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Adopting Environmental Management Systems in the South African Construction Industry

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A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

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ABSTRACT

It is widely acknowledged that sustainable development is a global imperative in order to achieve the dual objectives of development which meets the needs of the population, whilst ensuring long term impacts on the environment are minimised and mitigated. Therefore pressure is being placed on the construction sector to implement sustainable practices during development.

Studies show that construction industries vary in their environmental maturity and are affected to varying degrees by a number of drivers and barriers which influence the adoption of sustainable development practices, specifically the implementation of Environmental Management Systems (EMS) such as ISO 14001 EMS.

This study conducted interviews and administered surveys with key personnel within the major construction firms in South Africa in order to determine the level of adoption of ISO 14001 EMS and the factors affecting its uptake.

The key findings indicate that, although construction organisations acknowledge the sustainable development imperative, there is currently a sluggish implementation rate as a result of mainly the cost related barriers exceeding the expected benefits of implementation. Further, although the South African construction industry is supported by comprehensive and robust environmental regulations, implementation and enforcement of these regulations is weak, whilst trade associations and industry bodies are not promoting its uptake. This has resulted in a low desire by contractors to transition to environmental practices and there is no single stakeholder currently driving the green agenda in the construction sector.

Although there is degree of environmental management taking place in South African construction industry currently, it has a short term focus, rather than a long term, holistic approach encompassing all principles of sustainable development.

DECLARATION

I, _____, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

(Type your name in full here, and sign in the space above)

Signed at ……

On the …….. day of …… 2008

DEDICATION

ACKNOWLEDGEMENTS

I would like to acknowledge the support of the following people whose assistance I am very grateful

- Professor Gillian Marcelle in providing critical guidance during the process and for offering her expertise on the subject
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CHAPTER 1: INTRODUCTION

This introductory chapter outlines the purpose and context of the study, leading up to the research questions.

1.1 Purpose and context of the study

The purpose of this research is to assess the extent to which construction companies in South African are adopting Environmental Management Systems (EMS) and integrating environmental criteria into their projects, and to investigate the factors which effect its adoption.

Concern over the health of our environment has risen substantially in the public arena as awareness of the impacts of factors such the utilisation of scarce resources and the effects of increased carbon emissions have become better understood. The construction sector has been identified as an industry that is responsible for having serious adverse effects on the environment (Hendrickson & Horvath, 2000; March, 1992; Poon, 1997; Uher, 1999); in so far as it contributes towards soil erosion and sedimentation, flash floods, destruction of vegetation and dust pollution, depletion of natural resources and the use of building materials harmful to human health (Zainul Abidin, 2010; CIDB Malaysia, 2007a)

It is estimated that the construction sector is accountable for the following consumption of natural resources(Edwards & Hyett, 2005)

- Materials: 50% of all resources globally go into construction
- Energy: 45% of energy generated is used to heat, light and ventilate buildings and 5% to construct them
- Water: 40% of water used globally is for sanitation and other uses in buildings
- Land: 60% of prime agricultural land lost to farming is used for building purposes
- Timber: 70% of global timber products end up in building construction.

These data confirm the necessity for increased focus on environmental management in the construction sector as well as within the broader context of sustainable development. Global interest in sustainable development has steadily bloomed (Zainul Abidin, 2010) and has further been widely has been acknowledged by many governments, businesses, organisations and individuals (Ofori, Briffett, Gang, & Ranasinghe, 2000). The global construction industry has also begun to shift its focus from developing with the environmental concern as a small part of the process, towards the broader environmental agenda being integrated into the development process (Gandhi, Selladurai, & Santhi, 2006)

The rate of urbanisation globally in increasing, and the majority of rapid urbanisation is likely to take place in the category of developing countries, such as Brazil, Russia, India, China and South Africa. According to the most recent survey of the country released by the South African Institute of Race Relation (SAIRR) two-thirds of South Africa's population now lives in urban areas (SAIRR, 2013). As such the responsibility to limit the negative impacts of urbanisation will sit increasingly on the shoulders of major industries in South Africa, particularly the construction industry

The South African construction industry is a R1.800 billion industry, employing between 1.8 and 2.25 million people (van Wyk, 2009). It is a critical sector in the country, both as a stimulant to the growth in the economy, as well as a sector which will create housing for many of the previously disadvantaged citizens, and is therefore high on the government agenda. It may be described as oligopolistic, where a small number of large firms dominate the market, supported by a vast network of subcontractors. The sector has also received negative attention of late with findings of collusions levelled against some of these major players by the South Africa’s Competition Commission.

