control does not consult outside of the Government for requests to waive an EIA but that the planning process is public, and people can comment through this and, if the Department makes a mistake, a decision can be rescinded. He made clear that this has never happened, but the option was there. Interviewee–B spoke about how challenging a decision through court actions or judicial review seemed a bit extreme as essentially, it is an administrative decision review. He also spoke about the purpose of making everything publicly available, so that people could clearly see how and why a decision had been made. The fact that no information around screening and scoping, as well as the decisions to waive the requirement for an EIA, is published on the public register was discussed. Both Interviewee–A and Interviewee–B spoke of how transparency of Development Control’s decision making is essential, as a means of defence against challenge. Where this transparency is not available the MDs are used as that defence against any sort of challenge. This appears to undermine the purpose for removing the Minister from the process. As Interviewee–A pointed out, the decisions are operational decisions, and the Minister should not be involved in them. To change the legislation to give the Chief Officer the power to make these decisions and then to produce a MD anyway defeats this purpose. Interviewee–A also admitted that while he is content that the Planning Officers use due diligence this cannot be proven if challenged.

Interviewee–C spoke about how the public of Jersey want to maintain the quality of Jersey’s environment, this is supported by, or in support of, the Government of Jersey Strategic Priorities, one of which is *‘we will protect and value our environment’* (Common Strategic Policy 2018–2022). Interviewee–A made clear that the Department has not been asked to waive an EIA for large developments, the requests are for quite minor bits of development where the environmental impact, if there was any, would be so minute as to not require the full environmental assessment. Interviewee–B acknowledges that the odd bit of development here and there and suddenly the result is quite a significant impact to the Island.

All three interviewees acknowledge that there is pressure to develop. Interviewee–C spoke about this pressure from increased population, and this is supported by a recent report that predicts a shortfall of 2750 dwelling units from 2019 to 2021. Interviewee–B spoke about the pressures of time scales built into the planning process, but also about the pressure from third parties to make certain decisions and the high likelihood of personally knowing applicants. He went on to talk about land values in Jersey and

how there is a high expectation to develop due to the dwelling shortfall and because land values are so high, development on the Island can be worth a lot of money. This drive to develop, in conjunction with a lack of understanding of what EIA is, means applicants do not want to pay for an EIA; they see it as an unnecessary cost, one that can be dealt with after planning permission has been granted.

The lack of understanding of an EIA, and what types of development require an EIA under the Order, extends to members of the public commenting on them, including when there is a perceived lack of an EIA with a planning application. Interviewee–A spoke about this, and those people from different jurisdictions who expect the same thresholds to apply in Jersey. Interview–B discussed the consultation process further, making clear that Development Control needs to involve relevant stakeholders in certain decisions, and the decision makers should show they’ve taken those relevant inputs into consideration, before the decision is made, otherwise there is a risk of missing relevant environmental information in decision making. He also spoke about public consultation and how there needs to be a balance between the administrative resources the Department has available and the results that would be achieved. He believes there should be a threshold to maintain this balance.

One of the questions asked during the interview was what the interviewees would like to see improved about the process. Interviewee–C would like to see changes to incorporate an independent consultant into the process, to support the current in–house experience, but also to see a baseline study of the environment become a necessary part of the application process, to prove that a development will or won’t have an impact. Interviewee–B also brought up a similar point about the quality of data that the Planning Officers can draw on to help make decisions. In terms of cumulative impact, he would like to see a baseline of the environmental capacity and clear thresholds that if passed would be considered significant. Interviewee–B was keen to see simpler guidance on EIA – what the process is, what screening and scoping are, the basic information that is expected in an EIA but also clear examples of what makes a good EIA. In tandem with that he would like to see Planning Officers have the relevant training. Interviewee–A realises that the Order needs to be reviewed, possibly introducing more structure around the process, with thresholds on the scale of development and the recognition of environmentally sensitive areas. What he would like to see introduced is more transparency and the ability of third parties to interact with the process.

Jersey is a small island with a relatively high population density. A deficit of dwelling units and high property prices are an incentive for developers to build on the island. What was clear during the interviews, was the opinion that EIAs are an unnecessary cost, a barrier to development by developers and other applicants of planning applications. This indicates the benefits of EIAs are perhaps misunderstood and certainly are not embedded in the local architectural culture and development industry. Letters to the Minister requesting waive of the requirement of an EIA support this idea.

5. DISCUSSION

The purpose behind the EIA legislation is to make applicants of developments, those that have been pre–determined to have a significant impact on the environment, take into consideration those impacts in a formal way (Glasson & Therivel, 2019). The purpose of an EIA is to establish and acknowledge

where a development may impact the environment, both negatively and positively, and to propose mitigation methods for negative impacts. The information in the EIA can then be used by Planning Officers to support them making a decision (Carroll *et al.*, 2019). An EIA is not a decision of itself, nor are Planning Officers required to refuse a planning application if an EIA exposes significant negative impacts. However, they are a tool that appears to be misunderstood in Jersey.

EIAs do not have to be huge, complex, and expensive documents, they only have to be fit for purpose. Scoping opinions are an important part of EIA for this reason, they provide a reasoned foundation to build an EIA from, one that is tailored to individual developments (Environment Agency, 2002). In Jersey, scoping opinions must be requested by applicants, nothing of this process is published and, as they are not the same as requesting an EIA to be waived, they were not investigated further in this study. Although they were not used in this study, further examination of them would undoubtedly have given a fuller picture of the process in Jersey.

A constraint of this study was the lack of publicly available information. The lack of published documentation, in conjunction with a document management system that cannot search for information, promotes treating developments in isolation. While planning applications for large developments may have an EIA attached to the public register, there is no database or register for these documents, or the information contained in them, that could be used by other applicants. In comparison, Guernsey's legislation specifies that the Planning Department will provide relevant information to an applicant with a scoping opinion, including baseline information, along with where the information has come from. Information that comes into the Planning Department regarding environmental impact is then given to later applicants meaning cumulative impact can be assessed more comprehensively.

Schedule 1 of the Order is not subjective, while Schedule 2 and the Articles are much more open to interpretation, undermining themselves in the case of Schedule 2, and Schedule 1 in the case of Article 3. Schedule 2 allows applicants to only submit minimum information in an EIA. If an applicant does view EIAs as an additional cost, then they have no incentive to include more than the minimum. This leaves decision makers with less information to make informed decisions and consequently more likely to miss important evidence that may lead to a significant impact on the environment. The Articles in the Order are generalised and could be handled in different ways. For instance, there are no time limits incorporated into the Order so the Department could take a day or a year to consider a request under Article 3. These are details presumably left to subordinate documents. In theory, this is an opportunity for flexibility, the ability to change details as appropriate without the weight of law drafting, though, as mentioned in the interviews, there is a resource implication. The Order has only had minor changes made to it since its commencement in 2006, one of the reasons given for this was that resources were limited. The people who draft the legislation are the same people working operationally, and the operational work takes priority. If the resources are not available then subordinate documents will either not be written, or not updated frequently enough to exploit the flexibility in the system. While guidance information is available on the Government of Jersey website, there is no date as to when this was last updated and the text still refers to the Minister as having the power to determine screening and scoping opinions, which changed to the Chief Officer in 2016.

From the analysis of the MDs for waiving the requirement for an EIA, the types of development were often similar or even the same. If this is the case, and similar developments are expected to continue to be waived, it brings into question why they are in the Order. While providing EIAs is to the benefit of the environment overall, if the Order is not enforced then it undermines its purpose. The request to waive the requirement for an EIA is not a guarantee of a positive outcome, as evidenced with the requests for reconsideration that were refused, though the process appears to have changed over time so that only positive outcomes can be found on the Ministerial Decision register. From all evidence, it appears that the decision to waive is dependent on who is making the decision, the experience and judgement of the Minister or Chief Officer and of the Planning Officers. In turn, they can only decide based on the information they have. This can lead to decisions being made that do not take into consideration smaller environmental impacts or the contribution of small-scale developments to a larger cumulative impact.

It was noted that the number of MDs to waive the requirement for an EIA was greater since the power changed to the Chief Officer, but this also coincided with a new Minister of the Environment taking office. It is only through interviewing a former officer that this statement is proven untrue, as they confirmed they had decided to waive the requirement for an EIA outside of the MD process. It was also noted that while the Order has removed power from the Minister, since 2016, MDs were still being signed by the Minister in 2018. This calls into question why the powers were changed.

Small-scale development could be considered as developments that fall within the Planning and Building (General Development) (Jersey) Order (GDO). The GDO sets out what developments Development Control and the Minister have pre-emptively granted planning permission for. This may be because these developments are considered to have an insignificant impact on the built environment or that the resources necessary to determine these types of planning applications are not cost effective. Article 2 of the GDO states that planning permission is granted subject to any relevant exceptions, limitations or conditions specified in Schedule 1 of the GDO. This wording could be interpreted to mean that the relevant exceptions, limitation, or conditions are all specific to Schedule 1 or it could mean that only the conditions are specific to Schedule 1. In the former case, this means there are no exceptions from the GDO if a development falls under the remit of the Order. It is unclear how a development that is eligible under both the GDO, and therefore does not require planning permission, and the Order, and therefore requires an EIA, would be dealt with. If an applicant for planning permission did not seek advice directly from Planning Officers, and instead used the online advice available and determined their proposed development was permitted, they are unlikely to consider environmental impact.

Concerns raised in this study are not entirely unique. A lack of information relating to the cumulative impacts of permitted developments is often noted in articles from other countries, even those with long established planning legislation (such as the UK (Therivel and Ross, 2007), Canada (Bonnell and Storey, 2000) and the USA (Burris and Canter, 1997)). This may be because most analyses of cumulative impacts of planning decisions are considered 'weak' (Baxter *et al.*, 2000), or insufficiently deliberated. For instance, a study by Cooper and Sheate (2002) reviewed fifty different environmental impact

statements (EIS) and, while twenty-four included the term cumulative effect/impact, only nine of the documents actually discussed any potential issues. Despite being a requirement of EIA legislation, Duinker and Greig (2006) concedes that cumulative environmental assessment is not progressing in the planning arena. Moreover, if cumulative assessment is not being done or it is sub-standard then the consequences mean ill-informed decisions are being made (Connelly, 2011). To avoid this, it raises the question, who should be taking the lead position on addressing this issue? Connelly (2011) proposes it should not be the government's responsibility but rather the practitioners and the reviewers of the EIAs should be responsible for the development of practice.

6. CONCLUSIONS AND RECOMMENDATIONS

In gathering the insights from this study it is apparent that the current system for waiving the requirement for an EIA is not transparent and is potentially open to abuse. Although the Order does not specify publishing EIA information not associated with a planning application, this does not mean that it cannot be published. The public register is already set up and would be a way to provide evidence if Development Control is challenged. The register can be searched by interested members of the public and provide examples of what EIAs should look like and offer information that can be incorporated into later EIAs. The current process is subjective and relies heavily on the decision makers, their experience and judgement but also political pressure; the Minister, and the Planning Committee in particular circumstances, can overrule decisions made by Planning Officers and sometimes in contradiction of legislation.

The process in response needs to be more rigorous, this study found that the previous Minister had a different approach to environmental impact than the last, and the next is likely to have a different approach again. The purpose of removing the Minister from the Order was a beneficial one in this respect, decisions made by Development Control are likely to be less politically led and more likely to be based on relevant knowledge and experience. This does not cover mixed practice within the Department or inadequate training in dealing with EIAs. Planning is a subjective profession and without process there is no way to determine if things are being missed. The point raised by an interviewee was relevant, while environmental issues will be considered by Planning Officers during the planning application process, it does depend on the Officer, as to how involved that consideration is. This can be mitigated with focused training and continued professional development of Planning Officers. The process does not need to be complex. Using a similar process to a scoping opinion would be a good foundation. This would provide sufficient information for consultees to determine if there would be a significant impact on the environment. Furthermore, making that request of all consultees means the greatest range of potential effects of the development are considered. Having a scoping opinion in place, before a request to waive the requirement for an EIA is put before the Chief Officer or the Minister, will also provide them with better information to make informed decisions. Guernsey's process, of providing a scoping opinion for all applications that require an EIA as mandatory, makes what is expected of applicants clear but also takes into consideration a range of information that applicant's may not have considered.

Overall, it is surmised that the waiving of EIAs in Jersey undermines the purpose of the Order. As such, to make it more apt, either Schedule 1 should be more subjective (the Part referring to any development within the intertidal zone should be removed or re-worded) or the Order should be enforced as it is. The benefit of the latter being that a baseline of the Islands environment can be built up, and if Guernsey's example is followed this can be fed back into the public to improve future EIAs and the consideration of cumulative impacts. The important message drawn from this study is that Jersey should endeavour to compose legislative improvements to its planning processes, which make the procedure of granting permitted developments to be one that is transparent, wholesome considerate towards cumulative influences of developments and representative of all interested parties – especially listening to the notional voice of the natural environment as a stakeholder in the final decision-making (Hammond and Booth, 2010).

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Abstract

Building certification schemes have been hailed as a sustainable building solution; growing debate exists as to the efficacy of these schemes and whether they can really deliver a sustainable built environment. As no agreed definition of sustainability exists and minimal guidance is available towards the delivery of sustainable development, there is possibility for inadequate responses to be labelled as being sustainable. This poses the question as to whether building certification schemes are the answer to addressing the sustainability dilemma within the construction industry. In other words, do building certification schemes deliver sustainable outcomes across the multiple challenges faced by humanity? This study applies the Building Research Establishment Environmental Assessment Method (BREEAM) Certification Scheme to a listed building refurbishment case study. It analyses the use of credit assessments to determine the distribution of the scheme criteria against a common conceptualisation of sustainability: the three pillars of environmental, social and economic. Despite BREEAM being considered one of the strongest assessment tools, findings reveal limited consideration to all but environmental aspects. The assessment criteria focus on environmental improvements, e.g. energy efficiency, as opposed to a 'sustainable' assessment method that would address broader social and economic issues. The study concludes that BREEAM may be guiding the construction industry away from truly sustainable outcomes. For instance, the under-representation of non-environmental assessment criteria undermine the importance of the social and economic aspects within sustainability. Building certification schemes, heralded as a solution for a sustainable built environment, could paradoxically contribute to the energy efficiency paradigm problem. Misleading construction professionals and causing them to neglect valuable social and economic opportunities for sustainable project outcomes.

1. INTRODUCTION

Climate change is probably the greatest threat to our civilisation; with carbon dioxide (CO²) emission reductions garnering the majority of news headlines and media coverage, it is easy to forget that climate change is not the only challenge to humanity (Gorse *et al.*, 2021). As planetary boundaries reach tipping points in many other areas: resource depletion; biodiversity loss; drought; flooding; deteriorating human and mental health; air pollution and the economic disparity, are themselves critical threats. However, the interconnectivity of these issues often makes the enormity of the problem difficult to understand or simply too much to take in. These interrelationships between the symptoms of the global sickness facing humanity pose a major problem; yet there are opportunities towards solving these issues if viewed using a 'systems thinking' approach (Kaatz *et al.*, 2006).

The construction sector has a responsibility to address its current practices, particularly as it contributes 40% of all global CO² emissions and uses 40% of all raw materials, 25% of harvested timber, and approximately 10% of global energy supplies are used during the production of building materials (Doan

et al., 2017). ‘Business as usual’ solutions will not be enough to bring emissions in line with legislation targets or reduce the threat posed by wider challenges to sustainability.

Building certification schemes have been hailed as a solution to creating a sustainable building, yet there is growing debate about the efficacy of these schemes and whether they can truly deliver a sustainable built environment. The problems arise with determining what is a sustainable built environment; how buildings of differing sizes, types and uses can be judged against each other and benchmarks, whilst at the same time encouraging uptake of the schemes for use in the construction sector. Even if the schemes accurately benchmark the sustainability of a building, adoption is still voluntary in most cases, therefore the scheme has to be marketable to ensure adoption. BREEAM rated buildings achieve higher rents, sale values and have less rent-free periods (Michl *et al.*, 2016), however that will not be enough to attract developers and clients to use it; particularly if the system is too onerous (Mundy and Booth, 2019). Therefore, BREEAM has to find a balance between increasing sustainability and alienating potential users. This study poses the question as to whether building certification schemes are the answer to addressing the sustainability dilemma within the construction industry or whether they are simply designed to meet the needs of the market?

2. BACKGROUND

Defining Sustainability is a subject of much debate; over 200 definitions are currently in use (Parkin *et al.*, 2003). As there is no clear definition on what sustainability means, there is room for inadequate responses to be labelled as attaining these criteria. The term sustainability is eco-centric and is favoured by academics and non-governmental organisations (Cole, 1999). Whereas, the term sustainable development is favoured by business and industry as this makes the distinction of anthropocentric input, with humans being the focus and is favoured by governments and private industry (Cole, 2005). Sustainable development does not challenge existing entrenched powers or privileges, relying instead on incremental changes to a ‘business as usual’ ethos for which it has been criticised (Redclift and Springett, 2015). A common conceptualisation of sustainability involves the three pillars of sustainability: environmental, social and economic that act in unison to support sustainability. However, an agreed definition of what sustainability is and how to achieve it, is open to interpretation.

As with the ‘sustainability’ and ‘sustainable development’ discourse, there is a similar debate in the construction sector in terms of ‘green building certification’ (GBC) and ‘sustainable building certification’ (SBC). Kaatz *et al.* (2006) propose a ‘*redefinition of the objectives of building assessment methods*’ to enable a clear distinction between those tools seeking to address purely environmental issues and those seeking to address wider issues of sustainability. The BRE (2020) identify BREEAM as an SBC; however, arguments in literature suggest this is a subject for debate and interpretation. BREEAM is predominantly a ‘green’ building certification scheme as the assessment criteria focus on environmental improvements, as opposed to a ‘sustainable’ assessment method that would address broader social and economic issues equally. This is supported by Misirlisoy and Günçe (2016) who argue that although BREEAM is considered one of the strongest assessment tools, “*limited consideration is given to all but environmental aspects*”. Within BREEAM there is emphasis on environmental issues,

and despite this criticism, BREEAM is one of the only rating schemes to also assess social and economic aspects (Doan *et al.*, 2017). Sustainable construction requires more than current building certification schemes were conceived to deliver; it requires a 'systems thinking' approach (Kaatz *et al.*, 2006), which considers the context, location of the development, the associated direct and indirect stakeholders. There is no doubt that GBC schemes have contributed to the promotion of higher environmental expectations and are directly and indirectly (Cole, 2010) influencing a trend towards sustainable development principles within building design. Yet, although bridging the distance to sustainability within these schemes is difficult, they have initiated the discussion that is valuable in terms of facilitating the progress towards a sustainable built environment (Cole, 2005).

There is further debate and there are proponents for inclusion of a fourth 'cultural' pillar, which preserves heritage. According to Mateus and Bragança (2011), *"a building project can be regarded as sustainable only when all the different dimensions of sustainability: environmental, economic, social and cultural – are taken into account."* Historic buildings play a vital part in preserving and passing on cultural identity to future generations; providing a link to the past and helping to retain connections between communities and the local environment (Misirlisoy and Günçe, 2016). However, it is arguably harder to assess cultural, social and economic aspects of historic refurbishment as issues cannot always be scored using quantitative data and often result in intangible benefits (Kaatz *et al.*, 2005; Misirlisoy and Günçe, 2016). Less tangible cultural, social and economic aspects often take a back seat to quantitative CO² reductions in sustainability assessment, due to difficulties in quantification in terms of value of financial returns for clients and developers that seek a profit and return on their investment. BREEAM is then compromised, if a developer cannot see value in the assessment, they will not use it. So, by focussing on the quantifiable environmental elements, such as energy efficiency and CO² reductions, a business case and return on investment can be calculated and the scheme is more likely to be adopted. Therefore, BREEAM assessment needs to prioritise what the client wants, in terms of quantifiable results, rather than what is the best sustainable outcome, to ensure the scheme is adopted on projects. Thus, it is the market that is deciding what it values in sustainability rather than the assessment method itself.

This prioritisation of quantifiable environmental aspects is also reflected in legislation developments and it can be argued that current UK legislation is not consistent in supporting the principles of sustainability. The National Planning Policy Framework gives significant weight to the environmental, social and economic aspects of sustainable development in planning and decision-making, and acknowledges the importance of the conservation of built heritage to support the sustainable development goals (Harrison, 2016). However, this is not reflected in other legislation, principally the Climate Change Act 2008 and the Energy Act 2011, which are primarily concerned with improving operational energy efficiency rather than employing a lifecycle approach (Climate Change Act, 2008; Harrison, 2016). Based on current legislation, improvements in operational energy efficiency in buildings would be given precedence even if the proposals result in higher energy use during the construction phase (Harrison, 2016). The lack of legislation for the reporting of embodied energy undermines the principles of sustainable development in the built environment; legislating solely to deliver a CO² reduction through energy efficiency does not address the concurrent threats that are pushing the limits of planetary boundaries.

Energy efficiency results in demand for more energy through increased use; promoting energy efficiency alone is counterproductive (Shove, 2018). This idea has been presented as the 'Jevons Paradox' who noted the greater increases in the efficiency of steam engines lead to the use of more coal through greater adoption. This theory is reflected by Garrett *et al.* (2015), who identified reduced energy use through LED lighting technology, but noted the average number of lights, within rooms has increased, confirming that improved efficiency results in greater use. Each additional lamp requires manufacture, installation and associated wiring, which leads to increased material use during installation. Shove (2018) denounces this 'purification' of energy efficiency without consideration of embodied energy, production practices and material use. Focussing on energy efficiency is not only missing sustainable outcomes but increasing consumption of materials and driving unsustainable behaviours. Incremental improvements in energy efficiency are driving markets to produce more products that perform more efficiently in operation; however, the wastage of existing components, energy for installation and material resource are not considered in the calculations. This is coming at the detriment of our natural resources; our finite water supply and does nothing to challenge the dominant 'business as usual' ideology and is accelerating other sustainability issues to only save energy at an operational level. Sustainability is more than energy efficiency alone; this needs to be reflected through building certification schemes.

Building certification schemes, long heralded as a solution for a sustainable built environment, could be paradoxically contributing to the energy efficiency paradigm problem through their use by misleading building owners and users from real sustainable solutions. Research by Mundy and Booth (2019) found that half of construction professionals interviewed about their experiences with using BREEAM assessment schemes only conceptualised sustainability in terms of CO² emission reduction and energy efficiency; thereby, failing to identify social and economic aspects of sustainability. Sustainable construction should be taking refurbishment and adaptation of existing buildings to the forefront of the movement. The demolition of an existing building results in the loss of embodied energy in the original building materials and construction, energy used to refurbish and maintain the building over its lifetime. Refurbishment presents an opportunity to reduce the adverse impacts of construction, yet the benefits of new build could be seen to outweigh refurbishment. Research shows that it can take over 30 years to recover the energy used to demolish an existing structure and rebuild a new energy-efficient building (Jackson, 2005). It is, therefore, important to consider the whole building lifecycle and the embodied energy when assessing the sustainability impact of refurbishment building project. Refurbishment of existing buildings presents a significant opportunity to reduce energy consumption and CO² emissions, extend lifecycle and retain the embodied energy of existing buildings. Refurbishment and adaptation of existing buildings can offer benefits across the three pillars of sustainability, whilst bringing benefits to the debated fourth 'cultural' pillar of sustainability concurrently by retaining historic built environments.

3. RESEARCH DESIGN AND METHODOLOGY

The research responds to questions raised in published literature concerning the effectiveness of BREEAM to assess all aspects of sustainability, focussing on the issue of building refurbishment and

specifically historic buildings. Such projects not only support improvements in the environmental sustainability of the built environment; they can also bring significant economic, social and cultural benefits to communities. Research has shown that the non-environmental impacts of projects are not easily evaluated by the rigid assessment criteria of existing building assessment methods (Cole, 1999; Cole, 2005; Kaatz *et al.*, 2006). The limitations of the BREEAM assessment criteria, which predominantly focus on environmental aspects, could influence the outcome of the assessment score for historic building refurbishments and not take account of all aspects of sustainability when assessing projects.

Case studies are a research strategy commonly used to gather intensive information or in-depth details of an individual, group, community, event, institution, decision, period, project or policy, and which utilize particular types of evidence (Tight, 2017). Case study research has gained credibility as a research methodology in exploring complex phenomenon based on the real context (Bhatta, 2018). To address the specific aim of the study, this research opted to employ this strategy and incorporates a case study assessment of a BREEAM scheme listed building refurbishment working towards achieving sustainability within the setting of a construction project. The project client requested anonymity for the purposes of the study and, therefore, the project is described only using building characteristics known as “Project A”. Project A involved the construction of a new 9-storey building with connections into an existing Grade 1 listed building that was being refurbished. The project serves as an example of the application of BREEAM assessment on a project within a listed building of significant historic and cultural importance. The project utilised the BREEAM Bespoke assessment model, which is used for projects that are not considered standard due to factors including location, type and scope of works (BRE, 2015). Criteria from the BREEAM Refurbishment and Fit-out (RFO) scheme were used and tailored to reflect the unique project scope, which included the installation of offices, storage and specialist laboratory areas.

The BREEAM refurbishment certification for Project A was analysed in terms of whether the project would favour the Environmental, Social or Economic aspects of sustainability. The inclusion of cultural aspects was deemed inappropriate at this point as the debate on inclusion within the pillars of sustainability is currently undecided. Once categorised the criteria allocations would illustrate if the scheme itself favoured either of the three pillars of sustainability. BREEAM like many certification schemes uses a system of credits, with differing credit values across the criteria. How these are distributed across the criteria and in turn within the pillars of sustainability, illustrates the emphasis behind the scheme from which a clear understanding of the motivations of BREEAM can be attained. The research strategy allowed an introspective analysis of the certification of Project A and through reflection offers an opportunity for deeper analysis of BREEAM refurbishment certification scheme.

Ethics and moral standards are integral to research studies. Therefore, before consenting to participate, the project client was informed their involvement was voluntary and their case study project would remain anonymous. The project client was also informed that they could choose to withdraw before, during or after (up to two weeks) the study commenced. This was conducted in accordance with the ethics regulations at the University of Derby.

4. RESULTS

The BREEAM assessment categories used for the 'Refurbishment and Fit Out' (RFO) assessment for Project A demonstrated a focus heavily on environmental impacts (Figure 1). Social and economic impacts are addressed; however, within their sub-categories there is still a strong emphasis on environmental aspects. Most of the assessment criteria used for the Project A relate to environmental impacts of the project. Of the 106 credits available; 103 credits relate to environmental issues and 26 credits relate to more than one aspect of sustainability (economic, social or environmental). If the credits, which have more than one categorisation are included, a total of 29 credits relate to non-environmental impacts of the project, which makes up approximately 27% of the total score.

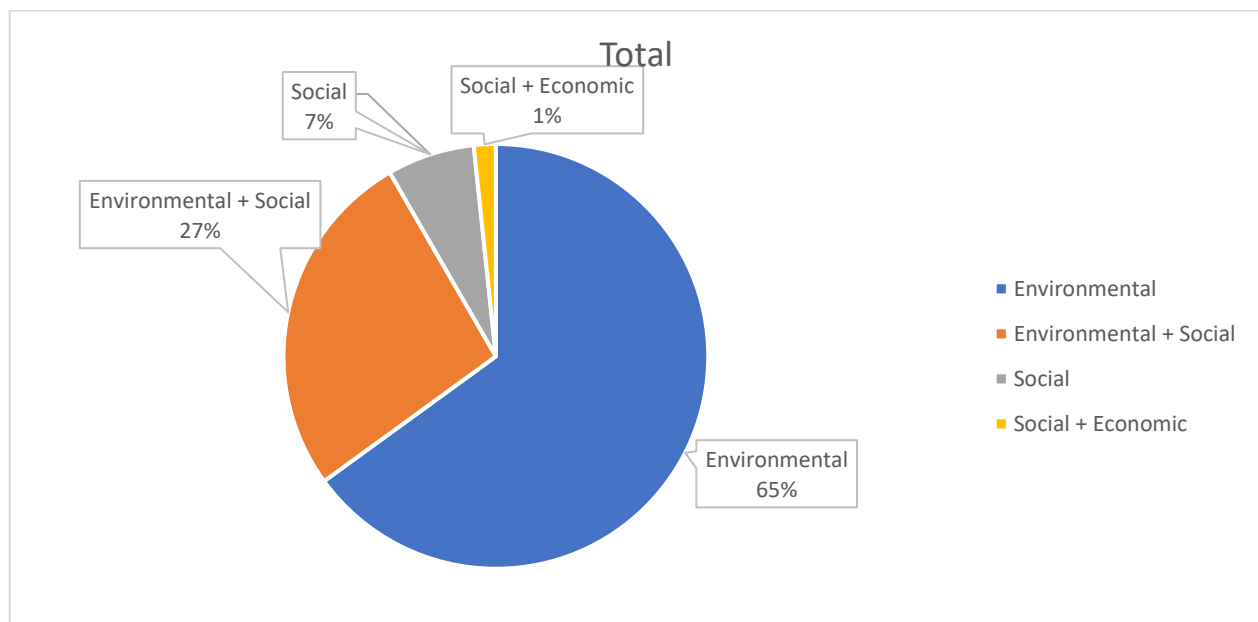


Figure 1: Distribution of BREEAM criteria over the dimensions of sustainability in Project A assessment

The underrepresentation of non-environmental assessment criteria in the BREEAM assessment undermines the importance of the social and economic aspects of sustainability compared to environmental aspects. The dominance of the environmental assessment criteria supports the view that BREEAM is a 'green' assessment tool with a focus primarily on environmental impacts. The small number of credits available for the non-environmental aspects limits the influence these factors have on the final score. In the case of historic building refurbishment, social and economic aspects present valuable benefits. An assessment tool, which can adequately assess and credit these issues, is vital in supporting sustainable development as the issues are interconnected with environmental considerations.

Non-environmental criteria are primarily covered in the Management, Health and Wellbeing and Transport sections of the assessment. Credit M8 – Consultation presents a valuable tool for safeguarding the interests of the community, ensuring that consultation takes place with relevant parties to have influence over the design process. Effective consultation ensures the project team

consider the concerns of the local community, which should be factored into the design and decision-making procedures. Credit M14 – Publication of Building Information also requires the project team demonstrate that information about the environmental performance of the building has been publicised. These credits encourage transparency and information sharing with the local community and stakeholders. M16 – The Development as a Learning Resource requires evidence that the building or landscaping design provides a learning resource that can be used to facilitate the development of education on environmental issues for students and visitors.

Some individual criteria relating to environmental impacts have more credits available. For example, E1 – Reduction of CO² Emissions has up to 15 credits and MW1 – Materials Specification has 7 credits. These higher credit values greatly increase the potential impact the criteria will have on the overall assessment score; heavily favouring environmental issues (Figure 2). The low credit scores for non-environmental aspects do not give sufficient weighting to these issues which, in the case of historic building refurbishment, could result in significant social benefits being undersold.

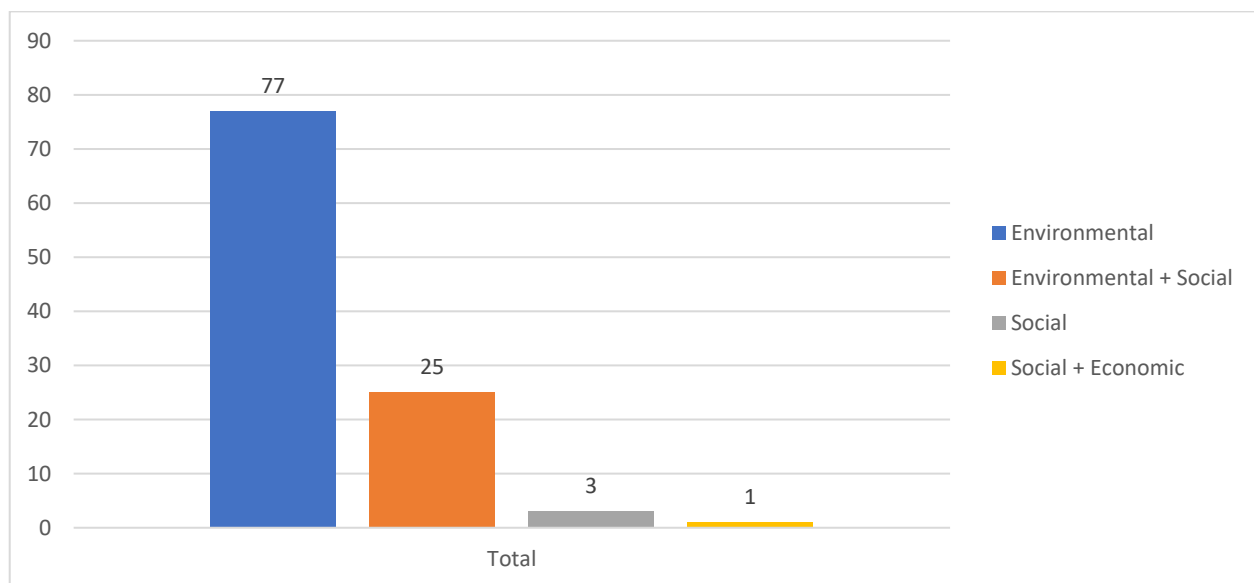


Figure 2: Distribution of BREEAM credits over the dimensions of sustainability in Project A assessment

The RFO scheme assessment criteria include many of the same criteria used for the assessment of new build projects. The main differences are the sections concerning: transport, materials, land use and ecology, accounting for the innate restrictions on refurbishment projects, specifically the restraints of the existing: locality, landscape, amenities, and building structure. BREEAM acknowledges that refurbishments generally outperform new build projects, as much of the existing material can be retained, allowing credits to be awarded by default (Balson *et al.*, 2014). However, refurbishment projects generally score fewer credits than new build projects and “less than 10% of refurbishment projects have achieved a BREEAM Excellent rating compared to more than 30% of new build projects” (Balson *et al.*, 2014). This suggests criteria do not account for the inherent environmental benefits of refurbishment when compared to new build. The omission of assessment criteria relating to embodied

energy savings and lifecycle impacts may be responsible for this disparity, as the significant environmental benefits of refurbishment are not fully assessed.

The assessment criteria make limited allowance for recognition of the benefits of refurbishment and maintaining the existing historic building. Credit M8– Consultation requires the project team to seek advice from relevant national and local bodies in relation to the heritage value of the building and surroundings. The credit is intended to encourage consultation and discussion amongst experts and interested parties to safeguard properties of historic value; recognising the value of heritage assets within the assessment. However, the assessment criteria do not adequately account for the benefits of refurbishing existing buildings. For example, the assessment criteria for Materials and Waste do not go far in promoting sustainable use of materials. Credits are included for MW8 – Responsible Sourcing of Materials, and MW1 – Materials Specification, which require the use of materials with low environmental impact and a Green Guide rating of A, yet make no reference to salvaging of materials from demolition or reuse of existing materials to further reduce the impacts of construction. Salvaging of materials from the demolition of existing structures can reduce the use of new materials; thereby, retaining embodied energy. Similarly, there is no reference to the evaluation of the lifecycle impacts of specific building materials. The assessment method should consider the project outcomes and building performance throughout the whole lifecycle of the building; however, this is not covered in the project assessment.

The BREEAM assessment methodology has received criticism in some instances for being highly technical; combining multiple complex issues into a single score (Schweber, 2013). As noted with Credit LE4 – Mitigating Ecological Impact, which requires confirmation of only a small negative impact or no impact to the ecological value of the site as a result of the development. A thorough response would require significant analysis and feedback from a range of stakeholders to determine the extent to which the project may have impacted the local ecology; outcomes may not be adequately encapsulated in a single score. This complex issue is awarded a maximum of 2 credits; thereby, devaluing the process, and not allowing nuanced assessment of impacts beneficial when assessing multifaceted criteria.

Some criteria are predetermined by specific project conditions. For example, credits T1, T3 and T4 consider the provision of public transport and proximity to amenities. In refurbishment, the location cannot be influenced and, therefore, buildings within proximity to public transport and amenities will automatically achieve these credits without any action. The lack of proximity to amenities and transport could be outweighed by other social and economic benefits of refurbishing a historic building in a remote location; this is not accounted for within the simplistic scoring system.

BREEAM RFO assessment is based on design information rather than actual building performance, which can only be validated by undertaking a further in-use assessment following building occupation (BRE, 2014). Project A was awarded based on the design information and predicted building performance; no post-occupancy assessment was undertaken. The assessment does not include a requirement for on-going monitoring or commissioning after the first 12 months; there is no reference to implementation of a planned maintenance programme to ensure systems are working efficiently, to support better post-occupancy operational performance of the building. There is also no requirement

to prove that the systems are working in line with the design parameters and that forecast energy use and emissions are as predicted. Credit M14 calls for the publication of information about the building's environmental performance. This is only as a one-off and is not an on-going requirement so there is no way to ensure the building performance is in line with the design proposals, meaning that heavily weighted criteria forming a large part of the total score do not require validation of performance in use.

BREEAM fails to account for the impact of embodied energy omitting an important factor used to determine the sustainability of a building over its lifetime (Schweber, 2013). Credit Mat06 – Material Efficiency in the RFO assessment criteria refers to the re-use of existing demolition materials; thereby, preserving embodied energy. However, the assessment criteria do not account for the energy lost through the demolition and disposal of the existing building in order to facilitate the refurbishment project; the associated embodied energy is not measured (Jackson, 2005).

Achievement of the credits for criteria M1, M2, M3, HW5, HW11, HW14, HW25, E1, T6, MW11 require adherence with British Standards and guidance from CIBSE: an expectation on any good building project. The criteria merely ensure that minimum standard of commissioning is undertaken and does not encourage the project team or client to go over and above what would ordinarily be considered good practice. Yet Credit E1– Reduction of CO² Emissions requires improvements above the requirement for CO² emissions as set out in the Building Regulations; this is the only example where it is specifically stated that improvements must exceed the current standards, again demonstrating prioritisation of environmental aspects.

Several criteria require targets to be set; however, there is no requirement to evidence that these targets are met. This encourages consideration of the economic and social impacts but with no requirement to monitor or validate results; the setting of a target is superficial and does not provide any incentive for targets to be achieved. This is an example of criteria which could be used to gain credits, whilst not requiring financial commitment, offering flexibility to users. These credits allow users to gain credits that have no or low cost making the scheme attractive and marketable to increase uptake and ensure survival of the voluntary assessment.

5. DISCUSSION

The limitations of the assessment scheme, questions the effectiveness of criteria to evaluate all aspects of sustainability to encourage improvement and innovation in construction. Assessment of case study Project A demonstrates the majority of criteria relate to environmental impacts, while social and economic aspects share the remaining 27% of credits available. While Project A shows examples of the assessment of social and economic impacts, the limited number of credits available for them reduces the influence on the final score and does not reflect the importance of these aspects of sustainability. This could be due to the difficulty in quantifying such aspects, in terms of value to clients or in terms of the return on investment that developers seek.

A historic building may be penalised unfairly through a BREEAM credit scoring that favours environmental aspects; as listed building restrictions limit changes to building envelope, effecting potential material upgrading and energy efficiency criteria. These two categories are amongst the highest scoring in BREEAM assessments, if unachievable then the overall score will be negatively impacted disproportionately as a result. This also fails to consider the embodied energy savings that may be made as a result of retaining the listed building envelope, further compounding the detrimental impact to the potential achievable score.

Although there is evidence of consultation taking place during the design phase, there is no reference to post-occupancy evaluation in Project A assessment; to determine if predicted outcomes were achieved. Effective stakeholder participation provides opportunities to address different viewpoints and complex social issues in the building process which enhances the overall sustainability of the project. Involvement of building users can also encourage a sense of ownership and support better outcomes through the operation and on-going maintenance of the building (Kaatz *et al.*, 2005). As there is such low credit awarded for stakeholder engagement it is clear that this aspect is not valued within the BREEAM assessment; but local communities around developments should be consulted to understand and determine the social impacts of developments.

A fundamental failure of the BREEAM assessment is the lack of post occupancy assessment of the building performance and impact of development. As Andrade and Braganca (2016) argue, *“even if a building is designed and built to be sustainable, do users use it wisely and according to the principles underlying it?”* Post occupancy evaluation is essential to validate actual performance, which is heavily reliant on operational factors (Curwell *et al.*, 1999). As the BREEAM assessment is voluntary there is no incentive for clients to undertake a second assessment to validate in-use building performance. This undermines the assessment as the data cannot be validated in operation. By including a requirement for follow-up assessment after building occupation, it would be possible to not only validate the original assessment score, but also to determine whether the BREEAM rating performance level is achieved.

BREEAM assessment does not incentivise users to ensure systems continue to function in line with their proposed design parameters. Optimum building performance is reliant on systems being properly maintained and serviced throughout their lifetime. The lack of a requirement for on-going servicing and maintenance undermines the potential benefits of new energy efficient systems. However, this requirement would be onerous for speculative developers who have no long-term interest in the building and would discourage scheme adoption.

The omission of embodied energy from BREEAM RFO projects demonstrates the limitations of accounting for the inherent benefits of refurbishment compared to new build construction. As Ding (2008) states, BREEAM *“ignores the impact of new build as a specific sustainability issue and benefit of saving embodied energy of existing buildings”*. This omission is important when considering historic buildings and the potential embodied energy that could be lost, as historic buildings tend to have higher embodied energy due to their size and traditional construction materials and techniques (Jackson, 2005). According to research it would take 65 years to recover the energy used in the demolition,

salvage and construction of a new energy efficient building (Sroufe *et al.*, 2019). The environmental benefits of refurbishment must be viewed in a lifecycle sense; in this respect, a green refurbished building will invariably have lower environmental impact over its lifetime than a green new building (Sroufe *et al.*, 2019). Since 2011, the BREEAM assessment for new construction includes two credits for lifecycle assessment (Doan, 2017). However, omission of the criteria in RFO projects undermines the long-term benefits of refurbishment of historic buildings as the inherent embodied energy savings of refurbishment are not accounted for. Developing a framework to help support clients estimate the embodied energy and lifecycle impact assessment of their building would help support improvements in sustainability assessment of refurbishments.

6. CONCLUSIONS AND RECOMMENDATIONS

BREEAM is not a SBC but a GBC and, as such, the predominance of environmental assessment criteria, is likely to be prejudicial and result in some historic refurbishment projects receiving a lower score. This may be due to the limits on significant environmental improvements through restrictions of the existing building structure, site or need to preserve aspects of historic importance. Prioritising environmental improvement leads to conflict on historic refurbishments, as achieving of high scores is contingent on heavily weighted environmental improvements.

The omission of assessment criteria relating to embodied energy and inadequate assessment of the lifecycle impacts of projects undermines the benefits of refurbishment compared to demolition and new build construction. BREEAM's simplistic scoring system undermines the complex sustainability issues, while the expansion of assessment criteria to account for embodied energy, social and economic aspects of developments on the whole project score would help address this imbalance providing clarity as to what constitutes sustainability.

Post-occupancy assessment should be mandatory for all BREEAM projects, providing accurate data on the building performance. This adjustment would close the performance gap ensuring design proposals are verified, and any issues of efficiency or operation can be rectified. This could present an opportunity for BREEAM to expand on the current assessment criteria to require validation of in-use performance before the credits relating to energy use and emissions are awarded.

This study demonstrates that BREEAM RFO favours environmental aspects, such as energy efficiency and CO² emission reduction, with greater credit awards suggesting these are of higher importance. The way that BREEAM favours environmental aspects over social and economic aspects is reflected in industry, where 50% of construction professionals viewed sustainability solely through the environmental sphere as energy efficiency and CO² reductions (Mundy and Booth, 2019). This correlation indicates that BREEAM may be defining sustainability for the construction sector, rather than just facilitating the discussion (Cole, 2010), misleading our construction professionals; leading to missed opportunities for sustainable outcomes to the multifaceted sustainability crises.

Based on the findings of this study, the following recommendations are proposed:

- BREEAM assessment for listed buildings should be revised to incorporate embodied

energy savings and heritage benefits into the scores to offset the constraints of the existing focus on environmental aspects which penalises listed buildings

- BREEAM assessments should require post occupancy assessment to validate the design proposals and identify the performance gap. This would ensure that the building performs as intended giving more credibility to the assessment system as a measure for building performance over design intentions.
- BREEAM or other sustainability assessment should be mandatory on construction projects. This would remove the need for assessments to seek adoption on projects by offering what developers want and instead can dictate what sustainability needs, resulting in better outcomes across all dimensions of sustainability.
- BREEAM should work with the construction industry to determine a definition of sustainability that offers clarity of the importance of all spheres of sustainability. By developing the social and economic aspects of the assessment construction professionals will begin to understand their value and can then advise their clients accordingly, leading to a balanced response to the multifaceted sustainability crises.
- Finally, it is suggested that future research should seek to define what the dimensions of sustainability mean in the context of the built environment. With this clarification in place it should be possible to determine an appropriate response to deliver real benefits for clients building users and local community stakeholders.

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Keywords: environmental management system, environmental performance, ecological positive gain, policy

Abstract

Environmental management systems (EMSs) (e.g. ISO 14001) have become a public relations badge for many organisations. This paper proposes an overdue broadening of the EMS adoption spectrum from a well-established Environmental Impact Minimisation (EIM) paradigm towards an Ecological Impact Enrichment (EIE) paradigm, which encourages proactive organisational responses towards ecological positive gain such as increase in biodiversity. Contemporary EMS processes are critiqued to develop a conceptual framework of how an approach to environmental performance management can be re-imagined towards being more ecologically holistic. Preliminary insights and backing from EMS professionals about the desirability and readiness for such a shift, alongside an acknowledgement of the potential constraints, are revealed. These endorse the transition from a dominant EIM paradigm towards an unprecedented EIE paradigm, which can be deployed at organisation, regulatory and policy levels. Practical implications of the transition include broadening the EMS remit within organisations and the deployment of resources, together with activities advocating proactive ecological preservation and positive business-nature interfaces. Regulators are required to acknowledge their responsibilities towards ecological conservancy and adjust their ‘reward-punishment’ approaches from minimising impacts on the natural environment to maximising ecological gains. Environmental policies at regional and national levels have to develop platforms and mechanisms that underpin and direct business support towards funding, skills development and innovation to deliver the necessities for the paradigm shift.

1. INTRODUCTION

The recent Dasgupta Review (2021) calls for transformation of the institutions and systems that undertake individual and societal engagement with Nature, in order to ensure “*our engagements with Nature are not only sustainable, but also enhance our collective wealth and well-being and that of our descendants*” (Dasgupta, 2001:3). In this context, the adoption of certified environmental management standards, as a mainstream approach to managing society–nature relationships in organisations to date, needs to be re-examined. Certified standards guide firms in the implementation of environmental management systems (EMSs) by designing and managing a set of organisational practices that reduce the impact caused by their economic activities on the environment, such as air pollution, waste production and climate change (ISO, 2015). EMS are adopted on a voluntary basis and are certified by a third-party auditor who verifies that an organisation’s system conforms to the requirements of the standard (Heras–Saizarbitoria and Boiral, 2013). However, they fall short of encouraging movement towards a more ecologically holistic approach to managing environmental management performance and subsequent environmental impacts. The role of environmental management professionals (EMPs) in such a change must not be underestimated as their professional practices and skills are essential to ensure EMSs are applied in a way which promotes a net positive ecological gain.

This paper is based on a pilot study designed to explore the dominant approach in application of the EMSs, the environmental impacts generated, and the opportunities and limitations of encouraging application of EMSs which maximise ecological gain. The aim of the study is to explore the validity of the argument for moving the EMS application approach from *Environmental Impact Minimisation* (EIM) to *Ecological Impact Enrichment* (EIE). One of the anticipated study outcomes is understanding the role of environmental management professionals, regulators and policy in promoting EMSs towards achieving the potential ecological enrichment impacts.

The study addresses the following research questions:

- Is environmental impact minimisation a dominant approach in EMS application?
- Is there a need to move away from the dominant approach in EMS application towards a more ecologically enriching impact?
- What is the role of individual organisations, environmental management professionals, regulators and policy in supporting a shift towards an ecological impact enrichment approach in EMS application?

This paper proceeds with a review of the literature on EMSs and the impacts generated through their application. The conceptual developments of how an approach to environmental performance management can be re-imagined towards being more ecologically holistic is proposed. It is followed by an outline of study design and methods, then proceeds further with the analytical developments and discussion. We conclude with recommendations for theory and practice.

2. ENVIRONMENTAL MANAGEMENT SYSTEMS AND ENVIRONMENTAL IMPACT

2.1 Environmental Management Systems: role and application trends

Environmental management systems (EMSs) are management processes that enable organisations to continually improve their environmental performance and through that reduce negative impacts on the natural environment. Although EMS literature offers a wide range of definitions, a common perspective is that an environmental management system is an internal regulatory system combining strategy making, assessment, planning, and implementation (Coglianese and Nash, 2001). The majority of EMSs are based on Deming's (1986) continuous improvement model.

The first EMS standards in the UK were BS7550 in 1992 followed up by the first release of ISO14001 in 1994, which has been updated over the years, most notably in 2015. ISO14001 is reported to be the main global environmental standard alongside other environmental systems, e.g. EMAS, the Environmental Management Assurance Standard (EU) and BS8555 (Boiral, 2011). While these other systems exist ISO14001 carries the most international recognition. In relation to reach, the EMSs can be categorised as regional, nation and international (Table1).

Table 1, Examples of EMSs by reach: regional, national, international.

Regional	National	International
Environmental Quality Mark, Peak District, UK	Investors in Environment, UK	ISO14001
Environmental Business Awards, Glasgow City Council, Scotland	Acorn Scheme – BS8555	EMAS
Green Dragon Environmental Standard, Wales	Eco-Campus	ISO14005

Boiral (2018) notes that EMS provides a structured approach to the organisation of activities towards the reduction of environmental impact while externally signalling the concern of the organisation for the natural environment. It promotes continuous environmental improvement, through a documented process, which is subject to external verification, and supports the environmental strategy of an organisation. The literature reports the significance of regulatory framework in selection and adoption of EMSs (Dejkovski, 2016; Ololade and Rametse, 2018). Any sector that lacks the regulatory landscape to support environmental management practices is often late to develop systems (Welford, 1994; Patton and Worthington, 2003).

The benefits of EMS implementation are widely reported. They are not limited to environmental improvements (Strachan *et al.*, 1997; Hillary, 2004) and enable organisations to make investment into energy efficiency and renewable technology. EMSs have been found to have a positive impact on brand and market value: to lead organisations to securing additional business (Strachan, 1999; Hillary, 2004; White *et al.*, 2014). There are, however, a number of challenges associated with EMS implementation, namely 'discretionary slack' (Lapoutre and Heene, 2006) and 'resource poverty' in small businesses. White *et al.* (2014) report that the costs of implementation in SMEs were substantially greater than the benefits realised over the first four-years post implementation. It is acknowledged that the costs of EMS implementation in SMEs can be significantly reduced if engaging in low-cost environmental initiatives (Kasim *et al.*, 2014), which could limit the pursuit of more ambitious environmental initiatives in SMEs.

2.2 Environmental impact of EMSs

Environmental sustainability scholars have long debated the value of EMSs as part of the organisational practices to manage environmental performance (Shen and Tam, 2002; Bailey *et al.*, 2020). Recent studies on ISO14001 adoption confirm the high costs associated with EMS implementation (Griffiths, 1994; Alonso-Pauli and Andre, 2015). This not only includes investment in technology but also investment in human capital to manage the EMS. Often demands on human resources are so great that organisations apply a 'surface' approach to managing such systems (Jabbour and Santos, 2008). Another factor in the rate of EMS adoption is found to be dependent on ownership model (Darnall and Edwards, 2006).

Despite these difficulties, improved environmental performance of organisations is one of the most commonly reported impacts of the EMS adoption. This is mainly driven by aspirations to minimise the impact of the natural environment (Ofori *et al.*, 2002; Turk, 2012; Harizanova, 2015; Owolana and Booth, 2016; Ololade and Rametse, 2018; Bailey *et al.*, 2020). Reduced utilisation of resources (Johnstone, 2020) and contribution towards environmental pressures (Lui *et al.*, 2010; Mariotti *et al.*, 2014) are also cited within the literature. Improved environmental legal compliance is also reported as one of the common impacts linked to EMS adoption highlighting the compliance-driven nature of EMS adoption (Sheldon and Yoxon, 2012).

Cost savings through; energy management, effective use of raw materials and waste management combined with an improved public perception of the organisation are other impacts reported (Briggs, 2007; Mori and Welch, 2008). The literature review confirms that researchers have not considered, to

date, EMS contribution towards holistic ecological outcomes (e.g. biodiversity gains). This highlights a research gap and an opportunity for opening a debate on the role of the EMS in delivering outcomes towards positive ecological gains as opposed to the limiting role of being a tool for managing organisation–nature interfaces whilst predominantly supporting delivery of the economic outputs. This re–imaging of the EMSs scope and direction is timely to accelerate proactive responses to sustainability challenges.

3. CONCEPTUAL POSITION

Our review of the EMS literature confirms the dominant approach to EMS application can be defined as an *Environmental Impact Minimisation* (EIM) paradigm. It reveals itself through the overarching rationale for EMS adaptation: identifying environmental areas and risks, and putting interventions in place to minimise the environmental impact of the areas and the associated risks. The EIM paradigm predominantly supports the achievement of the economic outcomes through managing the organisation–nature interface as a risk that need to be ‘contained’ and compliance proof.

Recognising the limitations of the EIM paradigm in targeting the ecological positive gains, we propose an alternative paradigm titled ‘*Ecological Impact Enrichment*’ (EIE). The EIE paradigm supports delivery of the ecological outcomes through a balanced approach towards nature–societal–organisational interactions and benefits. EIE approach to EMS adoption targets contribution to the following areas; but not exclusive to, biodiversity net gain, ecological conservancy, water preservation, zero waste, sustainability by design, carbon neutrality. It also has a strong potential for contributing towards the Sustainable Development Goals (SDGs) (UN, 2015). This approach requires a shift in organisational values concerning the role of business in society and nature–organisation interactions from a perspective of minimising environmental impacts to enriching ecological gains. This approach requires appropriate systems, skills and strategies to support delivery of its ambitions. It has a potential for enhancing the role of EMSs as key levers towards catalysing business engagement with SDG related activities in conjunction with a broader contribution towards sustainable development.

The literature review highlights the role of individual organisations in EMS adoption through the availability of resources dedicated to implementation, staff motivation, skills level, and leadership and managerial ambitions. Environmental management professionals (EMPs) play a significant role in designing and supporting the engagement with EMS. Their role must not be underplayed in the EMS organisational positioning on the *EIM–EIE adoption spectrum*. The role of regulators and policy have been discussed throughout the EMS literature (Haque and Ntim, 2018); thus, framing them as important stimuli in EMS adoption in various contexts. Figure 1 presents a conceptual position adopted to the study and provides a direction for the development of the design and method outlined in the next section of the paper.

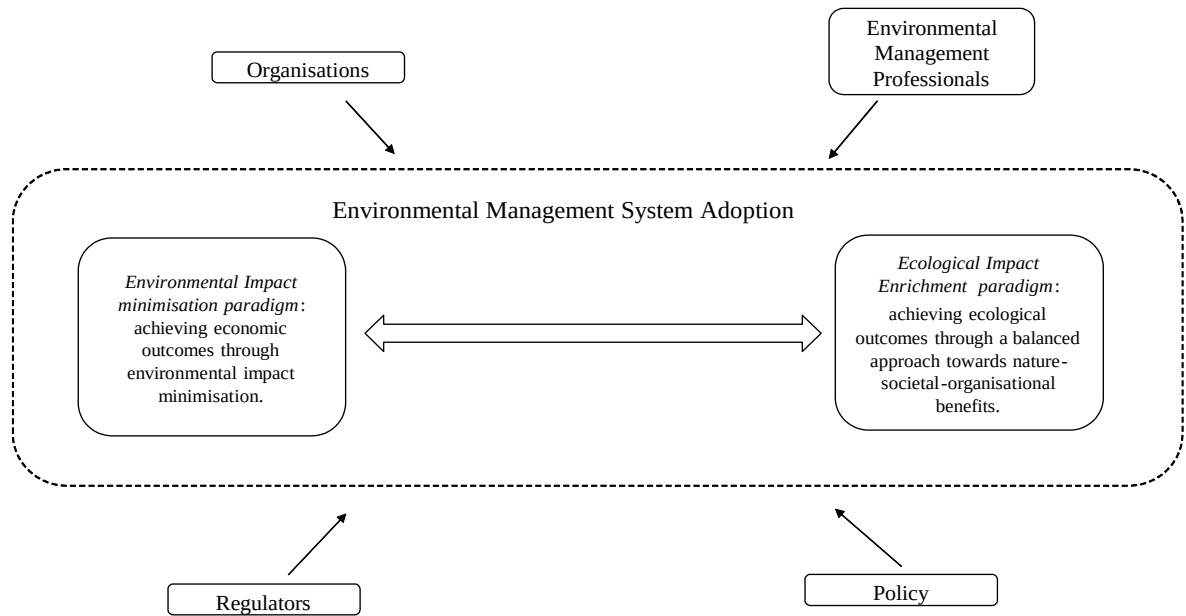


Figure 1. Environmental Management System adoption paradigms.

4. STUDY DESIGN AND METHOD

Philosophy promotes inquiry in many areas, which can largely be understood through the studies of reality, knowledge, and values (Jarvie, 2014). To achieve the purpose of this study, a critical realism epistemology (i.e., acknowledging that theories and concept can be revised) is adopted by applying an abductive reasoning approach and validated by deductive testing. Critical reality searches for causation to explain events and suggests practical policy recommendations to address problems (Fletcher, 2017). Figure 2 details the scaffolding of the stepwise four phase procedure used in this study.

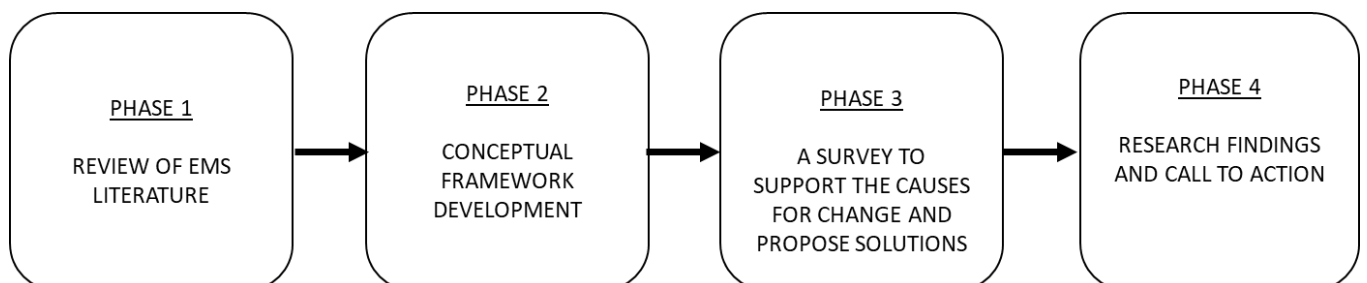


Figure 2. Four-phase study design.

4.1 Phase 1: Literature Review

Articles included in literature review were identified through a comprehensive screening of existing EMS literature following a PRISMA evidence-based transparent reporting process; whereby, extant articles were identified, screened and checked for eligibility before inclusion (Liberati *et al.*, 2009). A

host of databases (including Scopus, Web of Science and Engineering Village, amongst others) were chosen and the search included common phrases or keywords (such as environmental management system, EMS, ISO 14001). The literature search was constrained to articles from 1990 to 2020 (years inclusive), and restricted to peer-review journal papers, reviews, conference papers and book chapters, and only those works published in the English language. The typical code used to search the databases was: TITLE=ABS=KEY ('EMS and Environmental Management System and ISO 14001') and (LIMIT=TO (LANGUAGE, "English")).

4.2 Phase 2: Conceptual framework development

The conceptual framework, underpinned by the findings of the literature review, provides a visual representation of the relationships between the information gathered. Moreover, the design of the framework was based on the collective roundtable insights of the authorship team who have shared environmental management experience exceeding 50-years. However, since this design approach could be considered as being subjective, a decision was made to seek the opinions of experienced industry experts to validate its creation. Using panels of experts for validation is a common approach adopted across many disciplines (Hyrkas *et al.*, 2003; Martin, 2010).

4.3 Phase 3: Underpinning support for broadening of EMS adoption spectrum

An online questionnaire survey was chosen as the preferred means to solicit perceptions of industry experts on the need to amend current EMSs towards increased ecological enrichment. Participants were asked to complete a Qualtrics survey using a five-point Likert scale, one being 'strongly disagree' and five being 'strongly agree'. Where it was considered necessary, participants were also invited to include qualitative comments. The questionnaire was divided into two sections: (i) participant demographics and backgrounds; and (ii) participant perceptions of using EMS's. Themes of the main questions asked of the participants are listed in Table 2.

Table 2, Questionnaire survey themes.

#	Main survey themes
1	EMSs adopt a mainly environmental impact minimisation approach.
2	EMSs equipped to encourage an ecologically positive contribution.
3	There is a need to shift the application of EMSs from environmental impact minimisation to ecological impact enrichment.
4	A shift from environmental impact minimisation to ecological impact enrichment needs to be supported at various levels, e.g. policy.

A purposive sampling strategy (a non-probability sampling technique) was adopted, which used explicit inclusion criteria. Independent industry-facing environmental management professionals were invited to participate. Eligibility criteria used to gauge a participant as an experienced specialist was their years of service in the sector (minimum of three years), their highest educational achievement (minimum Bachelor degree) and to be a current professional body member (minimum of one). It is noteworthy that this form of sampling strategy can restrict the available sample size.

4.4 Phase 4: Study findings and call to action

The study results were analysed using statistical indicators to understand the response indicators and response pattern per question. The qualitative comments were analysed using thematic analysis (TA). The data analysis followed the stages of TA: data review, data coding, themes development and finally

refinement of the key themes (Braun and Clarke, 2006). Alongside knowledge contribution, development of the study findings targeted impact on practice and policy. Aspirations for study findings to support the call to action is consistent with the philosophical grounding of the study.

Ethics and moral standards are integral to research studies (Mertens and Ginsberg, 2009; AEA, 2017). All experts involved in this study were informed that their involvement was voluntary, anonymous and their decision to return their answers and comments would be deemed as their consent to take part. Participants were also informed that there would be a two-week window of opportunity to withdraw, if they so desired, once their responses had been returned. Research ethics approval has been obtained as part of the research process.

5. RESULTS AND ANALYSIS

Twenty three out of the 31 (74%) experts, environmental management professionals, surveyed stated they hold IEMA membership. One participant held IES membership and four held a membership in other professional bodies including IOSH, CMI, MCI, CQI and IRCA. 54% of the participants had more than 15 years of experience in working with EMSs; 29% stated that had between 11 and 14 years of EMS experience, three participants reported 7–10 years, one respondent 3–6 years and one under 3 years of EMS experience.

A large majority of EMPs surveyed; 80%, have been working with ISO14001. The remainder of the participants worked with other EMSs, including EcoCampus, IEnvA and bespoke EMSs adopted to organisational requirements. Many (66%) of the study participants hold Master's degrees, 21% have a minimum of Bachelor's degrees, and two hold Doctorates, amongst other qualifications, in Environmental Management. Overall, more than a half of study participants had over 20 years of experience of working on sustainability and environmental management related projects. Six (19%) participants had between 16–20 years of experience, five (16%) had between 11–15 years of experience, one (3%) had 6–10 years of experience and two (6%) 1–5 years of experience.

5.1 Environmental Impact Minimisation

Survey participants largely agreed, at a mean response of 4 (on a Likert scale 1–5, where 5 is strongly agree) and $\sigma=0.95$, that the EMSs usually target well-established environmental areas in order to minimise the impact on the natural environment, such as electricity, water and heat. Most (81%) participants agree or strongly agreed that EMSs are mainly designed to ensure the compliance with environmental regulations. Although, 19% disagreed with the statement, the contrasting views are of note against this question with $\sigma=1.09$ and $\sigma^2=1.19$. Despite this, the weight of 'agreeableness' level is distributed towards a mean of 4.03 which supports the literature on a *compliance-driven nature* of EMSs.

In response to the question if EMSs adopt a mainly environmental impact minimisation approach: 55% of the participants chosen 'agree' and 13% 'strongly agree', 16% remained 'undecided', 13% disagreed and 3% strongly disagreed. A mean of 3.61 and $\sigma=0.97$ in respect of this means that the *EIM approach in EMS adoptions* is confirmed by the experts in the study.

5.2 Environmental Impact Enrichment

Although 48% of EMPs surveyed agreed and 16% strongly agreed that EMSs rarely focus beyond traditional environmental areas to include contributions to biodiversity and ecological conservation projects, 23% disagreed with this statement. This question yielded a mean of 3.52 with an $\sigma=1.10$ and $\sigma^2= 1.22$ signalling diverse views on the matter. Surprisingly, when asked if ecological enrichment is rare in the EMS adoption, a mean level of 3.97 (agreed) and $\sigma=0.86$ was recorded indicating a good level of agreement across the panel.

When asked if EMSs are well equipped to encourage positive ecological contribution, the panel responses were largely undecided with a mean response level of 2.81. 29% of survey participants disagreed with this statement, 16% strongly disagreed whilst only 23% agreed. The expert panel were also undecided, with mean agreement level of 2.77, about the statement arguing that EMS are unfit to support net positive ecological gain. In fact, the panel views on this issue were quite diverse with $\sigma=1.13$ and $\sigma^2= 1.27$ indicating *an assurance about the fitness of EMSs in supporting ecological positive contribution*.

One of the key survey questions asked of the panel was in relation to the need to *shift from EIM to EIE approach in EMS adoption*. It received a largely positive response from the panel with a mean agreement level of 3.55, $\sigma=0.94$ and $\sigma^2= 0.89$. 55% of the panel has agreed, 19% remained undecided, 13% disagreed, 10% strongly agreed and one participant strongly disagreed.

The survey also explored the role of four district groups in the shift from EIM to EIE involved in the EMSs adoption. Table 3 provides an overview of survey results against the four groups concerned.

Table 3, Groups affecting EMS adaption: EIM–EIE spectrum.

A shift from EIM to EIE is down to:	Mean agreement level (μ)	Standard deviation in response rate (σ)	Population variance (σ^2)
Individual organisations	3.19	1.28	1.64
Regulators	3.42	1.01	1.02
Environmental management professionals	3.84	0.99	0.97
Policy	4.42	0.71	0.50

The results indicate that the panel emphasised the role of policy in encouraging a more balanced EMSs application towards positive ecological outcomes. Environmental management professionals were viewed as significant players in supporting EMSs adoption towards more ecologically holistic outcomes. Surprisingly, the panel registered little agreement level and was undecided about the role of individual organisations and regulators in enabling progression across the EIM–EIE spectrum.

6. DISCUSSION

The study results suggest that EMS adoption is largely focused on environmental impact minimisation. Further, the experts commented that much of the EMSs focus is on legal compliance, specifically “*waste minimisation through discharge emissions and pollution control*”. A number of participants indicated that EMSs they were familiar with are capable of supporting progression along the EIM–EIE spectrum:

“EMS provides the framework for environmental management. There are minimum criteria to adhere to and standard approaches, but as a framework it can support more ambitious objectives, if the organisation and/or individual has such aim”.

The experts indicated that more ambitious outcomes of EMS adaptation is dependent on the efforts of individual organisations. Drawing on participant’s own experience *“whilst EMS’s may not have been designed to promote biodiversity net gain outcomes, we have developed processes that allow us to form part of the EMS”*. Although EMSs are capable of targeting activities to support net positive gain, *“most businesses will aim for minimal compliance, as their core business and mission is not ecological enhancement. It cannot be assumed that they will voluntarily adopt these measures without legal drivers”*.

Our results indicate that the study participants supported a need for a move to a more ecologically inclusive adoption of EMSs. In fact, many felt that these two approaches are not mutually exclusive and *“both can be achieved simultaneously rather than a holistic shift from one to another”*. One of the participants noted *“reducing environmental impacts and enhancing ecological impacts aren’t mutually exclusive”* and that it is necessary to recognise that *“not all impacts are ecologically driven – some are specifically related to human health (e.g. noise, air pollution)”*. As ecologically holistic impacts are not targeted by EMSs at large, *“they [EMSs] could be altered to focus more on the importance of ecological enrichment where applicable”*.

In terms of the role various groups play in supporting a more balanced approach to ecological positive gains in EMS adoption, our findings start revealing an interesting pattern of relations. *Environmental Management professionals* play an important role in the broadening the EMS adaptation towards EIE approach: *“Whilst the presence of willing senior management helps, ultimately are the actions of competent environmental professionals which add value to environmental / ecological efforts not the EMS”*. This view puts emphasis on skills and competences of EMPs in application of EMS. Having said that, the role of senior managers must not be underestimated as stewards and advocates of balancing ecological and economic outcomes.

Regulators are another notable group in encouraging progression along the EIM–EIE spectrum. According to a survey comment: *“most EMSs are there to tick boxes and get certificates, the certification organisations play a key role here”*. It is disheartening to see the comment about the ‘tick–box’ side of EMSs, having said that if certification encourages progression to more inclusive EMS outcomes then this needs to be explored by the relevant regulators and certification bodies.

The study reports conflicting views on the role of *individual organisations* in EMS adoption as our earlier analysis delivered an ‘undecided’ verdict against this group. However, some of the survey comments put the emphases firmly back onto this group: *“a lot of this is down to the individual organisation, the scope of their EMS, and whether this has been identified in their aspects register”*.

The role of *policy* in encouraging ecological outcomes of EMS adoption has been confirmed by the study consistently. A number of comments highlighted the need to increase policy instruments *“legislation,*

industrial peer pressure and changes in industry are needed". The shift towards ecological impact enrichment approach *"should be influenced at industry level and driven by regulator policies"*. The study calls for policy makers to engage in a dialogue about proactive support towards ecological conservancy and development of platforms and mechanisms that encourage delivery of ecologically holistic outcomes.

7. CONCLUSIONS AND RECOMMENDATIONS

The study confirms that the dominant approach in EMS adoption is that of environmental impact minimisation. The approach is deemed to be insufficient for encouraging environmental practices that proactively seek to contribute towards ecological positive gain outcomes. Although EMSs are fit to support the environmental initiatives towards ecological enrichment, these practices are dependent on individual organisation, to a degree. Most significantly on the policy and regulatory landscape there is a need to encourage businesses to go beyond the 'minimal environmental compliance'. The role of environmental management professionals is also significant in these endeavours due to their position and skills, and the power dynamics they are part of.

The study confirms the desirability of broadening the EMS adoption from environmental impact minimisation (EIM) to ecological impact enrichment (EIE). As both stances are found to be valid, the study introduces the *EIM–EIE spectrum* as a tool in EMS adoption. Based on the study findings and the conceptual developments, recommendations are drawn that substantiate a call to action in relation to the main groups explored as part of the study:

1. EMS adoption practices need to be broadened in their scope and reach to go beyond economic focused deliverables and to strengthen contribution towards ecological outcomes. Such moves would require deployment of resources and strategic oversight advocating proactive ecological preservation and ecologically positive business–nature interfaces.
2. Environmental management professionals are to evaluate the professional skills base, professional organisation and support mechanisms against the fitness of the professional community to support delivery of ecologically holistic outcomes.
3. Regulators are required to acknowledge their responsibilities towards ecological conservancy and adjust their 'reward–punishment' approaches from minimising impacts on the natural environment to maximising ecological gains.
4. Environmental policies at regional and national levels have to develop platforms and mechanisms that underpin and direct business support. Providing funding, skills development and innovation to balance delivery of economic and a broader spectrum of ecological outcomes.

The study has a number of limitations. First, the experts in the study are mainly familiar with ISO14001 with some, but not extensive experience of other EMSs. Second, despite experts' extensive experience, it is largely confined to environmental management practices and systems in a UK context. Third, the study has not involved the input from regulators, policy makers and business leaders to validate the conceptual developments and findings. The research team is planning to initiate these steps in the next phase of the study.

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Abstract

There is a need within society to manage our impacts on the environment. The ISO14001 tool, based on the original BS7750 standard, was created in 1996 and subsequently updated in 2004 and 2015, has become the most prevalent type of Environmental Management Systems (EMS) adopted worldwide. Engineering and construction organisations wanting to implement ISO14001 should be fully acquainted with the advantages and disadvantages of adopting an EMS. Using the SCOPUS academic database, this study uses the PRISMA-method to identify and select publications (since 1999) for systematic review. Examination of the chosen articles (n=46) reveals a limited number of works per annum, with a peak in 2011 (n=6). The most frequently reported benefits are ‘enriching green corporate and public image’, ‘improved environmental performance’ and ‘regulation compliance’; whilst the barriers are ‘costs’, ‘lack of experience, expertise or knowledge’ and ‘lack of training’. Further analysis, using VOSviewer, has shown the network relationships between article keywords, notably that sustainability is increasingly listed (since 2011) and links with most other keywords. This suggests the engineering and construction sectors may be seeing beyond the cost barrier and are realising the positive difference ISO14001 can contribute to their operations, their local/national communities, and to the SDGs.

Key words: Environmental management system, Sustainability, Benefits, Barriers

1. INTRODUCTION

Management systems are used throughout many modern-day businesses as tools to monitor and improve operational performance (Brudan, 2010). The International Standards Organisation (ISO) are a major contributor to the production of these standards to which businesses can be certified. The ISO14001 standard is the most widely adopted global environmental management systems (EMSs) that allows the environmental impacts of an organisation to be managed and monitored. However, the latest versions of the standards also support the economic, environmental, and social pillars of sustainable development.

The United Nations 2030 Agenda for Sustainable Development sets out 17 sustainable development goals (SDGs) and 169 sub-goals (UN, 2023). This work was aimed at integrating sustainability into organizations worldwide through addressing current and future stakeholder needs and contributing to the achievement of sustainable development for society and the planet. The SDGs were more ambitious than the Millennium Development Goals (MDGs). The SDG goals, extended the remit to cover the natural world, as well as the human-centric approach (Gusmao Caiado *et al.*, 2018). The goals were to engage all countries not just the developing nations. The additional issues considered included climate change, life on land, life below water, responsible production, responsible consumption, sustainable cities and communities. This work brought an increased focus within society on the need to protect the environment for future generations, as well as building upon many issues that had initially come to the fore in 1987 with the Brundtland Report, followed by the United Nations Conference on Environment and Development known as the “Earth Summit” in 1992. This has been supported by documents such as the UK 25-year Environmental Plan (UK Gov, 2023), a new strategy for the Environment (OECD, 2023), the EU 8th Environmental Action Programme (EU, 2023) along with the ongoing work of the UN Environmental Programme (UNEP, 2023).

Greater environmental awareness and wider promotion of sustainability issues has meant EMSs have increased in use and popularity over the last 20 years and can be found operating in a variety of sectors. Adoption of the ISO14001 EMS has increased from ~15,000 certifications in 1999 to more than 346,000 in 2016 (ISO, 2023). Neumayer and Perkins (2004) examined the uptake of ISO14001 and noted certifications were 49.6% in Europe, 34.8% were in Asia, 7.3% in North America, 3.9% in Australia and New Zealand, 2.5% in Africa and 1.9% in Central and South America. In 2021 the number of valid certificates had reached 420,433 (ISO, 2023). These figures have not only increased but there is also a geographical change in terms of the highest number of certificates; China - 217,592; the UK - 17,378; Spain - 14,122; Japan - 21,976 and Italy - 18,135; America - 4,171; and Thailand - 4,381 certificates (ISO, 2023). Other researchers (Orcos and Palomas, 2019) have investigated the uneven application of ISO14001. This implies that there are differing factors that impact where engagement takes place and the areas which are finding most value in using the system. It is noteworthy that of the declared sectors

(in 2021), the construction industries had the highest representation of all sectors with 68,551 certificates (ISO, 2023).

2. PURPOSE

The increase in awarding of EMS certificates, particularly in the construction sector, suggests a value in the implementation of EMSs. It is possible that certain sectors are more proactive in engaging with sustainability (ISO 2023) and that this may be a driver for this uptake. The last 20-years, however, has seen much debate about the benefits and barriers of implementing ISO14001 and there is still a basic need to understand the reasoning for the uptake. A question remains as to the factors which influence engagement with EMS in the engineering and construction sectors. To enable this question to be answered this study aims to provide a systematic review of EMS publications linked to the engineering and construction sectors to identify the most widely reported benefits and barriers of using ISO14001 and to determine whether growth of sustainability in the sectors has influenced reporting.

3. METHODOLOGY

This work was conducted using an interpretivist epistemology (i.e., taking a variety of different points of view or aspects of reality), applying an abductive reasoning approach (i.e., considering the different possibilities but with most effective explanation proposed), which was utilised to deliver on the aim of this study. A comprehensive review was conducted of the existing peer reviewed ISO14001 benefit and barriers literature following the PRISMA evidence-based process which is transparent and provides a complete reporting process. In this process articles are firstly identified, then screened, and finally checked for eligibility before being included in the systematic review (Liberati *et al.*, 2009). In this study the literature was restricted to peer-reviewed journal papers, due to the rigorous process and peer scrutiny undergone to ensure a higher validity of the findings than some other available materials.

The Scopus academic database was chosen as it covers a variety of different discipline areas (such as engineering, business, social science). The search was limited to common phrases or keywords (such as environmental management, environmental management systems, ISO14001) within fields (such as architecture, engineering, construction) and the literature search was restricted to articles from 1999 to

2022 (years inclusive) and only works published in the English language; book chapters, documents and website articles were excluded due to the lack of peer review within these formats.

The typical code used to search the databases was: *TITLE-ABS-KEY ((“environmental management”) OR (“environmental management systems”) OR (“ISO14001”) AND (“architecture”) OR (“construction”) OR (“engineering”)) OR LIMIT-TO (DOCTYPE, "re") OR LIMIT TO (DOCTYPE, "cp") OR LIMIT-TO (DOCTYPE, "ch")) AND (LIMIT-TO (SUBJAREA, "busi") OR LIMIT-TO (SUBJAREA, "engi") AND (LIMIT-TO (LANGUAGE, "English") AND (PUBYEAR AFT 1999)).*

This study aim will be supported through the production of a list of the benefits and barriers associated with the use of ISO14001 which have already been identified in existing literature. After all journal articles were screened and checked, the content analysis was performed as a means for selecting the publications which meet the inclusion criteria for this study and thereby can be included in the systematic review.

A scientometric analysis process was further applied to objectively measure and map the status of the current understanding and evolution of knowledge within the comprehension of the benefits and barriers to the use of ISO14001 within the engineering and construction sectors. VOSviewer software (version 1.6.17) was used to construct and visualise the bibliometric networks, by the use of keywords and associations identified by the software and within this it was possible to visually demonstrate the distance between two nodes which could be utilised to indicate the relationships of the nodes (i.e., strongly related nodes are closely located and vice-versa). The nodes themselves are within a two-dimensional space within a given network and clusters, here colour has been used to highlight which node has been assigned and the size of the font has been used to show the recurrence of the term used (van Eck *et al.*, 2010; van Eck and Waltman, 2014).

4. FINDINGS

The article searches conducted produced the following outcomes and the findings are presented in the sections which follow. This is presented in five sections: (i) identification and selection of articles; (ii)

article sources; (iii) co-occurrence of countries; (iv) co-occurrence of keywords; and (v) classification of articles.

4.1 Identification and selection of articles

An initial literature search was conducted using Scopus generating, 176 articles. A screening process was then followed to remove any articles which were irrelevant or duplicated. Also, articles that were not relevant to the scope of the enquiry, or area of research were removed (Figure 1). This resulted in a final selection of (n = 46) articles which were included based on the chosen classification (Table 1). The number of publications which discuss ISO14001 appears to be consistent over the years with a slight increase post-2010 (n=24) which equates to 52% of articles within this study and all articles chosen for this study were published post–1999 (Figure 2).

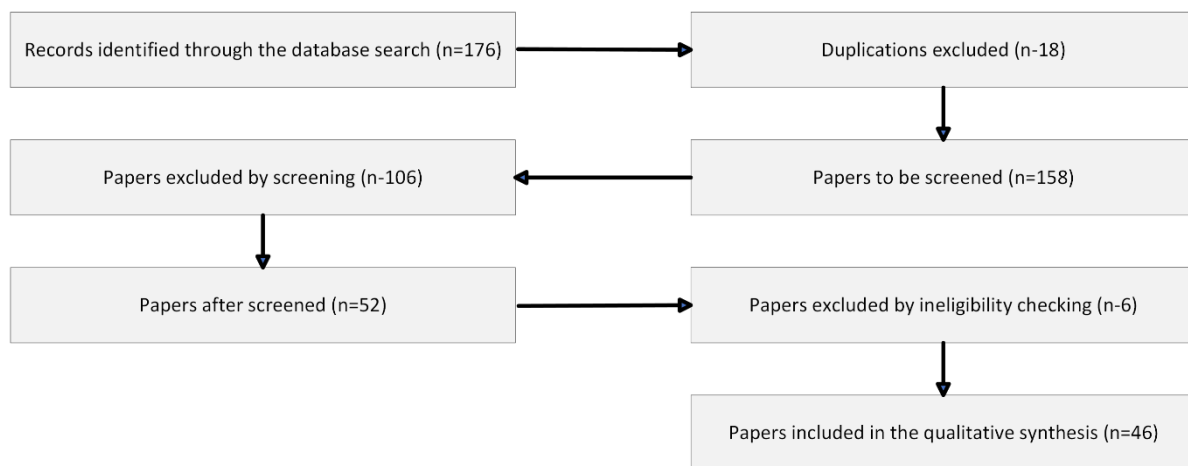


Figure 1: PRISMA Flow Diagram of Literature Search and Selection Process (Adapted from: <http://prisma-statement.org/prismastatement/flowdiagram.aspx>)

The papers were then classified to highlight year of publication, country of study, sector, methodology used, authors, and source type (all journal articles) (n=46).

Table 1: Details of the papers reviewed including the year of publication, country, sector, methodology used and the authors.

id	Year	Country	Sector	Method	Authors
1	2022	UK	Construction	Questionnaire	Horry <i>et al.</i> ,
2	2020	UK	Construction	Questionnaire	Bailey <i>et al.</i> ,
3	2020	Various	Construction	Interview	Johnstone
4	2019	Italy	Construction	Questionnaire	Chiarini <i>et al.</i> ,
5	2018	South Africa	Construction	Questionnaire	Ololade and Ramestse
6	2017	Germany	Construction	Questionnaire	Schmidt and Osebold
7	2016	Various	Construction	Literature Review	Campos <i>et al.</i> ,
8	2016	Australia	Construction	Audit	Dejkovski
9	2016	China	Engineering	Questionnaire	Feng <i>et al.</i> ,
10	2016	Nigeria	Construction	Questionnaire	Owolana and Booth
11	2015	Bulgaria	Construction	Questionnaire	Harizanova
12	2015	Vietnam	Engineering	Questionnaire	Nguyen and Hens
13	2015	Malaysia	Construction	Case Study	Yusoff <i>et al.</i> ,
14	2012	Italy	Engineering	Questionnaire	Arena <i>et al.</i> ,
15	2012	Turkey	Construction	Questionnaire	Turk
16	2011	USA	Engineering	Questionnaire	Frachetti
17	2011	Spain	Construction	Case Study	Gangolells <i>et al.</i> ,
18	2011	Hong Kong	Construction	Questionnaire	Lam <i>et al.</i> ,
19	2011	Spain	Construction	Questionnaire	Rodriguez <i>et al.</i> ,
20	2011	Finland	Construction	Action Research	Terio and Kahkonen
21	2011	China	Engineering	Questionnaire	Zeng <i>et al.</i> ,
22	2010	Malaysia	Engineering	Questionnaire	Abdullah and Fuong
23	2010	Egypt	Construction	Questionnaire	Sakr <i>et al.</i> ,
24	2010	Latvia	Construction	Case Study	Tambovceva
25	2009	Turkey	Construction	Questionnaire	Turk
26	2008	Germany	Engineering	Questionnaire	FrondeI <i>et al.</i> ,
27	2007	Spain	Construction	Questionnaire	Rodriguez <i>et al.</i> ,
28	2007	Slovenia	Construction	Questionnaire	Selih
29	2005	USA	Engineering	Interviews	Curkovic <i>et al.</i> ,
30	2005	Various	Construction	Literature Review and case study	Swaffield and Johnson
31	2004	China	Construction	Literature Review	Chen <i>et al.</i> ,
32	2004	USA	Construction	Case Study	Christini <i>et al.</i> ,
33	2004	Australia	Enginnering and Constuction	Questionnaire and interviews	Zutshi and Sohal
34	2003	UK	Construction	Questionnaire	Adetunji <i>et al.</i> ,
35	2003	USA	Engineering	Questionnaire	Babakri <i>et al.</i> ,
36	2002	USA	Construction	Review	Ball
37	2002	Singapore	Construction	Questionnaire	Ofori <i>et al.</i> ,
38	2002	Hong Kong	Construction	Questionnaire	Shen and Tam
39	2002	USA	Construction	Literature Review and case study	Valdez and Chini
40	2001	Hong Kong	Construction	Review	Pun <i>et al.</i> ,
41	2001	Hong Kong	Construction	Case Study	Tse
42	2000	China	Construction	Case Study	Chen <i>et al.</i> ,
43	2000	Singapore	Construction	Questionnaire	Ofori <i>et al.</i> ,
44	2000	USA	Construction	Case Study	Quinn
45	2000	Australia	Construction	Case Study	Walker
46	1999	Singapore	Construction	Questionnaire	Kein <i>et al.</i> ,

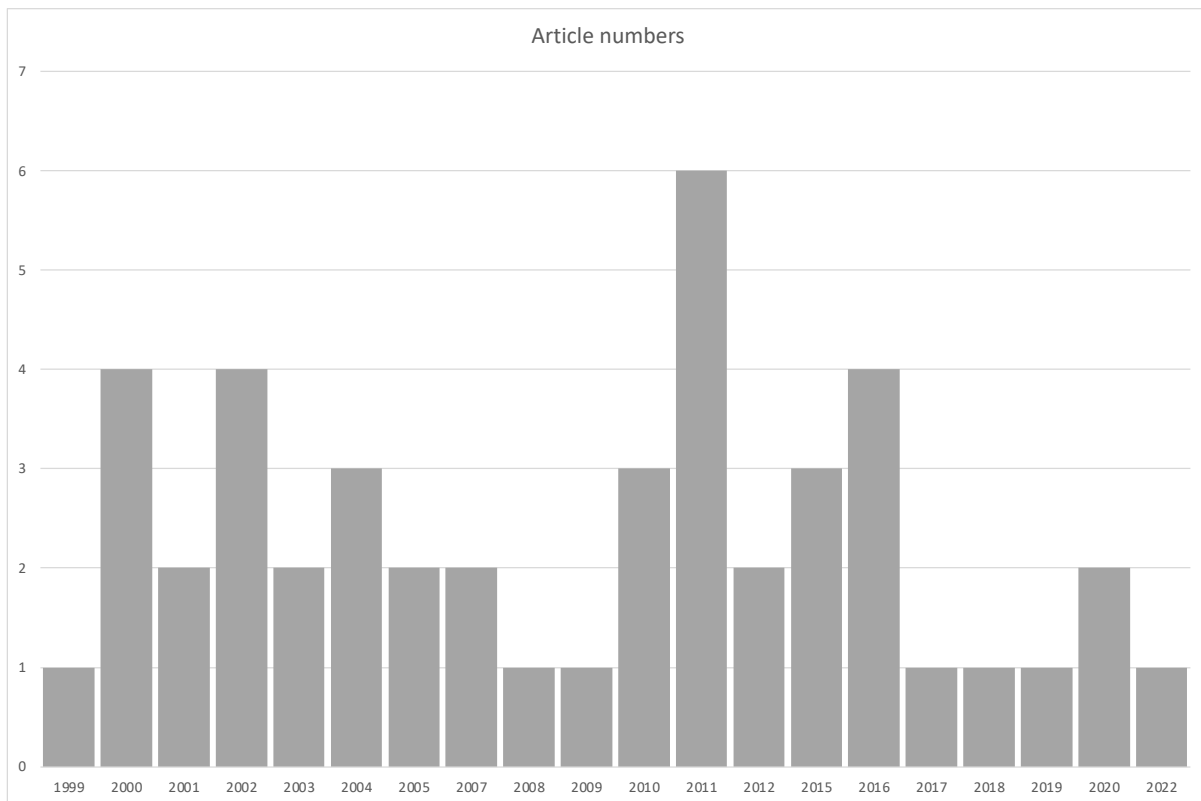


Figure 2: Annual number of scientific articles published between 1999 and 2022 within the engineering and construction sector which highlight benefits and barriers to the use of ISO14001.

The publications reviewed (Figure 1) included 8 projects from China and Hong Kong and 7 from the USA, the remainder were conducted in a variety of countries including Australia, UK, Latvia, Italy, Nigeria, and Spain. The data shows that there was a noticeable increase in papers in 2011 which has since declined, although over the whole-time frame there are only minor fluctuations in the academic interest surrounding this topic. The analysis of the papers reviewed noted a variety of methods (Table 1) were used to ascertain the effectiveness of ISO14001, which are classified into 9 different types. The methodologies used are classified as action research, audit, case study, interview, literature review, literature review and case study, questionnaire, review, and structured interviews. The types listed in the methodology column are detailed in Table 1, showing that questionnaire is the most utilised method (59%) with case studies (17%) ranked second in popularity. Thus, questionnaires are by far the most

popular method, possibly because of the time required and ease with which these can be conducted and produce large amounts of data.

4.2 Article sources

The selected articles are from a range of peer reviewed journals demonstrating the range of interest in this topic area across many subject specialisms (Table 2).

Table 2: Source Journals and time frame of publications for ISO14001 research papers between 1999 and 2022.

Journal names	1999	2000	2001	2002	2003	2004	2005	2007	2008	2009	2010	2011	2012	2015	2016	2017	2018	2019	2020	2022	Grand Total
Architectural Engineering and Design Management							1														1
Asian Social Science											1										1
Automation in Construction						1															1
Building and Environment				2								1									3
Business Strategy and the Environment																	1	1			2
Construction Management and Economics	1	1										1									3
Ecological Economics									1												1
Economic Engineering in Agriculture and Rural Development														1							1
Economics and Management											1										1
Environment, Development and Sustainability																				1	1
Environmental management													1								1
Environmental Practice				1																	1
ICE Management, Procurement and Law																			1		1
International Journal of Business Management													1								1
International Journal of Project Management				1																	1
Issues in Social and Environmental Accounting														1							1
Journal of Civil Engineering and Management								1													2
Journal of Cleaner Production			1		1						1	2		1	2				1		9
Journal of Construction Engineering and Management		1				1															2
Journal of Environmental Assessment and Policy			1																		1
Journal of Environmental Engineering and Landscape Management															1						1
Journal of Environmental Management												2									2
Pollution Engineering		1																			1
Proceedings of the Decision Science Institute							1														1
Proceedings of the Institute of Civil Engineers - Engineering Sustainability					1																1
Resources, Conservation and Recycling								1													1
Technovation						1															1
The TQM Magazine		1																			1
Total Quality Management and Business Excellence										1											1
Waste Management															1						1
Grand Total	1	4	2	4	2	3	2	2	1	1	3	6	2	3	4	1	1	1	2	1	46

4.3 Co-occurrence countries

When considering the areas of the globe and over time where research into ISO14001 has been conducted (Table 3) there are a variety of countries where research into ISO14001 benefits and barriers has occurred. The country with the most publications is the USA ($n = 7$), however, this is a small number of papers, and many other countries have research interests including Australia, Bulgaria, China, Egypt, Finland, Germany, Hong Kong, Italy, Latvia, Malaysia, Nigeria, Singapore, Slovenia, South Africa, Spain, Turkey, UK, Vietnam. A wide variety of countries were found in the sample ($n = 39$). These articles were then reviewed with the aim of identifying key themes to ascertain the benefits and barriers to the uptake of ISO14001.

Table 3: Source journals and time frame of publications for ISO14001 research papers between 1999 and 2022.

Journals	1999	2000	2001	2002	2003	2004	2005	2007	2008	2009	2010	2011	2012	2015	2016	2017	2018	2019	2020	2022	Total
Architectural Engineering and Design Management							1														1
Asian Social Science											1										1
Automation in Construction						1															1
Building and Environment				2								1									3
Business Strategy and the Environment																	1	1			2
Construction Management and Economics	1	1										1									3
Ecological Economics									1												1
Economic Engineering in Agriculture and Rural Development														1							1
Economics and Management											1										1
Environment, Development and Sustainability																				1	1
Environmental management													1								1
Environmental Practice				1																	1
International Journal of Business Management													1								1
International Journal of Project Management				1																	1
Issues in Social and Environmental Accounting														1							1
Journal of Civil Engineering and Management								1								1					2
Journal of Cleaner Production			1		1						1	2		1	2				1		9
Journal of Construction Engineering and Management		1				1															2
Journal of Environmental Assessment and Policy			1																		1
Journal of Environmental Engineering and Landscape Management															1						1
Journal of Environmental Management												2									2
Pollution Engineering		1																			1
Proceedings of the Decision Science Institute							1														1
Proceedings of the Institute of Civil Engineers - Engineering Sustainability					1																1
Proceedings of the Institute of Civil Engineers - Management, Procurement and Law																		1			1
Resources, Conservation and Recycling								1													1
Technovation						1															1
The TQM Magazine		1																			1
Total Quality Management and Business Excellence										1											1
Waste Management															1						1
Total	1	4	2	4	2	3	2	2	1	1	3	6	2	3	4	1	1	1	2	1	46

4.4 Co-occurrence of keywords

Keywords are used to provide a concise description of the subject of the papers. This information has enabled the production of a network of keywords to demonstrate the knowledge provided by researchers (Su and Lee, 2010). By use of a software system, VOSviewer, “Author Keywords” and “Full Counting” filtered to keywords appearing 5 or more times in the papers. The software system then looked for those words which appear most frequently as keywords in this literature review (Hosseini *et al.*, 2018).

Figure 3: Network visualisation of keywords presented in articles on ISO14001 in the engineering and construction sectors (from 1999-2022).

The size of the node in Figure 3 and the lines connecting to other keywords which occur in the article on ISO14001 are presented in a variety of colours and these colours demonstrate the links between the recurring keywords within the journal articles on ISO14001. The clusters are in different colours, and then keywords within the same cluster which are linked strongly are shown in the same colour. As expected, environmental management and environmental performance are clearly shown but also is industry (Figures 3). It is interesting, however, to note that sustainability appears at a lower level in the density and lower still is sustainable development (Figures 3), which may reflect a change in attitude towards the use of ISO14001, for more than just environmental management in the purest sense. It is

noted that sustainability as a keyword has not been used as much as environmental, but this has been slowly changing in papers from 2011 onward which supports the idea of a shift in attitude to organisations being more sustainable rather than just environmentally aware.

4.5 Classification of articles

This review focusses on the benefits and barriers to the use of ISO14001 in the engineering and construction sectors using literature within this area to support on the aim of the research. From the literature review (Table 1) the articles were analysed to produce a list of the benefits and barriers that have been identified through previous research into environmental management, ISO14001, and environmental management systems. These benefits and barriers associated with the use of ISO14001 were then sorted into key themes (Tables 4–11) namely: Public Relations (PR), Economics, Environmental, Legal, Community (only benefits found), Operational, Human Resources (HR) and Sector Specific (only barriers found).

Those most frequently cited benefits in the literature reviews are (i) enriching green corporate and public image (appearing in 44% of the articles), (ii) improved environmental performance (39%) (iii) compliance with regulations (39%), cost savings (37%) and long-term competitive advantage (35%). While in respect to the barriers to implementation, the highest reported barriers are (i) cost (61%), (ii) lack of expertise (30%), (iii) lack of training (28%), (iv) lack of stakeholder support (26%), (v) not a legal requirement, lack of government pressure, time, and documentation (22%). Tables 4–11 show the benefits and barriers and the number of times these are mentioned in the literature that has been reviewed.

Table 4: Classification of PR Benefits and barriers highlighted in literature.

		Benefits							Barriers		
		Enrich green corporate and public image	Future proofing for defacto standard	Company strategy	Better env comms and dialog	Reduced complaints	Market differentiation	Investor confidence	Negative publicity	Open to public scrutiny	Just a badge (superficial adoption)
Year	Authors										
2022	Horry <i>et al.,</i>	X			X	X	X	X	X	X	X
2020	Bailey <i>et al.,</i>	X				X					
2018	Ololade and Ramestse	X									
2016	Owolana and Booth	X				X	X				
2016	Dejkovski										X
2015	Harizanova	X									
2015	Nguyen and Hens				X						
2015	Harizanova <i>et al.,</i>	X									
2012	Arena <i>et al.,</i>	X									
2012	Turk	X				X					
2011	Terio and Kahkonen	X							X		
2010	Haslinda and Chan	X									
2010	Sakr <i>et al.,</i>	X									
2009	Turk	X				X					
2008	Fronde! <i>et al.,</i>	X									
2007	Selih			X							
2005	Curkovic <i>et al.,</i>										X
2005	Swaffield and Johnson	X									
2004	Christini <i>et al.,</i>				X						
2004	Zutshi and Sohal									X	
2003	Adetunji <i>et al.,</i>	X	X					X			
2002	Ofori <i>et al.,</i>	X									
2002	Shen and Tam	X									
2002	Valdez and Chini	X									
2001	Tse						X				
2000	Ofori <i>et al.,</i>	X									
2000	Walker	X									
		20	1	1	3	5	3	2	2	2	3

4.5.3 Environmental Benefits and Barriers

Table 6 details the reported benefits and barriers in relation to Environmental factors, here the most reported factors are “*improved environmental performance*”, followed by that of “*protecting the environment*”. These are factors which are a requirement of ISO14001 so would be expected to be found as being a benefit. The barriers noted are low in number of times they are reported.