South Africa is reliant on cheap energy reliant on fossil fuels, and buildings contribute over 40% (van Wyk, 2009) to national energy use over the entire lifetime of the building. The capacity of traditional energy generating resources, and the future pressures on water supply to have created an urgency these components of construction are looked a frugally in the future. Improved

environmental performance in South Africa needs to take into account the full spectrum of environmental impacts construction activities exert, from the pre-construction stage and the materials and processes used, to the entire lifecycle of the building, taking into account the long-term cost/benefit and not merely the short-term cost benefit.

During the early stages of sustainable development, Hart's (1997) stated that a clear and fully integrated environmental strategy should not only guide competency development, it should also classify the nature of a company's relationship with its customers, suppliers, other companies, policy makers and all its stakeholders. More recently in the developed nations, where sustainable development is at a more advanced stage of maturity, merely complying to environmental legislation and rising standards of stewardship is now being surpassed as company's use their environmental strategy, as with any strategic tool, as a mechanism of differentiation and competitive advantage (Christini & Fetsko, 2004; Langford, 2006). This has created an increasing interest in Environmental Management Systems (EMSs) in these regions (Christini & Fetsko, 2004; Ofori, 1992; Sambasivan & Fei, 2008).

This investigation into the status of environmental management systems, as well as the factors affecting its adoption and implementation will give an understanding of the current state of environmental practices in the South African construction sector, and aid policy makers on the appropriate plan in order to increase adoption.

1.2 Problematique

1.2.1 *Main Research Question*

In this study the main research question investigates to what extent the major construction companies in South Africa are implementing environmental management systems, and the key determining factors which are influencing the adoption of Environmental Management Systems (EMSs).

1.2.2 *Sub-questions*

The study is organised in terms of the sub-questions. The first sub-question is: what is the scale of adoption of Environmental Management Systems and environmental practice amongst South African construction organisations?

The second sub-question is: what are the drivers and barriers to adoption of Environmental Management Systems (EMSs) in the South African construction sector?

1.3 Significance of the study

The study fills a gap in that although the benefits of incorporating strategies for managing environmental issues have been documented and modelled internationally (Langford, 2006; Sterner, 2002), the extent to which these strategies apply in South Africa is relatively unknown. Similarly, although the forces that drive the movement towards sustainable business practises has been identified (Shen & Tam, 2002; Tse, 2001), the extent to which they are shaping the South African construction industry has not been determined.

The study will provide guidance to all stakeholders in the construction industry, particularly those involved in the strategic planning within these companies.

It will also present relevant findings for environmental legislative bodies on the current status and trends of sustainable development practises in South Africa's thriving construction industry.

1.4 Delimitations of the study

Hillier and Bowen describes a four pillared model of sustainable development which includes social, economic, bio-physical or environmental and technical structures (Sakr, Sherif, & El-Haggar, 2009). Although sustainable development involves these interconnected facets, this study will only investigate the status quo with respect to the environmental components.

The main actors in the construction industry are owners and consultants, architects/designers, manufacturers, suppliers and contractors. This study will only interview and investigate the perceptions of the major construction companies, or contractors, currently active in South Africa. .

It will also focus the attention on the general building sector as categorised by the registered projects with the Construction Industry Development Board (CIDB). The study is interested in organisations where there is likely to be environmental management systems in place. As such it will only be investigating organisations with active projects with a grade 8 (R130 million) and above.

1.5 Definition of terms

The following terms are used in the study:

- Sustainable development - a process of change in which the exploitation of resources, direction of investments, orientation of technological development, and institutional change are made consistent with future as well as present needs(Banerjee, 2002)
- Environmental Management Systems – the part of the overall management system which includes the organisational structure, planning activities, responsibilities, practises, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining a company's environmental policy (ISO, 2004)

1.6 Assumptions

Certain assumptions were made in carrying out this study.

The interviewed personnel from the construction companies will been senior and able to articulate company strategy as well as perceived benefits from an environmental strategy.

The sample should first and foremost include the major players in the industry, as well as specialised niche players in the industry with specialist knowledge in sustainability and environmental strategy. These groups will have the greatest effect on the validity of the results.

The most prevalent companies by way of the size of projects undertaken are assumed to represent the most mature section of the construction sector where systems and policies would be the most advanced, where there a stronger likelihood of organisations have staff with environmental management responsibilities, and be in better position to articulate environmental issues and trends in the construction sector.

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CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

The concept of sustainable development has evolved considerably since the initial notion of preserving the world's natural resources in clearly demarcated areas through the practice of nature conservation. There has since been a shift away from this "limits to growth" philosophy where development and conservation were seen as two ideas which were in direct conflict with each one another, to viewing conservation and development as integrated concepts (Hill & Bowen, 1997)**.** The Brundtland Report, published by the World Commission on Environment and Development (WCED) entitled *Our Common Future* (Bruntland, 1987) is often referred to in the literature as the earliest definition of the modern concept of sustainable development. The definition; 'development which meets the needs of the present without compromising the future generations to meet their needs,' places more emphasis on the social and economic goals of society, particularly in the developing countries, but stressed that the attainment of these goals was interconnected with the achievement of environmental goals (Hill & Bowen, 1997)

In 2002, the UN World Summit on Sustainable Development adopted the Johannesburg Plan of Implementation which undertook to fully resolve underdevelopment around the world which called for an international shift in emphasis from the mainly Green Agenda issues of the Agenda 21 for Sustainable Construction in Developing Countries, to the Brown Agenda(du Plessis, 2007) The Green Agenda has dealt with the long term sustainability of the earth's life support systems, whilst the Brown Agenda focuses on the problems of poverty and underdevelopment. Thus the Brown agenda is the development part of the equation, and the Green Agenda is what will make the development sustainable, and as Du Plessis, Plessis (2007) points out, the two are very much interdependent and the one without the other is not sustainable development. The construction sector therefore sits right at the interface between the two Agendas; it is both the vehicle for improving quality of life, and

the actor that will determine the environmental and social sustainability of development endeavours.

Global interest in sustainable development has risen dramatically over the past few decades, with increased pressure being placed on governing bodies to put measures in place to ensure sustainable development objectives are reached. For example, public pressure was noticeable at the COP 17 conference in December 2011 in Durban where policy makers were urged to emerge with specific and binding action plans. More recently, the United Nations Conference on Sustainable Development, or Rio+20, which took place in Rio de Janeiro, Brazil in June 2012, resulted in a focused political outcome document which contains clear and practical measures for implementing sustainable development. In Rio, Member States decided to launch a process to develop a set of Sustainable Development Goals, which would build upon the Millennium Development Goals and converge with the post 2015 development agenda which sets out eight global development targets which come to an end in 2015.

In South African construction sites have become synonymous with the urban centres and are a representative yardstick of the economy's development and progress. When one considers the rapid rate of urbanisation in South Africa, and the great need for basic housing for the country's citizens, there is a real urgency to introduce sustainable construction practices in the country. Plessis (2007) stated that the challenge for the construction sector is not just to respond to the need for adequate housing and rapid urbanisation, but to do it in a way that is responsible.

Construction can be interpreted at four levels: as site activity, as the comprehensive project cycle, as everything related to the business of construction, and the broader process of human settlement creation (Irurah, 2000). As such, in order for construction to incorporate the wider environmental agenda into the development process, it will need to be done across each of the four levels.