Table 6: Classification of Environmental benefits and barriers highlighted in literature.

Year	Country	Sector	Method	Authors	Source	Type of research	Environment															
							Reduced costs through improved efficiency	Reduced costs through improved efficiency	Reduced costs through improved efficiency	Reduced costs through improved efficiency	Reduced costs through improved efficiency	Reduced costs through improved efficiency	Reduced costs through improved efficiency	Reduced costs through improved efficiency	Reduced costs through improved efficiency	Reduced costs through improved efficiency	Reduced costs through improved efficiency	Reduced costs through improved efficiency	Reduced costs through improved efficiency	Reduced costs through improved efficiency	Reduced costs through improved efficiency	
2022	UK	Construction	Questionnaire	Henry et al.	Environment, Development and Sustainability	Journal	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2020	UK	Construction	Questionnaire	Bailey et al.	ICE Management, Procurement and Law	Journal																
2020	Various	Construction	Interview	Adenomon	Journal of Cleaner Production	Journal	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2019	Italy	Construction	Questionnaire	Chiarini	Business Strategy and the Environment	Journal																
2019	Italy	Construction	Questionnaire	Chiarini et al.	Business Strategy and the Environment	Journal																
2018	South Africa	Construction	Questionnaire	Okoye and Rameksee	Business Strategy and the Environment	Journal																
2017	Germany	Construction	Questionnaire	Schmidt and Schubert	Journal of Civil Engineering and Management	Journal																
2016	China	Engineering	Survey	Feng et al.	Journal of Cleaner Production	Journal																
2016	Nigeria	Construction	Survey	Owolara and Booth	Journal of Environmental Engineering and Landscape Management	Journal																
2016	Australia	Construction materials testing labs	Audit	Dijkovski	Waste Management	Journal																
2015	Bulgaria	Construction	Questionnaire	Horizanov	Economic Engineering in Agriculture and Rural Development	Journal																
2015	Vietnam	Engineering	Questionnaire	Nguyen and Hens	Journal of Cleaner Production	Journal																
2015	Malaysia	Construction	Case Study	Yusoff et al.	Issues in Social and Environmental Accounting	Journal																
2012	Italy	Engineering	Questionnaire	Anna et al.	International Journal of Business Management	Journal																
2012	Turkey	Construction	Questionnaire	Turk	Environmental Management	Journal																
2011	USA	Engineering	Questionnaire	Frachetti	Journal of Cleaner Production	Journal																
2011	Spain	Construction	Case Study	Gargallo et al.	Building and Environment	Journal																
2011	Spain	Construction	Questionnaire	Rodriguez et al.	Journal of Environmental Management	Journal																
2011	Finland	Construction	Action Research	Vierola and Kahkonen	Construction Management and Economics	Journal																
2011	China	Engineering	Questionnaire	Jiang et al.	Journal of Cleaner Production	Journal																
2010	Malaysia	Engineering	Questionnaire	Abdullah and Fung	Journal of Cleaner Production	Journal																
2010	Egypt	Construction	Survey	Saei et al.	Journal of Cleaner Production	Journal																
2009	Turkey	Construction	Questionnaire	Turk	Total Quality Management and Business Excellence	Journal																
2008	Germany	Engineering	Survey	Frondel et al.	Ecological Economics	Journal																
2007	Spain	Construction	Survey	Rodriguez et al.	Resources, Conservation and Recycling	Journal																
2007	Slovenia	Construction	Survey	Sethi	Journal of Civil Engineering and Management	Journal																
2005	USA	Engineering	Structured interviews	Carlock et al.	Proceedings of the Decision Science Institute	Journal																
2005	Various	Construction	Literature Review and case study	Swaffield and Johnson	Architectural Engineering and Design Management	Journal																
2004	China	Construction	Literature Review	Chen et al.	Automation in Construction	Journal																
2004	USA	Construction	Case Study	Christen et al.	Journal of Construction Engineering and Management	Journal																
2003	UK	Construction	Questionnaire	Adetunji et al.	Proceedings of the Institute of Civil Engineers - Engineering Sustainability	Journal																
2002	USA	Construction	Review	Ball	Building and Environment	Journal																
2002	Singapore	Construction	Survey	Ofori et al.	Building and Environment	Journal																
2002	Hong Kong	Construction	Survey	Shen and Tam	International Journal of Project Management	Journal																
2002	USA	Construction	Literature Review and case study	Valdez and Ochi	Environmental Practice	Journal																
2001	Hong Kong	Construction	Review	Pan et al.	Journal of Cleaner Production	Journal																
2001	Hong Kong	Construction	Case Study	Tse	Journal of Environmental Assessment and Policy	Journal																
2000	Singapore	Construction	Questionnaire	Ofori et al.	Construction Management and Economics	Journal																
2000	USA	Construction	Case Study	Quinn	Pollution Engineering and Toxicology	Journal																
2000	Australia	Construction	Case Study	Walker	The TQM Magazine	Journal																
1999	Singapore	Construction	Questionnaire	Nain et al.	Construction Management and Economics	Journal																
							3	3	3	3	18	6	2	7	4	11	10	3	7	2	3	

4.5.4 Legal Benefits and Barriers.

The legal impacts of implementing ISO14001 in Table 7 list the most reported benefit as “*compliance with legislation*” and again the barriers reported are not significant in the number of times that they are reported. Here again legal compliance is an expected outcome of the implementation of an EMS.

Table 7: Classification of Legal Benefits and Barriers highlighted in literature.

Year	Authors	Benefits										Barriers	
		Int. standards	Compliance with regulations	Liability threats	Reduction in fines	Lower risk of liabilities/due diligence	Cost of non-compliance	May become mandatory	Improved relations with regulators	Legal ramifications	Legal issues resulting	Legal compliance	No mechanical control
2022	Horry <i>et al.</i> ,		X	X	X	X	X		X	X	X	X	X
2020	Bailey <i>et al.</i> ,	X			X								
2020	Johnstone		X										
2018	Ololade and Ramestse		X										
2017	Schmidt and Osebold		X										
2016	Owolana and Booth					X							
2016	Dejkovski		X										
2015	Nguyen and Hens		X										
2015	Harizanova		X			X							
2011	Terio and Kahkonen									X	X		
2010	Haslinda and Chan								X			X	
2009	Turk		X					X					
2008	Frondel <i>et al.</i> ,		X										
2007	Rodriguez <i>et al.</i> ,		X										
2007	Selih		X										
2004	Chen <i>et al.</i> ,		X										
2004	Christini <i>et al.</i> ,		X										
2003	Adetunji <i>et al.</i> ,		X		X	X	X						
2002	Ball												X
2002	Ofori <i>et al.</i> ,			X				X					
2002	Shen and Tam		X		X								
2002	Valdez and Chini								X				
2001	Pun <i>et al.</i> ,		X										
2000	Ofori <i>et al.</i> ,		X										
1999	Kein <i>et al.</i> ,		X									X	
		1	18	2	4	4	2	2	3	2	2	3	2

4.5.5 Community Benefits and Barriers

In relation to the community benefits (Table 8) these are only mentioned in a small number of papers (n=9), and none of the community related barriers reach a reporting number which is deemed significant to report.

Table 8: Classification of Community Benefits highlighted in literature.

Year	Authors	Benefits					
		Improved community relations	Social Pressure (Community/activists)	Social legitimacy and responsibility	Community participation	To improve industry/ government relations	Government support/incentives
2022	Horry <i>et al.</i> ,	X	X	X	X	X	X
2018	Ololade and Ramestse			X			
2012	Arena <i>et al.</i> ,	X				X	
2012	Turk			X			
2011	Zeng <i>et al.</i> ,		X				
2009	Turk			X			
2007	Selih						X
2003	Adetunji <i>et al.</i> ,		X			X	X
2002	Shen and Tam				X		
		2	3	4	2	3	3

4.5.6 Operational Benefits and Barriers

In respect of operational factors (Table 9), it is interesting to note that the benefits are not significant enough to reach the number required for reporting, but here more barriers are reported in respect of “*lack of stakeholder support*” and “*documentation*”. This is worth noting as it has been reported in other studies that stakeholders can be the reason for implementing ISO14001. This value placed on stakeholders could be to in respect of the ability to enable engagement with tenders, but this may of course be also influenced by the the nature of the stakeholders who are being discussed in this literature. A potential barrier which is reported is that the supply chain is not able to deliver on ISO14001. Another barrier is in relation to documentation. The required documents can be challenging for smaller companies to manage.

Table 9: Classification of Operational benefits and barriers highlighted in literature.

Year	Authors	Benefits															Barriers														
		Increases knowledge and expertise	Efficient operations	Improved quality products or services	Support of operational system	Reduces transaction	Increases efficiency and productivity	Manages resources to respond and/or within	Supports decision making	Supports risk management (RM)	Supports management	Supports efficiency	Supports	Supports	Supports	Supports	Supports	Supports	Supports	Supports	Supports	Supports	Supports	Supports	Supports	Supports	Supports	Supports	Supports	Supports	Supports
2022	Herry et al.,	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2020	Bailey et al.,																														
2020	Johnstone		X																												
2019	Oliveira et al.,	X																													
2018	Obstade and																														
2017	Schmidt and																														
2016	Campos et al.,																														
2016	Feng et al.,																														
2016	Owolara and Booth																														
2015	Nguyen and Hien		X																												
2015	Husoff et al.,																														
2012	Arnes et al.,			X																											
2012	Turk																														
2011	Lam et al.,																														
2011	Rodriguez et al.,																														
2011	Torio and Kahkonen		X	X																											
2010	Hirsh and Chan																														
2010	Saker et al.,																														
2010	Tambozeva																														
2009	Turk		X	X																											
2008	Fronzelli et al.,																														
2007	Selvi																														
2005	Curkovic et al.,																														
2005	Swaffield and		X																												
2004	Christini et al.,	X		X	X																										
2004	Zuhri and Sahal																														
2003	Adeniyi et al.,																														
2003	Bakken et al.,																														
2002	Bail			X																											
2002	Offori et al.,																														
2002	Shen and Tam																														
2002	Valdes and Chen																														
2001	Pun et al.,																														
2001	Tse																														
2000	Offori et al.,		X																												
2000	Quinn																														
1999	Klein et al.,																														

4.5.7 Human Resource Benefits and Barriers

In the category of Human Resources (HR) (Table 10) there are issues pertaining to the knowledge of the staff who would be required to engage with the system, with expertise being highlighted as a barrier along with the lack of training on the system. Time is also noted in this category as a barrier to the implementation. The main reported benefit is that of the environmental awareness of the staff.

Table 10: Classification of HR benefits and barriers highlighted in literature.

Year	Authors	Benefits										Barriers									
		Employee environmental awareness	Morale Building within the organisation and fulfilling the customers expectations	Environmentally motivated employees	Cooperation between management and employees	Subcontractor relations	Top management involvement and commitment	Increasing staff skills	Better working conditions	Need for tailor made training	Lack of experienced consultants	Lack of experience, expertise or knowledge	Lack of training	For sales not environmental stuff	Lack of worker support, involvement or resistance	Inadequate organisational structure	Time	Lack of awareness	Change is stressful	Insufficient leadership	
2022	Horry <i>et al.,</i>	X	X	x		X	X	x	X	X	X	X	X	X	X	X	X	X	X		
2020	Bailey <i>et al.,</i>		X					X	X		X	X		X		X			X		
2020	Johnstone	X													X						
2019	Chiarini <i>et al.,</i>			X	X		X	X										X			
2018	Ololade and Ramestse										X	X		X				X			
2017	Schmidt and Osebold							X			X	X									
2016	Campos <i>et al.,</i>										X										
2016	Owolana and Booth	X	X						X		X	X		X		X					
2015	Nguyen and Hens	X																			
2015	Yusoff <i>et al.,</i>	X		X			X		X			X									
2012	Turk										X										
2011	Lam <i>et al.,</i>																X				
2011	Rodriguez <i>et al.,</i>										X	X									
2011	Terio and Kahkonen																X				
2010	Haslinda and Chan		X	X																X	
2010	Sakr <i>et al.,</i>										X										
2010	Tambovceva										X							X			
2009	Turk				X			X			X	X		X		X					
2007	Rodriguez <i>et al.,</i>	X																			
2007	Selih													X							
2005	Curkovic <i>et al.,</i>			X																	
2005	Swaffield and Johnson											X		X							
2004	Christini <i>et al.,</i>	X					X				X	X									
2004	Zutshi and Sohal										X	X		X				X			
2003	Babakri <i>et al.,</i>											X		X		X					
2003	Adetunji <i>et al.,</i>		X																		
2002	Ofori <i>et al.,</i>										X							X			
2002	Shen and Tam								X		X		X	X	X	X				X	
2002	Valdez and Chini													X							
2001	Pun <i>et al.,</i>																			X	
2001	Tse					X			X			X		X		X					
2000	Chen <i>et al.,</i>																X				
2000	Ofori <i>et al.,</i>									X	X										
		7	5	5	1	2	3	4	4	6	2	16	13	2	12	3	10	6	2	3	

4.5.8 Sector Specific Benefits

In relation to the sector benefits none are noted in the literature reviewed in relation to the implementation of ISO14001 within the sector-specific category (Table 11). There are, however, barriers with the one cited most as being “*lack of government pressure.*” This lack of pressure would suggest that it appears that a legal requirement is needed for some organisations to engage with environmental management systems and that the lack of this requirement is resulting in many not engaging.

Table 11: Classification of Sector barriers highlighted in literature.

Year	Authors	Barriers						
		Industry not ready	Relies on peer pressure and management incentives which may be ineffective	No major impacts in the sector	Lack of Government Pressure	Lack of guidelines	Competitive pressures	government demand or pressure
								Sector weak in terms of env
2022	Horry et al.,	X	X	X		X	X	X
2020	Bailey et al.,				X	X		X
2018	Ololade and Ramestse			X				X
2017	Schmidt and Osebold				X			
2016	Owolana and Booth				X			
2009	Turk				X			
2007	Selih				X			X
2002	Ofori et al.,				X			
2002	Shen and Tam		X	X	X	X	X	X
2001	Tse				X			X
2000	Ofori et al.,				X			
1999	Kein et al.,	X			X			X
		2	2	3	10	3	2	6

5.0 DISCUSSION

This section sets out to review the findings of the literature review in respect of the engineering and construction sectors to establish the practical implications of the most reported benefits and barriers to the use of ISO14001 within organisations.

5.1 Benefits of ISO14001

Those most frequently noted by the literature review are (i) Enriching green corporate and public image, (ii) Improved environmental performance and compliance with regulations, (iv) cost savings and (v) Long-term competitive advantage. Improved environmental performance and compliance with regulations are a requirement of ISO 14001, therefore this discussion will focus on the other leading benefits; enriching green and public image, cost savings and long-term competitive advantage (Ofori *et al.*, 2000; Shen and Tam, 2002; Valdez and Chini. 2002; Adetunji *et al.*, 2003; Swaffield and Johnson, 2005; Turk, 2009; Terio and Kahkonen, 2011; Bailey *et al.*, 2020, Horry *et al.*, 2022).

It is, however, interesting to note that enriching green corporate and public image is highlighted more frequently than improved environmental performance which is one of the requirements of the system. It is possibly more beneficial to an organisation to improve their public image rather than their environmental performance in terms of improved economic prosperity. There is a risk, however, that this could result in the EMS becoming a badge rather than bringing about positive actions, but this is not reflected in the literature. Compliance with regulations is seen as being a notable benefit but again this is about legal requirements and not something out of the ordinary. This, however, could be linked back to economic benefits due to the reduced risk of liability and hefty fines for non-compliance (Arimura *et al.*, 2008; Chan, 2008). Cost savings again, are an economic advantage and as such may well be judged against the costs of implementation to ascertain if this is an economically viable or even a beneficial action for a company to take. The last benefit which was seen as significant was the one of long-term competitive advantage (Chavan, 2005) which may well link to the ability to compete for tenders (Turk, 2009). Certain organisations have witnessed increased export opportunities due to having a recognised management system and thus, organisations experience additional positive PR. The use of ISO14001 can

also be beneficial to companies looking to expand their environmental work to have a more sustainability focussed strategy and to enable engagement with the SDGs (Horry *et al.*, 2022). It is possible to use the system as a means of mapping how their work contributes to the delivery of the SDGs (Horry *et al.*, 2022).

5.2 Barriers of ISO14001

The most frequently cited barriers in the literature reviewed are cost, lack of stakeholder support and lack of experience, expertise or knowledge (Ofori *et al.*, 2000; Ofori *et al.*, 2002; Shen and Tam, 2002; Zutshi and Sohal, 2004; Turk, 2009; Turk, 2012; Owolana and Booth, 2016; Bailey *et al.*, 2020; Horry *et al.*, 2022a).

The leading barrier to the implementation of ISO14001 is cost. Shen and Tam (2002) noted this in their research in Hong Kong and cost as a barrier has continued to be a major factor in the uptake of environmental management systems. It must also, however, be remembered that cost savings are seen as a benefit. There is a balance to be achieved between the costs and the savings to be made which will majorly influence the decisions as to whether to adopt an environmental management system or not. The next major factors in relation to barriers, is that of lack of experience, expertise and knowledge closely followed by lack of training. As these barriers are similar, they will be examined together.

There are issues as seen from the literature review in relation to the lack of knowledge and the sectors inability to increase that knowledge, which is a major factor in the uptake of the system approach. Whether the stakeholders are committed to the system is another factor that has been highlighted in the past. It has been noted more recently, however in Horry *et al.* (2022) that more companies are highlighting the requirement of having an EMS to ISO14001 standard as a prerequisite for engagement with the tender process. So, while lack of stakeholder commitment is listed as a barrier, there is a growing stakeholder requirement within the tender process. Furthermore, documentation has also been noted as a challenge by previous researchers (Owolana and Booth, 2016; Schmidt and Osebold, 2017) in relation to environmental management systems, and this is particularly relevant for SMEs who may not have the

staff time available to manage the requirements. Finally, time is identified as a barrier (Bailey *et al.*, 2020; Horry *et al.*, 2022) as this is an extra task on top of an organisation's daily routine.

6.0 ORIGINALITY

The benefits and barriers of ISO14001 have been well documented over the years. As opinions and public awareness change in relation to issues such as climate change, there is an increasing focus on not just environmental management but also sustainability. The engineering and construction sectors are having to adapt to the new world and the changing expectations of societies and their governments in respect of environmental protection. The use of ISO14001, however, is still very much focused on short-term economic factors, and HR challenges of staff awareness and training. It is vital that as a society, there is a move to encourage more environmentally aware staff, to ensure not only the survival of engineering and construction organisations but also the sustainability of their operations in relation to their impact on the planet. The uptake of ISO14001 has been consistently increasing since it was introduced in 1996, and the benefits and barriers have for the most part been consistent over time. One factor which seems to be changing is the inclusion of sustainability in the keywords as opposed to purely environmental management.

7.0 CONCLUSIONS

This work has presented a systematic literature review, which has examined the benefits and barriers to the use of ISO14001 over the last twenty-plus years. The main finding of this research is the generation of a comprehensive list of major benefits and barriers to the use of the system within the engineering and construction sectors. Those most often noted by the literature review are: (i) enriching green corporate and public image (44%), (ii) improved environmental performance (39%) (iii) compliance with regulations (39%), cost savings (37%) and long-term competitive advantage (35%). While in respect to the barriers to implementation, the highest reported barriers are: (i) Cost (59%), (ii) Lack of experience, expertise, or knowledge (35%), (iii) Lack of training 28%, (iv) Lack of stakeholder support (26%) and (v) Time and Lack of Government pressure (22%). Most of the articles included in this review used questionnaires as their data collection instrument which provides a view of the participant completing the questionnaire and are reliant on the validity of the questions being asked. It must also be noted that the answers to the questions will be dependent on the maturity of the system and the demands of the

supply chain within which these organisations sit. Further, in-depth phenomenological research would be required to ascertain the reasons behind the selection of each of the benefits and barriers. Since cost has featured as both a benefit and a barrier, it would be worthwhile investigating to ascertain what dictates whether it is one or the other.

The uptake of ISO14001 demonstrates the benefits for many organisations related to improving their PR, reducing their environmental impacts, ensuring compliance, reducing costs, and improving long-term competitive advantage, rather than driving their sustainability objectives. The driving force appears to be economic benefits to the organisation. Therefore, more research is required to ascertain the following:

- Examine the impact of tender requirements in relation to the uptake of ISO14001 from a pool of suitable professionals within the engineering and construction industry.
- Clarification of the challenges faced by organisation in relation to the knowledge, skills and expertise and the training available to remedy the skills gap within the sectors.
- Establish whether the focus for an organisation is on environmental management or whether the focus is more about sustainability and environmentally social governance. This could be done by using case studies of organisations who are engaged with delivering on the SDGs via their environmental management system.

Throughout this study, it has been highlighted that whilst the engineering and construction sectors use ISO14001, they may not be using it to the extent of what is possible in line with prescriptions in the document. It is currently restricted by the narrow focus on economics and staff experience. By examining more details about the opportunities and case studies demonstrating how sustainability has been brought within the bounds of ISO14001, other companies may be encouraged to see the art of the possible. Through this approach they could begin to use the system not just to save money, but to make a positive difference in relation to the sustainability of their operations but also to the sustainability of the sector. Using the ISO14001 system to examine how their organisation could deliver on the SDGs and improve the local and national community would be a useful starting point to engaging with the delivery of the broader opportunities in respect of sustainability.

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Abstract

Unprecedented increases in both tourism and population growth have put extreme pressure on the Republic of the Maldives, which has resulted in significant changes to the islands as a result of construction activities. This study is the first to investigate perceptions of the benefits and barriers of implementing environmental management systems (EMS) in the Maldivian construction industry, and what effective measures and strategies exist to drive environmental management practices. A subjectivist stance and deductive approach have been taken with an online survey adopting a quantitative strategy with a range of construction professions across the Maldivian construction sector. Using a central tendency measure of weighted average, the respondents' opinions suggest that the primary benefits of having an EMS in the Maldives are perceived as the enhancement of corporate image and environmental protection; while the major barriers are lack of legal enforcement and the requirement for company structures and policies to change to accommodate an EMS. The findings also suggest that those companies who establish a waste management plan and where authorities enforce legal environmental requirements are believed to be the most effective means to encourage more widespread adoption. Based on these findings, it is recommended that managers, need to increasingly promote the principles of environmental management and sustainable practices/behaviours amongst construction industry stakeholders. Furthermore, policy makers within the Maldives should be exploring the viability of establishing financial incentive schemes (particularly for SMEs), in addition to encouraging wider adoption of EMSs across the Maldivian industry sectors.

Keywords: ISO14001, Environmental management, Environmental standards, Corporate social responsibility, Sustainable construction, Maldives.

Introduction

The construction industry is widely recognised as a major cause of environmental issues accounting for a larger percentage of GHG emissions, land contamination, biodiversity loss and water usage (Hammond and Booth, 2010). Some construction organisations are becoming more environmentally proactive, which may be as a result of it being perceived to yield positive social, economic and environmental outcomes (Lisi, 2015). A method that can be used to facilitate this is the implementation of an environmental management system (EMS), such as the ISO 14001, which provides a mechanism by which companies can integrate sustainable practices and environmental principles into their business operations (Zhang *et al.*, 2000).

Environmental management was traditionally seen as being a top–down approach, restrictive and reactive in nature, defined by the implementation of environmental policies enforced through laws and fines (Barrow, 2005; Tinsley, 2014). However, as the system has developed it has become more open in approach; enabling more consultation and engagement with stakeholders which is seen as critical to achieving the aim of improving environmental management (Reed, 2008; Coccia and Watts, 2020). Some researchers have noted that by placing environmental management at the core of an organisation’s mission it enables it to work towards environmental integrity and social equity (Barrow, 2005; Keene and Pullin, 2011; Vasovic *et al.*, 2017).

Environmental management practices can be defined as “*the techniques, policies and procedures a firm uses that are specifically aimed at monitoring and controlling the impact of its operations on the natural environment*” (Yu and Ramanathan, 2016). The positive impacts of environmental management on business performance have been recognised since its inception in the 1970s. Many researchers have reiterated the view that environmental management positively influences the economic performance of an organisation (Gotschol *et al.*, 2014; Yu and Ramanathan, 2016). These practices are shown to minimize risks, improve revenue and strengthen stakeholder relations (Ervin *et al.*, 2013). However, Yang *et al.* (2009) suggests that environmental management does not directly influence financial performance, rather it is the resulting improved environmental performance that reduces negative environmental impacts on the economic performance of an organisation. Barrow (2005) suggests environmental management can contribute to sustainable development as it can identify key issues, threats, opportunities, and limits, as well as determine realistic strategies by coordinating the physical, biological and socio–economic interests of the stakeholders. These stakeholders can include members of the public, noting that public pressure has intensified, and the increased awareness of the natural environment has contributed to an improved corporate accountability and responsibility (Ormazabal *et al.*, 2017). Along with the public desire for better protection of the environment there has been an increase in regulatory standards, as well as market pressures to protect investors’ interests and maintain competitiveness, which have also contributed to promote positive actions (Ervin *et al.*, 2013; Khanna and Speir, 2013; Ormazabal *et al.*, 2015). Within organisations, Ormazabal *et al.*, (2015) noted that efforts are often managerially driven by attitude, organisational frameworks and training mechanisms.

Implementation of environmental management measures across organisations have resulted in the development of many tools and techniques to monitor, forecast and aid management decision–

making, as Barrow (2005) argues '*what cannot be measured, cannot be managed*'. Environmental impact analyses, environmental flow assessments, life cycle assessments and standardized environmental management systems have all become a means to manage the environmental commitments of organisations (Ormazabal *et al.*, 2015). More recently, powerful technological mechanisms, such as remote sensing and geographical information systems, have demonstrated their capacity to support environmental management processes (Herbei *et al.*, 2016). However, all these tools require funding and financial constraints remain the major barrier towards the adoption of environmental management practices within organisations (Ervin *et al.*, 2013; Kuppig *et al.*, 2016), particularly in developing nations.

The Maldives, often defined as a 'paradise on earth', has become a magnet for global tourists in recent decades (Niyaz, 2002; de-Miguel-Molina *et al.*, 2014; Bowen *et al.*, 2017). However, this is a developing nation and parts of the island group are now amongst the most densely populated places on the planet (i.e. Island of Male') (UN, 2020). A developing nation with unprecedented growth and the resulting environmental pressures creates a perfect storm due to the demands of construction associated activities (UNEP, 2006; Karthikheyen, 2010; Zubair *et al.*, 2011; Bowen *et al.*, 2017; Cowburn *et al.*, 2018). These issues support Barrow's (2005) point that it is important to examine local conditions and engage with stakeholders at community level to seek suitable environmental remedies for the developing world. Developed countries and multi-national corporations have largely driven environmental management efforts, while the developing nations focus has been on the struggle to tackle socio-economic issues, such as extreme poverty and poor infrastructure. Therefore, the purpose of this study is to explore the potential of EMS for managing these challenges by examining the perceptions of the benefits and barriers of implementing EMSs within the construction sector of a developing nation, the Maldives. In doing so, the study highlights the primary benefits that are perceived to be the key drivers for stimulating environmental management in construction organisations across the Maldives. Further, it also emphasises the barriers that must be addressed both by the government, as well as by the industry stakeholders, to improve the environmental impacts due to construction activities. This is important because the information is crucial for the formulation of strategies that could be implemented to enhance the adoption of EMSs in construction practices.

The article is organized as follows: the next section proffers a background to EMS and ISO 14001, before reviewing literature that covers its adoption across construction sectors; a description of the case study country and details of the methods used to collect and analyse data are then revealed; thereafter, presentation of the findings and an associated discussion follow, before conclusions are drawn and related recommendations made.

Background

Environmental Management Systems

Environmental management systems are a holistic approach by which organisations can identify and manage the environmental impacts of their business activities, products, and services (Sunderland, 1997). An EMS is identified as a self-disciplined strategic management tool, used by organisations to drive their environmental commitments (Zhang and Tang (2019). The approach used in an EMS follows Deming's management cycle of 'Plan-Do-Check-Act', which provides a cyclical mechanism to ensure

continual improvements in environmental performance (Barrow, 2005; Tinsley, 2014). Its use is intended to address the environmental impacts by considering firstly the organisational structure and operational framework (Tambovceva, 2016). It then needs to encompass the environmental policy commitment as a minimum and present a detailed structure and documentation template, usually verifiable by a third-party external auditor (Tinsley, 2014). The system itself comprises several interlinked elements to encourage an organisation to set objectives against which its performance is measured, and corrective actions that are taken (Delmas, 2000; Barrow, 2005).

An increasing number of organisations have implemented EMSs primarily driven by the opportunity it presents to showcase their environmental commitment (Castka and Prajogo, 2013). Some perceived benefits are improved corporate image and enhanced public perception (Arulrajah *et al.*, 2015; Santos *et al.*, 2016; Horry *et al.*, 2022). It also provides a platform to communicate the environmental performance of an organisation to the wider audience through certification (Hibiki and Arimura, 2011; Camilleri, 2022). It has been suggested that EMS also promote financial benefits (Berrone and Gomez-Mejia, 2009; Mariotti *et al.*, 2014; Zhang *et al.*, 2022). They are also credited with promoting sustainable practices by increasing the environmental awareness within the employees (Zhang *et al.*, 2014; Boiral *et al.*, 2018; Johnstone, 2022) and standardizing management procedures to minimise negative environmental impacts (Gallagher *et al.*, 2004; Barrow, 2005; Ong *et al.*, 2023). Other internal benefits which are acknowledged within the use of an EMS include improved energy efficiency (Pesce *et al.*, 2018; Jeong and Lee, 2023) and waste minimization (Comoglio and Botta, 2012; Camilleri, 2022). External motivation includes pressures from the supply chain and legal compliance (Hillary, 2004; Tinsley, 2014; Zhang *et al.*, 2014; Jum'a *et al.*, 2022).

An EMS, while useful in encouraging best practices and setting benchmarks, does not provide a complete solution for environmental management. Sunderland (1997) argues that meeting the specifications of an EMS does not guarantee a strong commitment towards environmental management. Additionally, he suggests environmental management standards do not assure continued improvements in environmental performance unless woven in to the Organisation's business as usual activities, and at worst could potentially encourage separation of EMS effort from existing business practices. EMS is also criticised as a management approach, as it does not guarantee optimal results in environmental outcomes even though it promotes continual improvement of environmental performance (Gallagher *et al.*, 2004; Qi *et al.*, 2013).

While the use of EMS has proliferated in recent years, many organisations have not used the standard due to financial barriers, such as return on investment, payback and limited investment capital (Kuppig *et al.*, 2016). Hillary (2004) pointed that SMEs are further challenged by barriers such as lack of knowledge towards the environment and lack of pressure within the supply chain supported in Horry *et al.* (2022). A lack of human resources is also cited as a barrier to implementing an EMS (Bracke *et al.*, 2008; Waxin *et al.*, 2023). All issues which will influence the use of ISO 14001 within the Maldivian construction sector,

ISO 14001

ISO 14001 is the most widely recognised global EMS standard. Originally published in 1996 (Boiral and Sala, 1998; Hillary, 2000) and updated in 2004 and again in 2015. ISO14001 has experienced rapid growth with over 300,000 certifications issued in 171 countries worldwide (International Organisation for Standardization, 2015). It is intended to provide harmonisation, to avoid trade barriers and potential conflicts in businesses (Sunderland, 1997; Chan and Wong, 2006; Muktiono and Soediantono, 2022). As a system it has demonstrated significant influence in the field of environmental management, as ISO 9000 did in quality assurance and management areas (Psomas *et al.*, 2011), providing a means to manage organisations environmental performance (Carrillo–Labella *et al.*, 2020).

ISO 14001 is based on a top–down management approach encompassing the traditional management principles of commitment and policy, planning, implementation, and operation, checking and corrective action, management review and continual improvement (Boiral and Sala, 1998). It is suggested that top management commitment, which became explicitly required in the 2015 version (Chiarini *et al.*, 2018, Chiarini, 2019) of the standard is the single most important factor to ensure the successful implementation, as it helps motivate the employees towards continuous improvement, while showcasing the ethical position of the organisation on environmental issues to the wider audience (Bridgen and Helm, 2000; Ejdys *et al.*, 2016). A factor which links to the work of Balzarova *et al.* (2006) who highlighted the four dimensions of organisational culture: people, process, structure, and environment as influencing factors in the implementation of the ISO 14001 standard.

Other studies have suggested organisations are primarily driven to implement ISO 14001 due to the competitive advantage gained through the improved corporate image (Feng *et al.*, 2016; Schmidt *et al.*, 2017; Bailey *et al.*, 2020), as well as sustainable outcomes (Castka and Balzarova, 2008; Liu *et al.*, 2012). This improved corporate image is supported by researchers who state that ISO 14001 improves relations with stakeholders, due to the responsible environmental measures adopted in business practices (Poksinska *et al.*, 2003; Castka and Balzarova, 2008; Psomas *et al.*, 2011; Horry *et al.*, 2021). All issues which are thought to exist within the construction sector within the Maldives.

ISO 14001 when used well is a proactive approach to help minimise environmental impacts, but it is criticised as a management standard because it does not guarantee any real improvements in environmental performance, as the standard does not explicitly state the criteria for defining and

measuring a particular environmental aspect (Valdez and Chini, 2002; Mariotti *et al.*, 2014). This is reflective of a concept termed ‘symbolic adoption’, which refers to the “*use of standards by firms as a way to legitimise environmental practice by looking for the support from the institutional environmental but without necessarily implying real environmental commitment*”. This concept is detrimental to the credibility and reliability of the standard, as it does not result in a tangible reduction of any negative environmental impacts (Ferron–Vilchez, 2016). Furthermore, the effectiveness of ISO 14001 as a proactive management model is challenged by Ball (2002), as it is suggested the standard is only useful in reducing the impact, in reaction to environmental issues. Thus, the ISO 14001 standard is perceived as a tool, rather a means of addressing the environmental management concerns in an organisation (Boiral and Sala, 1998).

Despite all these concerns ISO 14001 is becoming increasingly popular in the developing world, as it provides the opportunity for organisations to demonstrate legal compliance in respect of environmental legislation. However, limited financial capital and human resources, as well as lack of awareness and knowledge within the organisations, has impeded the widespread implementation of ISO 14001 standard in some developing nations (Davy, 1997; Owolana and Booth, 2016). Hortensius and Barthel (1997) also emphasise poorly defined legislation and enforcement structure as barriers to organisations effectively managing and measuring their environmental performance through a formally recognised EMS. Therefore, Davy (1997) proposes it necessary for developing nations to receive external support and assistance, to encourage the uptake of environmental management in commercial activities.

Environmental Management in Construction

The construction industry is perceived as a key player in the national economies of both the developed and developing nations, owing to its investment value, job creation potential and contribution to the GDP (Zhang *et al.*, 2000). The industry is closely linked to the indices of sustainable development in the form of the Sustainable Development Goals (SDGs), as construction activities significantly impact the natural environment, as well as the social and economic conditions of a society (Myers, 2005; Du Plessis, 2007). Christini *et al.* (2004) suggests the construction industry would benefit greatly from having a comprehensive and certified EMS, while Murillo–Avalos *et al.* (2021) note it would help deliver on the SDGs. In response to the increasing pressure on the construction industry to be more ecologically responsible, organisations have developed various methodologies such formal EMSs to support the protection of the natural environment (Kartam *et al.*, 2004; Liyin *et al.*, 2006; Camilleri, 2022). This may assist a sector which is often criticised due to its poor performance and wasteful practices, resulting from the fragmented and diverse nature of the industry (Liu *et al.*, 2012).

The role of the government and local institutions are also highlighted, as it is suggested that legal enforcement and financial incentives could promote the implementation of EMS in the construction industry (Ofori *et al.*, 2002; Tam, 2008; Sakr *et al.*, 2010; Bashir *et al.*, 2022). Liyin *et al.* (2006) and Serpell *et al.* (2013) support this idea that the construction industry environmental management practices are primarily driven by legislative and regulatory pressures. It is to a lesser degree influenced by client demands and the competitive advantage (Selih, 2007; Rodriguez *et al.*, 2011; Serpell *et al.*, 2013), which has a financial impact (Vatalis *et al.*, 2011; Chen *et al.*, 2016). Studies across several

countries have revealed that organisations are primarily driven by economic benefits, plus other factors such as improved corporate image and opportunity to access international markets (Zhang *et al.*, 2000; Tam, 2008; Tambovceva and Geipele, 2011; Owolana and Booth, 2016; Hasanah *et al.*, 2022). This has resulted in construction organisations becoming more receptive to the notion of environmental management within their organisations (Yusof *et al.*, 2016).

It is recognised that environmental management measures in construction are directly related to the reduction of environmental risks and improving environmental protection efforts (Shen and Tam, 2002). A formal EMS is perceived to improve the efficiency in waste management (Arimura *et al.*, 2008; Turk, 2009; Camilleri, 2022) and contribute significantly to protection of the natural environment (Zhang *et al.*, 2000; Owolana and Booth, 2016). However, even though interest in environmental issues continues to grow, implementation of EMS in organisations is still relatively uncommon (Turk, 2009; Schmidt and Osebold, 2017). Furthermore, to avoid the mistakes of the developed nations, developing nations should aim for meaningful dialogue between stakeholders at all levels of government, broader construction industry and civil society, as it is evident that lack of integrated decision-making leads to poor connections between policies and reality (Du Plessis, 2007).

Barriers to the engagement of environmental management practices in the construction industry have been noted as being lack of knowledge and awareness, limited human resources, expertise and financial constraints (Shen and Tam, 2002; Sakr *et al.*, 2010; Brennan and Cotgrave, 2014), especially in developing nations (Turk, 2009; Owolana and Booth, 2016). Liyin *et al.* (2006) further suggests the passive environmental culture in the construction industry impedes organisations from adopting a proactive approach towards protecting the natural environment.

Uptake of Environmental Management Systems in Maldivian Construction

The first Maldivian National Building Code (introduced in 2008), governing building practices in the country (Ministry of Construction and Public Infrastructure, 2008) counteracts observations by Shaheen and Charoenngnam (2004) who noted mechanisms in Maldivian construction activities lack adequate consideration for the natural environment. They also suggest stakeholders within the industry are uninformed on sustainable construction practices and highlighted the need for greater emphasis on construction and its impact on the environment. The Construction Industry Development Board was established in 2014 with the main intent of contributing to the development of the industry and to provide support to the Ministry in formulating policies, regulations, standards and procedures (Ministry of Housing and Infrastructure, 2014). The Implementation of Construction Law in the Maldives (April 2017) mandated the enactment of the National Building Code. However, the Law does exempt construction activities on lagoons and islands leased for tourism (Moosa, 2017). However, in the regulatory guidelines for tourist resort developments mandated under the Ministry of Tourism it does state that tourist resort projects must gain environmental permits such as approvals from statutory bodies for environmental impact assessment (EIA) studies, land reclamations, dredging of lagoons and for the felling of coconut palms and trees (Ministry of Tourism, 2005). So, a situation exists where companies need to assess their environmental impacts and EMS could assist in this process.

Environmental management practices are uncommon in the Maldivian construction industry in comparison to the UK. EMS in the Maldives is in its infancy, and there are no known studies that have explored the uptake of EMS in the Maldivian construction sector. This paper sets out to address this issue using the wealth of existing studies that have explored the uptake worldwide which identified diverse sets of benefits and barriers of implementing EMS (Shen and Tam, 2002; Owolana and Booth, 2016; Bailey *et al.*, 2020). The known benefits, barriers and implementation strategies for EMS, which have been detailed and discussed in the articles already mentioned and other, more general, EMS literature, are surmised in Tables 1, 2 and 3.

Table 1: List of known beneficial factors identified in EMS literature

	Benefit Factors	References
A	Cost savings due to the reduction of fines associated with convictions	Owolana and Booth (2016); Rino and Salvador (2017); Pesce <i>et al.</i> , (2018)
B	Improving corporate image in environmental performances	Abdullary and Fuong (2010); Arulrajah <i>et al.</i> (2015); Bernardo <i>et al.</i> , (2015)
C	Contribution to the improvement of public environmental standards	Ololade and Rametse (2018); Bailey <i>et al.</i> , (2020); Johnstone (2020);
D	Contribution to environmental protection	Owolana and Booth (2016); Santos <i>et al.</i> , (2016); Pesce <i>et al.</i> , (2018)
E	Increasing overall business competitiveness	Darnall <i>et al.</i> , (2008) Aiyub <i>et al.</i> , (2009); Castka and Prajogo (2013)
F	Reduction of environmental complaints	Turk (2009); Owolana and Booth (2016); Bailey <i>et al.</i> , (2020).
G	Improving staff work environment, thus increasing their morale	Darnall and Edwards (2006); Gavronski <i>et al.</i> , (2008); Arulrajah <i>et al.</i> , (2015)
H	Reduction of environment–related sickness and injuries	Turk (2009); Nguyen and Hens (2015); Santos <i>et al.</i> , (2016)
I	Reduction of environmental risks– polluted air, lands and water	Darnall and Edwards (2006); de Oliveira <i>et al.</i> , (2010); Hibiki and Arimura (2011)

Table 2: List of known barrier factors identified in EMS literature

	Barrier Factors	References
A	Lack of government legal enforcement	Christini <i>et al.</i> , (2004); Massoud <i>et al.</i> , (2010); Mariotti <i>et al.</i> , (2014).

B	Increase in management and operation cost	Bellesi <i>et al.</i> , (2005); Campos <i>et al.</i> , (2016); Boiral <i>et al.</i> , (2018).
C	Lack of trained staff and expertise	Kim <i>et al.</i> , (2015); Campos <i>et al.</i> , (2016).
D	Lack of client support	Owolana and Booth (2016); Bailey <i>et al.</i> , (2020); Johnstone (2020).
E	Lack of sub-contractor cooperation	Owolana and Booth (2016) Bailey <i>et al.</i> , (2020).
F	Lack of supplier cooperation	Mariotti <i>et al.</i> , (2014); Owolana and Booth (2016).
G	Difficult coordination of environmental performance among multi-tier subcontractors	Mariotti <i>et al.</i> , (2014); Bailey <i>et al.</i> , (2020).
H	Lack of working staff support	Chavan (2005); Kim <i>et al.</i> , (2015); Ololade and Rametse 2018
I	Time consuming for improving environmental performance	Teriö and Kahkonen (2011); Owolana and Booth (2016); Bailey <i>et al.</i> , (2020).
J	Change of existing practice of company structure and policy	Yusoff <i>et al.</i> , (2015); Owolana and Booth (2016); Bailey <i>et al.</i> , (2020).
K	Increase in documentation workload	Owolana and Booth (2016); Schmidt and Osbold (2017); Bailey <i>et al.</i> , (2020).
L	Lack of tailor-made training on environmental management	Yusoff <i>et al.</i> , (2015); Owolana and Booth (2016); Bailey <i>et al.</i> , (2020).
M	Lack of technological support within organisation	Selih (2007); Owolana and Booth (2016).

Table 3: List of known implementation strategy factors identified in EMS literature

	Strategy Factors	References
A	Legal requirements on environmental protection	Schmidt <i>et al.</i> , (2017); Ololade and Rametse (2018); Johnstone (2020)
B	Reduction, reuse and recycling of construction and demolition wastes	Teriö and Kahkonen (2011); Bailey <i>et al.</i> , (2020); Johnstone (2020)
C	Imposing responsibilities of protecting environment on managerial staff	Sambasivan and Fei 2008: Chiarini (2019)
D	Applying environmentally friendly technology on site	Sambasivan and Fei (2008); Padma <i>et al.</i> , (2008)
E	Providing in-house training on environmental management	Rodriguez <i>et al.</i> , (2007); Nguyen and Hens (2015); Yusoff <i>et al.</i> , (2015).
F	Establishing waste management processes	Turk 2009; Tse (2001); Swaffield and Johnson 2005 Bailey <i>et al.</i> , 2020; Johnstone 2020.
G	Continuous efforts in improving environmental management	Ololade and Rametse (2018); Bailey <i>et al.</i> , (2020); Johnstone (2020)
H	Inclusion of environmental management in tendering requirements	Turk (2009); Rodriguez <i>et al.</i> , (2011); Bailey <i>et al.</i> , (2020)
I	Effective communication of environmental issues between all layers of subcontractors	Christini <i>et al.</i> , (2004); Turk 2009 Nguyen and Hens (2015)
J	Close supervision at site level	Ofori <i>et al.</i> , (2000); Shen and Tam (2002); Dejkovski (2016)

Methodology

The flowchart presented in Figure 1 illustrates the methodological sequence of steps adopted in this study.

Case Study

The Republic of Maldives is an independent archipelagic, a small island developing state of 341,256 residents (Asian Development Bank, 2015), located in the Indian Ocean, comprising 26 atolls that stretch 750km north–south. The ocean area is extensive, with an exclusive economic zone of 859,000 km², but land (coral reefs and sand bars) is scarce, with total area 298 km² (Buckley *et al.*, 2017). Of the 1192 low-lying individual islands in the Maldives, 188 are recognised as being ‘inhabited’ while 1004 are classed as ‘uninhabited.’ Of the inhabited islands, only 2.5% support populations greater than 5000 residents; whilst ~60% support 1000–5000 residents. The remaining islands have less than 1000 residents (Buckley *et al.*, 2017). Karthikheyan (2010) highlights the lack of land to accommodate the growing population and the limited resources to build the necessary infrastructure poses a significant challenge. This is seen in the capital–city island of Male which is home to ~35% of the Maldivian population. Here, population growth and urbanisation has been rapid in recent decades. Policy bias towards the capital city, alongside progressive migration, has further exacerbated the issue. To ease the land demand pressures the island’s land mass was extended 15 ha with coralline landfill (blasted from coral reefs). Despite this work the amount of new land has proved insufficient (Naylor, 2015). On an island where natural resources are scarce, coral constructed buildings were favoured as replacements to traditional wooden–frame houses until the realisation of the environmental impact of the destroying reefs was fully appreciated. To disrupt the supply chain of coral blocks (now made illegal) being used on construction projects, the government made the decision to subsidize concrete block manufacture (made possible by economic growth) by importing aggregates. However, the need to provide housing remains and, as is a common consequence of a housing market that cannot meet demand, it has been reported that housing conditions and the associated services are acutely inadequate in Male', and several other islands (World Bank, 2003; Mohit and Azim 2012). To further ease land demand pressure, the artificial landfill island of Hulhumale' (182 ha; started in 2003) has been built on the nearby reef flats of Hulhule' Falhu with the expectation of housing 150,000 inhabitants by 2020 (Naylor, 2015).

The Maldivian economy has been highly dependent for the last 50 years on tourism and leisure industries. For instance, in 2015, tourism accounted for 24% of the GDP, 32% of direct employment, and 41% of government revenue (National Bureau of Statistics, 2016; Shakeela and Weaver, 2018). Tourism in the Maldives initially developed in an unplanned laissez–faire manner (1972–1983) through the private sector (Bowen *et al.*, 2017). The Government who owns the land in the Maldives it opted to lease its islands for tourism resort development through a strict policy of enclave resorts (known as one island–one resort tourism (Bowen *et al.*, 2017)) on previously uninhabited islands (Buckley *et al.*, 2017). In 1983 there were 14 resort islands; in 2007 there were 89; and in 2015 there were 111 resorts in operation, with a joint capacity of 23,917 beds (Ministry of Tourism, 2015). These island resorts are autonomous units, totally self–contained, providing their own infrastructure; electric power, water supply, accommodation, restaurants, leisure facilities, sewage and solid waste disposal, plus housing

and other facilities for employees (Zubair *et al.*, 2011; Bowen *et al.*, 2017). However, a change in the nation's tourism master plan policy (in 2008) now permits "*guesthouse tourism*" on inhabited islands. This has enabled the construction of 9 hotels (1704 beds) and 220 guesthouses (3,209 beds), together with the use of 161 safari vessels (2739 beds). In 2015, a further 82 resorts and 7 hotels were under development, with additional capacity of 13,067 beds (Ministry of Tourism 2015; Buckley *et al.*, 2017). It is estimated this will enable 1.5 million tourists to stay each year (Ministry of Tourism, Arts & Culture, 2012; Bowen *et al.*, 2017).

These conflicting needs of houses and tourism have resulted in development of both new and improved infrastructures, buildings (hotels and houses), and services across many of the Maldives' islands to continuing at a pace. Therefore, in a place where the tourism product is sold as a luxury brand, it is essential that construction organisations proceed in a sustainable manner with the acknowledgement of 'the environment' as a stakeholder across the industry, to preserve the natural environment for residence and tourist alike (Hammond and Booth, 2010).