The principles of sustainable construction have been effectively summarised by Abidin and Pasquire (2005) as; showing concern for people by ensuring they

live in a healthy, safe and productive built environment and in harmony with nature, safeguarding the interests of future generations while at the same time, meeting today's needs, evaluating the benefits and costs of the project to society and the environment, minimising damage to the environmental and its resources, improving the quality of buildings and services and promote social cohesiveness, using technology and expert knowledge to seek information and in improving project efficiency and effectiveness, legislating compliance and responsibility.

As the “green” movement gains momentum in South Africa and fiscal and regulatory measures to reduce environmental degradation expand, increasing attention will be focussed on the major construction companies. Thus, in order to manage reputation and acquire internal efficiencies, strategic management of environmental issues will become part of the firms long term strategic planning (Langford, 2006). To successfully implement such long-term planning and environmental policies, and therefore take its environmental aims seriously, organisations will need to relate core business objectives to its environmental aims(Fryer, Ellis, & Egbu, 2004). In the construction sector this has taken the form of Environmental Management Systems (EMS), and in particular the implementation of the ISO 14000 series of standards.

A review of the literature on the adoption of environmental management systems, and the factors which effect implementation, will aid in assessing the environmental status of the construction sector in South Africa. The first section discusses Environmental Management Systems in the sphere of the construction industry. The second area concerns factors which affect the implementation of environmental management systems.

2.2. Environmental Management Systems in the Construction Sector

The developed world accounts for some 75% of the world’s energy and resource consumption(Hart, 1997), and it is noticeable that the majority of the literature and case studies on successful integration of environmental

management systems have originated from the developed nations (Chen, Li, & Hong, 2004; Christini & Fetsko, 2004; Varnas, Faith-Ell, & Balfors, 2009), with a smaller body of work on EMS on construction in developing nations(Sakr et al., 2009; Zeng, Tam, Deng, & Tam, 2003). Indeed with the majority of future urban development expected to be in these emerging economies, there will be global pressure on them to build with the environment in mind. Certified construction firm in the United States of America showed that, although certification was still rare in 2004 in the U.S. construction industry, EMS development and implementation has gained momentum among contractors, and ISO 14001 EMS serves as the primary model for a contractor's EMS (Christini & Fetsko, 2004).

In order to move towards improved environmental performance in the construction sector organisations will benefit from the implementation of an EMS, which have been recognised as a way to achieve sustainable development in the construction industry (Lam, Chan, Chau, Poon, & Chun, 2011). The International Organisation of Standardisation (ISO) issued the ISO 14000 series, with principles similar to the British Standards, Specifications for Environmental Management System in the 1990s, and In the world today it is currently the main frame of reference used by construction companies to guide the implementation of an Environmental Management System (Rodríguez, Alegre, & Martínez, 2011). EMS implementation is typically a voluntary and proactive approach to environmental management which aims to afford construction companies a far better chance of addressing the issues of sustainable construction and testing solutions before legislative involvement by government(Hill & Bowen, 1997). The main purpose of an EMS is to systematically control adverse environmental impacts and ensure that established objectives and targets are met.