Data Collection

A subjectivism epistemology (i.e. reality is made from perception and actions), applying a deductive reasoning approach was applied to this study. Therefore, aligned to the study's aim, a quantitative cross-sectional questionnaire survey was adopted as the method of inquiry, enabling the capacity to collect a large amount of statistical data in a controlled setting with minimal influence by the researcher. The choice of this strategy was borne out of the need to capture both the benefits and the barriers of implementing EMSs in Maldivian construction organisations and accords with the approach used in similar studies by Shen and Tam (2002), Owolana and Booth (2016) and Bailey *et al.* (2020).

An exhaustive online search for construction organisations with company websites was utilised to identify organisations and individuals to invite to participate in the survey, as despite the creation of the Maldives Association of Construction Industry (MACI) founded 2001, the Association of Maldivian Engineers (AME) founded in 2008 and the Architects Association of Maldives (AAM) founded in 2017, currently there is no single public register listing construction companies within the country. Notwithstanding the limited size of the country and the construction sector across the Maldives, this search enabled 75 email invitations to be sent to a range of people holding a variety of construction roles across the sector (this included architects, surveyors, engineers, project managers and directors, amongst others). It is readily acknowledged this sample selection approach creates a bias towards those construction companies with an online presence. However, most companies who choose to engage with an EMS appear to have company websites. The email invitation to participants introduced the purpose of the study and a hyperlink to the questionnaire, available through the Bristol Online Survey (BOS) tool (now known as www.onlinesurveys.ac.uk).

The questionnaire survey consisted of four main sections: participant background information, benefits of an EMS, barriers of an EMS, and implementing an EMS. Section 1 was designed to capture the respondent's professional details and their construction industry experience; Section 2 listed nine factors used to determine apparent organisational advantages of having an EMS (derived from Table 1); Section 3 listed thirteen factors used to gauge perceived organisational challenges against having

an EMS (derived from Table 2); and Section 4 listed ten factors used to capture possible organisational implementation strategies for having an EMS (derived from Table 3). For sections 2–4, participants were asked to record their opinions for each factor on a five–point Likert–type scale (*1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree*) in a horizontal grid system stored as ordinal data.

Ethics and moral standards are integral to research studies. Therefore, all participants were informed their involvement was voluntary and their decision to return their questionnaire would be deemed as their consent to take part in the survey. As their responses would be anonymous, participants were also informed that there would be no opportunity to withdraw once the completed survey had been returned. The study was conducted in accordance with the ethics regulations at the University of the West of England (UWE), Bristol.

Data Analysis

The primary data was entered into Excel (2016 version) and analysed by using a descriptive statistical tool: the central tendency measure of weighted average, as previously employed in research studies (Shen and Tam, 2002; Owolana and Booth, 2016 and Bailey *et al.*, 2020). Additionally, the demographical information was analysed by means of frequency analysis to provide a snapshot of the respondents' characteristics.

The following weighted average formula was used to calculate the average score for each factor. Where: WAS_i denotes the weighted average score for each factor i , α_j denotes the numerical value for each ranking level in which 1 is allocated to the lowest rank and 5 is allocated to the highest rank, n_{ij} denotes the number of respondents for factor i with ranking level α_j and N denotes the total number of respondents for the question.

$$WAS_i = \frac{\sum_{j=1}^5 (\alpha_j n_{ij})}{N}$$

Equation 1 Formula for Weighted Average Score

Shen and Tam (2002) further suggested that an additional formulation was required to address the weakness of the Weight Average Score, which did not account for the degree of variation between the responses. Hence, a coefficient of variation was added to each of the Weighted Average Scores to compute the Benefit/Barrier Index Value (BIV), which determined the final rankings as shown in the formula below.

$$BIV_i = WAS_i + \frac{WAS_i}{\delta_i}$$

Equation 2 Formula for the Index Value

Where: BIV_i denotes the Index Value for each factor i and δ_i denotes the standard deviation for each factor i .

This method of analysing the questionnaire data is the same used in other built environment studies (e.g. Begum *et al.*, 2009; Ball and Booth, 2021) and other environmental management system studies (e.g. Olowana and Booth, 2016; Bailey *et al.*, 2020).

Results and Discussion

Following screening of the returned questionnaires and scrutiny for missing data, the final response rate yielded 41 complete surveys (54.7%). Although this may be considered a small number of respondents, the response rate (based a limited sample size) is better than those reported for similar online surveys from other developing countries. Findings from the analysis of these responses are presented and discussed under the four main sections: Demographics; Benefits of having an EMS; Barriers to having an EMS; and Implementation strategies for having an EMS.

Demographics

Most respondents to the survey were architects, directors and engineers (34.1%, 24.4% and 12.2%, respectively) based in consultant, design, contractor and sub-contractor construction firms. In terms of experience, most respondents (58.5%) had at least 5-years construction industry experience in the Maldives.

Benefits of having an Environmental Management Systems

The questionnaire listed nine factors considered to be advantages to organisations in the construction industry (Table 4). Analysis of the questionnaire responses (Table 5) have been used to list the beneficial factors of implementing an EMS in a ranked order of importance (Table 6; Figure 2).

Table 4: List of beneficial factors

Code	Benefit Factors
BF-a	Cost savings due to the reduction of fines associated with convictions
BF-b	Improving corporate image in environmental performances
BF-c	Contribution to the improvement of public environmental standards
BF-d	Contribution to environmental protection
BF-e	Increasing overall business competitiveness
BF-f	Reduction of environmental complaints
BF-g	Improving staff work environment, thus increasing their morale
BF-h	Reduction of environment-related sickness and injuries
BF-i	Reduction of environmental risks- polluted air, lands and water

Table 5: Survey responses and calculation of parameter values to beneficial factors

Code	SA	A	N	D	SD	Total	WAS	δ	BF-BIV	Rank
BF-a	3	22	12	4	0	41	3.59	0.76	8.28	8
BF-b	13	27	1	0	0	41	4.29	0.51	12.78	1
BF-c	21	15	4	1	0	41	4.37	0.76	10.13	3
BF-d	19	17	5	0	0	41	4.34	0.68	10.68	2
BF-e	6	22	12	1	0	41	3.80	0.71	9.19	6
BF-f	8	23	7	2	1	41	3.85	0.87	8.28	8

BF-g	10	22	6	3	0	41	3.95	0.82	8.74	7
BF-h	12	22	5	2	0	41	4.07	0.78	9.31	5
BF-i	21	14	4	2	0	41	4.32	0.84	9.46	4

Table 6: List of beneficial factors in ranked order

Rank	Code	Benefit Factors
1	BF-b	Improving corporate image in environmental performance
2	BF-d	Contribution to environmental protection
3	BF-c	Contribution to the improvement of public environmental standards
4	BF-i	Reduction of environmental risks– polluted air, lands and water
5	BF-h	Reduction of environment–related sickness and injuries
6	BF-e	Increasing overall business competitiveness
7	BF-g	Improving staff work environment, thus increasing their morale
8	BF-f	Reduction of environmental complaints
9	BF-a	Cost savings due to the reduction of fines associated with convictions

The results illustrate improving corporate image in environmental performance is perceived to be the most significant benefit in the adoption of EMS in construction practice within the Maldives. This is probably as a result of the competitive nature of the construction sector in area, which is comprised of mainly SMEs contending to gain a competitive advantage in the industry. A similar outcome was observed in a study conducted in China, to analyse the benefits of implementing the ISO 14000 standards. It was suggested that ISO certified organisations were likely to be regarded as more competent due to the international recognition of the standard; hence, improving the corporate image and credibility of the organisation (Tam, 2008). Likewise, even in developed countries, such as the Sweden and Hong Kong, the enhancement of corporate image was cited as a significant motive and benefit of adopting an EMS (Shen and Tam, 2002; Poksinska *et al.*, 2003; Horry *et al.*, 2022).

The contribution to environmental protection was perceived to be the second most significant benefit. This perception would link to the increased focus on environmental issues in Maldives in recent years, including achieving carbon neutrality by 2020 (UNFCCC and Ministry of Housing and Environment, 2010). Additionally, stakeholders are becoming more aware of the impact of construction activities on the environment, such as pollution of air and water resources, generation of substantial waste quantities and consumption of renewable and non–renewable energy sources and material (Zhang *et al.*, 2000). This result resonates with the findings in both Hong Kong (Shen and Tam, 2002) and Nigeria (Owolana and Booth, 2016), where contribution to environmental protection was identified as one of the most significant benefits of implementing an EMS in construction (Bailey *et al.*, 2020).

The research findings interesting cite cost savings due to the reduction of fines associated with convictions was deemed the least significant benefit. This is probably due to the absence until recently of any construction law in the Maldives, and hence, there have not been any legislative frameworks to regulate the industry. Thus, until now organisations have rarely been held accountable for the impacts of their construction activities. Similar to the situation in Nigeria, reported by Owolana and Booth (2016), where environmental management is not accounted for in the tendering requirements and construction procurement is largely aimed at securing the lowest bid. Hence, the participants are less likely to expect cost savings associated with environmental convictions.

The reduction of environmental complaints was found to be the next least significant benefit. This finding can also be seen to relate to the lack of government legislations and legal frameworks to govern the industry, limiting the avenues that could be used in raising environmental complaints by third parties. Additionally, the lack of legal frameworks in the country has contributed to the diminished transparency in dealing with environmental complaints that are lodged by concerned parties. Thus, this result signifies the importance of establishing open dialogue between the different levels of the government, as well as external stakeholders such as educational institutes, research bodies and the civil society (Du Plessis, 2007). The case study in Nigeria, also a developing country, shows similarities to the Maldives relating to the political sphere and corruptive practices, and a lack of concern for the implementation of standards and policies in environmental management (Owolana and Booth, 2016). However, if consideration is given to Hong Kong, a more developed country, the reduction of environmental complaints was ranked as a more significant beneficial factor, indicating the presence of appropriate channels for lodging complaints and raising concerns (Shen and Tam, 2002).

Barriers to having an Environmental Management Systems

The questionnaire listed thirteen factors considered to be challenges to organisations in the construction industry (Table 7). Analysis of the questionnaire responses (Table 8) have been used to list the barrier factors of implementing an EMS in a ranked order of importance (Table 9; Figure 3).

Table 7: List of barrier factors

Code	Strategy Factors
EB-a	Lack of government legal enforcement
EB-b	Increase in management and operation cost
EB-c	Lack of trained staff and expertise
EB-d	Lack of client support
EB-e	Lack of sub-contractor cooperation
EB-f	Lack of supplier cooperation
EB-g	Difficult coordination of environmental performance among multi-tier subcontractors
EB-h	Lack of working staff support
EB-i	Time consuming for improving environmental performance
EB-j	Change of existing practice of company structure and policy
EB-k	Increase in documentation workload
EB-l	Lack of tailor-made training on environmental management
EB-m	Lack of technological support within organisation

Table 8: Survey responses and calculation of parameter values to barrier factors

Code	SA	A	N	D	SD	Total	WAS	δ	EB-BIV	Rank
EB-a	23	13	3	1	1	41	4.37	0.90	9.19	1
EB-b	11	19	6	5	0	41	3.88	7.99	7.99	6
EB-c	15	17	5	4	0	41	4.05	8.38	8.38	3
EB-d	7	16	13	4	1	41	3.56	7.26	7.26	8
EB-e	5	18	5	12	1	41	3.34	6.39	6.39	12
EB-f	2	16	7	15	1	41	3.07	6.08	6.08	13
EB-g	6	22	9	3	1	41	3.71	7.87	7.87	7
EB-h	4	18	8	10	1	41	3.34	6.60	6.60	11
EB-i	8	18	7	6	2	41	3.59	6.83	6.83	9
EB-j	8	18	14	1	0	41	3.80	8.73	8.73	2

EB-k	6	14	15	4	2	41	3.44	6.83	6.83	9
EB-l	13	21	3	3	1	41	4.02	8.26	8.26	4
EB-m	17	15	4	5	0	41	4.07	8.16	8.16	5

Table 9: List of barrier factors in ranked order.

Rank	Code	Strategy Factors
1	EB-a	Lack of government legal enforcement
2	EB-j	Change of existing practice of company structure and policy
3	EB-c	Lack of trained staff and expertise
4	EB-l	Lack of tailor-made training on environmental management
5	EB-m	Lack of technological support within organisation
6	EB-b	Increase in management and operation cost
7	EB-g	Difficult coordination of environmental performance among multi-tier subcontractors
8	EB-d	Lack of client support
9	EB-i	Time consuming for improving environmental performance
9	EB-k	Increase in documentation workload
11	EB-h	Lack of working staff support
12	EB-e	Lack of sub-contractor cooperation
13	EB-f	Lack of supplier cooperation

The research findings reveal the most significant barrier to implementing an EMS in the Maldives is the lack legal enforcement. This result reflects the lack of a well-structured and effective legislative framework to regulate the construction industry, a case common to most developing countries (Hortensius and Barthel, 1997; Tam, 2008; Owolana and Booth, 2016).

The government could lead efforts to promote and encourage environmental management practices in the country, by improving the legal framework and developing the required infrastructure for formal environmental management practices within the industry. Additionally, financial incentive schemes administered by the government may trigger widespread adoption of EMSs in the country (Davy, 1997; Ofori *et al.*, 2002). However, Liyin *et al.*, (2006) remarked that government efforts alone would be insufficient to drive the environmental management agenda, unless organisations are internally motivated and committed to such practices. As noted in research from Hong Kong a lack of legal enforcement was perceived as one of the least significant barriers to the uptake of EMS in the construction sector. It was suggested that while organisations acknowledged the impacts of legislative measures, at the same time, regarded them as being excessive and overemphasised (Shen and Tam, 2002).

Changes of existing company structure, policy and the lack of trained staff and expertise were also found to be significant obstacles to the implementation of EMS in the Maldives. This finding signifies the reluctance of the industry to change their organisational structure, which stems from top management commitment to the subject. Shaheen and Charoenngnam (2004) suggests industry in the Maldives is still in its infancy in understanding the concept of sustainable construction, demonstrating similarities to a case study from Egypt (Sakr *et al.*, 2010) and so their hesitancy to restructure the organisational policies to include environmental management components is justifiable. However, top management commitment has proven to be a crucial factor in the implementation, as well as in the improvement of an EMS in an organisation (Ejdys *et al.*, 2016). Furthermore, the two aforementioned factors are closely related, as organisations often lacks the human resources required to restructure

organisational frameworks to accommodate environmental management measures; a challenge more likely to be encountered by SMEs (Hillary, 2004). Additionally, construction firms in the Maldives are primarily driven by short-term cost savings, similar to a case study in Hong Kong (Shen and Tam, 2002), and hence, are less likely to consider the potential benefits of investing in staff training or employing subject experts.

The research findings also indicate lack of supplier and sub-contractor cooperation were the least important barriers in the uptake of environmental management within the industry. This result is rooted in the fragmented nature of the relationship that exists between the supply chain and the construction organisations in the Maldives, the former is often perceived to be less influential than the latter. A similar outcome was observed in the study undertaken in Nigeria (Owolana and Booth, 2016) indicating that issues with the supply chain are typically considered to be minor barriers in developing countries. In contrast, a case study in Hong Kong revealed subcontractor cooperation was a major barrier, as main contractors were challenged with regulating the environmental performance of their supply chain (Shen and Tam, 2002).

Lack of support of working staff was also observed to be a less significant barrier to the adoption of EMSs in the Maldives. This is due to the top-down management approach that is still prevalent within construction organisations in the country, where working staff are designated their roles and responsibilities. This managerial style mirrors the traditional top-down approach used in environmental management, in which environmental policies are implemented and enforced through laws and fines (Barrow, 2005). Hence, the support of the working staff is expected, regardless of the organisations' decision to adopt environmental management practices.

Implementation strategies for having an Environmental Management Systems

The questionnaire listed ten factors considered to be organisational implementation strategies for an EMS in the construction industry (Table 10). Analysis of the questionnaire responses (Table 11) have been used to list the strategy factors of implementing an EMS in a ranked order of importance (Table 12; Figure 4).

Table 10: List of strategy factors

Code	Strategy Factors
EM-a	Legal requirements on environmental protection
EM-b	Reduction, reuse and recycling of construction and demolition wastes
EM-c	Imposing responsibilities of protecting environment on managerial staff
EM-d	Applying environmentally friendly technology on site
EM-e	Providing in-house training on environmental management
EM-f	Establishing waste management plan
EM-g	Continuous efforts in improving environmental management
EM-h	Inclusion of environmental management in tendering requirements
EM-i	Effective communication of environmental issues between all layers of subcontractors

EM-j	Close supervision at site level
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Table 11: Survey responses and calculation of parameter values to strategy factors

Code	SA	A	N	D	SD	Total	WAS	δ	EM-BIV	Rank
EM-a	26	11	4	0	0	41	4.54	0.67	11.35	2
EM-b	19	16	2	2	2	41	4.17	1.06	8.12	9
EM-c	15	19	6	1	0	41	4.17	0.76	9.64	6
EM-d	14	22	3	2	0	41	4.17	0.76	9.64	6
EM-e	13	24	2	2	0	41	4.17	0.73	9.89	5
EM-f	24	14	3	0	0	41	4.51	0.63	11.68	1
EM-g	22	17	0	2	0	41	4.44	0.73	10.49	3
EM-h	23	12	5	1	0	41	4.39	0.79	9.93	4
EM-i	14	18	6	2	0	41	4.10	0.83	9.04	8
EM-j	16	20	2	3	0	41	4.20	0.83	9.23	7

Table 12: List of strategy factors in ranked order.

Rank	Code	Strategy Factors
1	EM-f	Establishing waste management plan
2	EM-a	Legal requirements on environmental protection
3	EM-g	Continuous efforts in improving environmental management
4	EM-h	Inclusion of environmental management in tendering requirements
5	EM-e	Providing in-house training on environmental management
6	EM-c	Imposing responsibilities of protecting environment on managerial staff
6	EM-d	Applying environmentally friendly technology on site
8	EM-j	Close supervision at site level
9	EM-i	Effective communication of environmental issues between all layers of subcontractors
10	EM-b	Reduction, reuse and recycling of construction and demolition wastes

The findings of this study demonstrate establishing a waste management plan is considered as the most significant strategy towards implementing environmental management in the Maldivian construction sector. This is probably because construction and demolition waste accounts for nearly 30% of total waste generated within the country, a figure comparable to many developed nations (Tam, 2008; Pucino, 2016). Thus, effective waste management is increasingly recognised as a critical aspect of construction project management, as most of the construction waste tends to end up in landfills, which subsequently results in pollution of the biosphere (Tam, 2008; Alwan *et al.*, 2017). In the Maldives, until recently, the entire island of Thilafushi was used as a waste disposal site on which untreated waste was burnt and construction debris was used to infill the lagoon (Medina, 2012; Hassan and Peterson, 2016). This type of activity will negatively impact on the tourism industry therefore, it is essential that the construction sector establish suitable waste management plans. This will encourage the implementation of environmental management systems in the construction industry, as studies in Latvia and Nigeria have illustrated that EMS' can drastically improve waste management efforts on construction sites (Tambovceva and Geipele, 2011; Owolana and Booth, 2016). Additionally, Rodríguez *et al.* (2011) pointed that construction and demolition waste is generally not included in technical specifications and is not budgeted for; hence, the implementation of an EMS would result in significant savings as shown in a study on the mining industry in Ghana (Fei-Baffoe *et al.*, 2013).

Legal requirements on environmental protection were also identified as a critical strategy that can be employed in driving environmental management efforts in the Maldives. This outcome is reasonable, as the lack of government legislation was perceived to be the most significant barrier to environmental management, a typical situation in developing countries (Owolana and Booth, 2016). Barrow (2005) stated that developing countries with limited financial resources, such as the Maldives, are more likely to implement environmental management standards to satisfy aid donors or conform to legal regulations.

The study outcomes illustrate that the reduce–reuse–recycle strategy of construction and demolition waste was perceived to be less relevant in strategic terms for promoting the uptake of EMSs in construction organisations. This is linked to the absence of a formal recycling agenda administered by the government, as well as levels of awareness among the general public on the reduce–reuse–recycle strategy (Pucino, 2016). Recycling is a challenge due to the limited technological resources and infrastructure in the country, similar to the circumstances present in Nigeria (Owolana and Booth, 2016).

Effective communication of environmental issues between all layers of subcontractors was regarded as a less significant strategy by construction professionals in the Maldives. This outcome is associated with the fragmented nature of the construction industry in the Maldives, in which the subcontractors wield less influence over the main contractors and designers. Moreover, the construction industry in the country is still characterised by hostile relationships between main contractors and the supply chain. Hence, communication efforts between the subcontractors would be less effective, than strengthening the influence of the main contractors in the industry.

Conclusions

This study makes a distinct contribution to knowledge by responding to a research gap at the interface of environmental management systems and the Maldivian construction sector. It provides an insight into the uptake of EMS within the industry in the Maldives and discusses the benefits and barriers to implementing EMS as perceived by the industry stakeholders.

The findings of the study reveal that the main motivation for construction organisations in Maldives to adopt environmental management standards is to strengthen their corporate image and increase their competitiveness in the market. A formal environmental management certification, such as the ISO 14001, is perceived to be linked to the credibility of the organisation. Further, industry professionals believe environmental management systems would contribute positively to the protection of natural

environment– a perception which stems from the increasing awareness on environmental issues in Maldives in recent years.

The main barrier to the uptake of EMSs in the Maldivian construction industry was identified as the lack of government legal enforcement. Without a legislative framework to regulate the industry, organisations were less likely to adopt environmental management standards voluntarily. Hence, it signifies that government–led efforts to encourage environmental management practices and to introduce financial incentives are critical in the context of the Maldivian construction industry. The change of existing company structure and lack of trained staff and expertise were also recognised as significant obstacles, likely due to the associated cost implications and human resource limitations.

The research results also indicated the significance of establishing a waste management plan to drive the environmental management agenda in the Maldives. Construction waste is generally not accounted for in technical specifications of projects; hence organisations would be more likely to opt for waste management options incurring the least expense, not necessarily the most effective. The results also highlighted the need for legal requirements on environmental protection, which reflects the perception that the lack of legal enforcement is the key barrier to the adoption of EMSs in Maldives.

This research study has provided an insight into the construction industry of the Maldives, with regards to environmental management practices. While the number of responses was only 41 this is considered sufficient in comparison to other similar studies within developing nations. A limitation of the research is that it does not identify the opportunities for improvement in the situation from the perspective of this group of professionals. However, what it does provide are the primary benefits, perceived to be the key drivers in stimulating environmental management in construction organisations. It has also emphasised the barriers, which must be addressed both by the government, as well as by the industry stakeholders, to improve the environmental impacts due to construction activities in the Maldives. Lastly, the research has been crucial to the formulation of strategies that could be implemented to enhance the adoption of EMSs in construction practice.

Based on the conclusions it is proposed that:

1. Environmental managers, or those managers with any environmental responsibility, need to be more active in promoting the principles of environmental management and increasing awareness of sustainable practices and behaviours amongst construction industry stakeholders.
2. Due to the nature of the construction industry in the Maldives in that it is top–down in nature, education of the top–management about the environment is crucial to ensuring real commitment at managerial level to addressing environmental issues in the Maldivian construction sector. Research is needed in this area, to gain an understanding of their perspectives.
3. Environmental Managers within construction organisations also have a responsibility to ensure necessary guidelines and practical benchmarks are incorporated into any formal EMS, and they should encourage continuous monitoring of the system for maximum effectiveness. Environmental Managers should also play a key role in lobbying for legislative standards for environmental performance within the industry.

4. Policymakers hold a moral obligation to the public, to ensure that they are protected from the harmful impacts of economic activities such as construction. In the case of the Maldives, policymakers are critical to ensuring construction organisations conform to environmental standards. Thus, creating legislation and setting up enforcement structures are primary responsibilities of Policymakers. Research into the views of policy makers would encourage this process.

5. Research into the viability of establishing financial incentive schemes, particularly for SMEs to encourage wider adoption of EMSs within the industry, is needed.

6. Future research should also focus on studying the relationship between waste management, which emerged as the top issue, and the reduction, reuse and recycling of construction waste, which was ranked as the least effective. This would permit an understanding of how best the reduce–reuse–recycle strategy can be incorporated into waste management plans of Maldivian construction organisations.

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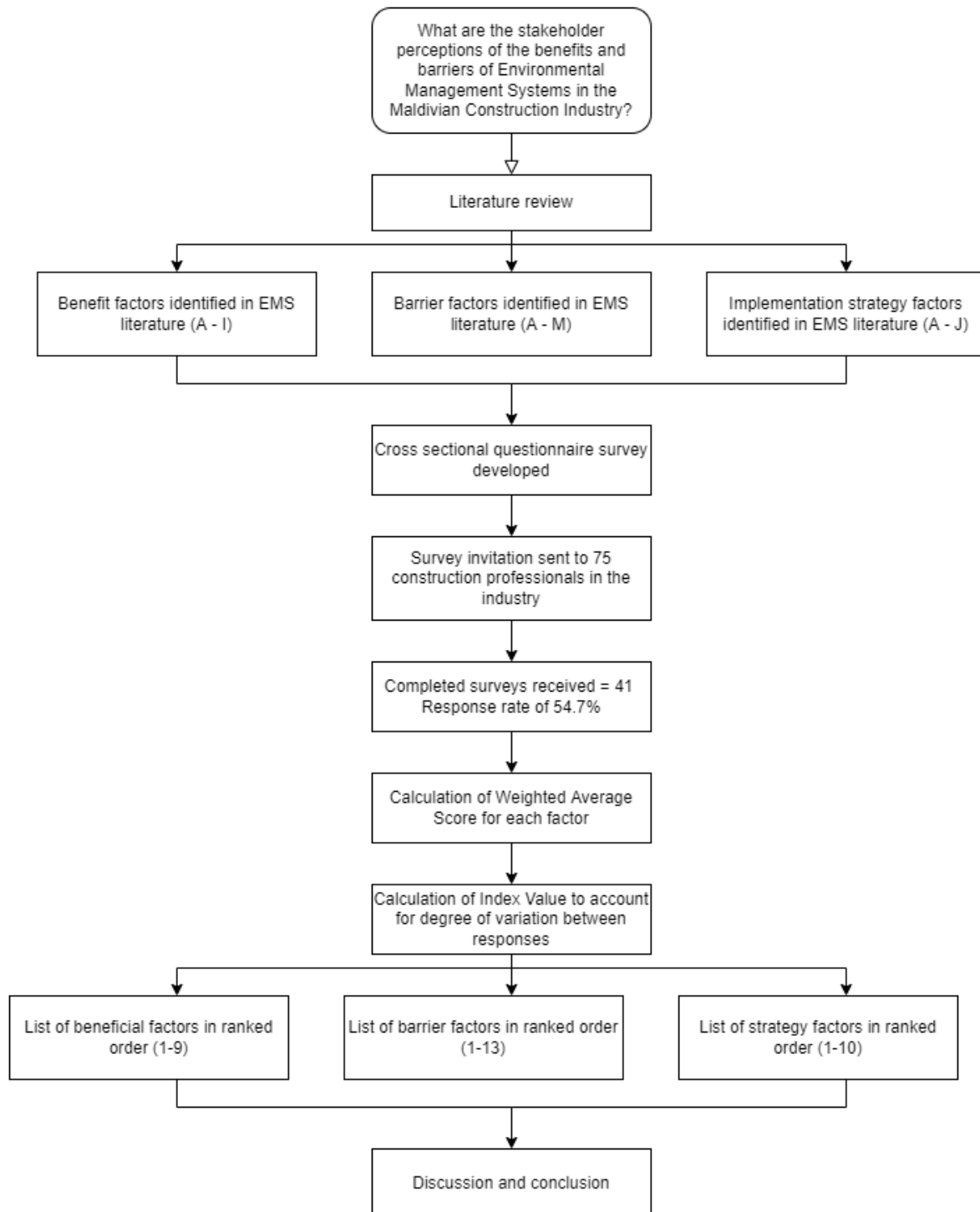


Figure 1: Illustrative flowchart to describe the methodological steps of the study

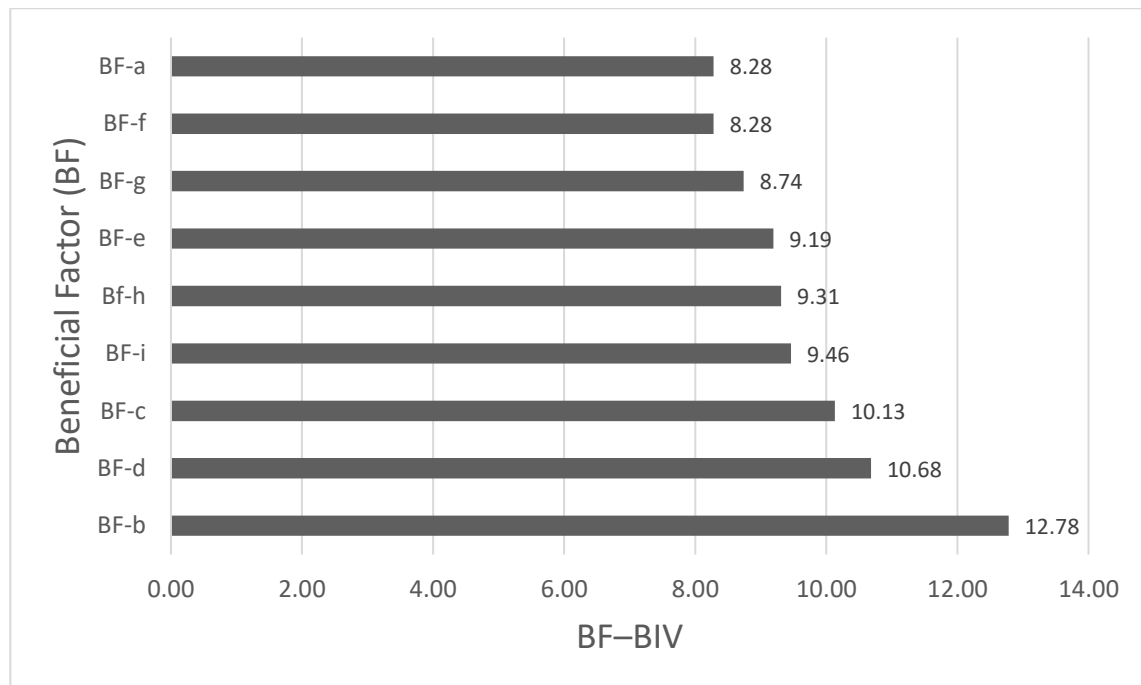


Figure 2: Ranking profile of beneficial factors to the implementation of EMS

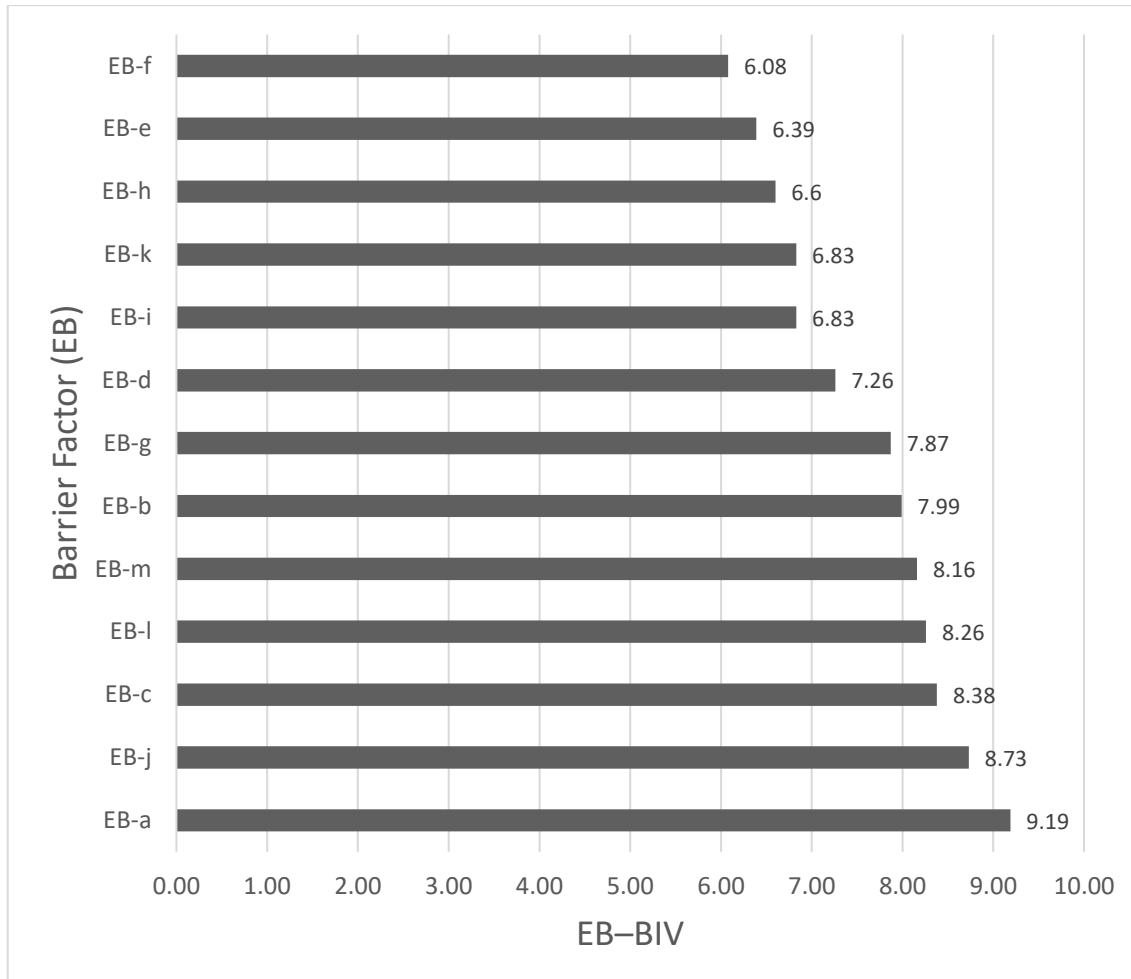


Figure 3: Ranking profile of barrier factors to the implementation of EMS

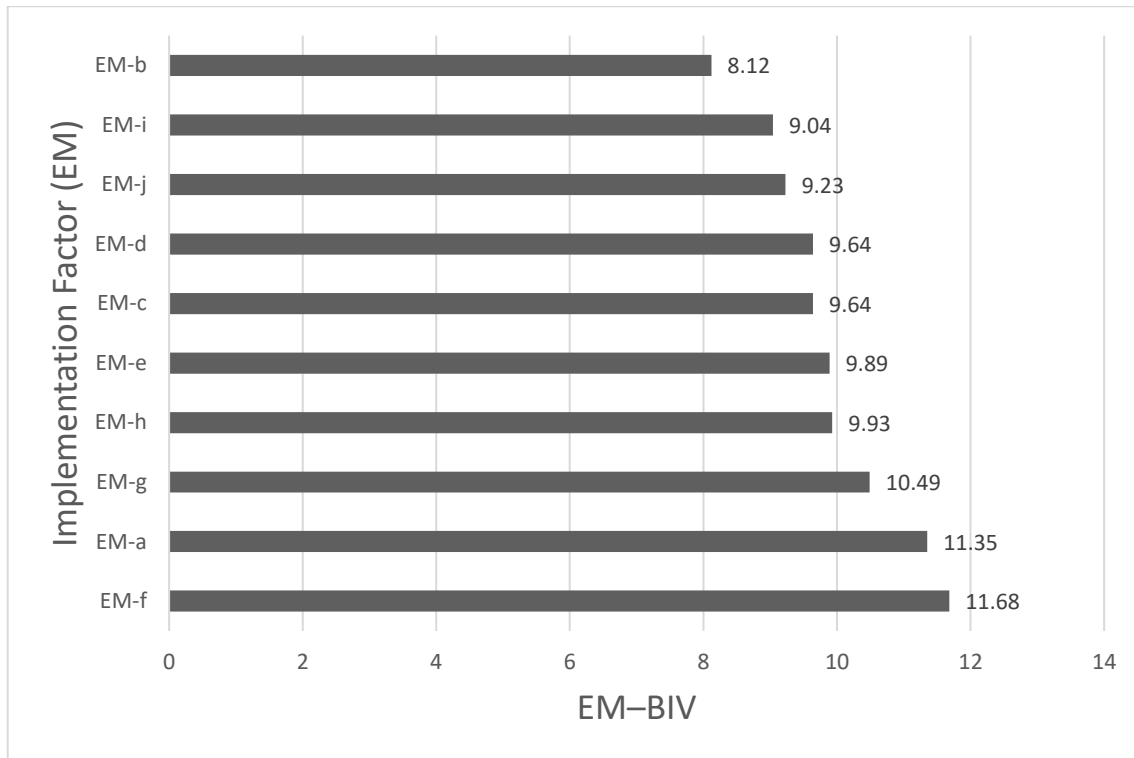


Figure 4: Ranking profile of implementation measures to EMS

Notation

BIV _i	benefit/barrier index value for each statement i
j	numerical value for each ranking level, in which 1 is allocated to the lowest rank and 5 is allocated to the highest rank
N	total number of respondents for the question
n _{ij}	number of respondents for statement i with ranking level j
WAS _i	weighted average score for each statement i
δ _i	standard deviation for each statement i

Glossary

AAM	Architects Association of Maldives
AME	Association of Maldivian Engineers
BOS	Bristol Online Survey
EIA	Environmental impact assessment
EMS	Environmental Management System
GDP	Gross Domestic Product
GHG	Greenhouse Gases
ISO	International Standards Organisation
SDG	Sustainable Development Goals
SME	Small and Medium sized Enterprise
MACI	Maldives Association of Construction Industry
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UWE	University of the West of England

Article 7 (Journal Paper): Beck-Schildt, J.C., Booth, C.A., Horry, R.E. and Wiejak-Roy, G. (2023) Stakeholder opinions of implementing environmental management systems in the construction sector of the USA. *Buildings*. 13, pp. 1241.

Abstract: Environmental concerns over the effects of construction sector activities necessitate meaningful measures to be taken. Despite worldwide increases in the uptake of environmental management systems (EMS), implementation of EMS across the construction sector of the U.S. remains slow. To date, stakeholder opinions about the uptake of EMS in the construction sector of the U.S. remain unexplored. The purpose of this study is to investigate the views of U.S. stakeholders towards the benefits and barriers of implementing EMS, and how these compare internationally. Underpinned by a positivism philosophy, an online questionnaire survey was used to collect the views of construction professionals (n = 50). Weighted average analysis scores reveal that the benefits of EMS are seen to improve the public perception and credibility of an organization/company and reduce waste levels and are a tool to improve the environmental standards of the U.S.'s construction sector; in contrast, the barriers of EMS are an absence of sub-contractor cooperation and resistance to change in existing company structure and policy, plus the requirement for additional employee training. The potential impact of this work demonstrates not only the role that the U.S. construction sector can play in advancing environmental and sustainability matters using EMS but also the obstacles that need to be addressed to enable their success. Understanding these benefits and barriers at an organizational level could enable them to devise more effective business strategies/policies, where evidence-based practices could be used to support EMS implementation.

Keywords: environmental sustainability; environmental impact; EMAS; ISO 14001

1. Introduction

The growing global population brings about an increased requirement for construction not only for new homes but also for the infrastructure needed to accommodate the increased population. Concomitantly, this causes both direct and indirect impacts on the environment. The increased construction requirement places demand on the natural environment both in terms of resources and land to accommodate this requirement. The construction sector is one of the largest users of energy, non-renewable resources and water [Error! Reference source not found.]. It uses a variety of materials that have potential to contaminate water supplies, land and the atmosphere [Error! Reference source not found.]. Further, it must not be forgotten that there are substantial amounts of both waste and pollution resulting from construction and demolition projects [Error! Reference source not found., Error! Reference source not found.].

It is not, however, just the direct effects of construction that are causing concern but also the indirect effects, because the occupation and use of buildings after construction have environmental impacts too. Carbon dioxide emissions from the operation of buildings and the construction sector are estimated to contribute 36% of the total global amount; within this, 10% is classed as embodied carbon from construction [Error! Reference source not found.]. Thus, the impacts from the construction sector are significant.

The construction sector has many unique characteristics and complex challenges to consider. These include safety, a contractual workforce and the necessity to balance time, cost, quality and efficiency [Error! Reference source not found.]. Therefore, a multifaceted approach is required to enable this sector to become environmentally sustainable [Error! Reference source not found.]. The integration of sustainable development concepts to reduce the environmental impact of construction has prompted a host of sustainable building practices and management tools [Error! Reference source not found.], such as Leadership in Energy and Environmental Design (LEED) or the Building Research Establishment Environmental Assessment Method (BREEAM).

Environmental management systems (EMS), such as EMAS and ISO 14001, are widely used across many industries and sectors to aid organizations in minimizing their environmental impact, enabling companies to manage their operations and improving their environmental policies, objectives and plans [Error! Reference source not found.,Error! Reference source not found.]. An EMS also enables organizations to ensure their continuing compliance with legislation by identifying, managing, monitoring and regularly reviewing the environmental aspects of their operations [Error! Reference source not found.].

Studies have shown EMS uptake worldwide is substantial, and it has been consistently increasing across the Asian and European construction sectors [8–10]. In contrast, the uptake of EMS by the construction sector of the U.S. has been slow. Furthermore, unlike other nations (such as China, Australia, Italy and the UK) where investigations have been conducted to understand the reasoning for and against the uptake of EMS, there is an absence of reporting about this issue for the U.S. construction sector and, therefore, a research gap exists. As a consequence, the aim of this study is to investigate the views of U.S. construction professionals towards the benefits and barriers for implementing EMS in the U.S. and to reveal how these compare with the views of construction stakeholders from other nations.

1.1. Background

Historically, in the U.S., there was notable activity and interest in environmental protection, resulting in the creation of the National Environmental Policy Act in 1969 [Error! Reference source not found.]. This legislation encouraged businesses to protect the environment. Later, there was growing recognition of the benefits of reducing environmental impacts not only to comply with regulatory pressures and costs associated with those regulations but also as a response to stakeholder concerns [Error! Reference source not found.,Error! Reference source not found.]. In response to this, there was increasing adoption of environmental management tools, such as ways to reduce pollutants during the design phase of construction and environmental auditing programs [Error! Reference source not found.]. Similarities were noted in the various environmental management practices, and companies began integrating these into management systems [Error! Reference source not found.,Error! Reference source not found.]. These early EMS were independently designed in house, which meant comparisons between companies was challenging not only within sectors but internationally too [Error! Reference source not found.]. To ensure reductions in cost and removal of trade barriers, there was a need for a standardized approach [Error! Reference source not found.]. The need for better environmental management and creation of a standardized approach was also supported at the 1992 Earth Summit in Rio de Janeiro, where professional bodies, governments and international organizations highlighted the issues and put forward guidelines [Error! Reference source not found.,Error! Reference source not found.].

Nowadays, the two most used systems employed globally throughout a multitude of sectors are the Eco-Management and Audit Scheme (EMAS), which is a European standard, and ISO 14001, which is an international standard [Error! Reference source not found.]. The latter, ISO 14001, is the commonly used EMS adopted across industries and sectors of the U.S.

1.2. Benefits of the Implementation of EMS in the Construction Sector

There are a variety of reasons that may encourage an organization to adopt an EMS. The main benefit for many is improved corporate image [Error! Reference source not found.], with companies believing that an EMS can strengthen their image, thereby increasing their competitiveness [Error! Reference source not found.]. The use of an EMS could provide a competitive advantage in the ‘green’ market [Error! Reference source not found.]. Previous studies note that growing awareness of the environmental impacts and improved environmental performance of construction are the major benefits, with enhanced corporate image also being noted [Error! Reference source not found.–Error! Reference source not found.].

Previous studies note that contractors were not only looking to improve their image but also to reduce costs via waste reduction within their EMS [Error! Reference source not found.]. This supports past observations [Error! Reference source not found.] that while corporate image was the major advantage within the company

surveyed, to improve that image, specific actions were taken to not only promote safe working environments but to comply with government regulations to implement clean product practices and also to reduce waste. The implementation of ISO 14001 helps to reduce costs through actions such as waste reduction, which will also improve employee safety and reduce insurance premiums [Error! Reference source not found.].

1.3. Barriers to the Implementation of EMS in the Construction Sector

Consideration cannot be given just to the benefits of ISO 14001. It must be noted that there will also be barriers to adoption. The most reported barrier is that of the costs linked to EMS implementation, especially in the short term [Error! Reference source not found.]. This is further supported by several studies that observed that an increase in management and operation costs are significant obstacles to EMS implementation [Error! Reference source not found.,Error! Reference source not found.–Error! Reference source not found.]. Other studies have noted obstacles such as a lack of trained staff and systems expertise, inadequate knowledge of the benefits of EMS in construction and an absence of government pressure [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]. However, some researchers [Error! Reference source not found.,Error! Reference source not found.] argue that increased management support could resolve these issues in conjunction with the certification benefits. One vital point to remember, however, is that ISO 14001 does not guarantee an improved environmental performance [Error! Reference source not found.].

1.4. Worldwide Implementation of EMS in the Construction Sector

Studies in a global context have been conducted in various countries to assess regional differences in relation to the benefits and barriers to EMS implementation within the construction sector (Table 1). Surveys within Asian operations established major barriers including increased management costs, absence of trained staff and expertise, lack of sub-contractor cooperation and insufficient client support [9,Error! Reference source not found.,Error! Reference source not found.]. The local business culture of focusing on short-term results is a common factor contributing to these obstacles [9]. The significant benefits noted include contributions to environmental protection and improved environmental corporate image [9,Error! Reference source not found.]. It has also been noted that there has been a recent increase in certification within Asia [Error! Reference source not found.]. When this is compared to similar studies within the African construction sector, the benefits and barriers cited were only marginally different. In these studies, technological advancement, infrastructure and management culture were more likely to influence the reasons for engaging with an EMS [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]. Furthermore, cost and environmental protection were reported to be key [Error! Reference source not found.]. Additional examples of regional differences include improvements in waste management, a lack of technical, government and legislative support of organizations and a lack of awareness of EMS [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]. Globally cited benefits are found in Table 1.

Table 1. Recognized benefits of implementing EMS in the construction sector.

Benefits	References
Improved corporate image	[Error! Reference source not found.,Error! Reference source not found.,9,Error! Reference source not found.,Error! Reference source not found.–

[illegible]

	not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.] [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.] [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]
Improved project quality and value	[Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.] [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]
Improved health, safety and welfare of staff	[Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.] [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]
Reduced environmental complaints from clients	[Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.] [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]
Improved relationships with stakeholders	[Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.] [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]
Improved work environment with increased training and development opportunities	[Error! Reference source not found.,9,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]

[illegible]

In Europe, the focus is firmly on the contribution to environmental protection [Error! Reference source not found.]. Surveys, however, from the perspectives of construction companies in Germany, the UK, Finland and Portugal found that the main benefits included a reduction of environmental-related sickness and reduction of waste production along with the levels of existing waste [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]. The barriers noted in Europe are the requirements to undertake training, a lack of senior management commitment and an increase in EMS documentation [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]. Globally cited barriers are found in Table 2.

Table 2. Recognized barriers of implementing EMS in the construction sector.

Barriers	References
Cost benefit	[Error! Reference source not found., Error! Reference source not found., Error! Reference source not found., Error! Reference source not found.]

	found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.] [Error! Reference source not found.,9,Error! Reference source not found.,Error! Reference source not found.–Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.] [9,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.] [Error! Reference source not found.,9,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.] [9,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.] [Error! Reference source not found.,9,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]
Low employee support	
Lack of client support	
Lack of sub-contractor cooperation	
Lack of internal technical support	
Employee training requirements	

	found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]
Human resource availability	[Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]
Change in practices of company structure and policy	[9,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]
Lack of legal enforcement	[Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]
Lack of concern for the environment	[Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]
Lack of senior management commitment	[9,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]
Increasing management and operation costs	[Error! Reference source not found.,9,Error! Reference source not

found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]

1.5. Prevalence of EMS in the Construction Sector of the U.S.

While there appears to be interest in the use of EMS within the U.S. [Error! Reference source not found.], particularly in organizations at a federal level, such as the U.S. Environmental Protection Agency and the U.S. Department of Energy, the uptake in the construction sector appears to be slow. In the U.S. manufacturing sector, there seems to be more engagement, possibly due to past environmental concerns [Error! Reference source not found.]. However, industrial and manufacturing companies find cost, uncertainty of benefits and additional training to be the main barriers to EMS implementation [Error! Reference source not found.]. The main benefits noted are a reduction of solid waste as a result of improved awareness and increased monitoring, measuring and reporting [Error! Reference source not found.]. Due to some of the similarities between manufacturing and construction, these could also be seen as being relevant to the construction sector. Further, in a case study of the firm 'Beers Skanska' [Error! Reference source not found.], it has been noted that their EMS provided benefits of cost savings, improved environmental performance and competitive advantage. The same study also suggested that these benefits outweighed the barriers of auditing and consistent implementation at operating sites and the challenges of monitoring environmental performance [Error! Reference source not found.]. To date, there is a scarcity of studies that have focused on EMS in the U.S. Therefore, it is still unclear why there is a general lack of EMS uptake within the U.S. construction sector.