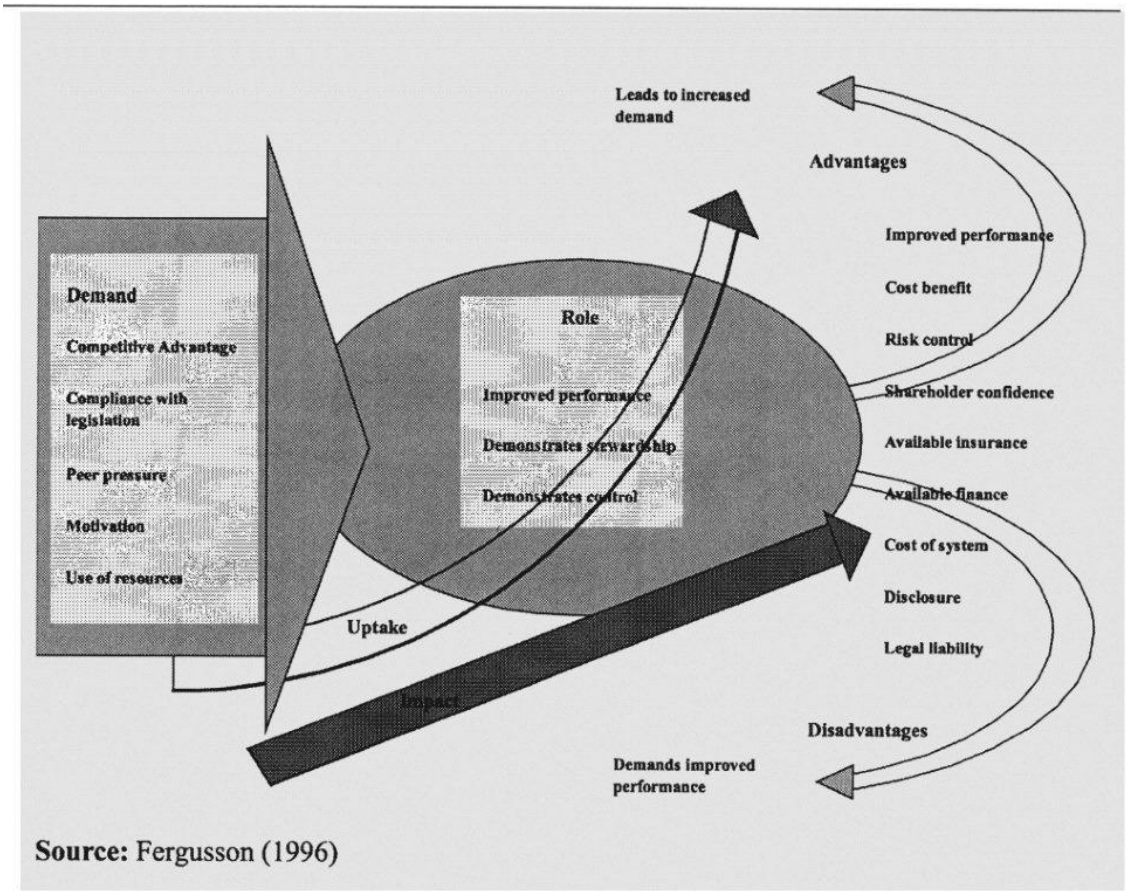


Figure 1: Model of the role and impact of environmental management systems

The above figure depicts an early explanation of the role of EMS in the construction sector (Fergusson & Langford, 2006) . The figures illustrates that the factors affecting the uptake of EMS include increased demand for it, achievement of a competitive advantage, ensuring compliance to legislation and succumbing to public or peer pressure. The EMS will create improved environmental performance, demonstrate stewardship to its external stakeholders and demonstrate control to its internal stakeholders. The benefits or advantages expected from implementation include a cost-benefit improvements, improved internal efficiencies and greater control of risk, whilst the barriers to implementation included the additional cost of implementation and the availability of finances.

2.2.1. ISO 14001 Environmental Management Systems

EMSs provide a mechanism for organisations to internalise their environmental objectives. ISO 14001 EMS is a component of the ISO 14000 series of standards on environmental management, which provides guidance on the establishment, implementation, maintenance and improvement of an environmental management system and its coordination with other management systems (ISO, 2004). ISO 14000 includes five different standards: environmental management systems, environmental auditing, environmental labelling, environmental performance evaluation and life-cycle assessment.

ISO 14001 is an environmental management standard; it is not an environmental performance standard. It has evolved from the ISO 9000 series of quality management standards in response to the trends towards sustainable development. They have been described by Puri and Bodek (1996) as providing the key to the actualisation of environmental strategic management in organisations.