2. Research Design and Methodology

This study takes a positivist approach to gain an objective understanding [Error! Reference source not found.] on the assumption that knowledge is best understood through both objective observation and reason [Error! Reference source not found.]. Given the adopted philosophy, a quantitative cross-sectional online questionnaire survey was designed to collect a large amount of data in a controlled setting with minimal influence by the researcher. The choice of this strategy was borne out of the need to capture both the benefits and the barriers of implementing EMS in construction organizations, in line with previous studies [9,Error! Reference source not found.,Error! Reference source not found.].

2.1. Data Collection

The questionnaire design of exploring the opinions of construction professionals towards the benefits and barriers of implementing EMS in the construction sector of the U.S. was adapted from similar studies [9,22,43]. A pilot survey (n = 8) was conducted to validate the draft questions [Error! Reference source not found.] that helped improve the wording, layout and design. The final questionnaire comprised four sections: personal profile, company profile, benefits to EMS implementation and barriers to EMS implementation. Participants were requested to answer each question before progressing to the next. The personal profile (Q1–6) included participants' demographic information, including job title, education level, state, membership of any professional body(s) and years of experience both within construction and environmental sustainability. The company profile (Q7–10) gathered data on the companies' demographics, such as the company size, the project locations and whether that company had an EMS in place. The questions regarding benefits of EMS implementation (Q11–24) focused on perceived advantages to EMS implementation, including 14 statements relating to previously identified benefits. The questions regarding barriers to EMS implementation (Q25–40) examined perceived disadvantages to implementation and consisted of 16 statements relating to previously identified barriers. The last two sections both used a five-point Likert scale. The participants were also invited to provide qualitative comments. The questionnaire survey was then shared with participants via the online Qualtrics XM platform.

A purposive sampling strategy was employed. Before answering questions, all participants were asked to confirm they were over the age of 18 years and currently employed in the construction sector with a minimum of three years of experience and have been involved in environmental- and/or sustainability-related construction projects. All invitations were sent out to publicly available email addresses accessed through website searches of U.S. construction professional bodies, whose geographical coverage spread over the four main regions of the continental U.S. (i.e., west, midwest, northeast and south).

2.2. Data Analysis

All primary data collected were entered into Microsoft Excel (2019 version) for statistical analysis. Demographic information was analyzed by means of frequency analysis to provide a snapshot of the participant characteristics. As with many other construction [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.] and built environment [Error! Reference source not found.–Error! Reference source not found.] studies that have scrutinized questionnaire data, a weighted average method was used to analyze the data.

The following weighted average formula was used to calculate the average score for each factor (Equation (1)), where WAS_i denotes the weighted average score for each factor *i*, α_j denotes the numerical value for each ranking level in which 1 is allocated to the lowest rank and 5 is allocated to the highest rank, n_{ij} denotes the number of participants for factor *i* with ranking level α_j and *N* denotes the total number of participants for the question.

$$WAS_i = \frac{\sum_{j=1}^5 (\alpha_j n_{ij})}{N} \quad (1)$$

An additional formula was used to address the weakness of the weight average score, which did not account for the degree of variation between the responses. Hence, a coefficient of variation was added to each of the weighted average scores to compute the Benefit/Barrier Index Value (BIV) (Equation (2)), which determined the final rankings, where BIV_i denotes the Benefit/Barrier Index Value for each factor i and δ_i denotes the standard deviation for each factor i .

$$BIV_i = WAS_i + \frac{WAS_i}{\delta_i} \quad (2)$$

Prior to commencing the data collection, ethical approval was sought. Once gained, approval meant all participants were informed in an information cover page that their consent to be involvement in the study was entirely voluntary. Further, since the data collected would be anonymous, at the end of the questionnaire, all participants were invited to create their own unique identification code that they could later quote in an email if they decided to withdraw their data responses within a two-week window from the date of their involvement. This procedure is compliant with the expectations of university research ethics regulations in the UK.

3. Results

This section is separated under three main headings: (i) Participants and their Companies; (ii) Benefits to Implementing an EMS; and (iii) Barriers to Implementing an EMS.

3.1. Participants and their Companies

Following the screening of returned questionnaires and scrutiny for missing data, the data collection exercise yielded 47 fully completed surveys. Given the size of the U.S. construction sector, this may be considered a somewhat modest number of participants to proceed. However, the precedent of similar studies can be used to determine an acceptable sample size [Error! Reference source not found.]. A similar EMS study in the Nigerian construction sector received 40 completed responses [Error! Reference source not found.], while another EMS study investigating the UK construction sector received 49 completed responses [Error! Reference source not found.]. As these are comparable to the sample size of this study, 47 responses are considered adequate.

The demographics of the participants were assessed in relation to education, years of experience, membership of a professional body, job level and years of experience in environmental/sustainability projects. This enabled support for the findings' relevance [Error! Reference source not found.]. Almost all participants were university educated, with almost one-third of participants (30%) holding postgraduate qualifications. In terms of job level, 57% reported to be in management-level positions, with the remainder being in associate or mid to senior level positions. Importantly, all participants confirmed they were over the age of 18 years and currently employed in the construction sector with a minimum of three years of experience (including 30% with >10 years) and have been involved in environmental- and/or sustainability-related construction projects.

Information was collected about the organizations where the participants are employed. Almost two-thirds of participants' companies reported to have a current and operational EMS in place. The workplaces of most of the participants were small- and medium-sized businesses (SMBs) as defined by the U.S. Census Bureau as having under 500 employees [Error! Reference source not found.]. Large businesses employed only 21% of participants compared to the 79% of those whom SMBs employed. The U.S. Census Bureau notes that most of the U.S. construction sector is made up of SMBs, therefore, the survey data align to this demographic [Error! Reference source not found.].

In respect of the type of work undertaken by the participants' companies, 34% and 15% of participants identified their company as only involved in constructing buildings or only as specialized trade contractors, respectively. Twenty-one percent of participants identified their company as working in 'other' areas of construction. The participants listed various areas, including, but not limited to, construction management, consulting, engineering and surveying. The category of 'other' was used by the remainder of the participants.

One identified that their company builds healthcare facilities and another specified that their company was a specialty trade contractor working in flooring. The remaining 30% of participants identified their company as performing multiple types of construction work, such as heavy and civil engineering, environmental services, wetland delineation and construction of buildings.

3.2. Benefits to Implementing an Environmental Management System

The questionnaire listed fourteen factors considered to be advantages to organizations in the construction sector (Table 3). Analysis of the questionnaire responses (Table 4) has been used to rank the beneficial factors of implementing an EMS (Table 5; Figure 1).

Table 4 provides details of the responses to the benefits section of the questionnaire survey. It also provides the results of the calculations for Equations (1) and (2) to determine the ASS, BIV and, therefore, the highest and lowest ranking of factors.

Table 3. List of beneficial factors used in the questionnaire.

Code	Beneficial Factors
BENa	Reduces environmental impacts (air pollution, land and water)
BENb	Improves environmental performance of a company
BENc	Increases energy savings
BENd	Reduces environmental complaints from clients
BENe	Contributes to the environmental standards of the construction industry
BENf	Reduces waste levels
BENg	Reduces costs
BENh	Increases a company's competitiveness
BENi	Improves finished project quality and value
BENj	Improves corporate image and credibility
BENk	Improves relationships with stakeholders, clients and regulators
BENl	Improves worker's health, safety and welfare
BENm	Relieves environmental regulation and policy burden
BENn	Improves employee work environment by providing training and development opportunities

Table 4. Questionnaire responses and calculation of parameter values for the benefit factors.

Factor	SA	SWA	N	SWD	SD	Total	ASS	ASS Rank	BIV	BIV Rank
BENa	18	19	6	3	1	47	4.06	4	8.23	6
BENb	17	21	7	1	1	47	4.11	3	8.77	4
BENc	12	21	12	1	1	47	3.89	7	8.31	5
BENd	10	18	16	2	1	47	3.72	10	7.79	9
BENe	18	19	9	1	0	47	4.15	2	9.35	1
BENf	17	16	13	1	0	47	4.04	5	8.80	3
BENg	10	11	15	7	4	47	3.34	13	6.11	14
BENh	10	17	14	4	2	47	3.62	11	7.09	12
BENi	11	19	15	1	1	47	3.81	9	8.08	7
BENj	20	18	7	2	0	47	4.19	1	9.17	2
BENk	14	17	10	6	0	47	3.83	8	7.67	10

BENI	20	11	14	1	1	47	4.02	6	8.04	8
BENm	7	16	14	6	4	47	3.34	13	6.28	13
BENn	9	16	17	4	1	47	3.60	12	7.34	11

Table 5. List of beneficial factors in ranked order.

Rank	Code	Beneficial Factors
1	BENe	Contributes to the environmental standards of the construction industry
2	BENj	Improves corporate image and credibility
3	BENf	Reduces waste levels
4	BENb	Improves environmental performance of a company
5	BENc	Increases energy savings
6	BENa	Reduces environmental impacts (air, land and water pollution)
7	BENi	Improves finished project quality and value
8	BENl	Improves worker's health, safety and welfare
9	BENd	Reduces environmental complaints from clients
10	BENk	Improves relationships with stakeholders, clients and regulators
11	BENn	Improves employee work environment by providing training and development opportunities
12	BENh	Increases a company's competitiveness
13	BENm	Relieves environmental regulation and policy burden
14	BENg	Reduces costs

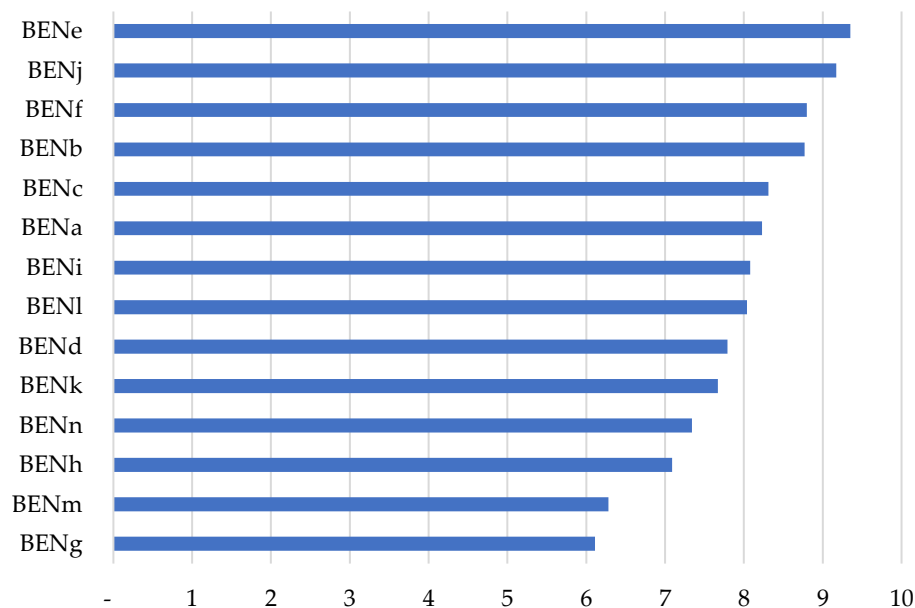


Figure 1. BIV ranking profile of the beneficial factors (BEN).

Participants were asked to rank each of the benefits using a Likert scale: 'Strongly Agree' (SA), 'Somewhat Agree' (SWA), 'Neither Agree nor Disagree' (N), 'Somewhat Disagree' (SWD) or 'Strongly Disagree' (SD). In the survey, the vast majority (79%) of participants noted either 'Strongly Agree' or 'Somewhat Agree' with BENa (Reduces environmental impacts (air pollution, land and water)) and BENe (Contributes to the environmental standards of the construction industry). More, however (81%), chose to 'Strongly Agree' or 'Somewhat Agree' with BENb (Improves environmental performance of a company) and BENj (Improves corporate image and credibility). Fewer disagreed with the presented beneficial factors. BENg (Reduces costs) had the most

considerable amount, followed by BENm (Relieves environmental regulation and policy burden), with 23% and 21% of participants indicating they ‘Somewhat Disagree’ or ‘Strongly Disagree’, respectively.

The ranking profile was established based on the BIV data, as shown in Table 5. Based on the results, participants considered BENE (Contributes to the environmental standards of the construction industry), BENj (Improves corporate image and credibility) and BENf (Reduces waste levels) as the top three benefits of EMS implementation. The lowest ranking benefit factors were found to be BENh (Increases a company’s competitiveness), BENm (Relieves environmental regulation and policy burden) and BENg (Reduces costs). Figure 1 provides a visual representation of the ranking.

3.3. Barriers to Implementing an Environmental Management System

The questionnaire listed sixteen barriers to organizations in the construction industry (Table 6). Analysis of the questionnaire responses (Table 7) has been used to rank the barrier factors of implementing an EMS (Table 8; Figure 2).

Table 6. List of barrier factors.

Code	Barrier Factors
BARa	The costs savings do not balance the cost of implementing EMS strategies
BARb	The implementation costs of EMS are high
BARc	Difficulty identifying environmental issues
BARd	Uncertainty regarding the benefits of EMS
BARe	Additional documentation
BARf	Low employee support
BARg	Lack of client support
BARh	Lack of sub-contractor cooperation
BARi	Lack of internal technical support
BARj	The requirement for additional employee training on new policies
BARk	Availability of human resources
BARl	Changes in existing practices of company structure and policy
BARm	Lack of legal enforcement
BARn	Weak environmental culture or lack of concern about environmental issues
BARo	Lack of top management commitment
BARp	Increases management and operation costs

Table 7. Questionnaire responses and calculation of parameter values for the barrier factors.

Factor	SA	SWA	N	SWD	SD	Total	ASS	ASS Rank	BIV	BIV Rank
BARa	8	7	21	7	4	47	3.17	15	5.96	16
BARb	10	14	16	6	1	47	3.55	12	7.01	11
BARc	3	15	17	9	3	47	3.13	16	6.25	15
BARd	13	22	7	4	1	47	3.89	2	7.90	4
BARe	13	18	13	1	2	47	3.83	3	7.67	7
BARf	10	15	18	4	0	47	3.66	9	7.70	6
BARg	6	17	19	4	1	47	3.49	13	7.38	8
BARh	17	19	10	1	0	47	4.11	1	9.21	1
BARi	9	15	18	4	1	47	3.57	10	7.29	9
BARj	7	22	14	4	0	47	3.68	7	8.13	3

BARk	8	12	19	7	1	47	3.40	14	6.80	13
BARl	7	24	14	2	0	47	3.77	5	8.79	2
BARm	10	17	12	5	3	47	3.55	11	6.71	14
BARn	12	18	9	6	2	47	3.68	8	6.99	12
BARo	14	16	10	6	1	47	3.77	6	7.27	10
BARp	11	22	8	6	0	47	3.81	4	7.87	5

Table 8. List of barrier factors in ranked order.

Rank	Code	Barrier Factor
1	BARh	Lack of sub-contractor cooperation
2	BARl	Changes in existing practices of company structure and policy
3	BARj	The requirement for additional employee training on new policies
4	BARd	Uncertainty regarding the benefits of EMS
5	BARp	Increases management and operation costs
6	BARf	Low employee support
7	BARe	Additional documentation
8	BARg	Lack of client support
9	BARi	Lack of internal technical support
10	BARo	Lack of top management commitment
11	BARb	The implementation costs of EMS are high
12	BARn	Weak environmental culture or lack of concern about environmental issues
13	BARk	Availability of human resources
14	BARm	Lack of legal enforcement
15	BARc	Difficulty identifying environmental issues
16	BARa	The costs savings do not balance the cost of implementing EMS strategies

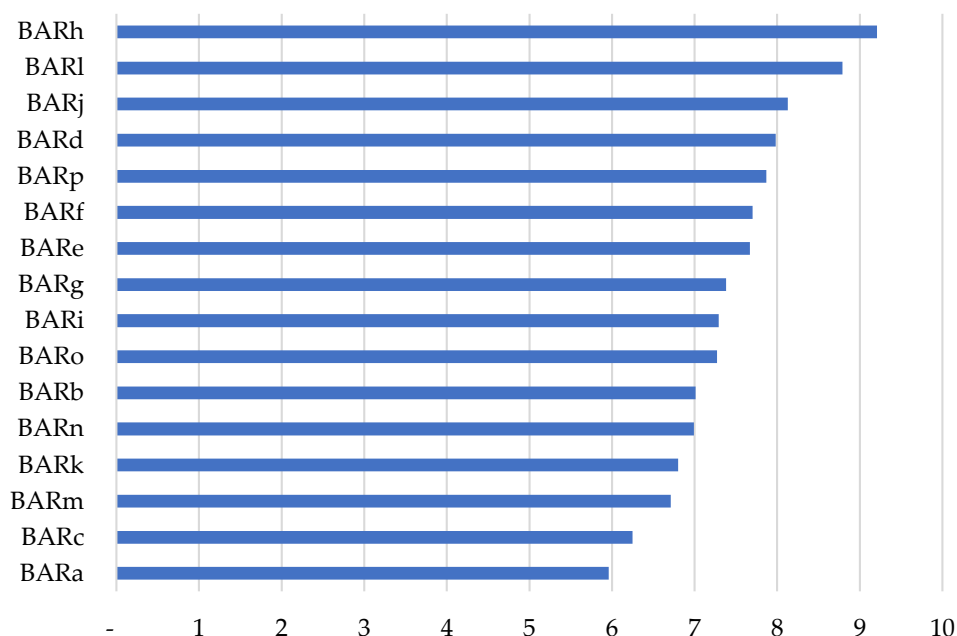


Figure 2. Ranking profile of the barrier factors (BAR).

Participants were then asked to rank each of the barriers using a Likert scale: 'Strongly Agree' (SA), 'Somewhat Agree' (SWA), 'Neither Agree nor Disagree' (N), 'Somewhat Disagree' (SWD) or 'Strongly Disagree' (SD). Table 7 provides details of the responses along with the calculated Average Significant Score (ASS) value and the BIV value for the barriers section of the questionnaire survey. Responses to BARh (Lack of sub-contractor

cooperation), BARI (Changes in existing practices of company structure and policy), BARn (Weak environmental culture or lack of concern about environmental issues) and BARo (Lack of top management commitment) had the highest ratio of participants (77% for each) who either chose 'Strongly Agree' or 'Somewhat Agree'. More participants chose to select 'Neither Agree nor Disagree' for barrier factors than for the beneficial factors; it was noted that 45% selected this option for BARa (The costs savings do not balance the cost of implementing EMS strategies) and 40% selected it for BARg (Lack of client support) and BARk (Availability of human resources).

BIV data was used to provide the final ranking (Table 7). Based on the results (Table 8; Figure 2), the top three ranked barriers to EMS implementation according to participants are BARh (Lack of sub-contractor cooperation), BARI (Changes in existing practices of company structure and policy) and BARj (The requirement for additional employee training on new policies). Meanwhile, the lowest ranking barriers to implementation of an EMS were found to be BARm (Lack of legal enforcement), BARc (Difficulty identifying environmental issues) and BARa (Costs savings do not balance the cost of implementing EMS strategies).

4. Discussion

4.1. Perceived Benefits of EMS Implementation in the Construction Sector of the U.S.

This study suggests the main benefit of EMS implementation is its contribution to the environmental standards of the construction sector. This is in line with previous studies [Error! Reference source not found.] that have highlighted this factor among those considered significant in understanding the perceived benefits of contractors in the UK regarding EMS implementation. It was suggested that contractors see a rising of standards as making a positive contribution to the environment [Error! Reference source not found.]. Considering that participants ranked environmental improvements as the third, fourth, fifth and sixth most significant benefits, it can be implied that there is a rise in environmental awareness among U.S. construction professionals. This is further supported by recent studies and professional reports that have shown a steady rise in environmental awareness throughout not only the U.S. construction sector but also the general U.S. population [Error! Reference source not found.,Error! Reference source not found.].

Recent studies have noted that environmental codes and standards are among the main influencing factors for U.S. designers and builders to use 'green' building practices [Error! Reference source not found.]. Although mandatory city, state and voluntary building-specific 'green' codes and standards have been developed in the U.S., there are still many other local, state and federal building codes and standards that remain outdated [Error! Reference source not found.]. These codes and standards are unable to provide mitigation against the effects of climate change and contribute to an inconsistency in standards across the U.S. construction sector [Error! Reference source not found.]. The rise in environmental consciousness, which is being witnessed in the U.S. construction sector, could allow for EMS to be used to promote improved environmental performance of the construction sector by redefining the operational environmental management practices despite the variation in mandatory and voluntary building standards and codes [Error! Reference source not found.,Error! Reference source not found.].

This study also revealed that corporate image and credibility were perceived to be improved by EMS implementation. This is in line with previous studies, such as the findings of a study on Malaysian manufacturing firms [Error! Reference source not found.]. However, this was not found to be the case in an Italian study [Error! Reference source not found.], where they reported that EMS has no significant effect on corporate image performance, which may be due to the location of the companies and variety of industries beyond construction. Conversely, it has been reported that highly visible environmental practices, such as EMS, significantly contribute to a better corporate environmental image and reputation of businesses in the U.S. [Error! Reference source not found.]. This improved image and reputation could be a result of demonstrating commitment to environmental management through increasing stakeholder confidence in reducing environmental impact by incorporating EMS into company policy and strategy [Error! Reference source not found.,Error! Reference source not found.].

The results in this paper suggest that participants see the implementation of EMS as a decision to enhance their company's external recognition to provide marketing benefits when targeting clients with an environmental focus. Using an EMS to improve business performance could raise issues in relation to only having an EMS for appearance while hiding poor environmental performance. It has, however, been noted that even if environmental standards are being used to increase economic value and wealth, it does not mean that they are not concurrently improving their environmental impact [Error! Reference source not found.,Error! Reference source not found.].

In the current study, the reduction of waste levels was ranked third out of the list of benefits. This ranking may be due to the large amount of construction and demolition waste generated in the U.S. and the level of regulations for waste management, which play a primary role in regulating construction and demolition waste management [Error! Reference source not found.,Error! Reference source not found.]. A U.S. case study of 'Beers Skanska' [Error! Reference source not found.] further validates these findings by highlighting a high waste diversion rate from landfills as a result of an EMS. The outcome of the findings of this and previous studies [Error! Reference source not found.,Error! Reference source not found.] suggest the ability of an EMS to increase financial savings while reducing environmental impact. These reduced costs can further enhance corporate image, increase competitiveness and highlight a potential relationship between this benefit and an improved corporate image [Error! Reference source not found.].

It is interesting, considering the interrelationship that exists between the reduction of costs and waste levels among other financial benefits, that the participants did not consider reducing costs as more beneficial. This factor was considered the least relevant benefit of EMS implementation. This result contrasts with previous studies in the U.S., the UK and Germany, where it was reported that improved environmental performance from well-designed EMS implementation generates cost savings and increases direct and indirect financial benefits due to savings associated with reduced waste, landfill tax and energy consumption [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.].

Comments from the participants noted that clients viewed the costs of implementing site-specific EMS as excess spending where expenses could be reduced. The same participants considered EMS implementation to increase management and operational costs, which ranked as the fifth barrier. This finding is consistent with a Hong Kong study [9] noting that contractors often have a greater concern for increased short-term implementation costs, such as investment of time and resources, rather than the long-term benefits. Further, owners of U.S. construction companies were found to prefer upfront savings rather than long-term ones and are unwilling to invest in sustainable construction practices that require extra time and training [Error! Reference source not found.]. It should be recognized that the findings of this study may be connected to participants' thoughts on 'uncertainty regarding the benefits of EMS' as a barrier to EMS implementation. This barrier implies a lack of awareness and education of long-term benefits for owners, contractors and clients. When this is considered in conjunction with the business culture of immediate savings, the rationale for the participants' responses may be understandable.

The relief of environmental regulation and policy burden was ranked as the next-to-last benefit. Interestingly, one respondent commented that instead of relieving environmental regulation and policy burden, 'self-reporting on EMS efforts invites regulatory agencies to look closer and implementation increases policy work'. However, a case study examining the utilization of EMS on a project in New York takes an opposing perspective on this [Error! Reference source not found.]. It suggested that the risk of non-compliance increases as building regulations and codes increase in complexity by involving multiple regulatory agencies, permits and trades [Error! Reference source not found.]. This implies that the increased complexity in an already complex sector emphasizes the need for EMS in construction [Error! Reference source not found.]. It has also been reported that the motivation to develop ISO 14001 was a result of the increase in the number of environmental laws and regulations worldwide, driving companies to implement EMS to ease problems of compliance with laws and regulations [Error! Reference source not found.]. Here, the results suggest that a more passive approach

may be taken towards compliance with environmental building regulations, codes and EMS to avoid attention. This also implies that until more stringent regulations and policies are implemented, an active approach will be avoided.

Similar to previous studies [9], one of the least significant benefits was found to be the increased competitiveness due to EMS implementation. However, it has been suggested [Error! Reference source not found.,Error! Reference source not found.] that an environmentally friendly image can increase competitiveness in the 'green' building market. The construction sector is highly competitive, but EMS implementation may not increase competitiveness unless the target is the 'green' building market.

The belief that an EMS does not reduce costs but is more likely to increase them may also contribute to participants ranking this benefit factor as they did. Increased overhead cost may lead to higher prices and, consequently, a loss of competitiveness [Error! Reference source not found.]. A company may choose to rely on more straightforward environmentally sustainable construction practices, as mentioned in the comments of one respondent.

4.2. Perceived Barriers of EMS Implementation in the Construction Sector of the U.S.

The most significant obstacle to EMS implementation was found to be a 'lack of sub-contractor cooperation'. This is in line with previous studies [9]. To establish effective EMS implementation, previous studies have recognized that sub-contractors must improve their commitment to the contractors' EMS [Error! Reference source not found.,Error! Reference source not found.]. It is, however, the responsibility of the contractor to communicate and provide training to raise awareness [Error! Reference source not found.,Error! Reference source not found.].

The perceived significance of the barrier, 'the requirement for additional employee training on new policies', implies that U.S. construction professionals may not see communicating environmental issues and providing training for EMS as worthwhile for their own employees let alone their sub-contractors. Effective communication of environmental issues has been reported to be an effective strategy for implementing EMS among sub-contractors, but overcoming this barrier is further complicated by the reluctance of participants to invest in short-term costs such as time and resources for training and education [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.].

The need to implement changes to existing practices within the organization to then implement EMS demonstrated resistance. This perceived resistance to change indicates that participants may view this type of change as more of an imposition than an opportunity. Despite different local circumstances for the construction sector, similar challenges were reported in Egypt [Error! Reference source not found.] and Nigeria [Error! Reference source not found.,Error! Reference source not found.]. Resistance to change suggests that there is an absence of continuous improvement culture regarding the traditional construction approaches built up over decades that continue to have consequences for the environment [Error! Reference source not found.,Error! Reference source not found.,Error! Reference source not found.]. Resistance to organizational changes could also indicate the level of education and understanding of construction stakeholders on the importance of environmental impact and EMS uptake, increasing the necessary commitment of time and personnel towards these types of changes [Error! Reference source not found.]. It is also required that an EMS contains an employee training plan, among other aspects, to respond and increase environmental awareness [Error! Reference source not found.]. This links to the barrier rated as third in the ranking of this study, which was the requirement for additional employee training on new policies. Although training has also been found to be one of the most relevant factors to ensure EMS effectiveness, it has previously been identified in the U.S. as one of the elements of ISO 14001 that requires the most significant effort [Error! Reference source not found.,Error! Reference source not found.]. The resistance seen towards training could potentially signify the level of value placed on EMS and the management approaches needed to promote a continuous improvement towards organizational changes within the U.S. construction sector.

The response that notes cost reductions as the least significant benefit is further validated by the reported perception that ‘cost savings do not balance the cost of implementing EMS strategies’. This is in line with previous studies that highlight the idea that U.S. construction professionals may be more likely to believe that EMS implementation generates additional internal costs, resulting in a lower likelihood to invest time and resources [9]. However, this conflicts with more recent studies [Error! Reference source not found.] suggesting that this barrier is more significant to contractors in the UK, inferring that investments do not compensate for any actual costs or add monetary value to the organization. The main difference seen here is that EMS implementation was found to occasionally produce cost reduction benefits such as cost savings from the segregation of waste, waste minimization and efficient procurement. Therefore, if participants do not believe long-term cost savings occur, they will not justify the implementation costs.

Difficulty identifying environmental issues was considered the second-to-last most significant barrier to EMS implementation. Identifying environmental aspects is essential to the development of EMS and was reported to be the element that requires the most effort when implementing an EMS in the U.S. [Error! Reference source not found.]. This study, however, suggests that progress has been made in stakeholder ability to identify environmental aspects and impacts of construction. This aligns with recent studies that have focused on the Italian construction sector, where it was found that this factor was not relevant to the success of EMS implementation [Error! Reference source not found.]. Interviews suggested that environmental impacts were easier to identify, and it was revealed that they were fewer than in other industries [Error! Reference source not found.]. More insight would be required from stakeholders in the U.S. to ascertain if there is a similar reason for the low ranking of this barrier factor. The rise, however, of environmental awareness within the U.S. may also contribute to better identification of environmental issues [Error! Reference source not found.,Error! Reference source not found.]. Although, it can be argued that the most significant barriers, ‘lack of sub-contractor cooperation’, ‘changes in existing practices of company structure and policy’ and ‘the requirement for additional employee training on new policies’, suggest that stakeholder understanding or awareness of the impacts of environmental issues remains questionable.

Participants in this study perceived a lack of legal enforcement to be among the least significant barriers to EMS implementation. The opinions on the benefit of relieving ‘environmental regulation and policy burden’ imply that a company-specific EMS may not be considered necessary if there is no adequate legal pressure. This also suggests that nothing more than the bare minimum is required to avoid added legal implications. It has been previously highlighted that an absence of legal enforcement is also one of the least significant barriers in Hong Kong [9]. In this study, interviews with contractors suggested that legislation was a motivating factor behind environmental management practices [9]. However, the lack of government enforcement and support limited the effectiveness of environmental regulations, which could restrict the desire to implement an EMS [9]. Since a report on the environmental value and impact of permits and codes in the U.S. points out that environmental legal requirements for buildings are often not enforced well enough, a similar assumption that EMS is not needed to comply with environmental legislation can be made of the U.S. construction sector [Error! Reference source not found.].

5. Conclusions and Recommendations

The significance of the various benefits and barriers towards implementing EMS in the U.S. construction sector has revealed multiple opportunities for improved implementation. In this study, the perceived key benefits by U.S. construction stakeholders include the following: ‘contributes to the environmental standards of the construction industry’, ‘improves corporate image and credibility’ and ‘reduces waste levels.’ These statements demonstrate that U.S. construction professionals perceive EMS as a structured approach required to drive the improvement of both voluntary and non-voluntary standards for more environmentally conscious construction. Additionally, it demonstrates that there is an awareness of the sizeable amounts of waste the sector produces and the need for effective waste reduction methods. EMS implementation is also viewed as

improving public perception. Therefore, while construction professionals view EMS implementation as improving the sector and society, they are equally concerned about improving their business.

EMS implementation has visible benefits to construction stakeholders, but it is clear that U.S. construction professionals also recognized existing obstacles. This study showed that a 'lack of sub-contractor cooperation' and resistance to 'changes in existing company structure and policy', along with 'the requirement for additional employee training' are some of the main barriers to EMS implementation in the U.S. These perceived barriers reveal that the core challenge in relation to EMS implementation among U.S. construction professionals is the level of importance given to effective communication of environmental issues. Without a foundation of knowledge, the U.S. construction sector is unlikely to overcome the barriers to EMS implementation reported in this study.

The U.S. construction sector has a significant responsibility to minimize adverse effects on the environment due to construction projects. The progress of this sector in addressing the environmental impacts of its operation and the need for sustainability could be improved, as there is a growing concern in society of the environmental pressure that exists. EMS will be vital in assisting this journey for the construction sector as society moves towards a more environmentally sustainable world. This study demonstrates not only the role that the U.S. construction sector can have in advancing sustainable development using EMS but also what obstacles need to be addressed to enable success.

The findings from this study have implications for various stakeholders in the U.S., including, but not limited to, clients, contractors and consultants. Understanding the perceived benefits and barriers of EMS implementation at the organizational level could enable organizations to devise more effective business strategies and policies enabling evidence-based practices to promote EMS implementation. Given the views surrounding the benefits and barriers to EMS implementation, the evidence from this study also suggests that training, awareness and understanding are the keys to positive change and overcoming any barriers. This is critical at all levels of an organization, as successful implementation of EMS requires the support of knowledgeable managers equipped with effective change management, teamwork and communication skills to champion the cause. Thus, it is essential that organizations, professional bodies and higher education carefully plan well-informed training for managers and employees. Training could mitigate perceived barriers by increasing the level of understanding for management and employees, therefore increasing the likelihood of improved sub-contractor cooperation.

Despite widespread promotion of the opportunity to engage with this study through appropriate professional channels, a possible limitation or issue of the study could be the recruitment of participants. Whilst the sample size accords with the precedent of previous national EMS studies, there may be an underlying reason why many construction professionals in the U.S. chose not to participate (e.g., not meeting the specific criteria for the study's selection process, having a lack of personal insight and/or knowledge of EMS or having a disconnect to engage with environmental agendas [**Error! Reference source not found.**]). This may also resonate with other issues identified and discussed in previous EMS studies [**Error! Reference source not found.**].

Based on the evidence revealed in this study, the following recommendations for stakeholders are proposed:

1. implement training programs for managers to aid in setting out the value of training for employees and sub-contractors;
2. incorporate environmental management education as a part of organizational management programs and construction-related courses at undergraduate and postgraduate levels within colleges/universities;
3. offer short training courses provided by construction professional bodies and trade unions; and
4. offer in-house training for employees and toolbox talks for sub-contractors.

The study has also highlighted where there are opportunities to expand EMS implementation research, which include the following proposals:

1. The uptake of EMS across 'global south' nations remains limited compared to 'global north' nations. Therefore, we propose for similar studies, using the same approach used here, to be conducted for many nations across Asia, Africa and South America.
2. Many studies, similar to this, have adopted a weight average method for analyzing the data collected. Therefore, we propose that future studies may wish to employ an alternative method using the analytic hierarchy process (AHP), particularly as this will allow participants to indicate their consensus opinion on the collective responses.
3. Quantitative data collection techniques have dominated many EMS studies. Therefore, we propose that more qualitative studies are conducted. For instance, this should include studies that utilize a phenomenological methodology so the 'lived experiences' of implementing and using EMS are explored through the hands-on experience of those experts managing the systems.

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Abstract

Pressure to reduce the environmental impact of construction activities has increased and as a consequence a paradigm shift is required. Stakeholder opinions of Environment Management Systems (EMS) as a means for the construction industry to respond to these issues are presented to address this issue. Utilising a previous approach (Shen and Tam, 2002) the views of SME construction companies have been sought, using questionnaires to ask respondents to reveal their perceived benefits and barriers of implementing ISO 14000 in the UK. Detailed statistical analysis shows systems can sometimes produce quantifiable benefits to organisations in terms of costs reduction, but also illustrate, from a contractors' view, the greatest benefit is a reduction in the impact on the environment outweighing those benefits of a financial nature. Findings also demonstrate numerous barriers, both internal and external to an organisation, exist with regard to the adoption and use of EMS. 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 indicate 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 EMS, the reality is that EMS may not be the panacea to sustainable development, as is often touted.

Research Article

Keywords: Environment, Management, Sustainability

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.*” While, 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.*, 2013). 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 *et al.*, (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.

Literature review

Benefits from the implementation of EMSs

Organisations adopt ISO14001 for a variety of reasons. King *et al.*, (2005) found increasingly firms implement ISO (International Organization for Standardization) 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 *et al.*, 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 & Tam, 2002; Sroufe, 2003; O'Laoire & Welford, 2013). Indeed, a UK survey by Tharkore *et al* (2014) 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 External, 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).

Barriers to the 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, 2017). 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 (Zuthsi 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, 2017). 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 (2017) 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 2-6 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.

Methodology

Methodological approach

This study adopts 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 Kelly *et al.* 2003) who suggest the usefulness of investigating opinions, seeking explanation and providing data for hypothesis testing.

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.

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

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.*, (2011) 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. Owolona 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).

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.

Whilst 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.

Results and Discussion

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 ($BENIV \geq 7.5$); and least significant benefits ($BENIV < 7.5$) (table 4).

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

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’.

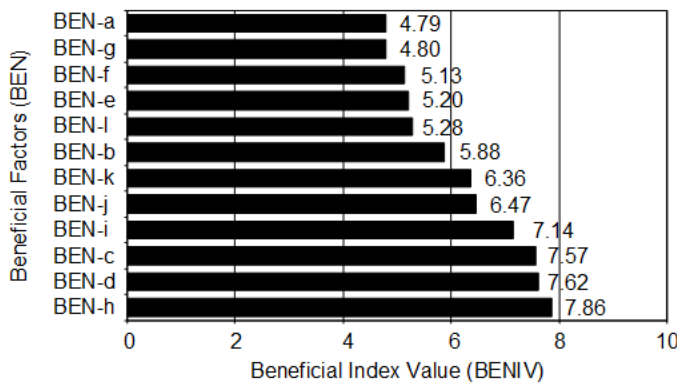


Figure 1: The ranking profile based on SIV data for responses given to statements on benefits to implementation of EMS.

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.

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 were 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 rationale for this is likely three-fold. Firstly, in the years since they undertook their survey general awareness of the supposed benefits has increased (Weiß 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 KPIs, put forward (DBERR, 2007; BERR, 2007; BRE, 2003; 2014), 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 it is 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 environment 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*’

Analysis of Barriers to the 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 ($BENIV \geq 7.5$); and least significant barriers ($BENIV < 7.5$).

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

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 2nd 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 3rd 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.

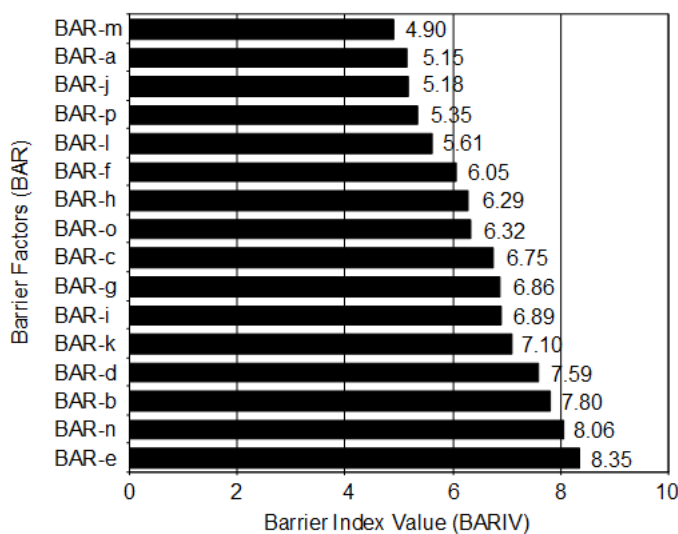


Figure 2: The ranking profile based on SIV data for responses given to statements on barriers to implementation of EMS.

'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 & Tam (2002), increases in management and operational costs was the most highly ranked statement, which is comparable with this study. Shen & 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 2nd *'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. Whilst 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 3rd was *'Increase in management and operational costs'*. This is directly correlated with the 2nd 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 & 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.

Least Significant Barriers to EMS

The 4th 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 & 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 5th 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 & Tam (2002) this statement was ranked 9th 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 6th is also linked to increases in management time and associated costs. In the study by Shen & Tam (2002) it received a similar rank in 5th place showing that despite the time-lag between studies and cultural differences similar problems persist.

Ranked 7th was the statement '*Difficult co-ordination of environmental performance of multi-tier subcontractors*'. As lack of subcontractor co-operation is ranked 1st 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 8th 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 & Tam's (2002) survey this was considered the 2nd 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 (Laoire and Welford 2013). 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 9th 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 & Chan 2004). Shen & 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 10th 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 & Tam's (2002) survey the statement was ranked of similar magnitude.

'*Lack of supplier co-operation*' was ranked 11th 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 & 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 16th 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 12th, '*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; Love *et al* 1998; Egan 1998; 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 & 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 & 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)

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.

Conclusion

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, as a global society we are 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 we move 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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ABSTRACT

As society places greater emphasis on sustainability and environmental management, particularly within the Architecture, Engineering and Construction (AEC) sectors, it is vital to understand the effectiveness of the tools available to deliver change in these areas. The AEC sectors contribute to a significant impact on the environment, both in terms of materials used and waste produced. They are also seen as being environmentally negative. Therefore, the use of ISO14001 is of increasing importance in terms of demonstrating a commitment to working towards being more sustainable within their operations. Therefore, the aim of this study is to reveal the opinions of an expert panel of environmental management professionals working within the AEC sectors on the benefits and barriers of implementing ISO14001. A Delphi study was conducted, which consisted of two rounds (Round-1 involved n=15 participants; Round-2 involved n=9 participants). The participants were asked to independently rank 145 statements (comprising: n=86 benefits; n=59 barriers), across n=17 categories, which were derived from ISO 14001 and AEC literature. After two survey rounds and weighted average analysis, the results reveal the highest ranked benefits are: (i) improved relationships with stakeholders, (ii) tender requirement, (iii) community participation, (iv) industry standards, (v) efficient operations, (vi) employee environmental awareness, (vii) cost savings through energy efficiency and (viii) improved environmental performance; whilst the highest ranked barriers are: (i) open to public scrutiny, (ii) costs involved, (iii) top management commitment towards implementation (iv) lack of link to EIA, (v) public not interested; (vi) lack of support to assist staff; and (vii) legal compliance. However, unlike previous Delphi studies that have sought to gather consensus, most participants in this study were unwilling to shift their opinions towards a shared middle-ground. Therefore, whilst the survey results enlighten our appreciations of ISO14001 implementation within the AEC sectors, they also indicate significant differences in opinion by different environmental management professionals.

Keywords: *Environmental Management Systems, Obstacles, Opportunities, Delphi Survey.*

1 INTRODUCTION

ISO14001, an international environmental management system (EMS), has been in existence since 1986. EMSs were created to ensure organisations have a system that enables them to assess and mitigate their impacts on the environment [1]. An EMS also enables organisations to demonstrate they are legally compliant and have the relevant procedures in place to manage their operations in a sound environmentally safe manner [1]. As the ISO14001 system has become more well known, there has been an increase in its uptake across the architecture, engineering and construction (AEC) sectors [2]. It is thought that this is a result of the wealth of benefits available [3]. However, there are several possible barriers restricting their uptake [4]. Therefore, the aim of this study is to reveal the consensus opinions of an expert panel of sustainability and environmental professionals working within the AEC sectors on their perceptions of the benefits and barriers of implementing ISO14001 in the UK.

2 BACKGROUND

AEC sector organisations are often scrutinised for their unfavourable impacts and influences on both sustainability matters and environmental issues [5]. Consequently, there is a greater expectation for organisations in these sectors to implement an EMS. However, as Horry *et al.* [6] has shown, there is an abundance of articles available that highlight reasons why organisations do and do not choose to adopt an EMS standard, such as ISO14001. The most frequently reported benefits for their implementation are: (a) improved corporate image (b) competitive advantage, (c) customer satisfaction, (d) waste management savings, (e) improved environmental performance, (f) compliance with legislation. Benefits can be considered to be internal or external to the organisation [7] and can be categorised in terms of organisational, financial, people, external commercial, environmental and communication. This can also be considered appropriate for the barriers. In contrast, the most frequently reported barriers against their implementation are: (a) cost, (b) lack of government pressure, (c) lack of experience, (d) lack of training and (e) lack of client support. Excluding costs, these can be seen as barriers [7], which discourage engagement.

To understand and comprehend the plethora of benefits and barriers of ISO 14001 reported in academic and industrial literature, it is necessary to gain a consensus of opinions from expert professionals who are time-served within the AEC sectors.

3 METHODOLOGY

This study adopts a positivism epistemological stance and observes a deductive research approach to address the aim of the research. The study follows a stepwise three phase process (Figure 1).

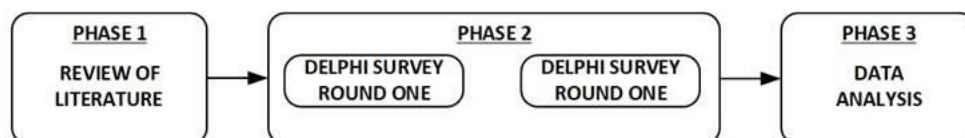


Figure 1: The phases of this research study.

3.1 Literature Review (phase one)

A review of existing environmental management systems literature followed the PRISMA evidence-based transparent and complete reporting process. This is surmised in Horry *et al.* [6], which identifies an exhaustive list of the benefits (n=86) and barriers (n=59) of implementing ISO14001 in the AEC sectors. These factors were used in the next phase of the study.

3.2 Data Collection (phase two)

A Delphi survey was selected as the data collection instrument. This enables the systematic collection and analysis of the opinions of experts on specific issues, where the purpose is to gain an unbiased consensus through a controlled feedback mechanism [8]. Throughout the process the researcher is working to reduce any variability in the answers throughout the rounds, using the mean or median scores of the previous round to inform experts of the consensus responses [9]. Normally, the Delphi is complete when there are diminishing returns, a convergence of opinion or the agreement did not improve [10]. At this point Babayan *et al.* [11] states that no further investigation is required.

The Delphi technique uses purposeful sampling, where experts are selected based on their interest or expertise on the subject [12], although criteria are often used to define an expert (e.g. participant qualifications and/or professional body membership, amongst others). Cantrill *et al.* [13] states that they are informed and knowledgeable individuals with relevant experiences and interests in the theme of the study. Okoli and Pawlowski [14] noted that choosing appropriate participants is extremely important within the planning of the Delphi process, as it is reliant on expert opinions and, therefore, is reliant on expert knowledge. The optimal number of experts for a Delphi survey has been a subject of debate. Okoli and Pawlowski [14] proposes that panels should be between 10 and 18 experts; while Linstone and Turoff [15] suggests between 10 and 50 experts is appropriate. Moreover, Mitchell and McGoldrick [16] recommends that panels should be no less than 8 experts. In this study 41 experts were approached to take part in the survey, which was administered using Qualtrics. This was done in accordance with the expectations of the UWE research ethics regulations.

3.3 Data Analysis (phase three)

The data was scrutinised using the IBM Statistical Package for the Social Science (SPSS) statistics (v28) to determine the Kendall's coefficient of concordance (W), used to reveal the level of agreement amongst participants [17]; to determine basic descriptive statistics; and to determine the weighted average rankings of the responses [18].

4 RESULTS AND DISCUSSION

This section is divided into four sections, namely: (i) Delphi Participants; (ii) EMS Benefits; (iii) EMS Barriers; (iv) Delphi Engagement.

4.1 Delphi Participants

Fifteen industry experts opted to accept the invitation to take part in the study. Table 1 shows the profiles of the Delphi participants. This reveals the participants are all employed in senior posts relevant to the theme of the study, they are very experienced in the AEC sectors, they are highly qualified, they are members of relevant professional bodies and they are very experienced in sustainability.

Each participant completed and returned a survey (Delphi Round One) that asked them to independently rate 145 statements, across 17 subject categories, using a Likert-scale (strongly agree, agree, slightly agree, neutral/neither agree nor disagree, slightly disagree, disagree, strongly disagree). These responses were analysed and used to inform the next stage of the Delphi process. A follow-up survey (Delphi Round Two) was returned to all of the participants, which showed the statistical mean response for each statement from round one, and asked them to confirm or adjust their original responses in comparison to the group responses. Nine of the original experts (a 60% response rate) opted to accept the invitation to take part in the second round. However, of these experts, only one participant wished to make any amendments to their original selections. Consequently, the Delphi survey was closed after only two rounds.

Table 1: An overview of the industry expert profiles who opted to engage with the study.

#	Role	Sector	AEC Experience	Highest Qual.	Professional Membership	Sustainability Experience
1*	Sustain. Director	Architecture	>20	Doctorate	RIBA	>20
2*	Group Head of Env.	Construction	16–20	Bachelor	IEMA	11–15
3*	Sustain. Manager	Construction	11–15	Bachelor	IEMA	11–15
4*	Asst Design Manager	Construction	1–5	Master	ICE, CIOB	1–5
5*	Group Sustain. Manager	–	>20	Masters	–	>20
6	Head of Sustain.	Architecture	11–15	Masters	CIBSE	6–10
7	Group Head of Env.	Construction	11–15	Bachelor	IEMA	16–20
8	Director for Env. Man. and Sustain.	Engineering	>20	Masters	ISE	>20
9	Sustain. Ops. Director	Construction	>20	Masters	IEMA, ICWM, CEnv	>20
10*	Senior Env. Advisor	Construction	1–5	Masters	CEnv, IEMA, CIWEM, CIWM	6–10
11*	Associate Director Environment	–	16–20	Masters	IEMA, CEnv	>20
12*	Director	Construction	6–10	–	IEMA, IOSH	1–5
13	Head of Materials Development	–	>20	Doctorate	IoQ, GSL	>20
14*	Partner, Sustain Futures	Architecture	>20	Masters	RIBA	11–15
15	Group Env. Manager	Construction	6–10	Bachelor	IEMA	6–10

*denotes those participants who took part in rounds one and two

In respect of consensus there is debate about what is actually required with Duffield [19] defining consensus as being the stability of the responses between the rounds. Others have stated that it would be when most participants agree [20]. In this instance, a Kendall's W value greater than or equal to 3.5 was used, where the top three categories of benefits (Table 2) where agreement is found are: employee engagement, public relations and legal compliance. This is interesting, particularly in terms of employee engagement, as while it is flagged as a benefit in research it is not usually cited as the major benefit. Also interesting in terms of the barriers (Table 3) was the

fact that the participants did not reach an acceptable level of agreement on any categories of the barriers, which would suggest that barriers maybe very specific to the individual organisations involved and depends on the reasons for the implementation of the system and/or what is deemed a barrier.

4.2 EMS Benefits

The experts' responses (after two rounds) to the benefit statements are surmised in Table 2. This includes the weighted average rankings (BIV) for each of the eight categories, which reveals the highest ranked benefits of implementing ISO14001 are: (i) improved relationships with stakeholders, (ii) tender requirement, (iii) community participation, (iv) industry standards, (v) efficient operations, (vi) employee environmental awareness, (vii) cost savings through energy efficiency, and (viii) improved environmental performance.

Table 2: A consensus of the expert responses to the reported benefits of implementing ISO14001 in the AEC sectors

Category code	Reported benefits of implementing ISO14001	Mean	SD	BIV	Kendall's W
PR1	Enriches corporate and public image	5.94	0.827	14.17	0.375
PR2	Enhances image with regulators	6.06	0.966	12.26	
PR3	Improves relationships with stakeholders	5.82	0.728	16.90	
PR4	Credibility of the organisation	6.24	0.752	14.40	
PR5	Green image	5.82	0.951	10.81	
PR6	Reduced complaints	4.35	1.455	8.46	
PR7	Reduced complaints	4.76	1.251	7.86	
PR8	Investor confidence	5.41	1.278	10.25	
ENV1	Competitive advantage	5.06	1.197	9.48	0.338
ENV2	Long term competitiveness	5.18	0.883	10.95	
ENV3	Higher profits	4	1.118	7.31	
ENV4	Market based pressures	4.76	1.147	9.76	
ENV5	Stakeholder pressure	5.41	1.121	11.37	
ENV6	New market opportunities	5.18	1.38	8.47	
ENV7	Tender requirement	6.53	0.514	19.75	
ENV8	Equal access to green market	4.94	1.519	8.02	
ENV9	Facilitate trade	4.59	1.176	8.99	
ENV10	Pressure from competitors	4.47	1.231	8.09	
ENV11	Remove trade barriers	4.18	0.951	10.00	
ENV12	To increased market share	4.59	1.278	8.26	
ENV13	Customer satisfaction	4.71	1.404	8.20	
ENV14	Improved customer perception	5.47	1.179	14.97	
ENV15	Customer trust	5.35	1.272	13.13	
SOC1	Improved community relations	4.65	1.539	7.97	0.163
SOC2	Social pressure (community/activists)	4.47	1.419	8.46	
SOC3	Increase stakeholder confidence	5.06	1.519	8.96	
SOC4	Social legitimacy and responsibility	4.88	1.495	8.76	
SOC5	Less complaints	4.29	1.105	8.81	
SOC6	Community participation	4.35	1.169	9.41	
SOC7	To improve industry/ government relations	4.71	1.49	9.08	
SOC8	Government support/ incentives	4.35	1.412	7.80	
LC1	Industry standards	6.06	0.556	15.00	0.359
LC2	Compliance with regulations	6.18	0.809	13.10	
LC3	Liability threats	5.59	1.064	11.37	
LC4	Ensuring legal compliance	5.76	1.2	9.10	

LC5	Reduction in fines	4.65	1.412	7.95	0.317
LC6	Lower risk of liabilities/due diligence	5.41	1.121	13.67	
LC7	Cost of non-compliance	5.06	1.144	8.75	
LC8	Improved relations with regulators	5.76	1.393	9.47	
OP1	Efficient operations	5.53	0.8	13.10	
OP2	Improved quality in product/service	5.24	1.091	9.99	
OP3	Cost savings through process improvements	5.06	1.209	9.62	
OP4	Improve organisational systems	6.06	0.827	11.37	
OP5	Increase in efficiency and productivity	5.24	1.091	11.04	
OP6	Management open to research/criticism	4.76	0.752	9.79	
OP7	Higher productivity	4.59	1.228	9.09	
OP8	Standardised processes	6	0.866	11.14	
OP9	Improved risk management (H&S)	5	1.225	10.29	0.453
OP10	Corporate management	5.47	1.231	9.48	
OP11	Conformity	5.53	0.943	11.14	
OP12	Flexible	4.29	0.849	9.09	
SE1	Better employee morale	4.59	1.228	11.87	
SE2	Employee environmental awareness	5.94	0.748	13.13	
SE3	Employee involvement and collaboration	5.24	0.903	9.74	
SE4	Motivated employees	4.53	0.874	9.32	
SE5	Employee satisfaction	4.35	0.996	8.61	
SE6	Subcontractor relations	4.59	1.604	8.71	
SE7	Involvement of senior management	5.82	0.951	10.39	0.099
SE8	Top management commitment	6.06	0.966	10.88	
SE9	Increasing staff skills	5.41	1.064	9.81	
SE10	Better working conditions	5.06	0.899	10.95	0.249
CS1	Cost reduction	4.65	1.32	7.81	
CS2	Lower insurance costs	4.47	0.8	9.62	
CS3	Cost savings through energy efficiency	5.06	1.029	10.86	
EI1	Reduce resources used	5.47	0.874	11.52	
EI2	Reduced carbon footprint	5.59	0.712	11.87	
EI3	Reduce waste generation at source	5.71	0.772	11.87	
EI4	Save costs related to water use	5.47	0.8	12.05	
EI5	Better environmental information flow	5.59	1.004	10.25	
EI6	Continuous improvement	6.18	0.636	12.61	
EI7	Reduction in pollutants	5.82	0.636	13.33	
EI8	Monitor and measure supplier performance	5.29	0.849	11.87	
EI9	Environmental impact reversal awareness	5.12	0.993	11.52	
EI10	Improved environmental performance	5.94	0.748	14.17	
EI11	Pollution prevention	5.94	0.748	12.24	
EI12	Increase public awareness of environmental issues	4.71	0.985	12.24	
EI13	Reduced env impact	5.94	0.748	14.17	
EI14	Reduced environmental risks	6.12	0.697	13.88	
EI15	Protect the environment	6.06	0.899	12.08	
EI16	Reduce waste generation at source	5.76	0.664	13.67	
EI17	Increased recycling	5.53	0.8	11.14	
EI18	Environmental awareness	6.06	0.827	12.08	
EI19	Desire for certification	5.59	1.176	10.77	
EI20	Reduce emissions	5.65	0.702	13.33	
EI21	Commitment to environmental responsibility	6.24	0.831	10.88	
EI22	Reduce environmental incidents	5.94	0.827	11.68	

Descriptors for the benefit category codes: PR= Public relations; ENV= Business improvements; SOC= Societal impacts; LC= Legal compliance; OP= Improved operations; SE= Staff engagement; CS= Cost savings; and EI= Environmental improvements

These benefits suggest that as systems develop there is more of a focus on the benefits in relation to the external environment in relation to (i) improved relationships with stakeholders [21], which could be a result of the impact of public pressure, (ii) tender requirement [18],[21], where more companies are looking at the impact of the supply chain (iii) community participation [22] (iv) industry standards [18], where there is increasing interest within sectors. Also noted are those areas where there are financial implications, such as: (v) efficient operations [20], which has the potential to increase cost savings, (vii) cost savings through energy efficiency [22] highlight the increasing pressure because of Covid and rises in energy prices. While those factors which focus on the environmental performance with (vi) employee environmental awareness [4], which assists in the running of an EMS, and (viii) improved environmental performance [4],[18] have become more significant again possibly due to an increase in public attention through the media.

4.3 EMS Barriers

The experts' responses (after two rounds) to the barrier statements are summarised in Table 3. Again, this includes the weighted average rankings (BIV) for each of the seven categories, which reveals the highest ranked barriers to implementing ISO14001 are: (i) open to public scrutiny, (ii) costs involved, (iii) top management commitment towards implementation (iv) lack of link to EIA, (v) public not interested; (vi) lack of support to assist staff; and (vii) legal compliance.

Table 3: A consensus of the expert responses to the reported barriers of implementing ISO14001 in the AEC sectors

Category code	Reported barriers of implementing ISO14001	Mean	SD	BIV	Kendall's W
PR1	Negative publicity	2.59	1.06	4.75	0.28
PR2	Purely image building	2.76	0.97	5.47	
PR3	Open to public scrutiny	3.06	1.03	5.85	
C1	Cost involved	3.82	1.38	6.68	0.13
C2	Cost may be higher than benefits	3.41	1.70	6.44	
C3	Does not add value	2.82	1.38	6.01	
M1	Top management commitment towards	3.18	1.63	6.01	0.13
M2	Industry not ready	2.47	1.38	4.55	
M3	Setting up management structures required	3.65	1.50	5.47	
E1	Identification of environmental aspect slash impact	3.07	1.62	5.00	0.14
E2	Little improvement in environmental performance	2.87	1.60	5.64	
E3	Lack of link to EIA	3.87	1.25	6.29	
E4	Lack of environmentally sound technology	3.53	1.19	6.01	
E5	No environmental improvements	2.53	1.13	5.50	
OP1	Decreased competitiveness	2.82	1.13	5.23	0.20
OP2	Existing subcontractor system	3.59	1.33	6.34	
OP3	Unsuitable standard	2.88	1.36	4.88	
OP4	Change to existing practises	3.41	1.18	5.38	
OP5	Not required for export	3.47	1.23	7.28	
OP6	Public not interested	3.94	1.09	7.79	
OP7	Lack of resources	4.00	1.17	7.31	
OP8	Disruption to workflow	3.41	1.37	5.69	
OP9	Bureaucratic	3.41	1.54	5.83	
OP10	To increase sales not to improve environment	3.53	1.46	6.74	
OP11	Time	3.94	1.52	6.14	
OP12	Lack of awareness of standard	4.12	1.41	6.44	
OP13	Need for audits	3.53	1.59	5.75	

OP14	Documentation required	3.82	1.51	5.56	0.10
OP15	Can use ISO 9000 to deliver the objectives	3.76	1.52	6.56	
OP16	Uncertainty of the benefits	3.76	1.64	6.48	
OP17	Lack of incentives	4.00	1.62	6.06	
OP18	Relies on peer pressure/manufacturing initiatives	3.35	1.41	5.38	
OP19	No major impact in the sector	3.12	1.50	5.67	
OP20	Lack of guidelines	2.88	1.11	4.80	
OP21	Incompatible sub-contracting system	3.59	1.28	6.01	
OP22	Suppliers and contractors must also improve	4.59	1.33	6.49	
OP23	Competitive pressures	3.59	1.42	6.34	
OP24	Lack of stakeholder support	3.59	1.42	5.87	
OP25	Lack of stakeholder demand or pressure	3.41	1.54	5.38	
OP26	Lack of rigour in the process	3.00	1.17	6.22	
OP27	Focus is on the process not the results	3.53	1.63	5.38	
OP28	Sector is weak in terms of environment	3.53	1.46	5.91	
OP29	Risk low	3.00	1.28	6.50	
OP30	Lack of materials/technology to assist	3.29	1.45	5.93	
EE1	Employee resistance	3.59	1.58	6.02	
EE2	Complexity of the standards	3.53	1.63	5.22	
EE3	Lack of knowledge about ISO 14001	4.24	1.52	6.45	
EE4	Lack of support to assist staff	4.00	1.32	7.21	
EE5	Change is stressful	4.24	1.35	6.83	
EE6	Need for TaylorMade training	4.00	1.50	5.75	
EE7	Lack of experience consultants	3.59	1.77	5.55	
EE8	Lack of experience	3.71	1.61	6.14	
EE9	Lack of expertise	3.76	1.89	5.76	
EE10	Lack of training (general)	3.82	1.67	6.14	
EE11	Lack of knowledge	3.88	1.90	5.85	
LR1	Legal ramifications	2.76	1.35	5.53	0.19
LR2	Legal issues resulting from engagement	2.82	1.47	5.69	
LR3	Legal compliance	2.82	1.43	5.85	
LR4	No mechanical control	2.88	1.22	5.60	

Descriptors for the barrier category codes: PR= Public relations; C= Costs; M= Management; E= Environmental issues; OP= Organisational operations; EE= Employee engagement; and LR= Legal requirements.

A barrier that is now proposed as being important is that of being open to public scrutiny [23], which could be explained in relation to the ease with which information is obtained and negative publicity shared. The new version of ISO 14001 did put a requirement on senior management engagement, so it is understandable that this has now become a more significant barrier to engagement [4]. However, it is interesting how the other barriers have changed from being ones which are more to do with enabling the organisation to implement systems and how these system work as a whole with other projects, such as the linkages to the EIA process [24]. The inclusion of the lack of public interest [24] is a surprise as it is generally thought that there is more interest in the environment at this time however this is viewed as a barrier by the participants. While training and experience have always been listed as barriers, in this study a lack of support to assist staff [4] was highlighted which of course may include training. (vii) legal compliance [25] is listed as a barrier to engagement, which given it is a necessity is a finding, needs further investigation to ascertain why it is a barrier.

4.4 Delphi Engagement

Sample population sizes and response rates are points of debate amongst researchers involved in any studies using surveys. Whilst the suggested sample size of expert participants required for Delphi surveys is much smaller than traditional survey studies, the process of multiple rounds, revisiting the same questions repeatedly can mean

participants lack motivation to participate in Delphi studies and it can contribute to a low response rate and drop-out [26]. Anticipating this may become an issue in this study, 41 experts were invited and 15 experts accepted the invite to take part in round one. This sample size (n=15) fitted well with the suggested size of Delphi studies. Further, the response rate to the second round (60%) was comparable to other Delphi studies (e.g. [27]).

As mentioned earlier, the Delphi technique is designed to gain an unbiased consensus through a controlled feedback mechanism [8]; whereby, after each round of the process the participants responses reach tend towards closer agreement. For instance, the Delphi survey by Asah-Kissiedu [27] generated Kendall's W scores of 0.38 after one round and 0.61 after two rounds. Those values indicate a shift in experts' opinions from having a '*fair agreement*' to having a '*good agreement*' [28]. However, in this study, the Kendall's W scores, which reached 0.45 (*moderate agreement*) for one category, remained the same after both rounds because the experts involved in this study mostly maintained their responses between the rounds (except for one participant). This highlights a potential issue with the data collection method because, whilst the purpose of the Delphi process is working towards a consensus amongst the experts, it does not allow for any discussion between experts to permit an explanation for why decisions were made, which could provide important insights in terms of the perspectives of experts [29]. It is possible this issue may be unique to this discipline field (i.e. environmental management) or it could be unique to this particular profile of experts (i.e. senior, experienced professionals) who are steadfast in their opinions and do not respond well to having their judgements queried. However, further study searches and/or additional investigations are necessary to confirm these statements.

The duration and/or length of any questionnaire can influence a participant's decision to engage with a survey or not. In this study, the questionnaire was formed of 145 statements. This may have restricted the participants decisions in choosing not to shift their responses. In other words, rather than re-running the survey and comparing their original responses with the collective responses, it was simply easier and more convenient for them to respond by saying they did not wish to change their opinions. Feedback comments, such as *I don't have time to complete this* and *there are too many options*, support the possibility of this notion.

5 CONCLUSIONS

The study has revealed a consensus of AEC expert opinions on the benefits and barriers of implementing ISO14001 in the AEC sectors. The responses of the experts to the various types/categories, which were originally identified by Horry *et al.* [6], have been ranked to ascertain the main benefits and barriers of implementation. The highest ranked benefits were: (i) improved relationships with stakeholders, (ii) tender requirement, (iii) community participation, (iv) industry standards, (v) efficient operations, (vi) employee environmental awareness, (vii) cost savings through energy efficiency and (viii) improved environmental performance. The highest ranked barriers were: (i) open to public scrutiny, (ii) costs involved, (iii) top management commitment towards implementation (iv) lack of link to EIA, (v) public not interested; (vi) lack of support to assist staff; and (vii) legal compliance.

Based on these findings, the study has highlighted how priorities appear to be changing in respect of the benefits and barriers of engaging with ISO14001. There is an increasing focus on external issues, in terms of the improved relationships with stakeholders and the need to have ISO14001 for certain tenders. Not forgetting changes in industry standards, which promote engagement. In respect of barriers, except for cost, these seem to have shifted focus too, with greater emphasis on concerns about public scrutiny and the lack of top management commitment, which could be because of the inclusion of this requirement in the 2015 version of the ISO14001 system. Similarly, another barrier that has emerged is legal compliance, which has traditionally been seen as a benefit but has now come forth as a barrier. These shifts are something that requires further investigation to ascertain the reasons for these changes in perspective in relation to the EMS, and whether this is influenced by the length of time that organisations have held ISO14001.

Whilst Delphi studies have been acknowledged as useful instruments when ascertaining a consensus, the study has highlighted several engagement issues, namely: the type of discipline, the seniority of the participant profiles and the duration/size of the survey may all be factors which influence participant decisions to take part or re-engage in subsequent rounds of the Delphi study.

To delve deeper and further understand the benefits and barriers of implementing ISO14001 in the AEC sectors, it is proposed that future investigations should examine the personal 'lived-experiences' of those persons with direct responsibility for overseeing and implementing EMSs in AEC organisations. Adopting a

phenomenological approach, using semi-structured interviews, could provide a useful means of uncovering what is fundamental for improving uptake across the AEC sector and why discipline experts in this field seem fixed in their opinions.

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ABSTRACT

Implementing and using environmental management systems (EMS) in the architecture, engineering, and construction (AEC) sectors has received worldwide attention but never through a phenomenological lens. This study investigates the ‘lived-experiences’ of experts who have implemented and used ISO14001 in AEC organisations based in the UK. Using a qualitative research strategy of semi-structured interviews, extensive analysis of the conversations reveals several themes, namely: participants believe ISO14001 is not just an environmental business tool, ISO14001 offers a means for delivering sustainability, ISO14001 accreditation opens doors for business accrue ment, and, moreover, ISO14001 is more than a badge, rather it is a modern-day business necessity. The study also reveals that not all those organisations asking for ISO14001 have the accreditation themselves. Based on this evidence, and contrary to previous studies that have proposed EMS are chiefly implemented to save costs and comply with legislation, it seems box-ticking as part of a tendering process is now the major motivation for organisations to attain and maintain ISO accreditation. Further, concerns are expressed that some organisations are unwilling to state their sustainability objectives or embed their operations within an EMS that will be audited because it could emphasise their poor performance to stakeholders.

KEYWORDS: Environmental impact, Sustainability, EMS, ISO14001, Business performance

INTRODUCTION

Environmental management systems (EMSs) were originally instigated to encourage organisations to manage their environmental impacts (Horry and Booth, 2019). There are many EMSs available worldwide (e.g., EMAS, ISO14001, amongst others), adopted across many industries and sectors (e.g., manufacturing (Jannah *et al.*, 2020), retail (Naidoo and Fasparatos, 2018), hospitality (Achmad and Yulianah, 2022), amongst others). Their uptake by the Architecture, Engineering and Construction (AEC) sectors is hugely important because these sectors are notable for their potential detrimental environment impacts (e.g., consumption of virgin resources, wasteful design and build practices, excessive high energy uses, amongst others) (Gomes *et al.*, 2023).

Implementing systems to manage environmental impacts can be traced back to BS7750 (published in 1992) (Dzakhmisheva *et al.*, 2022), a forerunner to the now widely adopted ISO14001. ISO14001, created in 1996 and updated in 2004 and 2015 (Ferreira *et al.*, 2019), is a multi-purpose system that helps organisations reduce negative impacts on the environment, prevent pollution, and continually improve their environmental performance along with enabling compliance with appropriate legislation (Sorooshian *et al.*, 2018). Initially some viewed ISO 14001 as a badge, something to display rather than having a positive impact on the environmental performance of the organisations (Dogui *et al.*, 2014). EMSs are a voluntary standard, so their implementation is a choice remembering that their implementation and operation does incur costs, demands staff training and require buy-in from senior management. Organisations considering the use of an EMS need to be fully aware and have a comprehensive understanding of the benefits and barriers to their uptake and usage (Waxin *et al.*, 2019).

Many international studies have attempted to gauge organisational benefits and barriers of implementing ISO14001 (Rodriguez *et al.*, 2011; Waxin *et al.*, 2019; Carrillo-Labela *et al.*, 2020; Chen *et al.*, 2020a), especially in the AEC sector (e.g. Hong Kong (Shen and Tam, 2002), Nigeria (Owolana and Booth, 2016), UK (Bailey *et al.*, 2020), Maldives (Rasheed *et al.*, 2023). Most of these studies have utilised quantitative approaches (e.g. questionnaires) for their investigations. No previous studies have delved deeper and used a phenomenological methodology to investigate implementing EMS in the AEC sectors. Therefore, the aim of this study is to explore the ‘*lived-experience*’ of those environmental professionals involved in the implementation and operation of ISO14001 in AEC organisations, as an attempt to understand underlying issues associated with their uptake and to gather insights into gaining and maintaining ISO14001 accreditation.

BACKGROUND

Ensuring economic prosperity of any organisation which factors in their environmental impact is a challenge for any industrial sector (Chen *et al.*, 2020b). Most organisations will only survive if they are profitable or, at least, their forecast shows them to be heading in a viable direction. The decision therefore to employ an EMS is often multifaceted, requiring careful consideration because it can impact the short- and/or long-term performance of an organisation. However, EMS can also be a mandated prerequisite for attracting business and enabling engagement with tenders for future business thereby improving prosperity.

Shen and Tam (2002) were amongst the first to explore the plethora of benefits and barriers associated with adopting ISO14001. Their study investigated the Hong Kong construction industry,

revealing that environmental protection and reduced environmental risk were considered the most significant benefits of implementing an EMS, whilst increased management costs and lack of trained staff and expertise were considered the most important barriers. Owolana and Booth (2016) investigated the Nigerian construction industry, revealing reduced environmental related sickness and injury, and environmental protection were considered the most significant benefits and lack of government legal enforcement and lack of technological support were considered the most important barriers. More recently, Bailey *et al.* (2020) investigated the UK construction industry and revealed reduction of environmental risks and contribution to environmental protection were considered the most significant benefits and lack of subcontractor co-operation and cost benefit of the system were considered the most important barriers.

Other benefits, cited in literature, include improving corporate image, reducing environmental risks, improving environmental standards, reducing environmental complaints, reducing environmental related sickness, increasing competitiveness, improving workforce morale, cost savings due to reduced risk of fines (Shen and Tam, 2002; Turk, 2009; Sakr *et al.*, 2010; Teriö and Kähkönen, 2011; Nguyen and Hens, 2015; Owolana and Booth, 2016; Johnstone, 2020). Other barriers cited include lack of appropriately trained staff, lack of client and subcontractor support, time required, lack of supplier cooperation, difficulty in coordinating environmental work over a multitude of tiers in the supply chain, lack of workforce support, increased documentation, lack of technical support, lack of training, lack of legal enforcement and the required change processes (Shen and Tam, 2002; Babakri *et al.*, 2003; Turk, 2009; Turk, 2012; Owolana and Booth, 2016; Schmidt and Osebold, 2017; Bailey *et al.*, 2020; Johnstone, 2020).

Opinions differ as to whether the benefits and barriers are location-linked and/or time-dependent, and the choices identified in the literature vary, so this needs further exploration. For instance, Horry *et al.* (2022a) suggests, over time, the benefits and barriers have changed slightly reflecting new expectations within business and wider society. Today, there is more focus on the improvements with stakeholders, tender requirements, community participation, industry standards, more efficient operations, increased employee awareness, energy efficiency savings; yet environmental improvement is still viewed as the main benefit of implementing and using an EMS (Horry *et al.*, 2022a). In terms of barriers, cost is still the main influencing factor but, the challenge of senior management commitment has been mitigated to a degree by the 2015 update of ISO14001 (Lewandowska and Matuszak-Flejszman, 2014).

RESEARCH DESIGN AND METHODOLOGY

Philosophy underpins the design of research studies. Traditional philosophical fields proposed by Aristotle, Socrates, Plato and Russell are: Ontology, which asks - what is? Epistemology, which asks - how we know? Logic, which asks - how to reason? and Ethics, which asks - how we should act? However, the later philosopher Husserl proposed phenomenology, which asks - how we experience? It is this latter stance that provides the underpinning position for this study.

As this work uses a phenomenological-based methodology (i.e. understanding experiences) it uses a lifeworld perspective to gain a deeper understanding of personal experiences (Willig, 2013). Using a qualitative research strategy encouraged the use of semi-structured interviews as the means of inquiry. This enabled the main questions to be asked in the same manner with the same words but

where necessary the addition of follow-up questions if particularly interesting responses were received or any clarification of answers was required (Doody and Noonan, 2013). The main intent of the interviews was to gain a detailed knowledge and understanding of the personal experiences of professionals from within the AEC sectors who had direct involvement in the implementation and operation of ISO14001. The interviews were in two parts: Firstly, questions about a participant's background and demographics; and secondly, questions about a participant's 'lived-experience' of ISO14001 (Table 1).

Table 1: A list of the main questions posed to the participants.

#	Interview questions
1	Please describe your organisations approach to addressing their environmental impacts.
2	Please describe how your organisation approached the ISO14001 accreditation process.
3	Tell me about your experience throughout the process of attaining ISO14001.
4	Tell me about your experience of the potential organisational benefits yielded from implementing and gaining ISO14001 accreditation.
5	Tell me about your experience of the potential organisational barriers yielded from implementing and gaining ISO14001 accreditation.
6	Tell me about your experience of using ISO14001 to achieve the objectives of your organisation.
7	Finally, based on these experiences, would you recommend ISO14001 to other AEC organisations or would you encourage them to seek an alternative approach to meet their environmental/sustainability targets?

Sample Size, Selection and Recruitment

Due to the nature of the enquiry, participants needed to be experienced in respect of ISO14001 so purposive sampling (a non-probability sampling technique) (Etikan and Bala, 2017) was adopted, using explicit inclusion criteria, namely: participants must have a minimum of five years' experience in the sector, be employed by an AEC organisation holding ISO14001 and they must have personal involvement in the implementation and operation of ISO14001 before and/or after accreditation.

This allowed a specific targeted group of participants to be invited for interview (Klar and Leeper, 2019). Anonymity was assured to encourage open and frank discussion.

Data Collection and Analysis

All interviewees requested online interviews. These were digitally video recorded (taking ~30 minutes) and the recordings transcribed using captions on the system. This was then reviewed to ensure that the captions were verbatim. To preserve the participants anonymity, no names were stored in the transcribed text.

Typical of phenomenological studies, no computer data analysis software was used (Capodanno *et al.*, 2020). The transcripts were reviewed using a stepwise process (Table 2), where the researchers repeatedly reading each of the transcripts to extract interrelated themes and meanings (Amos, 2016). This ensured the themes and subthemes highlighted were an accurate representation of the phenomenon under review (Smith, 1995; Smith and Osborne, 2003).

Impartiality was maintained by the researchers being in accord with the phenomenological principle of epoche (or bracketing), where the aim is to avoid any preconceptions or expectations in relation to the phenomenon of the study (Souza, 2014). One researcher had previously implemented and used ISO14001, albeit not in the AEC sector, they abstained from the analysis process so they would not influence or impact the outcomes and interpretations.

Table 2: Description of the stepwise process used to analyse the participant interview narratives
(based on Smith (1995) and Smith and Osbourne (2003)).

Step	Description
1	Reading and re-reading of the interview transcripts to gain firstly a general sense of the whole interview responses.
2	The transcripts were then re-read noting any emerging themes.
3	Taking the noted themes, grouping and defining them, allowing for a focus on any interrelationships between the themes.
4	Where shared themes existed, these were then used to produce meaningful and accurate statements. These led to the production of the meaning and experience of the participants using their own words.
5	The subordinate themes and statements were then compared against the original transcripts to verify the findings.

Ethical approval was gained prior to the interviews and all participants received a project letter detailing that their consent and involvement was anonymous and entirely voluntary. This information was reconfirmed at the interviews were being recorded and how the data would be kept at the interview. After the interview the interviewees were given a two-weeks to allow them (if they desired) to withdraw their responses. This approach is compliant with the expectations of UK university research ethics regulations.

RESULTS

Using the themes and subthemes generated through analysis of the transcripts, along with selected verbatim quotes, the findings are presented beneath under five main section headings: (a) Participant demographics and backgrounds; (b) Opening doors; (c) It is more than it ever was; (d) A standard for achieving objectives; and (e) A modern-day necessity. To ensure anonymity, no personal information about the participants is used in any of the descriptions and those direct comments included do not divulge any identifying factors.

(a) Participant Demographics and Backgrounds

Eight participants responded to the invitation to be interviewed about their '*lived-experiences*' of ISO14001. This number, which may seem small, is in accordance with what is expected of a phenomenological study (the number of participants being between 6-8, aligning with those noted in Laczko *et al.* (2022), Serjeant *et al.* (2021) and Fong *et al.* (2021) who used six, seven and eight participants, respectively.

Table 3: Participants profile data (n=8).

Participant	ISO14001 in place	Role	Years experience	Turnover (£ sterling)	Sectors	Highest Qualification	Professional body membership
1	Yes	Environmental Manager Large Scale Construction	22	Over 10 billion	AEC	BSc	IEMA
2	Yes	Group Sustainability Manager	20	Over 1 billion	AEC	MSc	IAQ, IES, Chartered Scientist
3	Yes	Regional Environmental Advisor	21	Over 1 billion	EC	MSc	IEMA
4	Yes	Group Head for Environmental Risk and Compliance	30+	Over 1 billion	EC	BSc	IEMA, Chartered Environmentalist, Chartered Manager.
5	Yes	Environmental Manager	14	Between 5 and 10 billion	AEC	MSc	IEMA
6	Yes	Senior Environmental Manager	25	Over 10 billion	EC	MSc	IEMA, Chartered Environmentalist, Chartered Member of IOSH.
7	Yes	Director	22	Over 100 million	AEC	MSc	No
8	yes	Divisional Quality Manager	6	Over 5 billion	E	MSc	CQI, IHT

Each of the participants who took part in the study confirmed they had personally been involved in the implementation and use of ISO14001. The timescales for participant experience ranged from 6 to over 30 years.

(b) “Opening Doors”

All the participants stated that their companies were engaged in the sustainability agenda, and many were keen to note that their companies were early adopters in setting sustainability-related objectives. Those early adopters had to deal with a lack of knowledge of ISO14001 and appears to have been driven by their directors. This is highlighted by statements such as participants recollecting being instructed *“we want this ISO14001, come back and tell us when we have it”* (Participant-7). This emphasises a lack of involvement by senior leadership - common in early adopters. Often the Health and Safety staff tended to be handed the task (Participant-5), and it is treated as a risk-focused exercise. Several of those interviewed noted that they were doing much of the work themselves and that this had required them to pull together data and documents needed and organise it into an auditable set of information. This situation has changed as evidenced by the statement *“it isn't something in a book down here on the shelves [reaching down behind their desk] it is actually lived and breathed daily within the business”* (Participant-7).

Several participants mentioned that there is a *“groupwide approach to sustainability”*. The majority of those interviewed worked for organisations who used combined management systems, bringing together health and safety, quality, and environmental management. It was noted that the *“key is making sure that that everyone is using the same information and that all the policies are aligned. The*

biggest issue we have found is consistency" (Participant-2) This was particularly observed within companies procuring smaller businesses to be part of their group, where the smaller companies did not have an EMS in place.

In relation to the groupwide sustainability most of the participants highlighted that their organisation's sustainability strategy was about their company survival. This is evidenced by the statement *"really a business needs [great emphasis on needs] to win work on their sustainability framework. So, whilst we're happy doing 'the carbon' to a level, a simple level, we probably wouldn't have continued doing that if it wasn't for the fact our customers were asking for it"* (Participant-2).

This shows that while an organisation may engage voluntarily on the easy, quick wins in relation to sustainability it is customer pressures that is driving them to do more in relation to sustainability.

The pressure is external with requests from their customer base driving this increased engagement.

This was highlighted by all participants noting that they were involved in bidding on UK government frameworks, which is where most government contracts are found in the UK. These frameworks

specify mandatory criteria which are requirements for engagement and include requirements such

as the organisation quoting for the tender must have ISO14001 certification. All the participants

stated that a primary benefit of ISO14001 was the ability to engage with frameworks and tendering

processes to bid for contracts. This is clearly demonstrated by the statement *"in any contract in*

business, if you're not meeting the current standards, you won't be entertained or considered for a framework or contract." (Participant-4). It is satisfying to hear that all the companies are delivering

environmental improvements, it is however disappointing that their rationale is not for the good of

humanity or because it is the right thing to do but because it is seen as a necessity to win new

business. This is confirmed by the statement *“whilst we'd like to say it's the right thing to do...really it's a business success requirement”* (Participant-2) and this was further confirmed by the participant, who stated the reason for doing their sustainability work was *“...in order to win contracts [nodding]”* (Participant-3). So, while these professionals all indicate that protecting the environment and being a sustainable organisation is the right thing to do, the reasons why many organisations are involved is to increase their opportunities to engage with tendering processes and ensuring the financial health of their companies.

(c) “It Is More Than It Ever Was”

All of those interviewed emphasised that ISO14001 was a starting point and not the end of their company's sustainability journey. This collective view that ISO14001 is a minimum standard may hold out some hope for environmental improvements. This is supported by the statement *“to say that there's any benefit to having the minimum, there isn't, because I think the world expects a lot more on top of that...14001 is just like a benchmark”* (Participant-2). This suggests the sector has moved away from examining whether ISO14001 has benefits or barriers, to it is the expected norm. It is also noted that the norm is not sufficient, and that stakeholders and customers are expecting much more *“a hell of a lot more than ISO14001 is”* (Participant-2). The idea that ISO14001 is a minimum is supported by the questions that the participants state are the increasing expectations of their customers such as *“what can you do to help us design a carbon zero building...which are far more advanced than 14001”* (Participant-2). Of course, ISO14001 can be whatever the system is designed to be. It is for the organisation involved to decide on the objectives they choose to include, such as the management of risk in relation to climate change.

Risk management is a significant issue within business and was flagged as a benefit of ISO14001 by most of the participants. They noted that the system has made their organisations consider their impacts in a more deliberate manner. This is noted by comments such as *“I think what it really helped to do...was help to get parts of the organisation that maybe didn't think they had an environmental impact to understand they actually did...purchasing would be a good example [smiles] that, you know, the conventional thing is we are just in an office...but it's the decisions you make and the suppliers you choose...will their control, be as good as ours”* (Participant-6). This issue was noted earlier where central teams sometimes did not comprehend their impacts. This could be extremely important moving forward in relation to hidden environmental impacts in areas such as the supply chain which will also need to be managed.

The management of the supply chain is a potential challenge, however site operations and the opportunities for cost savings were benefits highlighted by several of the participants. Participants are quoted as noting *“management of waste can actually be a massive cost, not saving necessarily, but actually generate profit”* (Participant-7). This demonstrates another means by which organisations can increase their profits through careful management of their resources, but this requires knowledge and facilitation within the organisation to enable this opportunity to be accrued.

The enforced involvement of the senior management team is seen as a big step forward from the situation mentioned earlier where the board just instructed someone to go away and get the standard. The current standard requires active observable involvement of those in positions of

senior management. This increased focus on senior management commitment in the 2015 version has had a positive impact in the views of some of the participants as this comment suggests *“whilst directors might have said ‘yes, we’re committed to this strategy’, getting them to prove their commitments and that they were delivering on it was then much firmer with-it being part of the 14001”* (Participant-4).

(d) “A Standard for Achieving Objectives”

One issue within the AEC sector noted by all the participants was the focus of ISO14001 on the organisations facilities rather than their operations. This is an issue for the AEC sector because their major impacts are on the sites where they have management control purely during the build phase, the sites then being handed over to others. The AEC organisations obviously have impacts on those sites, during construction but the scope for their ISO14001 system is their offices and may include transport but it is unlikely for individual construction sites to be in scope. Concerns were expressed by several of the participants that there is a gap in the system due to this. This is supported by the statement *“not really much you would want to put into 14001 that was construction site related apart from your policies and procedures...because if you put it in, you’re bound to it”* (Participant-2). This demonstrates concern over deliverables in the management system, raising an interesting question as to whether a management system should be set up to pass or should it challenge organisation to do more? It could be questioned as to whether this produces the best outcome for the environment, if those involved are only working towards objectives that they know are guaranteed to be delivered rather than being purposefully challenging. This raises an interesting question in relation to audits, target and auditor involvement and independence (Dogui *et al.*, 2014).

It is important to recognise that ISO14001 is just a system, it does not specify objectives and so is only as ambitious as the organisations, or senior management teams setting the objectives. In this work those interviewed were from organisations who have held the standard for many years, and it was interesting to hear comments such as *“we felt as a team, that 14001 didn't [hesitating, before continuing with reticence] drive us in terms of environmental performance...we felt that having an environmental management system was very good at risk identification and management of risk, but it didn't necessarily sit with...moving the business forward...we wanted something that was a bit more, a bit more dynamic, a bit more fluid, ... a bit more engaging. The structure of 14001 means that it doesn't necessarily resonate with people, particularly non-operational, people who aren't used to following processes, which is why we then sort of pulled back a bit and developed an overarching strategy that was a bit more, I don't know, user friendly, if you like”* (Participant-3), while Participant-8 noted *“it's all about waste...mixed waste in that bin”*. This suggests that while ISO14001 is great at managing the environmental impacts it could help guide companies when they have gone past that initial phase of their EMS, and they are looking for something more aspirational. As a standard ISO14001 can deliver on this, however the organisations may not want to commit themselves to objectives which lack clarity of definition or do not have measurable outcomes for fear of the auditors' reactions.

In relation to how organisation use the standard some of the participants declared they were purely using the EMS for environmental management, as originally designed; therefore, the focus was on reducing energy use or the amount of waste produced. This is supported by the statement *“14001 is*

largely environmental...we split environmental [looking skyward] ... It's all about planning consents, discharge and planning consents, tree preservation orders, wildlife stuff...nothing to do with sustainability and carbon reduction [smiling]" (Participant-2). Most participants, however, were using the system to manage their sustainability work too, which was highlighted by the participant who said *"you only put in what you are happy to achieve...we don't have a separate 14001 management system. You make the 14001 fit the system you've got...14001 isn't being used as a marketing tool, [shakes head] but the net zero strategy in approach is...maybe there needs to be another 14001, which looks at sustainability rather than environmental stuff"* (Participant-2). This highlights that there may be some lack of vision in relation to the opportunities for the use of ISO14001, it is a system and, as such, could easily be used to support the zero-carbon agenda, sustainability, or risk management. However, this would require organisations to make commitments in relation to all their objectives and expand the scope.

(e) "A Modern-day Necessity"

The participants were clear about whether they would recommend ISO14001 with comments such as *"I would certainly recommend for any organisation that wants to be independently challenged and scrutinised to a common standard to adopt ISO14001"* (Participants-4 and -5). Others noted that ISO14001 has benefits that would be useful, with Participant-3 stating *"14001 really does well when it comes to risk management...I think [pausing] as a performance enhancing system."* There were, however, also expressions of concern in relation to the size of the organisations considering using the system and thoughts were expressed that *"ISO14001 might not be the best approach for an SME organisation"* (Participants-1 and -4). In such scenarios it was thought that larger companies could

direct smaller companies within their supply chain towards alternative schemes (e.g., BS8555) so they can take their first steps towards ISO14001.

All the participants agreed that ISO14001 was not without challenges, with one participant saying, *"I've heard a lot of things for and against 14001...I would still see 14001 as the kind of de facto environmental management system"* (Participant-1). A small number noted you could do the same work but, in another way, but as one noted *"like a lot of badges. Is that the right way to describe it? It is a prerequisite to getting into their supply chain, let alone getting to the framework, the tenders, and the like. So, if you don't have it. You're not getting to them"* (Participant-7).

All the participants declared they would recommend ISO14001 but with the proviso that it *"has to work for the business"*. The scheme needs to identify an obvious value, which could be if they intended to engage in a tender process. Others noted it should not just be a badge, which is evidenced by the statement *"it has to have some business benefit to do it, whether that is just because your customers require it...it's always going to be an economic decision because the amount of resource you have to put into it [grinning]"* (Participant-2).

An interesting point made was that not all organisations who issue tenders requiring ISO14001 have it themselves. This is evidenced by the statement *"what I find fascinating is that many client organisations require 14001 as part of any contractual work that they undertake. But very few of those organisations have ISO14001 [shaking their head]"* (Participant-4). This questions how these organisations are managing their own impacts and what happens after the handover? Are they run

in a sustainable manner or are the owners relying on the AEC sector delivering an environmentally sound building?

DISCUSSION

While most participants within this study noted their organisations are using ISO14001 to manage both environment and sustainability objectives within their operations, some are still separating-out issues such as waste management and energy-use into an EMS while another department has responsibility for sustainability matters. It is suggested that this results in a doubling-up on costs, as environment and sustainability are inextricably linked and rationalising these areas could increase benefits (Boiral and Henri, 2012; Oyelakin and Johl, 2022). It is interesting to note the concern expressed in relation to the not achieving objectives and this brings into question whether all objectives should be to be ticked off the to do list in one or two years or being aspirational; something to aim for (Sorooshian and Yee, 2018; Mosgaard *et al.*, 2022).

It has become clear through this study that ISO14001 has become a requirement on a large proportion of tenders particularly those relating to government departments (Horry *et al.*, 2022b). To engage with these tenders there is a requirement for organisations to have an EMS in place. This new requirement demonstrates a change in stakeholder perspective and that the emphasis is on protecting the environment (Seroka-Stolka and Fijorek, 2022); however, it would be questioned as to whether those producing the tenders should also consider the environmental impacts of their own operations rather than relinquishing responsibility to the subcontractors.

The idea proposed by most of the participants was that ISO14001 is purely a starting point (Johnstone, 2022). This would suggest that the companies whose employees took part in this research are aiming to be more sustainable than purely box-ticking on a tender form. It must be noted though that all those taking part worked within organisations were early adopters of the ISO14001 system and had been working to these standards for many years. It does suggest though that something more is needed than just ISO14001 to enable companies to navigate the issues of delivering on their environmental and sustainability objectives over the years (Horry *et al.*, 2022a). Currently the system does not differentiate between those who have just gained the certificate and those who are really making a difference in respect of their environmental impacts (Horry *et al.*, 2022a).

The findings revealed that the benefits cited for using ISO14001 are moving away from purely legal compliance (Shen and Tam, 2002). An EMS is now seen as a necessity in relation to the tendering processes that are available through the various procurement frameworks. ISO14001 is seen as a starting point, from which companies move to be more engaged in the sustainability agenda (Maletic *et al.*, 2015). There is a difference of opinion witnessed in these interviews in relation to the suitability of ISO14001 to be used to manage both sustainability and environmental management, with some seeing the system as still purely an environmental management tool (Oyelakin and Johl, 2022). This is interesting, as the system, was designed to be flexible and as such can be used for whatever the requirements of the organisation are. The concerns expressed are very much centred around the ability or willingness of the organisations to state their sustainability objectives in a system that will be audited, particularly in relation to site specific issues.

The study suggests that ISO14001 has become an expected norm within business for engagement on frameworks for tendering for UK government projects. All the participants noted that it was a mandatory tick on the tender application paperwork, rather than being part of any more in-depth scrutiny (Morrow and Rondinelli, 2002). The professionals who took part in these interviews all vouch for the value in having a system to take their organisations further than just the basic criteria, or the idea of we “*have the badge*” (Johnstone, 2022). The challenge of bringing sustainability into the equation is another matter, with some suggesting that there may be a reluctance to state sustainability factors as objectives as this may require companies to deliver on something vague which may prove challenging (Mosgaard *et al.*, 2022). From the accounts analysed in this study, ISO14001 is still a firm favourite for delivery of environmental objectives, but it is not yet completely accepted as a delivery mechanism for sustainability.

CONCLUSIONS AND RECOMMENDATIONS

This research set out to look at the lived experience of the industry experts involved in the implementation and operation of ISO14001 within the AEC sectors. Cost, time, and staff knowledge are cited in the literature as being the main barriers to the implementation of ISO 14001. This study reviewed the barriers and benefits of ISO 14001 using a phenomenological approach, and the themes highlighted from the analysis of interview statements suggest ISO14001 is a starting point on an environmental-focused journey, and a necessary requirement for any organisation who are wanting to engage in the tendering process. To engage with many tenders (particularly those from UK government departments), organisations must now have ISO14001 in place. ISO14001 is a

prerequisite for engaging with certain organisations. How the system is implemented, and the effectiveness of the system is not judged, it is a mandatory tick box on the tender form.

All the participants in this research worked for companies that had ISO 14001, so their organisations had already established the benefit to establishing the system. The interesting finding was that some of those employee organisations were found to be using the system to deliver on sustainability priorities, as well as environmental management, while others are still separating the two terms from each other.

The voicing by the participants of ISO14001 as a starting point is comforting implying that organisations are taking their environmental responsibilities seriously and engaging proactively with the environmental/sustainability work even if this purely because of it being a stakeholder requirement. The separating of environmental management and the more ethereal sustainability agenda is an issue as there is the risk that organisations will be compliant but not aim for sustainability.

Further research would be useful to establish the benefits seen by those who are merging their environmental and sustainability objectives and what challenges are seen by those who choose not to do this. ISO14001 is clearly seen as a necessity by the participant involved in this research but how this is implemented is still subject to variation. More work is needed to ascertain whether the barriers and benefits are purely organisation or sector specific.

It is recommended that research is conducted into how environment and sustainability are managed within organisations to ascertain the effectiveness of splitting out environment and sustainability. As ISO14001 was seen as a starting point it would be interesting to see how far beyond the requirements of ISO14001 companies are progressing.

Finally, work is still needed to demonstrate to organisations that ISO14001 can deliver in respect of sustainability and that it is not just a system for managing the environmental impacts. Further research is suggested to investigate whether sustainability can be included within the management system (ISO14001) for the lifecycle of the buildings with numerous parties involved. It also needs to be established how an EMS can be audited so organisations do not fear their inability to deliver on their objectives immediately and how support could be provided to move them from a purely legal compliance environmental management situation to a more sustainability deliverable agenda.

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Abstract

Conveyance of the sustainable development goals (SDGs) will provide improvements to people's lives and longevity of the planet. The architectural, engineering or construction (AEC) sectors have a huge role aiding the delivery of many SDGs. The leading environmental management system (EMS), ISO 14001, can enable organisations in the AEC sectors to chiefly improve their business operations, whilst minimising their impacts on the environment and improving society. This study presents a systematic review of published literature across the AEC sectors to identify the reported benefits and barriers of implementing ISO 14001 systems and, in doing so, enabled the conception of a roadmap towards the delivery of the SDGs. The stepwise PRISMA review process facilitated the compiling of both academic articles and professional reports (n = 44), which permitted the creation of an inventory of the perceived benefits (n = 86) and the recognised barriers (n = 63) to implementing ISO 14001 across the AEC sectors. Improving environmental performance and compliance with legislation are the most widely reported benefits to AEC organisations; whilst lack of government pressure and lack of expertise are the most widely reported barriers after cost to AEC organisations utilising an EMS. The benefits and barriers were confirmed by environmental practitioners. Then using the benefits in the inventory has supported the development of a conceptual roadmap, which illustrates where linkages exist with the SDGs. SDG 4, 8, 12 and 13 are shown to exhibit the most associations with the benefits and barriers. It is surmised that the roadmap could be used for strategic organisational sustainable planning or for organisations to demonstrate the delivery of their corporate social responsibilities. This was reviewed by AEC sector professionals who confirm the usefulness and validity of the roadmap.