The presence of ISO 14001 EMS may be considered an indicator of the maturity of a given industry or a sector as implementation and the ongoing monitoring requirements are a commitment by the organisation to internalise environmental criteria into its daily operations(Ofori, Gang, & Briffett, 2002; Shen & Tam, 2002)

2.2.2. Implementation of ISO 14000 Environmental Management Systems (EMS) in Construction

Generally, the construction sector is considered to be an industry which is slow to innovate relative to other industries. (Kein, Ofori, and Briffett (1999); WEI and LIN (2004); Yitmen (2007)) characterise the sector as lacking in vision, often risk averse and slow in adopting new technologies and principles Studies have found that construction companies generally have not recognised environmental performance as an imperative and are not enthusiastic to pursue environmental commitment (Christini & Fetsko, 2004; Ngowi, 2001; Varnas et al., 2009). Zainul Abidin (2010) noted that many industry role-players were still ignorant of the

importance of sustainability practices; the study cites respondents feel no urgency to implement sustainable building practices and these respondents further that they will only do so when there is sufficient demand for it.

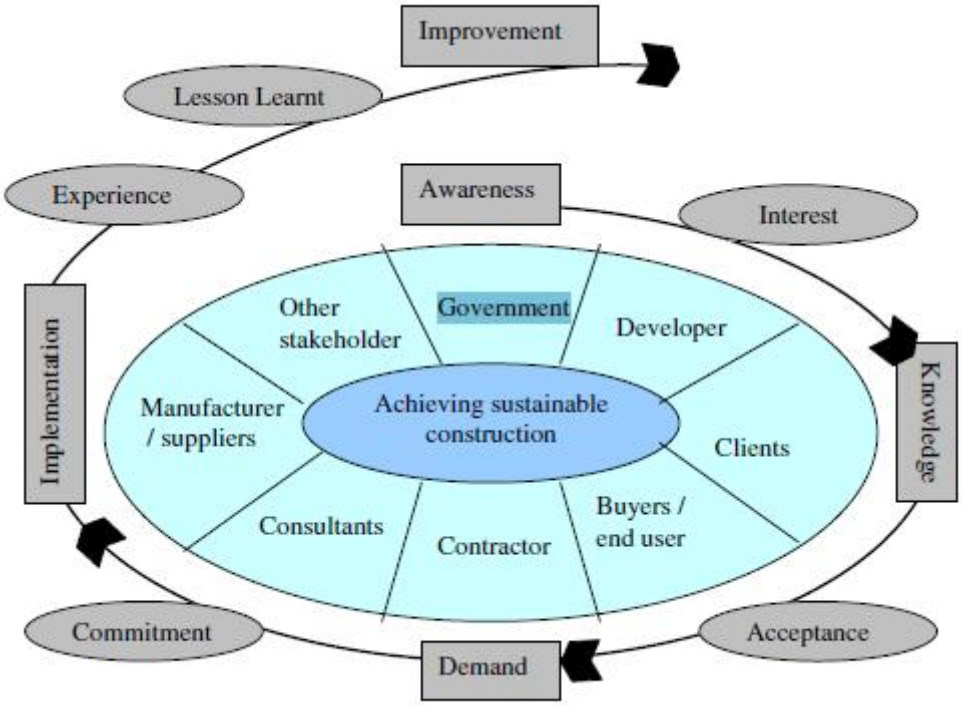
Globally, adoption and accreditation of ISO 14000 in the construction sector has been considered slow (Rodríguez et al., 2011; Zeng et al., 2003). It has been observed that contractors will often take a wait-and-see approach to EMS implementation. Environmental strategies in the construction sector have been found to be reactive in nature (Kein et al., 1999; Sakr et al., 2009; Zeng et al., 2003). These genera trends also appear to be experienced to an extent in SA. For example, in the Western Cape it was found that general contractors adopt an informal approach to management of environmental issues and generally a low level of attention is paid to the environment (Smallwood, 2000).

Analysis of sector distribution of firms holding ISO 14000 certificates throughout the world in December 2005 showed that 6.3% (2832) were held by firms in the construction sector (TurkÃ, 2009). Of the 845 certificates issued for ISO 14001 EMS in South Africa in 2012 only 24 (3%) were for the companies in the construction sector (ISO, 2012). The literature indicates that although construction organisations may be aware of the environmental impact of construction, and acknowledge the importance of improved environmental performance, most are not ISO 14001 EMS certified (Zeng et al., 2003).