Keywords: ISO 14001, PRISMA, Sustainability, Corporate social responsibility

1. INTRODUCTION

Data from the United Nations (UN) (2019) suggests that extraction and processing of materials, fuels and food produces half of the total greenhouse gases and is responsible for more than 90% of biodiversity loss in conjunction with water stress. Since the 1970s the extraction of resources has increased three-fold and estimations show that by 2060 material use could double to 190 billion tonnes and greenhouse gases could increase by 43% (UN 2019). Othman and Nadim (2010) suggested that the AEC sectors consumed around 50% of the natural resources consumed, utilised 40% of the energy generated and produced 50% of the waste created globally. The UN (2020a) expects that in terms of most vulnerable countries (MVC) and their populations, it is believed that in 2020 another 71 million people will be pushed back into poverty and that 2.2 billion people will lack safe drinking water. Water scarcity alone could displace 700 million people by 2030 (UN, 2020b). The Circle Economy (2020) notes that 50.8 billion tonnes of minerals are consumed each year and 38.8% of that goes into housing. Along with this data the Waste Framework Directive 2008/98/EC states that all European Union (EU) member countries need to achieve at least 70% re-use, recycling or other recovery of non-hazardous Construction and Demolition Waste (CDW) by 2020. The UK is leaving the EU and other countries in the world will not be impacted by EU legislation, but the question remains as whether this is enough and why is cradle-to-cradle not the aim (McDonough and Braungart, 2002). Therefore, it is vital that as a sector there is a move to be more sustainable.

Sustainability within the AEC sectors, particularly within construction has received increasing attention over recent years (Berardi, 2012). This links to the risks these activities can impose on the natural environment and also their impact in terms of the social, economic, cultural and political dimensions of sustainability (Boyko *et al.*, 2012; Villeneuve *et al.*, 2017). Figures suggest that 40% of the global energy consumption and over 30% of the global carbon dioxide equivalent emissions are attributed to buildings, making the building sector a significant contributor to harmful emissions (Cucuzzella, 2009; Ade and Rehm, 2019). Furthermore, the building sector also consumes 12% of freshwater and 30% of raw materials and it is responsible for around 20% of wastewater and up to 40% of landfill waste globally (Ade and Rehm, 2019). It is, therefore, clear that the AEC sectors have enormous potential for making a considerable impact in terms of the sustainability of the planet both in a positive or negative manner.

Projects within the AEC sectors and their impacts will be varied, and it is acknowledged that to mitigate the projected impacts effective sustainable development action is required. The current predictions suggest that by 2050, two-thirds of the global population will be living in urban areas (Mattoni *et al.*, 2018). There is an expectation that there will be 14 new mega cities and that these and the world's largest cities will require over 500 million m² of new office space and more than 250 million new houses (Ding, 2008; Ade and Rehm, 2019).

Therefore, how these cities are designed and built will have a major impact on the delivery of the SDGs and the future health of the planet.

It has been noted by researchers that for design and business to be really sustainable it needs to go beyond the traditional economic approach and short-term issues (Naess, 1994; Goubran *et al.*, 2019). Cucuzzella (2016) suggested a multistep framework that requires system-wide innovations to change unsustainable practices. Vefago and Avellaneda (2010) have highlighted some of these unsustainable practices in architecture. Dyllick and Muff (2015) proposed four levels for sustainability in business, the first being business as usual however, this is discounted as it is generally accepted that business as usual no longer acceptable, then there are only three options remaining, namely: (i) sustainability with economic considerations, (ii) sustainability with the creation of value across the pillars of sustainability or (iii) focussing on the sustainability challenges to bring about a better society (Dyllick and Muff, 2015). The use of the sustainable development goals would enable organisations to focus on what they could deliver. One potential route would be to use an existing process such as ISO 14001 to deliver these goals.

Environmental management systems (EMS) (particularly ISO 14001) aim to enable organisations to prevent pollution, enable continual improvement and comply with legislation (BSi, 2015). Although it is acknowledged that environmental standards have focused on continual improvement, they do not actually specify a level of improvement or harm reduction (i.e. pollution prevention). Therefore, they have been accused of not enabling a transformation in terms of sustainability (Brown, 2016). Others had suggested that standards are being used increasingly to create economic value; cost savings or increased market share and opportunities for business rather than environmental improvements (Jones and Laquidara-Car, 2018). However, it must be acknowledged that businesses exist to make an economic contribution to society, but this does not mean that they can't make a positive contribution to society at the same time. It is possible that companies can be sustainable in terms of economics, society and the environment. Some researchers have suggested that potential links exist between environmental rating tools and the SDGs (Gibberd, 2015; Alawneh *et al.*, 2018). Gibberd (2015) combined the ecological footprint criteria and the Human development index to suggest a BEST index. Alawaneh *et al.* (2018) looked at how a combined water and energy efficiency method could be developed to assess and improve United Nations (UN) Sustainable Development Goals (SDGs) delivery. However, there is a risk that the benefits which are being achieved are those that can be delivered at the lowest cost to the organisations or that the organisations use the system as purely a public relations (PR) tool, rather than to improve their environmental performance. This has promoted the view of the standards being less effective in promoting sustainability than market mechanisms, such as carbon trading (Bon and Hutchinson, 2010).

Researchers have attempted to ascertain how the construction sector could contribute to the SDG work with Lynch and Mosbah (2017) highlighting SDG 1 (no poverty), SDG 9 (industry, innovation and infrastructure) and SDG 11 (sustainable cities and communities). Goubran *et al.* (2019) also notes that buildings play a part in the use of renewable energy (SDG 7), in sustainable consumption and production (SDG 12), and in climate adaptation (SDG 13). Di Foggia (2018) also supports the idea that SDGs 11 and 13 are the significant ones. However, if research continues to focus on standard tools and regional case studies, the findings will remain of limited use when what is really needed is truly transformational change. The AEC sectors could lead the way in this process.

There are of course issues in respect of the potential trade-offs that could occur if organisations only focus on one or two of the SDGs as their work to improve those could have negative impacts on other targets (Moyer *et al.*, 2018; Allen *et al.*, 2019; Maes *et al.*, 2019). This is the reason for the need to have a roadmap to ensure that companies have the tools to deliver effectively on the SDGs. Then they can make a positive contribution to them without negatively affecting the work of others.

The aim of this study is to produce a roadmap that utilises the known benefits of implementing environmental management systems in the AEC sectors to support the delivery of the SDGs. A PRISMA review of AEC literature will be used to identify the known benefits and barriers of implementing environmental management systems. This will be endorsed by environmental experts. A roadmap linking these to each of the SDGs will be produced and then validated by AEC industry experts, before drawing conclusions and recommendations for future research.

2. SUSTAINABLE DEVELOPMENT GOALS

Sustainability and environmental management have become key words in our society since the Earth Summit in Rio de Janeiro in 1992 (UN, 2020). Governments and organisations have tried a variety of ways to promote this work from implementing legislation and issuing guidance to recommending management systems and voluntary standards. This work has resulted in increasing interest in the implementation of schemes such as ISO 14001 to manage the environmental impacts of organisations, which not only has enabled cost savings and better use of resources, but also brought an increased focus on the protection of the environment (Ofori *et al.*, 2002). ISO 14001 enables organisations to manage their impacts on the environment, through operating procedures, objectives and a policy, which commits them to continual improvement, legal compliance and prevention of pollution (Borial and Sala, 1998; Zutshi and Sohal, 2004). It is a tool which also allows organisations to monitor and measure the positive impacts that they are having and justify their work to insurers, customers and stakeholders across the globe (Arimura *et al.*, 2008; Nishitani, 2009) and regulators, as well as the general public (Zeng *et al.*, 2011).

Interest in the sustainability agenda from the general public has increased in recent years (Erdos, 2019; Jung *et al.*, 2020). Hindsight demonstrates that there was talk about sustainability prior to 1992 in Rio (Scoones, 2007) but it was this conference that brought the subject of sustainability to the attention of the media. Following on from Rio, a roadmap for Agenda 21 was created (Spangenberg *et al.*, 2002), which highlighted ways for society to be more sustainable. Then as society moved forward to 2000 there was the release of the millennium development goals of which there were eight. These aimed to reduce extreme poverty by 2015 but the primary focus was on the benefits to humans. These were reviewed and became the SDGs in 2015. These SDGs comprise of 17 goals (Table 1) that cover relevant thematic areas such as energy, water, climate, urbanisation, transport, science and technology based around five key themes of people, planet, prosperity, peace and partnership (Caldes and Rodriguez, 2018). The SDGs are more ambitious than the MDGs with a focus not just on poverty but on the human and natural environment (Gusmao Caiado *et al.*, 2018). These goals form a voluntary approach to produce a better society for all, but for these to be effective they have to have contribution not just from governments but from industries and sectors worldwide.

Table 1: The seventeen sustainable development goals (source: UN, 2015)

#	Sustainable Development Goal
SDG1	No poverty
SDG2	Zero Hunger
SDG3	Good health and Well-being
SDG4	Quality Education
SDG5	Gender Equality
SDG6	Clean Water and Sanitation
SDG7	Affordable and Clean Energy
SDG8	Decent work and Economic growth
SDG9	Industry, Innovation and Infrastructure
SDG10	Reduced Inequalities
SDG11	Sustainable Cities and Communities
SDG12	Responsible Consumption and Production
SDG13	Climate Action
SDG14	Life Below Water
SDG15	Life on Land
SDG16	Peace Justice and Strong Institutions
SDG17	Partnerships for the goals

The current focus is not just about how governments can improve society and the environment but also the positive impact that organisations can make, particularly the multinational organisations. In society, individuals are now more powerful in terms of their impact on companies either through avoiding products or buying more environmentally friendly ones. There is, therefore, a huge opportunity and a risk in terms of how and whether

companies engage with the SDGs. This could potentially have a huge impact on the construction industry as Goubran *et al.* (2019) states that the construction sector has direct or indirect influence on the SDGs with 17% of the SDF targets being directly dependent and 27% indirectly dependent.

It must, however, be noted that the aims and objectives of the SDGs are broader and more encompassing than is possible for any sector to achieve alone. Maes *et al.* (2019) supported this by highlighting 102 SDG targets, which had links to all the goals and while their research considered the natural environments in urban areas, it should not be taken on face value that the only SDGs that are impacted by the AEC sectors are SDG 15 (life on land) and SDG 11 (sustainable cities and communities) (Gusmao Caiado *et al.*, 2018; Allen *et al.*, 2019). There is a need for more interdisciplinary research to achieve the SDG aims and objectives as a sector and society (Salvia *et al.*, 2019). In an analysis conducted by Goubran *et al.* (2019) it was found that the sector related to all the goals but that the largest contribution was made in respect of SDGs 6, 7, and 11. It is contested here that actually SDGs 4, 8, 12, and 13 would also have a major impact. Based on extensive literature searches, this is the first known study to demonstrate the potential opportunity of supporting the delivery of the SDGs through the utilisation of environmental management systems.

3. RESEARCH DESIGN AND METHODOLOGY

An interpretivist epistemology, applying an abductive reasoning approach with elements of positivism was used to achieve the purpose of this study (Figure 1).

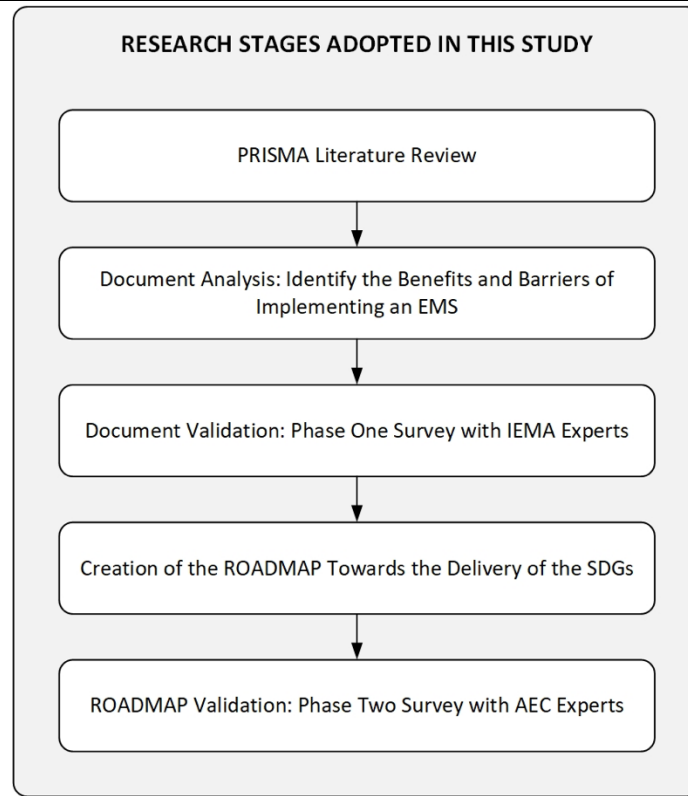


Figure 1: Stages of the research design used in this study

3.1. Literature review

A comprehensive review of Environmental Management Systems literature followed the PRISMA evidence-based transparent process (Moher *et al.*, 2009); whereby, journal articles are identified, then screened for suitability before inclusion in a structured review (Liberati *et al.*, 2009). There are many reasons for conducting a literature review (Randolph, 2009). In the case of this study peer reviewed literature was the main focus and only a few relevant professional/technical reports were found and included (Abanda *et al.*, 2015).

A range of databases (including Scopus and Web of Science, amongst others) were chosen so as to cover a variety of different discipline areas (such as engineering, business, social science). The search, however, was limited to common phrases or keywords (such as ISO 14001, Environmental Management Systems and EMS) within relevant fields (such as architecture, engineering, construction) and the literature search was constrained to articles from 1999 to 2020 (years inclusive), and restricted to peer-review journal papers, reviews, conference papers and book chapters, and only works published in the English language. The typical code used to search the databases was: TITLE-ABS-KEY (('ISO 14001 AND EMS and

Environmental Management System') AND ('architecture' OR 'engineering' OR 'construction')) and (LIMIT-TO (LANGUAGE, "English"))).

Document analysis (Bowen, 2009) was then used to identify all the known benefits and barriers of implementing EMS in the AEC sectors. This involved a systematic process of examining and interpreting the information to gain meaning and understanding thereby increasing knowledge (Corbin and Straus, 2008). Information was then organised in a database and analysed, before the content was validated (Ezekannagha *et al.*, 2020).

3.2 Validation by experts

Validation of the document analysis (Phase One) and validation of the Roadmap (Phase Two) was conducted by questionnaire surveys shared with relevant experts:

Phase One – the list of benefits and barriers were shared via a Qualtrics questionnaire survey (recording participant details and opinions) with a panel of environmental experts who were members of the Institute of Environmental Management and Assessment (IEMA) LinkedIn group. Eligibility criteria used to include participants as experts was that they needed to be: (i) an IEMA member of five years or more, who work in environmental management; and (ii) hold the minimum of a Bachelor degree qualification.

Phase Two – the Roadmap (explained in the next section) was shared via a Qualtrics questionnaire survey (recording participant details and opinions) with a panel of AEC industry-facing professionals from each of the sectors and who are based in organisations that hold ISO 14001 certification. Eligibility criteria used to include participants as experts was that they needed to be: (i) employed in one of the AEC sectors for a minimum of five years and work on sustainability-related projects; (ii) membership of an AEC professional body; and (iii) hold the minimum of a Bachelor degree qualification.

3.3 Roadmap creation

The purpose of a roadmap is to provide a strategic abstract visual representation of information (Blackwell *et al.*, 2008). Therefore, the roadmap created in this study was constructed by cross-linking each of the validated benefits of implementing ISO 14001 in the AEC sectors against each of the SDGs. Recognising that some of these could be achieved more easily than others, an indication of the relative expected timescales was included. The creation of the roadmap was based on the collective roundtable opinions of the authorship team who have shared AEC and sustainability experiences exceeding 100-years and 50-years, respectively. However, since this approach could be considered as being subjective, a decision was made to seek the opinions of independent AEC industry experts with sustainability experience to validate its creation and, hence, Phase Two (detailed above) was implemented.

4. FINDINGS

This section presents the outcomes of the literature review and shares the opinions of IEMA experts on the information that was extracted from the review, it then describes the roadmap created by the authors and shares the views of the AEC experts who proffered opinion towards its validation.

4.1 Identification of the benefits and barriers of implementing EMS in the AEC sectors

The PRISMA search resulted in 131 articles being screened and checked for eligibility before a final group of articles (n = 44) were used for the literature review (Figure 2). A summary of these works is presented in Table 2.

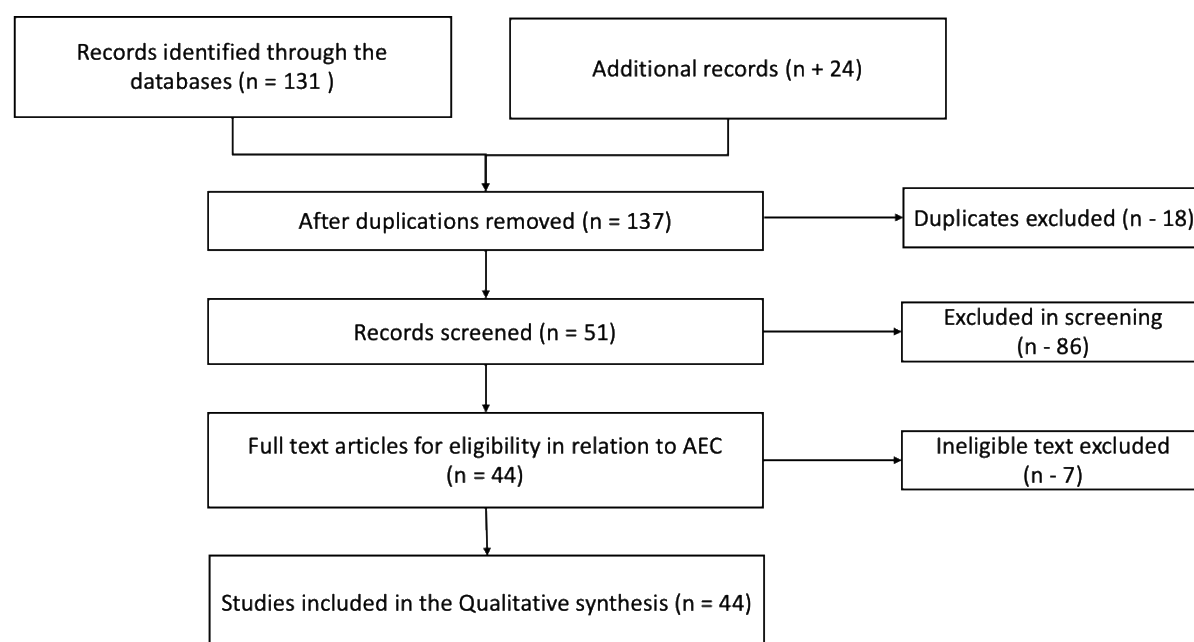


Figure 2: Outcomes of the various stages involved in the PRISMA literature selection and identification process

Table 2: Summary details about the articles and reports (n=44) identified from the PRISMA literature review.

#	Year	Country	AEC Sector	Method(s) used	Author(s)	Source title and source type
1	2020	UK	Construction	Questionnaire	Bailey <i>et al.</i>	ICE Management, Procurement and Law/ Journal Article
2	2020	Various	Construction	Interview	Johnstone	Journal of cleaner production/ Journal Article
3	2019	Italy	Construction	Questionnaire	Chiarini	Business Strategy & the Environment/ Journal Article

4	2018	South Africa	Construction	Questionnaire	Ololade and Rametse	Business Strategy & the Environment/ Journal Article
5	2017	Germany	Construction	Questionnaire	Schmidt and Osebold	Journal of civil engineering and management/ Journal Article
6	2016	Various	Construction	Literature review	Campos <i>et al.</i>	Journal of cleaner production/ Journal Article
7	2016	Australia	Construction	Audit	Dejkovski	Waste management/ Journal Article
8	2016	Chinese	Engineering	Survey	Feng <i>et al.</i>	Journal of cleaner production/ Journal Article
9	2016	Nigeria	Construction	Survey	Owolana and Booth	Journal of Environmental Engineering and Landscape Management/ Journal Article
10	2015	Bulgaria	Construction	Questionnaire	Harizanova <i>et al.</i>	Economic Engineering in Agriculture and Rural Development/ Journal Article
11	2015	Vietnam	Engineering	Questionnaire	Nguyen and Hens	Journal of cleaner production/ Journal Article
12	2015	Malaysia	Construction	Case study	Yusoff <i>et al.</i>	Issues in Social & Environmental Accounting/ Journal Article
13	2012	Italy	Engineering	Questionnaire	Arena <i>et al.</i>	International Journal of Business management/ Journal Article
14	2012	Turkey	Construction	Questionnaire	Turk	Environmental management - Book
15	2011	USA	Engineering	Survey	Frachetti	Journal of cleaner production/ Journal Article
16	2011	Spain	Construction	Case study	Gangoellis <i>et al.</i>	Building and Environment/ Journal Article
17	2011	Hong Kong	Construction	Survey	Lam <i>et al.</i>	Journal of environmental management/ Journal Article
18	2011	Spain	Construction	Questionnaire	Rodriguez <i>et al.</i>	Journal of environmental management/ Journal Article
19	2011	Finland	Construction	Action research	Terio and Kahkonen	Construction management and economics/ Journal Article
20	2011	China	Engineering	Questionnaire	Zeng <i>et al.</i>	Journal of cleaner production/ Journal Article
21	2010	Malaysia	Engineering	Questionnaire	Abdullah and Fuong	Asian Social Sciences/ Journal Article
22	2010	Egypt	Construction	Survey	Sakr <i>et al.</i>	Journal of cleaner production/ Journal Article
23	2010	Latvia	Construction	Case study	Tambovceva	Economics and Management/ Journal Article
24	2009	Turkey	Construction	Questionnaire	Turk	Total Quality Management & Business Excellence/ Journal Article
25	2008	Germany	Engineering	Survey	Frondele <i>et al.</i>	Ecological economics/ Journal Article
26	2007	Spain	Construction	Survey	Rodriguez <i>et al.</i>	Resources, conservation and Recycling/ Journal Article
27	2007	Slovinia	Construction	Survey	Selih	Journal of civil engineering and management/ Journal Article

28	2005	USA	Engineering	Structured interviews	Curkovic <i>et al.</i>	Proceedings of the Decisions Science Institute/ Conference paper
29	2005	Various	Construction	Literature review and case study	Swaffield and Johnson	Architectural Engineering and Design Management/ Journal Article
30	2004	China	Construction	Literature review	Chen <i>et al.</i>	Automation in construction/ Journal Article
31	2004	USA	Construction	Case study	Christini <i>et al.</i>	Journal of Construction Engineering and Management/ Journal Article
32	2004	Australia	Engineering and Construction	Survey	Zutshi and Sohal	Technovation/ Journal Article
33	2003	USA	Engineering	Survey	Babakri <i>et al.</i>	Journal of Cleaner Production/ Journal Article
34	2002	USA	Construction	Review	Ball	Building and Environment/ Journal Article
35	2002	Singapore	Construction	Survey	Ofori <i>et al.</i>	Building and Environment/ Journal Article
36	2002	Hong Kong	Construction	Survey	Shen and Tam	International Journal of Project Management/ Journal Article
37	2002	USA	Construction	Literature review and case study	Valdez and Chini	Environmental Practice/ Journal Article
38	2001	Hong Kong	Construction	Review	Pun <i>et al.</i>	Journal of cleaner production/ Journal Article
39	2001	Hong Kong	Construction	Case study	Tse	Journal of Environmental Assessment and Policy/ Journal Article
40	2000	China	Construction	Case study	Chen <i>et al.</i>	Journal of Construction Engineering and Management/ Journal Article
41	2000	Singapore	Construction	Questionnaire	Ofori <i>et al.</i>	Construction Management and Economics/ Journal Article
42	2000	USA	Construction	Case study	Quinn	Pollution Engineering/ Journal Article
43	2000	Australia	Construction	Case study	Walker	The TQM Magazine/ Journal Article
44	1999	Singapore	Construction	Questionnaire	Kein <i>et al.</i>	Construction Management and Economics/ Journal Article

The benefits and barriers extracted from the works presented in Table 2 are listed and cross referenced to their sources (Tables 3 and 4). These have been scrutinised and the frequency of each benefit and barrier reported across all the works are presented (Figures 3 and 4). In terms of the benefits (Table 3 and Figure 3) the most widely reported ones are improved environmental performance (Shen and Tam, 2002; Owolana and Booth, 2016), improved corporate image (Shen and Tam, 2002; Turk 2009, 2012) and compliance with regulations (Turk, 2009; Johnson, 2020); whilst some of the least reported ones are subcontractor relations (Turk, 2009) and to facilitate trade (Sakr *et al.*, 2010). In terms of barriers (Table 4 and Figure 4) the mostly widely reported ones are cost (Shen and Tam, 2002; Babakri *et al.*,

2003; Johnson 2020), lack of expertise (Turk, 2012; Schmidt *et al.*, 2017) and lack of training (Turk, 2009; Schmidt *et al.*, 2017); whilst some of the least reported ones are industry not being ready (Kein *et al.*, 1999) and complexity of the standards (Turk 2009).

Table 3: List of the known benefits of implementing environmental management systems in the architecture, engineering and construction sectors reported in published articles and reports.

Benefits of implementing environmental management systems in the architecture, engineering and construction sectors	Authors who have reported the benefits
Enrich corporate and public image	Ofori <i>et al.</i> , (2002); Shen and Tam (2002); Valdez and Chini (2002); Adetunji <i>et al.</i> , (2003); Swaffield and Johnson (2005); Frondel <i>et al.</i> , (2008); Turk (2009); Sakr <i>et al.</i> , (2010); Terio and Kahkonen (2011); Arena (2012); Turk (2012); Harizanova <i>et al.</i> , (2015); Owolana and Booth (2016); Ololade and Rametse (2018); Bailey <i>et al.</i> , (2020)
Enhance image with legislators	Arena (2012)
Improve relationships with stakeholders	Adetunji <i>et al.</i> , (2003); Turk (2009)
Credibility of the organisation	Turk (2012)
Green image	Walker (2000); Shen and Tam (2002)
Reduced complaints	Owolana and Booth (2016)
Market differentiation	Tse (2001); Owolana and Booth (2016)
Investor confidence	Adetunji <i>et al.</i> , (2003)
Competitive advantage	Ofori <i>et al.</i> , (2000); Curkovic <i>et al.</i> , (2001); Tse (2001); Ofori <i>et al.</i> , (2002); Shen and Tam (2002); Adetunji <i>et al.</i> , (2003); Christini <i>et al.</i> , (2004); Turk (2009); Sakr <i>et al.</i> , (2010); Terio and Kahkonen (2011); Feng <i>et al.</i> , (2016); Schmidt <i>et al.</i> , (2017); Bailey <i>et al.</i> , (2020)
Long term competitiveness	Valdez and Chini (2002); Swaffield and Johnson (2005); Feng <i>et al.</i> , (2016)
Higher profits	Feng <i>et al.</i> , (2016)
Market based pressures	Kein <i>et al.</i> , (1999); Valdez and Chini (2002); Zeng <i>et al.</i> , (2011)
Stakeholder pressure	Adetunji <i>et al.</i> , (2003); Sakr <i>et al.</i> , (2010)
New market opportunities	Adetunji <i>et al.</i> , (2003); Turk (2009)
Tender requirement	Adetunji <i>et al.</i> , (2003); Turk (2009); Rodriguez <i>et al.</i> , (2011); Bailey <i>et al.</i> , (2020)
Equal access to green market	Arena (2012)
Facilitate trade	Sakr <i>et al.</i> , (2010)
Pressure from competitors	Adetunji <i>et al.</i> , (2003); Turk (2009)

Remove trade barriers	Curkovic <i>et al.</i> , (2001); Ofori <i>et al.</i> , (2002); Adetunji <i>et al.</i> , (2003); Turk (2009)
To increased market share	Walker (2000); Turk (2009)
Customer satisfaction	Kein <i>et al.</i> , (1999); Walker (2000); Curkovic <i>et al.</i> , (2001); Ofori <i>et al.</i> , (2002); Selih (2007); Turk (2009); Arena (2012); Turk (2012); Harizanova <i>et al.</i> , (2015); Ololade and Rametse (2018)
Improved customer perception	Turk (2009)
Customer trust	Turk (2009)
Cost reduction	Ofori <i>et al.</i> , (2000); Tse (2001); Shen and Tam (2002); Valdez and Chini (2002); Adetunji <i>et al.</i> , (2003); Christini <i>et al.</i> , (2004); Swaffield and Johnson (2005); Selih (2007); Frondel <i>et al.</i> , (2008); Turk (2009); Terio and Kahkonen (2011); Arena (2012); Harizanova <i>et al.</i> , (2015); Owolana and Booth (2016); Ololade and Rametse (2018); Bailey <i>et al.</i> , (2020)
Lower insurance costs	Tse (2001); Terio and Kahkonen (2011)
Cost savings through energy efficiency	Quinn (2000); Tse (2001); Shen and Tam (2002); Adetunji <i>et al.</i> , (2003); Swaffield and Johnson (2005); Johnstone (2020)
Reduce resources used	Quinn (2000); Adetunji <i>et al.</i> , (2003); Ofori <i>et al.</i> , (2000); Swaffield and Johnson (2005); Turk (2009); Bailey <i>et al.</i> , (2020); Johnstone (2020)
Reduced carbon footprint	Johnstone (2020)
Reduce waste generation at source	Quinn (2000); Curkovic <i>et al.</i> , (2001); Tse (2001); Ofori <i>et al.</i> , (2002); Swaffield and Johnson (2005); Rodriguez <i>et al.</i> , (2007); Turk (2009); Franchetti <i>et al.</i> , (2011); Terio and Kahkonen (2011); Bailey <i>et al.</i> , (2020); Johnstone (2020)
Save costs related to water use	Quinn (2000)
Better environmental information flow	Christini <i>et al.</i> , (2004); Nguyen and Hens (2015)
Continuous improvement	Schmidt <i>et al.</i> , (2017)
Reduction in pollutants	Turk (2009)
Monitor and measure supplier performance	Turk (2009)
Environmental impact reversal awareness	Shen and Tam (2002); Turk (2009)
Improved environmental performance	Quinn (2000); Curkovic <i>et al.</i> , (2001); Ball (2002); Ofori <i>et al.</i> , (2002); Adetunji <i>et al.</i> , (2003); Chen <i>et al.</i> , (2004); Christini <i>et al.</i> , (2004); Turk (2009); Gangoellis (2011); Arena (2012); Turk (2012); Harizanova <i>et al.</i> , (2015); Nguyen and Hens (2015); Yusoff and Nordin (2015); Owolana and Booth (2016); Ololade and Rametse (2018); Bailey <i>et al.</i> , (2020); Johnstone (2020)
Pollution prevention	Frondel <i>et al.</i> , (2008); Owolana and Booth (2016); Bailey <i>et al.</i> , (2020)
Increase public awareness of environmental issues	Shen and Tam (2002)
Reduced env impact	Quinn (2000); Ball (2002); Shen and Tam (2002); Valdez and Chini (2002); Christini <i>et al.</i> , (2004); Turk (2009)
Reduced environmental risks	Turk (2009); Turk (2012)
Protect the environment	Ofori <i>et al.</i> , (2000); Pun <i>et al.</i> , (2001); Ofori <i>et al.</i> , (2002); Shen and Tam (2002); Turk (2012); Harizanova <i>et al.</i> , (2015); Owolana and Booth (2016); Ololade and Rametse (2018); Bailey <i>et al.</i> , (2020); Johnstone (2020);

Reduce waste generation at source	Quinn (2000); Ofori <i>et al.</i> , (2002); Rodriguez <i>et al.</i> , (2007); Turk (2009); Franchetti <i>et al.</i> , (2011); Terio and Kahkonen (2011); Bailey <i>et al.</i> , (2020); Johnstone (2020)
Increased recycling	Bailey <i>et al.</i> , (2020); Johnstone (2020)
Environmental awareness	Turk (2009); Turk (2012); Ololade and Rametse (2018)
Desire for certification	Turk (2009)
Reduce emissions	Turk (2009)
Commitment to environmental responsibility	Turk (2009)
Reduce environmental incidents	Turk (2009); Bailey <i>et al.</i> , (2020)
Better employee morale	Owolana and Booth (2016); Chiarini (2019); Bailey <i>et al.</i> , (2020)
Employee environmental awareness	Christini <i>et al.</i> , (2004); Rodriguez <i>et al.</i> , (2007); Nguyen and Hens (2015); Yusoff and Nordin (2015); Owolana and Booth (2016); Johnstone (2020)
Employee involvement and collaboration	Chiarini (2019)
Motivated employees	Yusoff and Nordin (2015)
Employee satisfaction	Adetunji <i>et al.</i> , (2003)
Subcontractor relations	Turk (2009)
Involvement of senior management	Tse (2001)
Top management commitment	Chiarini (2019)
Increasing staff skills	Christini <i>et al.</i> , (2004); Yusoff and Nordin (2015); Chiarini (2019)
Better working conditions	Ofori <i>et al.</i> , (2002); Christini <i>et al.</i> , (2004); Turk (2009); Schmidt <i>et al.</i> , (2017); Bailey <i>et al.</i> , (2020)
Efficient operations	Ofori <i>et al.</i> , (2000); Swaffield and Johnson (2005); Turk (2009); Terio and Kahkonen (2011); Johnstone (2020)
Improved quality in product/service	Arena (2012)
Cost savings through process improvements	Ofori <i>et al.</i> , (2002); Valdez and Chini (2002); Turk (2009)
Improve organisational systems	Ball (2002); Christini <i>et al.</i> , (2004); Turk (2009); Terio and Kahkonen (2011);
Increase in efficiency and productivity	Ofori <i>et al.</i> , (2000); Pun <i>et al.</i> , (2001)
Management open to research/criticism	Turk (2009)
Higher productivity	Ofori <i>et al.</i> , (2002)
Standardised processes	Ofori <i>et al.</i> , (2000); Ofori <i>et al.</i> , (2002); Ololade and Rametse (2018)
Improved risk management (H&S)	Bailey <i>et al.</i> (2020); Christini <i>et al.</i> (2004); Ofori <i>et al.</i> (2000); Owolana and Booth (2016)
Corporate management	Quinn (2000); Adetunji <i>et al.</i> , (2003); Christini <i>et al.</i> , (2004); Selih (2007); Turk (2009)
Conformity	Turk (2009)
Flexible	Christini <i>et al.</i> , (2004)
Industry standards	Bailey <i>et al.</i> , (2020)

Compliance with regulations	Kein <i>et al.</i> , (1999); Pun <i>et al.</i> , (2001); Adetunji <i>et al.</i> , (2003); Chen <i>et al.</i> , (2004); Ofori <i>et al.</i> , (2002); Rodriguez <i>et al.</i> , (2007); Selih (2007); Frondel <i>et al.</i> , (2008); Turk (2009); Nguyen and Hens (2015); Dejkovski (2016); Schmidt <i>et al.</i> , (2017); Ololade and Rametse (2018); Johnstone (2020)
Liability threats	Ofori <i>et al.</i> , (2002)
Ensuring legal compliance	Ofori <i>et al.</i> , (2000); Shen and Tam (2002); Dejkovski (2016)
Reduction in fines	Shen and Tam (2002); Adetunji <i>et al.</i> , (2003); Bailey <i>et al.</i> , (2020)
Lower risk of liabilities/due diligence	Adetunji <i>et al.</i> , (2003); Owolana and Booth (2016)
Cost of non-compliance	Adetunji <i>et al.</i> , (2003); Ofori <i>et al.</i> , (2002); Turk (2009); Terio and Kahkonen (2011)
Improved relations with regulators	Valdez and Chini (2002)
Improved community relations	Arena (2012)
Social pressure (community/activists)	Adetunji <i>et al.</i> , (2003); Zeng <i>et al.</i> , (2011)
Increase stakeholder confidence	Turk (2012)
Social legitimacy and responsibility	Turk (2009); Turk (2012); Ololade and Rametse (2018)
Less complaints	Turk (2009); Turk (2012); Bailey <i>et al.</i> , (2020)
Community participation	Shen and Tam (2002)
To improve industry/ government relations	Adetunji <i>et al.</i> , (2003); Arena (2012)
Government support/ incentives	Adetunji <i>et al.</i> , (2003); Selih (2007)

Table 4: List of the known barriers to implementing environmental management systems in the architecture, engineering and construction sectors reported in published articles and reports.

Barriers to implementing environmental management systems in the architecture, engineering and construction sectors	Authors who have reported the benefits
Negative publicity	Terio and Kahkonen (2011)
Purely image building	Curkovic <i>et al.</i> , (2005); Dejkovski (2016)
Open to public scrutiny	Zutshi and Sohal (2004)
Cost	Kein <i>et al.</i> , (1999); Chen <i>et al.</i> , (2000); Ofori <i>et al.</i> , (2000); Tse (2001); Ofori <i>et al.</i> , (2002); Shen and Tam (2002); Valdez and Chini (2002); Babakri <i>et al.</i> , (2003); Chen <i>et al.</i> , (2004); Zutshi and Sohal (2004); Swaffield and Johnson (2005); Rodriguez <i>et al.</i> , (2007); Selih (2007); Lam <i>et al.</i> , (2011); Sakr <i>et al.</i> , (2010); Terio and Kahkonen (2011); Turk (2009); Turk (2012); Campos <i>et al.</i> , (2016); Feng <i>et al.</i> , (2016); Owolana and Booth (2016); Schmidt <i>et al.</i> , (2017); Bailey <i>et al.</i> , (2020)
Costs may be higher than BENEFITS	Ofori <i>et al.</i> , (2000); Ofori <i>et al.</i> , (2002); Shen and Tam (2002); Abdullah and Fuong (2010); Ololade and Rametse (2018); Bailey <i>et al.</i> , (2020)
Doesn't add value	Dejkovski (2016); Ololade and Rametse (2018)

Top management commitment towards implementation	Pun <i>et al.</i> , (2001); Shen and Tam (2002); Babakri <i>et al.</i> , (2003); Turk (2009); Rodriguez <i>et al.</i> , (2011); Ololade and Rametse (2018)
Industry not ready	Kein <i>et al.</i> , (1999)
Setting up management structures	Shen and Tam (2002); Yusoff and Nordin (2015); Owolana and Booth (2016)
Identification of env aspect/impact	Kein <i>et al.</i> , (1999); Abdullah and Fuong (2010)
Little improvement in environmental performance	Kein <i>et al.</i> , (1999); Ofori <i>et al.</i> , (2002); Babakri <i>et al.</i> , (2003); Dejkovski (2016); Johnstone (2020)
Lack of link to EIA	Chen <i>et al.</i> , (2004)
Lack of environmentally sound technology	Tse (2001); Shen and Tam (2002); Owolana and Booth (2016); Bailey <i>et al.</i> , (2020)
Lack of concern over environmental issues	Babakri <i>et al.</i> , (2003); Chen <i>et al.</i> , (2004); Schmidt <i>et al.</i> , (2017)
No environmental improvement	Ofori <i>et al.</i> (2002); Valdez and Chini (2002)
Decreased competitiveness	Shen and Tam (2002)
Existing subcontractor system	Tse (2001); Shen and Tam (2002); Selih (2007); Turk (2009); Sakr <i>et al.</i> , (2010); Bailey <i>et al.</i> , (2020); Johnstone (2020)
Unsuitable standard	Tse (2001); Shen and Tam (2002)
Change of existing practice	Shen and Tam (2002); Zutshi and Sohal (2004); Yusoff and Nordin (2015); Owolana and Booth (2016); Bailey <i>et al.</i> , (2020)
Not required for export	Shen and Tam (2002)
Public not interested	Chen <i>et al.</i> , (2000); Chen <i>et al.</i> , (2004)
Lack of resources	Tse (2001); Babakri <i>et al.</i> , (2003); Rodriguez <i>et al.</i> , (2011); Feng <i>et al.</i> , (2016)
Disruption to workflow	Owolana and Booth (2016)
Bureaucratic	Kein <i>et al.</i> , (1999); Tse (2001); Turk (2009); Tambovceva (2010)
For sales not environmental stuff	Shen and Tam (2002)
Lack of employee involvement	Tse (2001); Shen and Tam (2002); Valdez and Chini (2002); Swaffield and Johnson (2005); Selih (2007); Owolana and Booth (2016); Ololade and Rametse (2018); Bailey <i>et al.</i> , (2020); Johnstone (2020)
Inadequate organisational structure	Shen and Tam (2002); Johnstone (2020)
Employee resistance	Shen and Tam (2002); Babakri <i>et al.</i> , (2003); Turk (2009); Zutshi and Sohal (2004); Owolana and Booth (2016)
Lack of awareness	Ofori <i>et al.</i> , (2002); Zutshi and Sohal (2004); Tambovceva (2010); Ololade and Rametse (2018); Chiarini (2019)
Time	Chen <i>et al.</i> , (2000); Tse (2001); Shen and Tam (2002); Turk (2009); Lam <i>et al.</i> , (2011); Terio and Kahkonen (2011); Owolana and Booth (2016); Bailey <i>et al.</i> , (2020)
Audits	Shen and Tam (2002)
Documentation	Tse (2001); Shen and Tam (2002); Zutshi and Sohal (2004); Selih (2007); Turk (2009); Owolana and Booth (2016); Schmidt <i>et al.</i> , (2017); Bailey <i>et al.</i> , (2020)
Can use ISO 9000 to deliver objectives	Ofori <i>et al.</i> , (2000); Ofori <i>et al.</i> , (2002); Turk (2012)
Complexity of standards	Turk (2009)
Lack of knowledge about ISO 14001	Kein <i>et al.</i> , (1999); Shen and Tam (2002); Valdez and Chini (2002); Turk (2009); Turk (2012); Schmidt <i>et al.</i> , (2017); Ololade and Rametse (2018)
Lack of support	Owolana and Booth (2016)
Uncertainty of benefits	Ofori <i>et al.</i> , (2000); Ofori <i>et al.</i> , (2002); Babakri <i>et al.</i> , (2003); Turk (2012); Campos <i>et al.</i> , (2016)
Lack of incentives	Ofori <i>et al.</i> , (2002); Shen and Tam (2002); Turk (2012); Bailey <i>et al.</i> (2020)
Relies on peer pressure and management incentives, which may be ineffective	Shen and Tam (2002)
No major impacts in the sector	Shen and Tam (2002); Ololade and Rametse (2018)

Lack of guidelines	Shen and Tam (2002); Ololade and Rametse (2018)
Incompatible subcontracting systems	Tse (2001); Shen and Tam (2002); Owolana and Booth (2016); Bailey <i>et al.</i> , (2020)
Suppliers and subcontractors must also improve	Shen and Tam (2002); Zutshi and Sohal (2004); Swaffield and Johnson (2005); Owolana and Booth (2016) Bailey <i>et al.</i> , (2020)
Competitive pressures	Shen and Tam (2002)
Lack of stakeholder support	Ofori <i>et al.</i> , (2000); Tse (2001); Ofori <i>et al.</i> , (2002); Shen and Tam (2002); Tse (2001); Zutshi and Sohal (2004); Selih (2007); Turk (2009); Turk (2012); Owolana and Booth (2016); Bailey <i>et al.</i> , (2020); Johnstone (2020)
Lack of stakeholder demand or pressure	Kein <i>et al.</i> , (1999); Ofori <i>et al.</i> , (2000); Tse (2001); Shen and Tam (2002); Selih (2007); Turk (2009); Owolana and Booth (2016); Schmidt <i>et al.</i> , (2017); Bailey <i>et al.</i> , (2020)
Separate design and build	Selih (2007)
Lack of rigour	Lam <i>et al.</i> , (2011)
Focus on process, not results	Shen and Tam (2002)
Change is stressful	Bailey <i>et al.</i> , (2020)
Sector is weak in terms of environment	Kein <i>et al.</i> , (1999); Tse (2001); Shen and Tam (2002); Selih (2007); Ololade and Rametse (2018)
Risk low	Shen and Tam (2002)
Lack of materials/technology	Tse (2001); Selih (2007); Owolana and Booth (2016)
Need for tailor made training	Tse (2001); Shen and Tam (2002); Yusoff and Nordin (2015); Owolana and Booth (2016); Bailey <i>et al.</i> , (2020)
Lack of experienced consultants	Ofori <i>et al.</i> , (2000)
Lack of experience	Shen and Tam (2002); Rodriguez <i>et al.</i> , (2011); Turk (2012); Owolana and Booth (2016)
Lack of expertise	Ofori <i>et al.</i> , (2000); Ofori <i>et al.</i> , (2002); Shen and Tam (2002); Zutshi and Sohal (2004); Turk (2009); Sakr <i>et al.</i> , (2010); Tambovceva (2010); Turk (2012); Campos <i>et al.</i> , (2016); Owolana and Booth (2016); Schmidt <i>et al.</i> , (2017); Ololade and Rametse (2018); Bailey <i>et al.</i> , (2020)
Lack of training	Tse (2001); Babakri <i>et al.</i> , (2003); Zutshi and Sohal (2004); Swaffield and Johnson (2005); Turk (2009); Rodriguez <i>et al.</i> , (2011); Yusoff and Nordin (2015); Owolana and Booth (2016); Schmidt <i>et al.</i> , (2017); Ololade and Rametse (2018); Bailey <i>et al.</i> , (2020)
Lack of knowledge	Ofori <i>et al.</i> , (2002); Shen and Tam (2002); Zutshi and Sohal (2004); Sakr <i>et al.</i> , (2010); Tambovceva (2010); Turk (2012); Ololade and Rametse (2018)
Legal ramifications	Terio and Kahkonen (2011)
Legal issues resulting	Terio and Kahkonen (2011)
Legal compliance	Kein <i>et al.</i> , (1999)
No mechanical control	Ball (2002)

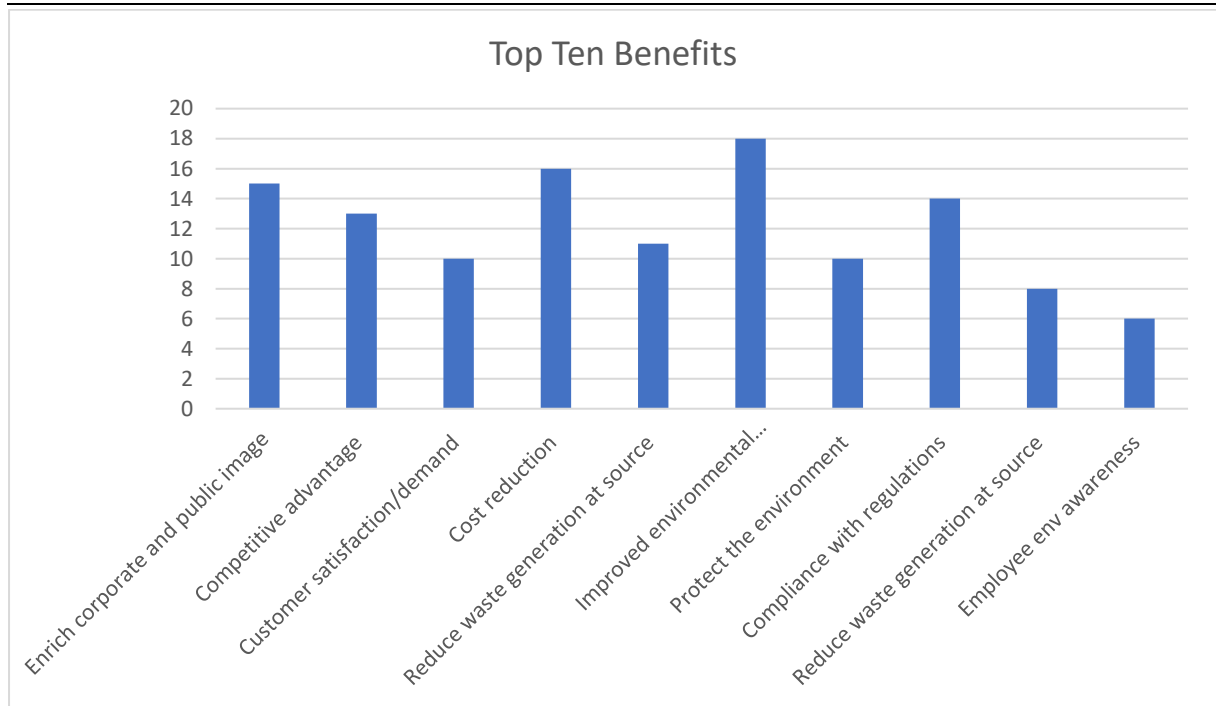


Figure 3 – Top 10 most frequently reported benefits of implementing environmental management systems in the Architecture, Engineering and Construction sectors

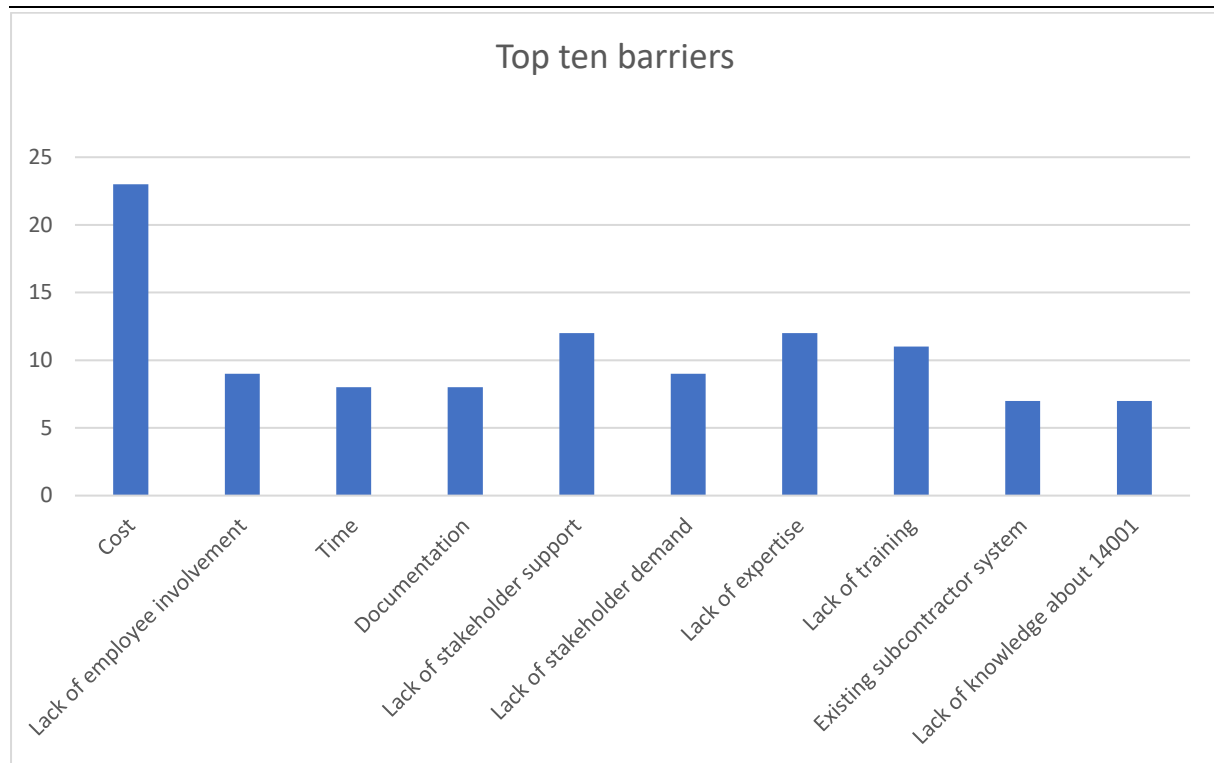


Figure 4: Top 10 most frequently reported barriers to implementing environmental management systems in the Architecture, Engineering and Construction sectors

It is noteworthy to mention that during the review process it became clear that the benefits and barriers can differ depending on the sector and also the maturity of the sector in terms of their environmental engagement. However, common themes were found. Researchers have highlighted the economic benefits to an organisation who choose to engage in ISO 14001 (Pokinski *et al.*, 2003; Gavronski *et al.*, 2008) and the environmental benefits have tended to be those that focus on cost or material savings (Haklik, 1997; Hibiki and Animura, 2011), such as using less energy, lower waste charges, reduction in the materials used and ensuring legal compliance, thereby avoiding fines. This is the traditional economic business approach that has existed for many years, however, there is an increasing change in focus and a questioning within society as to whether pure economic benefit should be the aim. In terms of ISO 14001 traditionally it has been used to focus on the significant aspects of the company's operations and how the negative impacts can be mitigated. A change in perspective to how positive impacts can be instigated would help deliver on projects connected to the SDGs. However, as it is the companies who choose what the focus of their operation is and whether they choose to be sustainable or not, there would need to be an incentive to enable more to choose the more altruistic options. For instance, a grading to all ISO 14001 certificates that demonstrated

a company's contribution to global issues, this may encourage more engagement in the SDG objectives.