In practice companies will exhibit varying degrees of environmental management; these range from merely complying to legislative requirements, to exceeding ISO 14000 requirements by adding additional goal setting and public reporting beyond legal requirements(Christini & Fetsko, 2004). Wu (2009) found that 55.2% of surveyed facilities surveyed in the United States over-complied with at least one standard, while 5.8% indicated that they violated at least one standard. Voluntary environmental management has been shown to be a powerful remedy or alternative to direct command-and-control regulations or market-based approaches(Konar & Cohen, 1997)**.**

2.2.3. *Awareness of EMS amongst industry practitioners*

A lack of awareness of ISO 14001 EMS and for the need for environmental protection in the construction industry can hamper implementation within the construction sector(Ofori et al., 2000).



Source: (Zainul Abidin, 2010)

Figure 2: Path for achieving sustainable construction

As illustrated in figure 2, Zainul Abidin (2010) noted that the pace of actions towards sustainable application initially requires there to be awareness of the need for the achievement of sustainable construction and the awareness of individual stakeholder's role in achieving it. With that comes, knowledge, interest and demand, and follows with implementation. It is Abidin's opinion that if the successes of EMS are shared with industry role-players, a positive feedback mechanism will be created and lessons for future improvement can be learnt. Further momentum for the move towards sustainable practices may also be achieved as the organisations implementing them will build up an archive of credentials in the field, and therefore position themselves as industry leaders.

Previous studies suggest that there is comparatively more awareness within the developed nations where environmental technology and knowledge is at a more advanced state than developing nations where the needs of rapid urbanisation and economic growth are paramount. For example Ofori et al. (2000) found that 76% of contractors in Singapore had heard about ISO 14000 EMS in the year 2000, whilst Sakr et al. (2009) found that only 18.2% of contractors in Egypt were aware of ISO 14000 EMS in 2009.

The research notes that environmental values and beliefs of senior management affect a facility's choice of compliance level. Specifically, a facility is more likely to over-comply with environmental regulations if it indicates that its senior management believes it has a moral responsibility for resource conservation and environmental protection, and that environmental management is good for business in the long term (Qi, Shen, Zeng, & Jorge, 2010)**.** Du Plessis **(**2007**)** also reasoned that behaviour changes towards environmental practices will only come about through personal commitment to them. In an environmental survey on the top 200 companies in South Africa it was discovered that the highest environmental awareness within a company exists within senior management and least among non-managerial staff (KPMG & IEF,1997)

The research also suggests that although environmental awareness exists within the construction sector and despite contractors being of the opinion that ISO 14001 should be made mandatory in the industry, most are not ISO 14001 EMS certified (Turk, 2009).

The planning stage of a project is an important stage of a project in which environmental management strategies can be incorporated into a project, and agreed on by clients and developers. Kein et al. (1999) however found that contractors in Singapore evaluated the projects impact on the environmental last in a list of factors, and give most priority to satisfying client's requirements and minimising costs.

Further, on-going training and up-skilling of staff on environmental protection is an indicator of the extent to which organisations are taking a proactive approach

towards its environmental management. In China only 8% of respondents provided frequent training, 37% occasional and 55% did not provided any training on environmental protection (Zeng et al., 2003).

Research Question 1

What is the scale of adoption of Environmental Management Systems and environmental practice amongst South African construction organisations?

2.3. Factors affecting adoption of ISO 14001EMS implementation in the construction sector

ISO 14001 EMS is a voluntary, consensus-based, and market driven standard (Kloepfer, 1997). As such there are a number of drivers which compel and a number of barriers which deter organisations from implementing. These factors exist at varying degrees of maturity within the various countries, and therefore differ in the extent of influence which they have on the organisation.

2.2.4. Drivers of Adoption

As Fergusson and Langford (2006) initially put forward in Fig 1 on page 11, there are a number of factors which influence the uptake of ISO 14001 EMS in firms. A major difference between the implementation of ISO 9000 and ISO 14000 is the former is a quality, cost and time qualification, and therefore is often a project objective from the client. Further, it may be required in certain mandatory legal frameworks. However, ISO 14000 standards are voluntary and therefore driven more by stakeholders, the community, or regulators (Zeng et al., 2003). As the global and local pressure for organisations to improve their environmental performance in a structured and measureable way increases, construction organisations will need to identify the potential benefits that EMS will offer.