In terms of the research into the barriers to engagement with ISO 14001, the research found the majority were in the construction sector but with a greater variety in the countries involved. Of the 63 barriers to implementation that were highlighted in the papers, these would need to be considered in future research as potential limiting factors to the delivery of the SDGs.

As can be seen, the one of the most often cited barriers is that of keeping pace with requirements: either of the standard or legal variety. These top barriers were closely followed by the need to have environmental expertise, the obvious cost involved and the lack of perceived value. All these barriers will potentially also impact on a company's willingness to engage with the SDGs as these may also be an issue in respect of the actions required to make a positive impact.

The SDGs cover a range of sustainability issues with many underlying targets in the topic areas. From these issues it was possible to map against the benefits of ISO 14001 to establish that the same benefits could be achieved while making a positive societal image. The SDGs (Table 1) were then mapped against the benefits to create the roadmap. The aim of the roadmap is to enable the sector to map their contribution to sustainability and to highlight the positive impacts that can be delivered through their operations. Thus, it can be seen that using the SDGs in areas of operation it is possible that they can also deliver the benefits of engaging with ISO 14001, so the same reasons potentially exist for working on SDGs as they do for working on the EMS. The difference would be that the SDGs enable an organisation to engage positively with the sustainability agenda outside the walls of their organisation and be seen to be making a positive difference to society as a whole.

4.2 Validation of the identified benefits and barriers of implementing EMS in AEC sectors

The lists of benefits and barriers (Tables 3 and 4) extracted from the literature were presented to IEMA experts to 'sign-off' as being accurate and complete. The profiles of the participants show they are all IEMA members, with the minimum of a Bachelor degree and they have all been working in environmental management roles for more than five years (Table 5).

All participants (100%; n=25) confirm both lists are accurate. Most participants (84%; n=21) agree that both lists are complete. Some participants kindly qualified their responses to the completeness questions by suggesting that there are other known benefits and barriers outside those extracted from the AEC literature. Whilst this is duly acknowledged, this study is focussed solely on the AEC sectors so inclusion of benefits and barriers outside the AEC sectors would not be appropriate for the purpose of inclusion in the roadmap output from this study.

Table 5: Participant profiles of the Environmental Management professionals used to validate the lists of benefits and barriers identified in the literature review

Participant	Highest academic achievement	Environmental professional body membership	Years of professional environmental or sustainability experience
1	MSc	IEMA	6-10 years
2	MSc	IEMA	11-15 years
3	MSc	IEMA	6-10 years
4	MSc	IEMA	11-15 years
5	MSc	IEMA	>20 years
6	MSc	IEMA	11-15 years
7	BSc	IEMA	>20 years
8	MSc	IEMA	11-15 years
9	MSc	IEMA	11-15 years
10	MSc	IEMA	6-10 years
11	MSc	IEMA	6-10 years
12	MSc	IEMA	6-10 years
13	MSc	IEMA	6-10 years
14	MSc	IEMA	11-15 years
15	MSc	IEMA	6-10 years
16	MSc	IEMA	6-10 years
17	MSc	IEMA	6-10 years
18	MSc	IEMA	6-10 years
19	MSc	IEMA	6-10 years
20	MBA	IEMA	>20 years
21	MSc	IEMA	11-15 years
22	MSc	IEMA	6-10 years
23	MSc	IEMA	6-10 years
24	MSc	IEMA	6-10 years
25	MSc	IEMA	6-10 years

4.3 Creation of a Roadmap to deliver the SDGs

The roadmap was created by mapping the benefits of ISO 14001 against the SDGs to ascertain which benefits would be delivered by working on the SDGs. The roadmap (Figure 5) shows 1,462 total potential cells where benefits could be achieved of which 503 were considered to produce a tangible opportunity to the organisation. Blank cells have been excluded due to their minimal cost benefit profile and hence the following percentages are calculated from the more realisable benefits. Most of these are green (74%, n=372), suggesting there are more achievable opportunities for AEC organisations operating EMS to contribute to the delivery of the SDGs and these could be achieved quite swiftly. There are blue coloured cells (equating to 21%) and grey coloured cells (equating to 5%) for the medium- and longer-term benefits.

As can be seen all the EMS benefits have linkages across to the SDGs. SDGs 8, 12 and 13, link with at least one of the sub-benefits for each of the group benefits. SDG 8 links with the

greatest number of sub-benefits (n=59), while SDG 2 links with the least number of sub-benefits (n=12). All SDGs link with at least ten of the sub-benefits, with four (SDG 4, 8, 12 and 13) linking with at least half of the benefits. The public relations, market and social group benefits link to the most SDGs (mostly 5, 8, 10, 12). In terms of the sub-benefits: customer satisfaction, commitment to environmental responsibility, green image, improved community relations and improved industry/government relations link to the most SDGs (mostly 3, 5, 10, 12, 13).

Benefits	Sub-benefits	1 People 	2 Energy 	3 Environment 	4 Education 	5 Gender 	6 Community 	7 Innovation 	8 Economic 	9 Social 	10 Culture 	11 Infrastructure 	12 Communication 	13 Health 	14 Education 	15 Environment 	16 Social 	17 Economic 
PR	Enrich corporate and public image																	
	Enhance image with legislators																	
	Improve relationships with stakeholders																	
	Credibility of the organisation																	
	Green image																	
	Reduced complaints																	
	Market differentiation																	
MARKET	Investor confidence																	
	Competitive advantage																	
	Long term competitiveness																	
	Higher profits																	
	Market based pressures																	
	Stakeholder pressure																	
	New market opportunities																	
	Tender requirement																	
	Equal access to green market																	
	Facilitate trade																	
	Pressure from competitors																	
	Remove trade barriers																	
	To increased market share																	
COST	Customer satisfaction																	
	Improved customer perception																	
	Customer trust																	
ENVIRONMENT	Cost reduction																	
	Lower insurance costs																	
	Cost savings through energy efficiency																	
	Reduce resources used																	
	Reduced carbon footprint																	
	Reduce waste generation at source																	
	Save costs related to water use																	
	Better environmental information flow																	
	Continuous improvement																	
	Reduction in pollutants																	
	Monitor and measure supplier performance																	
	Environmental impact reversal awareness																	
	Improved environmental performance																	
	Pollution prevention																	
	Increase public awareness of env issues																	
	Reduced env impact																	
	Reduced environmental risks																	
Protect the environment																		
Reduce waste generation at source																		

Benefits	Sub-benefits	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
ENVIRO	Increased recycling																	
	Environmental awareness																	
	Desire for certification																	
	Reduce emissions																	
	Commitment to environmental responsibility																	
WORKFORCE	Reduce environmental incidents																	
	Better employee morale																	
	Employee env awareness																	
	Employee involvement and collaboration																	
	Motivated employees																	
	Employee satisfaction																	
	Subcontractor relations																	
	Involvement of senior management																	
	Top management commitment																	
	Increasing staff skills																	
OPERATIONS	Better working conditions																	
	Efficient operations																	
	Improved quality in product/service																	
	Cost savings through process improvements																	
	Improve organisational systems																	
	Increase in efficiency and productivity																	
	Management open to research/criticism																	
	Higher productivity																	
	Standardised processes																	
	Improved risk management (H&S)																	
LEGAL	Corporate management																	
	Conformity																	
	Flexible																	
	Industry standards																	
	Compliance with regulations																	
	Liability threats																	
	Ensuring legal compliance																	
	Reduction in fines																	
	Lower risk of liabilities/due diligence																	
	Cost of non-compliance																	
SOCIAL	Improved relations with regulators																	
	Improved community relations																	
	Social pressure (community/activists)																	
	Increase stakeholder confidence																	
	Social legitimacy and responsibility																	
	Less complaints																	
	Community participation																	
	To improve industry/ government relations																	
	Government support/ incentives																	

Figure 5: Roadmap of how EMS benefits link to the SDGs (Green block = short-term achievement; Blue block = medium-term achievement; Grey block = long-term achievement) resources

4.4 Validation of the roadmap

After the roadmap was designed it was presented to a group of AEC industry experts to validate. These experts were from each of the AEC sectors and all met and/or exceeded each of the participant criteria detailed earlier. As with a similar study (Ezekannagha *et al.*, 2020), where validation was sought, a small cohort of participants were invited because the profile of the experts was deemed to be an overriding factor in the validation process. Table 6 shows the professional requirements for the nine experts who shared their thoughts and opinions of the roadmap. It also shows most experts have between 6-10 years' experience working in the AEC sectors and in some cases participants have even more experience in the sectors. All have worked on sustainability projects and everyone had a minimum of a Bachelor degree, with the majority qualified above this level.

Table 6: Participant profiles of the Architecture, Engineering and Construction sector professionals used to validate the roadmap

Participant	AEC sector	Years of professional experience	Highest academic achievement	Professional body membership	Years of professional environmental or sustainability experience
1	Architecture	>20 years	RIBA part 3	ARB	<1 year
2	Architecture	1-5 years	MSc	CIAT	<1 year
3	Architecture	6-10 years	MSc	RIBA	6-10 years
4	Engineering	6-10 years	MSc	CIBSE	1-5 years
5	Architecture	1-5 years	BSc	CIAT	1-5 years
6	Construction	>20 years	MSc	CIOB	16-20 years
7	Engineering	6-10 years	PhD	ICE	<1 year
8	Construction	>20 years	MSc	ICE	6-10 years
9	Engineering	6-10 years	PhD	IMechE	1-5 years
10	Engineering	>20 years	MSc	IMechE	11-15 years
11	Construction	6-10 years	BSc	ICE	6-10 years
12	Construction	1-5 years	MSc	CIBSE, ICE, CIOB	1-5 years

They were invited to review the document and to make comment (Table 8) about the usefulness of this in assisting organisations to engage with the SDG agenda.

While the majority of the participants thought that the roadmap was useful there were requests for instructions for the roadmap to make the process simpler. This roadmap tool was thought to be of use in one of two ways, depending on if the focus is on achieving the SDGs where it will show the potential benefits of this or, if the objective is to gain the benefits and therefore see which SDGs would help in the achievement of these. In terms of the green, blue and grey blocks, the green blocks are mapped to areas which are closely linked to the sector and would be easiest to achieve in the short term. The blue blocks tend to be areas outside the standard operations of this sector and will therefore require collaboration with other parties to deliver on the goal. The grey blocks are areas where it is more likely to be longer term before benefits are seen, as in the case of partnerships where the stakeholders may not be at the same point of the journey towards sustainability and therefore may not wish to be involved at the moment but in the long-term things will probably change.

5. DISCUSSION

The SDGs are a way for organisations to focus on the economic, environmental and societal needs of the planet. As a whole they may appear a huge challenge but if all organisations contributed, the combined effect would be increased. The roadmap is a method to enable organisations to consider what they are achieving through their EMS and to establish how they can achieve similar benefits while having an increased impact on the global issues. In many cases this could bring bigger rewards in terms of positive public relations and reputational issues, while demonstrating to the customers a genuine impact on societal issues and the positive well-being of their staff and neighbouring communities.

To enable this to happen there needs to be a clear understanding of which SDGs will be the easiest to target first. While other researchers have highlighted SDG 1, 9 and 11 (Lynch and Mosbah, 2017) 7, 12 and 13 (Goubran *et al.*, 2019) it is suggested here that first and foremost the AEC sectors should be focusing on SDG 4 – quality education to ensure that the workforce understands about the environment and sustainability, SDG 8 – decent work and economic growth, 12 – responsible consumption and 13 – climate action. If these are combined with SDG 17, which is partnership for goals, this would enable construction companies, architects, planners and government to work together to make sustainability possible. As previously noted, the construction sector has a huge potential to impact on the sustainability of society in a positive or negative manner. This roadmap is a method to improve the performance of this sector in delivering positive impacts for society. It should be acknowledged that there will be restrictions in terms of how companies can engage. Some will not have the finances or staff to make huge impacts such as SMEs due to their size, but every person and every organisation can make some impact. It may be that they focus on small positive steps to move to a more sustainable agenda within their strategy or work on a local project. But whatever they do, there is clear interest in terms of sustainability from the general public (Erdil *et al.*, 2018) and this will only increase over time. Currently there are huge threats in terms of biodiversity, food and health throughout the world (Daszak *et al.*, 2000) and the SDGs will help as a global society focus on improving our interactions (Georgeson *et al.* 2017) and how we can maintain work to improve the issues.

6. CONCLUSIONS

Literature shows there is worldwide interest in the adoption of sustainable practices within the AEC sectors. Therefore, it is proposed that a need exists for an amalgamated approach that is relevant for the sectors and all organisations working within them. In terms of the benefits and barriers these are similar to research that has been conducted in other industry sectors. This study has highlighted an extensive list of benefits to support the implementation of ISO 14001 within the AEC sectors, and while it is acknowledged that there are also barriers, to move forward in a sustainable manner the framework of ISO 14001 would enable companies to focus on delivery of SDG objectives. This linking of the benefits to the SDGs in a roadmap has shown how organisations could help in the delivery of the SDGs. As more people are pushing for a green return following the Coronavirus pandemic, there seems to be an increasing interest in the environment. Along with this there is a general desire amongst the population for sectors to be seen as being more responsible in terms of sustainability. The market mechanisms, however, limit the options in terms of what can be delivered, and it is suggested here that the standards could be used more effectively. One potential way forward is for the professional bodies to push for a level to be created for their individual sectors, that companies could then sign up to. A gold standard: they could gain a sector specific badge, meaning, that while organisations can use an EMS for the benefit of the impacts of the organisation and monitoring of their progress; they could also utilise it to demonstrate their commitment to the SDGs, by going above and beyond the standard.

If the AEC sectors are to play a leading role in the journey to sustainable development, there is a need to work towards a clear delivery plan for achieving the SDGs. This would help to ensure not just environmental survival but social and economic success against issues such as climate change and the resultant migration of populations. The sectors as a whole, need to work on the SDGs and to align with the 5 Ps: people, planet, prosperity, peace and partnership, which require actions to be taken by a range of stakeholders including governments and businesses to go beyond the purely environmental objectives of sustainable development. This provides a huge opportunity for the AEC sectors to be ahead of the curve in terms of using the roadmap to help demonstrate the economic viability of delivery of the SDGs.

As the SDGs will benefit society as a whole, it must be remembered that the achievement of these goals will result in an increased standard of living for all; everyone will benefit. Going forward it would be useful to understand:

- The impact of the roadmap when used by an organisation to focus on the delivery of the most relevant SDGs.
- An investigation into the opportunities and challenges of using the roadmap within the sector.
- Whether the roadmap changes an organisations perspective on the deliverability of the SDGs.
- Whether the roadmap could be focused on the national and local issues to gain a true perspective of where society is in terms of sustainability.
- How the roadmap could be used in other sectors that have an impact on a global scale.
- How the barriers to implementation of ISO 14001 may delay the delivery of SDGs through businesses.

Industries such as construction rely on the environment for their business and, therefore, it would be expected that they should be amenable to promoting sustainability, not just in terms of their operations but also in terms of how they interact with the communities that are situated in the area of their operations. More research is also needed in the application of the roadmap in practical terms to test the validity of the design and use. It is suggested that this should be a first step to understand the usefulness of the roadmap in helping organisations assess where they can make positive changes and how these can be highlighted to stakeholders.

This roadmap will promote involvement with the local community, which will allow stakeholders to have an increasingly transparent view of the company's sustainable performance. It would enable the process to highlight any conflicts that had occurred and how the response to these conflicts was appropriate and had been justified. This would result in a system which not only enables the SDGs to be worked towards on a global scale, but also the actions and impacts of those organisations who are engaging can be measured, recorded and actions justified, benefiting society, the environment and also the economic performance of the organisation involved. Data provided to the sector bodies from the organisations would

deliver more information on how their particular sectors are progressing in terms of the SDGs and demonstrate to all stakeholders which sectors and particular organisations are truly committed to sustainability.

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INTRODUCTION

ISO 14001 is a means of managing the environmental impacts of an organisation. The International Organization for Standardization (ISO), who created this standard has published numerous standards and other documents through international collaboration. These standards aim to support the economic, environmental, and social pillars of sustainable development, and a document has also been issued by ISO stating how these standards contribute to the UN Sustainable Development Goals and how they can help to transform our world, as proposed in the United Nations 2030 Agenda (Edenhofer, 2014). While many traditionalists still see ISO 14001 as a compliance standard (Fonseca *et al.*, 2017), where the focus is on, for example, discharge consents and waste management legislation, it must be remembered that this is a system and, as such, can be adapted to whatever is required by the organisation using it. That is, in many respects, the beauty of these standards is that it is the organisation that decides on the aims and objectives that they wish to deliver. So this type of standard can be used to implement work to support the delivery of the SDGs (Topple *et al.*, 2017; Morioka *et al.*, 2017; Horry *et al.*, 2022).

As stated, ISO 14001 has been used over the years since its creation to ensure compliance with relevant environmental legislation, reduce waste, minimise resource use and improve corporate reputation (Zeng *et al.*, 2005; Fonseca and Domingues, 2018). Cost savings have been reported as being one of the major benefits in terms of materials/resources saved, along with improved customer satisfaction and reduced pollution, but this requires knowledgeable staff.

As one of the main barriers is cited as being lack of knowledge and the need for training, the primary question should be what do the workforce need to know to enable them to engage with not only ISO 14001 but also sustainable resource use and SDG12? A good starting point may be for them to understand the history of sustainability, and how society has reached this point. This basically can be shown as the idea of sustainability gaining momentum in 1989 when the United Nations World Commission on Environment and Development released the "*Our Common Future*" report, also known as the Brundtland report (UN, 2022). This brought to the public's attention the idea of sustainable development. Despite the time that has elapsed since this date governments and other organisations are still trying to find ways to promote this work from the use of legislation, guidance and voluntary standards. However, this may cause more questions, in relation to why is it not being delivered? Why are we doing it if others are not? This then needs to be justified and an explanation of the history may help to highlight the issues which have existed over the years. Agenda 21 followed on from the Rio Conference in 1992 as noted by Spangenberg *et al.* (2002) this came a few years after the

Brundtland report was released, and proposed ways that society could be more sustainable. However, a serious challenge existed, in relation to the delivery of the proposals which were initially put forward in the Brundtland Report: to ensure not only economic development, but also social development, and environmental protection. The idea was that the world's population was to be provided with an improved standard of living while also protecting the environment. The proposals, at the time, required a huge shift in the way that society had for many years been operating and a shift from a purely economic based agenda, to one with more equitable values. The journey towards sustainable development with Agenda 21 has been ongoing, but more action was needed. This appeared in the form of the MDGs and then the updated SDGs. The focus in this chapter is that of SDG12.

SDG-12 is responsible for ensuring responsible consumption and production patterns. However, it must be questioned as to whether it is possible for this to be achieved in a world with so many differing sectors where the usual economic processes focus on profit rather than the triple bottom line. In this chapter to answer that issue the construction sector will be used as an example. Construction in the UK is thought to produce 47% of the total CO₂ emissions (BIS, 2010), the sector uses many non-renewable materials such as clay and limestone. The production of cement globally is the third highest manmade producer of CO₂ (Andrew, 2018), following transport and energy production. One tonne of cement causes 780kg of CO₂ (Tang *et al.*, 2021), so it is not only the raw materials but also the amount of CO₂ produced that requires this sector to closely examine its operations, material choices and responsible consumption overall. Then of course consideration must be given to the waste; it is estimated that 10-15% of building materials are wasted, another valuable resource lost. So as a sector construction uses a vast array of resources, it would be sensible both in economic and sustainability terms for them to ascertain how they can contribute to the delivery of the targets within SDG-12. To do this firstly it would be necessary to ascertain the resources they are using, where these are sourced from and whether they are renewable or non-renewable and then to examine the practicality of reducing the consumption. So, to enable the investigation of these factors a construction business could take a systems approach. One such approach could be to adopt an environmental management system such as ISO 14001, where the aspects/impacts of the business operations are a major focus which would include the non-renewable resources used and the waste produced. This chapter will explore the benefits and barriers of implementing environmental management systems in the construction sector and demonstrating how ISO 14001 and its associated training towards sustainability are key in facilitating the delivery of SDG-12.

THE EARTH'S FINITE RESOURCES

The Earth is one planet with a population of over 8.0 billion people who all want and deserve a certain standard of living and housing. Existing approaches and lifestyle to support the global population are putting a huge strain on the planet's natural resources. The building of houses, workplaces, and infrastructure are amongst the deliverables of the construction industry. The construction sector is the largest consumer of energy, globally consuming 1/3 of the absolute energy consumption and, as a result, producing a considerable amount of CO₂. As a society we cannot just assume that resources will always be available as a society. Therefore,

consideration must be given as to whether alternative design methods and construction materials or materials and approaches to construction be given serious consideration to reduce the demand on the precious resources used particularly those that are non-renewable. If everyone on the planet were to achieve the same standards of living a huge number of resources would be required, so to enable equity there must be some changes in the way that society manages these actions, to ensure parity for all without stripping the planet of every resource there is. Developed nations will need to re-examine their thoughts and ideas concerning what is a normal build, they will need to consider the implications of their actions and that the global resources are just that global and, therefore, not to be just supplied to the highest bidder but shared equitably between all. This means that as a global society, consideration must be given to not only how to ensure equity amongst the population but also that some people will need to reassess how they live, and companies will need to discover new and innovative means of ensuring that material resources are not just used once and then discarded. The construction sector uses a huge number of materials, but it is also increasingly known for reusing them when buildings are demolished. In fact, some modern buildings are now designed with foresight to follow cradle-to-cradle principles (Booth *et al.*, 2012); whereby, timbers are pre-marked at the construction stage to later indicate to demolish teams where to cut at the dismantling stage so as to salvage the most material. So, in this respect, the AEC sector is being responsible concerning the reuse aspect of the waste hierarchy. Still, the way the construction operates may not be the best in terms of the use of resources or the production of CO₂ resulting from the production of those resources for example concrete.

Waste

Prevention is the most preferred option of the waste hierarchy (Figure 1); if we have a closed-loop approach to construction where all resources are reused, it could be said that it fits in the prevention sector, although realistically, there will always be some waste, so it is more reduced waste. However, that is better than just disposing of the waste by either landfill or incineration. This type of approach does require more thought and leads from a cradle-to-grave lifecycle approach to a cradle-to-cradle thought process. Some construction firms have embraced this option and have set up recycling companies as part of their operations where builders and the public can source bricks, timber and other building materials that are pre-used. So not just reducing the waste but making a profit from these items and considering responsible consumption. A win-win. However, there are others where the demolition was just crushed. While this is then reused as an aggregate, the question, which needs to be considered, is whether this is the best option for responsible consumption. This is one reason why SDG-12 is about how we approach responsible resource use and consumption.

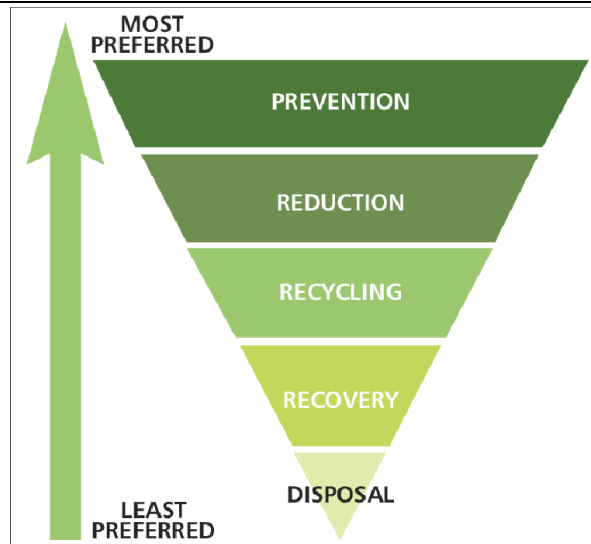


Figure 14.1: Diagram of the waste hierarchy (Tech Recycle, 2023)

Delivering the Sustainable Development Goals (SDGs)

The UN SDGs are goals that followed on from the UN MDGs as previously mentioned but rather than focusing purely on human benefits they are a mix of economic, social, and environmental development objectives with themes, such as the focus of this chapter that of Resource Consumption to combat climate change and its impacts by 2030 (Rosati and Faria, 2019). The SDGs are designed to encourage and enable sustainable development for society (UN, 2022). Topple *et al.* (2017) investigated how businesses were implementing SDGs and noted that multinational organisations were choosing to engage with the SDGs and extending this to their supply chains, be they based in the developed or developing world and that this leadership provides a means of encouraging more sustainable practices (Ball *et al.*, 2022). However, questions still exist as to how organisations can measure their performance concerning the delivery of these objectives (Stafford-Smith *et al.*, 2017).

This type of approach demonstrates the need to move from purely managing the environment, which can be very focused on limits and measurable targets for achievement, to sustainability, which is more nebulous, but this will not be achieved without addressing many challenges. Govindan *et al.* (2013) noted a significant challenge is how to bring into being the findings of the Brundtland Report, while Robert *et al.* (2005) were concerned about how sustainability can be measured. Maybe, however, it is not about how it can be measured but more about what is the right thing to do; what is the responsibility of the organisation to the environment and society as a whole?

ENVIRONMENTAL MANAGEMENT SYSTEMS

ISO 14001 is a voluntary environmental management system (EMS), which was originally set up in 1996 and has been updated in both 2004 and 2015. An EMS sets out to provide a

framework, by which organisations can manage their environmental aspects and impacts to ensure that they comply with legislation, prevent pollution, and continually improve on their performance. As noted by BSi (2015), an EMS aims to enable organisations to prevent pollution, deliver continual improvement and comply with legislation. A major selling point of ISO 14001 is that it is flexible, leaving companies to decide what issues they wish to focus on and how they go about approaching those issues. The standards aim to delivery continual improvement but do not actually specify a level of improvement or harm reduction (i.e., pollution prevention) and have been accused of not delivering sustainability (Brown, 2016). Jones and Laquidara–Car (2018) have suggested that the standards are being used to create economic value, cost savings or increased market share and opportunities for business rather than environmental improvements.

Studies since 2000 have examine the benefits and barriers to the use of this system for managing the environmental impacts of companies' operations (Shen and Tam, 2002; Owolana and Booth, 2016; Bailey *et al.*, 2021). However, in considering the benefits and barriers it is essential to remember that businesses exist to make money, if they are not economically successful, they will fail and cease to exist. As Drucker (1953 p11) notes *"business management has failed if it does not produce economic results"*. So, while businesses should protect the environment and do good in society, there is a primary need for them to be economically viable. However, if consideration is given to this last point, are environment protection, societal benefit, and economic survival that far apart? If consideration is given to this in relation to SDG-12, it could be inferred that responsible consumption is about using resources in the most efficient manner, reducing waste, reusing materials where and whenever possible, sourcing locally and, thereby, reducing transport costs, looking to use less materials and, therefore, again reducing costs. If the consideration is given to the benefits of using an EMS, it can be seen that cost savings are again an important benefit (Owolana and Booth, 2016; Bailey *et al.*, 2021).

It is accepted that businesses do of course exist to produce an economic benefit to society, but this does not exclude them from making other positive contributions in relation to society and the environment. To enable this to happen they need a mechanism to monitor and gauge their progress against. It has been noted in research that potential links exist between environmental rating tools and the SDGs (Gibberd, 2015; Alawneh *et al.*, 2018). Gibberd (2015) proposed a combination of the ecological footprint criteria and the Human development index to bring about a BEST index. While Alawaneh *et al.* (2018) combined a water and energy efficiency method, which could be developed to assess and improve United Nations (UN) SDGs delivery. However, this work on the SDGs must be considered in relation to the risk that any potential benefit has and that any benefit, which is achieved should not always be the lowest hanging fruit as a public relations (PR) tool, but that it must be to improve the organisations performance in relation to social, economic, and environmental objectives. This caused the suggestion that standards that are delivering on sustainability are actual market mechanisms, e.g., carbon trading (Bon and Hutchinson, 2010).

Putting that issue aside for a moment, it is possible to do both, to make a profit, benefit economically and still deliver on sustainability. In respect of the construction sector, Lynch

and Mosbah (2017) reviewed how the construction sector could contribute to the delivery of SDGs highlighting SDG-1 (no poverty), SDG-9 (industry, innovation, and infrastructure) and SDG-11 (sustainable cities and communities). However, it is Goubran *et al.* (2019) who also note that buildings play a part in the use of renewable energy (SDG-7), and in the SDG of interest here that of SDG-12 sustainable consumption and production, but while this chapter focuses on SDG-12 it is noted that there may be issues with organisations purely focusing on one SDG as their work to improve that singular objective may have negative impacts on other targets (Moyer *et al.*, 2018; Allen *et al.*, 2019).

For companies that are undergoing any phase of change the primary reason for engaging in that change is the benefits, which will be delivered because of the actions taken. Table 1 provides a breakdown of the most often cited benefits of engaging in ISO 14001, most notably: improved environmental performance (Owolana and Booth, 2016), improved corporate image (Turk 2009, 2012) and compliance with regulations (Turk, 2009; Johnson, 2020); whilst, some of the least reported ones are: subcontractor relations (Turk, 2009) and to facilitate trade (Sakr *et al.*, 2010). However, it is the barriers that are of most interest in relation to how these may prevent or slow the delivery of SDG-12 (Table 2). The most often reported barriers are cost (Babakri *et al.*, 2003; Johnson 2020), lack of expertise and training (Turk, 2012; Schmidt and Osebold, 2017). These are of particular importance to the discussions later in this chapter. However, before we go on to look at these issues, we should also note the least reported barriers are the industry not being ready (Kein *et al.*, 1999) and the complexity of the standards (Turk 2009), which could also be linked to a lack of training or understanding. Therefore, to examine in more detail, the issues of lack of expertise and training (Turk, 2009; Schmidt and Osebold, 2017), and the complexity of the standards (Turk, 2009) consideration needs to be given by each individual company as to where the skills and knowledge of their staff lie or more importantly where there are gaps in knowledge and understanding.

It is conceivable that training is required to deliver on SDG-12 in relation to responsible consumption but the issue also links to SDG-4 (the need for quality education). Therefore, within an organisation by providing training for the staff to improve the resource efficiency this also helps them to make an impact in relation to the delivery of SDG-4 but that is not all, due to the links that exist between the SDGs this would also contribute to decent work and economic growth (SDG-8) as any organisation that engages with these issues will be seen by potential employees as being better places to work. So, while the focus of this chapter is on the delivery of SDG-12, there are opportunities to make concomitant improvements in other areas.

Table 14.1: Top ten benefits of ISO 14001 in the AEC sector (based on Horry et al., 2022)

#	Benefits
1	Improved environmental performance
2	Cost reduction
3	Enrich corporate and public image
4	Compliance with regulations
5	Competitive advantage
6	Reduce waste generation at source
7	Customer satisfaction/demand
8	Protect the environment
9	Employee environmental awareness
10	Reduced environmental impacts

Table 14.2: Top ten barriers of ISO 14001 in the AEC sector (based on Horry et al., 2022)

#	Barriers
1	Cost
2	Lack of stakeholder support
3	Lack of expertise
4	Lack of training
5	Lack of stakeholder demand
6	Lack of employee involvement
7	Time
8	Documentation
9	Lack of knowledge about ISO 14001
10	Existing subcontractor system

While there are many barriers cited for lack of engagement with ISO 14001 (Table 2), those most frequently reported can be rectified with training and, in doing so, will increase the environmental awareness of employees. Environmental awareness is listed as a benefit of using an EMS (Table 1). The same, therefore, by inference, must be the case in relation to the SDGs as if employees are unaware of the environmental issues, then they will also be unsure of the wider sustainability issues represented within the SDGs.

The benefits that can be experienced by an organisation engaging in this would be similar to those seen in the use of ISO 14001 not only has it been shown that employees recognise when they are being valued by company, for example, through the training provided to improve their knowledge and skills, which in turn encourages them to perform to a higher

level within their day-to-day tasks. It is acknowledged that a workforce is a valuable commodity to any organisation. If the people doing the jobs have a good understanding of the environmental impact and sustainability opportunities, then they are likely to understand why procedures may have changed or why they are being more careful with waste from a process. They may also understand where there are options to make savings, such as where there are opportunities for reuse or where resources are being used unnecessarily: thereby, saving not only the resources but also making cost savings due to the reduced amount of materials required. Without training employees may not question particular processes and procedures as it may just be "the way we have always done it".

By providing training a workforce is given the opportunity to engage in discussions on how a company wants to be more sustainable and then they are also given the opportunity to put forward their own ideas on how things can be improved. Jia-Fang (2010) stated that training improves performance but also enables an opportunity to show a company in a positive light in relation to how they value their staff. This idea of developing trained staff is thought to provide those staff with more satisfaction in their role and by default increase both productivity and profit (Champathes, 2006). Training is chiefly about increasing an employee's knowledge and, therefore, improving performance. However, it also enables a bridge in relation to the gap that exists between current knowledge and what is required or deemed necessary within an organisation to make necessary improvements. There are, of course, many ways that training can be delivered. Traditionally, this would have been face-to-face but since the covid pandemic there is an increasing reliance to offer online training, or it could be through working with a trained colleague who shares their knowledge and experience to improve the performance of their team or by shadowing a work colleague.

Training is to improve an employee's performance and/or an organisations performance. David (2006) noted that it is not just about increasing the ability of the employee but to also improve their thinking in terms of creativity to facilitate better decisions. This is supported by Svenja (2007) who views training as developing self-efficacy in the workplace. Any organisation looking to engage with the SDGs needs to firstly ensure that its' staff understand what the SDGs are, in terms of where they have come from, how they have been developed and what their purpose is in terms of the future of the planet. However, training is not just about delivering information to an audience who are purely recipients of the information. It is about engaging the workforce to develop that creative thinking, which will enable them to come up with innovative ideas that help the organisation to improve and prosper for example by reducing the resource consumption within the organisation. A workforce is key to this work, their understanding of where there is wastage within the production or construction process is invaluable and using training, they are provided with the opportunity to share that knowledge and to be listened to. This creates a partnership between the workforce and the management, and it is that partnership which increases the profitability and productivity of the organisation. Chen *et al.* (2004) noted that if workers are present in a work environment where they feel that they don't understand why a task is being performed they may become disenfranchised and may decide to leave the organisation, as they no longer feel they fit or belong.

In this type of scenario, the sudden focus on sustainable development goals may be a shock to some of the employees, they may not have heard of these before and may feel they cannot ask for fear of being seen as out of touch. An organisation can help by introducing everyone to the ideas in a managed and thought through way where the staff and managers are encouraged to engage and brought along with the ideas rather than being dictated to. They could help form the strategy for increased impact in relation to sustainability through focus groups and peer discussions as part of the training and this could include for example SDG-12 as a discussion point on where they feel materials are wasted within the business operations. The aim is not to disenfranchise workers due to their lack of knowledge on sustainability but to encourage them to help the company by using their knowledge of working practice to improve performance in terms of economic, social, and environmental aspects. It is vital that the training is provided at an early stage, so the workforce and the senior management are on this journey to a more responsible future by improving the operations of the organisation together. Creating a workforce who understand the reasons for the new style of operation and buy into the direction of the company as has been previously stated will produce a more productive and more engaged organisation. They will feel part of the process. For instance, participants who took part in a recent interview process (Horry *et al.* in prep) noted that training is fundamental to the success of ISO 14001 because it is that understanding that is required to deliver on the standard; therefore, if an organisation is looking to reduce its resource consumption, again it is training that is going to be fundamental for the delivery of the objectives.

It has already been noted but it is worth repeating, the benefits that training delivers including increasing job satisfaction, productivity and reducing staff losses as trained staff increasingly feel part of the organisation. The nature of today's society means that increasingly people are having to upskill as a constant, this is in terms of the machines used but also the changes in understanding of business operations and how knowledge and science move forward because of environmental uncertainty (Tai, 2006) in areas such as climate change and resource availability. Change is recognised as being the new normal but to deal with such change requires training and the time and opportunities to consider how as an organisation such issues impact on the operations and where opportunities exist to moving forward.

An understanding of the issues and how these can be managed within business is something, which is individual to each organisation and, while Testa *et al.* (2018) notes, organisational leaders are expected to talk to their staff about the environmental management, compliance objectives and their company's sustainability strategy, there is no rule book written for how to do this. It is down to the individual company and the situations and communication strategies of that individual organisation and how they wish to contribute to society. However, as with implementing ISO 14001 it is necessary to have a plan in place before beginning to work towards ISO 14001 certification, during implementation and when monitoring its effectiveness (Latan *et al.*, 2018). The same will apply to delivering on SDG-12. However, to do any of this work requires staff who are aware and knowledgeable, otherwise there is a danger that it will be the work of one person within the organisation and there will be no support or buy in from the staff in general and very little progress will be made.

Relying on one member of staff, does not create a viable effective management system or opportunities to deliver on reducing consumption of resources. Therefore, as Heras-Saizarbitoria and Boiral (2013) and Jabbour (2015) noted there is a need to implement environmentally responsible behaviour amongst the staff, to have staff that are interested and care and, therefore, training needs to be delivered to engage the staff with the cultural shift and motivate them to engage with the system. Some researchers have suggested that this engagement requires an incentive (Potoski and Prakash, 2005; Darnall, 2006; Russo, 2009; Testa *et al.*, 2014); however, it is contested here that without the proper training there will be a lack of understanding as to the changes so any incentive used is unlikely to bring about the desired cultural shift, it is about hearts and minds. The need is for staff to understand the issues, have an awareness of the actions that are achievable and have them buy-in to delivering these actions. This requires training.

There is an expectation within organisations that employees need to work effectively and be competent in their roles within the organisation. This comes, therefore, with an implied expectation that for some new tasks staff will need to be provided with appropriate training to ensure that they are competent; and environmental management is no different. Looking back to ISO 14001:1996 (the earliest ISO system) many companies who began the accreditation process were aware of the gaps in knowledge and of the need to persuade staff of the importance of protecting the environment (Horry *et al.*, in prep). It is hoped that in the intervening years that society has gained more of an understanding of the need to ensure the 'natural environment' is recognised as a stakeholder that requires protection (Hammond and Booth, 2010). However, this cannot be assumed. There are people who do not believe in climate change and others who may believe but are not sufficiently interested to make changes. However, in the business world if an organisation wishes to improve its environmental performance it will need to ensure that its staff are informed of the reason for the actions that are being taken and their part in the delivery of these actions. This is about supporting the need for the delivery of the objectives of an EMS, which will necessitate some training of the staff in what is required, what is no longer acceptable and what the expectations of the organisation are in respect of their objectives and targets. This would be the same if the EMS focused on purely environmental objectives or was more focused on sustainability goals such as SDG-12.

DISCUSSION

The AEC sector is no different from any other sector in the need for training of staff, but it can potentially have huge impacts on sustainability due to the nature of the work and, therefore, there are major opportunities in terms of the potential contribution to the SDGs. Horry *et al.* (2022) noted that while Goubran *et al.* (2019) found the AEC sector were related to all the goals that potentially the greatest contribution could be made in SDGs 6, 7 and 11, they found reason to suggest that SDGs 4, 8, 12, and 13 were significant. Horry *et al.* (2022) went on to support this proposition through a PRISMA based literature review, a review of the findings, approval by professionals, and the creation of a roadmap, which again was reviewed. This resulted in a roadmap detailing how the SDGs could be delivered using ISO 14001 and when considering SDG-12 that this goal could be prioritised in at least 50% of the sub-benefits

(Horry *et al.*, 2022). These sub-benefits were relating to customer satisfaction, commitment to environmental responsibility, green image, improved community relations and improved industry/government relations, which also link to many of the other SDGs.

Suchman (1995) acknowledged that SDGs are a global challenge and although they provide an opportunity for organisations to focus on economic, environmental, and societal needs while increasing the organisations legitimacy in all these areas, a huge challenge in itself it will in turn reduce costs to the organisation. Training will, however, be required. The whole premise is that organisations must behave in a different manner from what has been custom and practise. To enable this to happen the workforce will need to be trained to understand not only what responsible consumption looks like but also how that can impact in a positive manner not only on the triple bottom line (Elkington, 1997). However, it must be remembered that as Hahn and Kuhnen (2013) noted many organisations may not have the financial ability or staff availability to do this work. Of course, even the smallest actions could make a difference and the SDGs provide a focus for action (Georgeson *et al.*, 2017), a means to improve all operations in terms of consumption of raw materials for example.

If the targets and indicators of SDG-12 are considered it can be seen from this that most of the targets can be delivered through a well thought out EMS and certainly all those where organisations other than the government can bring about change. As noted by a participant in a recent study *"by demonstrating that an obligation is as strong as a legal commitment and entwining the objectives of the system to the strategic measures, then it becomes one of the same thing. It doesn't need to be an additional burden to any business. You know, the sustainability metrics have got to be core business indicators. So as long as they're well integrated and the corporate systems are integrated and, you know, people are doing things to the best of our ability, they're doing it once and then that information has been used multiple times."*(unpublished data). However, for those EMSs to be successful there needs to be an understanding throughout the workforce of what their part is in the work and how they can help make a difference. In respect of the training for the successful delivery of this, there needs to be buy-in from those being trained, which will encourage them to engage actively with the training, opportunities to make a difference, that their opinions are heard and that they can be enabled to implement the required actions following their period of instruction. However, there are companies that experience high turnovers of staff and as the following statement suggests *"presenting someone with 300 or so documents for the Health, Safety, Quality and Environmental management system is a challenge. Leading to people only using the documents they needed when told by someone that they needed to fill them in"* (unpublished data).

This in an economically focused world and the concept of responsible consumption is an interested goal, as economic development requires there to be a demand and, therefore, consumption. However, if we assume that as a concept SDG-12 is the way the world should be moving then we accept that there is a need to limit our consumption and production to ensure a sustainable future then we have another challenge. That of who within society are qualified or sufficiently knowledgeable to enable the organisations to take this alternative path to the future. Green jobs are becoming a hot topic in sustainability and government circles

with the need being seen to train people in sustainability skills to enable the net zero agenda to be managed. It is these skills that are often cited as one of the barriers to the implementation of ISO 14001. This is evidenced by a participant in a recent study who said "*14001 is still is the main bedrock for the environment, part of sustainability*" (unpublished data). So, we have a situation where we need to be responsible in terms of consumption and production but those who produce the goods may not understand the concept or wish to abide by its philosophy.

In relation to the current state of play there are a variety of positions with some organisations leading the way and others being laggards. Looking at what would be considered good practice today in respect of SDG-12, the following would be a good starting point:

- *Sustainability reporting* – many companies report on their sustainability, but these are often viewed as being superficial and a marketing device (Squier and Booth, in prep).
- *Closed loop operations (circular economy)* – again a push for companies to operate closed loop exists but there is a challenge in terms of understanding and the opportunities to discover how you can produce a closed loop system either within your production processes or by linking with other organisations who may be able to use resources, which are no longer of use within your organisation. Further reading - Liu and Ramakrishna, 2021.
- *Efficient waste management* this is about reducing as much of the waste as possible so following the waste hierarchy, to ensure that the first option is prevention. The most effective way to prevent waste is to ensure that waste is considered in the design process. Reducing the waste is all about thinking of the options for closed loop systems. Further reading - Letcher and Vallero, 2019.
- *Renewable energy production* – here the idea is not so much about the materials in relation to construction but how you could make the building more sustainable in relation to energy. Further reading – Nelson and Starcher, 2015.
- *Reduced material footprints* – thinking about the carbon footprint of the materials both through the extraction, transport, use and ability to be reused is important in ensuring that it is responsibly consumed. Ideally the materials should be produced or sourced as close to the site of their use as possible. Further reading - Klemes 2015.
- *Net zero carbon opportunities* – all companies now should be thinking about the options for zero carbon. This is not just in terms of their resource use in the production processes but also in relation to energy used in their offices, transport options, waste production and disposal. So not limiting themselves to scope 1 and 2 being "*fairly easy to manage*" (unpublished data) but also considering scope 3 where confusion exists in relation to how to measure and who should measure it as noted "*some of that scope three stuff has been measured three or four times by four different people.*" (unpublished data).

Looking forward, it would certainly be useful to understand how companies are approaching these challenges and where the blockages exist in relation to becoming more sustainable. Issues may be that staff are reluctant to do what they see as extra work, that training is not always welcomed by staff or that even with training issues still exist in relation to managing resource use and the associated emissions particularly in relation to Scope-3 and how this will be monitored and by whom in the supply chain.

CONCLUSIONS

This chapter has explored the benefits and barriers of implementing environmental management systems in the construction sector and demonstrating how skills and training, gathered through the uptake of ISO 14001, are key in facilitating the delivery of SDG-12.

The use of ISO 14401 has traditionally been focused on the delivery of legal compliance and today is more focused on fulfilling the requirements of stakeholders. However, it must be remembered that ISO 14001 is a system where the control of the deliverables is very much in the hands of the company who are using it. If you set your objectives as being to achieve SDG12 then that is what the system will be set up to deliver. In relation to the delivery of this, engagement of staff is vital and as this chapter has highlighted the engagement of staff is influenced by how valued they feel as employees. By training staff on the topic of sustainability, an organisation can not only reduce costs and comply with legislation it can also enable the reduction of resources that are used.

Within the AEC sector it must be noted that resources and their consumption is not governed by one sector, but it is controlled firstly by architects and civil engineers who decide on the materials used and their suitability for the projects. From this point the sourcing of these is under the control of procurement for the construction firms and the waste produced sits with the project manager and their team. These people all have their professional competencies, but it can't be assumed that one of these competencies is sustainability. Materials are changing with new options such as hemp concrete becoming a possibility. It is becoming more vital that these professionals understand new developments and the art of the possible in relation to sustainable materials. However, it must also be remembered that at the other end of this process is the management of waste, which includes the need to be as sustainable as possible and if it is attainable to use a closed loop system where no waste is produced.

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