The benefits which a firm may experience from implementation include (Christini & Fetsko, 2004):

- Improved compliance with regulatory requirements;
- Access to open markets and reduction in trade barriers;
- Reduction in liability and risks;
- Enhanced credibility among customers and peers;
- Reduction of harmful impacts to the environment;
- Prevention/reduction of pollution and waste, many times resulting in cost savings;
- Improvements in site and project safety by minimising injuries related to environmental spills, releases and emissions

The drivers for firms to implement ISO 14001 EMS can be categorised into push and pull factors; push factors compel an organisation to implement as a result external forces in the market, such as competitors implementing it or new regulations which require it, whilst pull factors entice an organisation to implement based on the perceived benefits it will offer.

Push Factors:

Organisations are more likely to implement EMS if there are sufficient external pressures; these can include companies being driven by contractual and community requirements, competitive pressures, maintaining quality, the objective of being a good corporate citizen, clients' requests, and increased public awareness through scientific research of global environmental concerns (Petrovic-Lazarevic, 2006).

In an early study, Ofori (1992) describes the client as the key stakeholder in creating integration of environmental considerations into the construction sector. He suggests that adding the environment as the fourth client objective, together with time, cost and quality, will ensure practitioners work towards environmental objectives as well.

In a more recent study Anton, Deltas, and Khanna (2004) found that liability threats and pressures from consumers, investors and the public are motivating

EMS adoption and that consumer pressures are particularly effective in increasing the comprehensiveness of EMSs of firms.

Competition pressure can entice organisations to implement ISO 14001 EMS either through the competitive edge if offers over other non-certified firms, or as a result of the need to implement to reach a benchmark of standards in the industry. Wu (2009) found that competitive pressure to produce differentiated products, reduce costs, attract and retain quality employees, and create product and process innovations are significant factors contributing to environmental over-compliance. A competitive edge can be gained when an organisation takes cognisance of all the stakeholders of the firm and pays attention to the external influences that may affect the firm's activities (Fergusson & Langford, 2006). As such, where ISO 14001 EMS presents a differentiation such that clients would select it in their evaluation of tenders may create a competitive edge for a certified organisation.

Globalisation in some areas of the world is creating competitive pressures for firms to implement environmentally compatible standards. ISO 14001 EMS is an international standard and therefore is a means of standardising a set of minimum environmental management requirements across sectors. Yates and Aniftos (1997) suggests that to ensure global market share in the long term, U.S. firms should use international standards. Sakr et al. (2009) found that entering wider markets was one of the top reasons contractors in Egypt sought certification. As such, Sakr found that in a time of globalisation and liberation of international trade, developing countries like Egypt need huge efforts to prepare the construction industry for the new business requirements of the coming era where an increasingly competitive market environment would exist, and one of the constraints it faced was a lag in the adoption of EMS. Chen et al. (2004) reported that over the period 1996 to 2001 the proportion of foreign construction companies had grown by an average rate of 10.7%, whilst the proportion of domestic contractors declined by rate of 2.9%**.** Zeng et al. (2003) found that the major motivation for Chinese construction firms to seek EMS 14000 certification was to gain entry into international markets.

Another potential stimulant to adoption of EMS is the mandatory reporting of environmental performance. All EMS key elements are subject to an annual review by top managers, which is an important commitment to guarantee the credibility and effectiveness of a company's determination to sustain a healthy environment. Accordingly, the top managers' role is to communicate not only the annual review to stakeholders and lower managers, but also the value of such ethics to the company (Wu, 2009)

The push factors in a given country and sector may differ depending on the environmental and regulatory maturity of the country. In a survey conducted on construction contractor's reasons for seeking ISO 14001 EMS certification in Singapore, the top four ranked items which emerged were, if the Government makes it compulsory, if clients demand it, if end users insist on environment-friendly buildings and if there most likely competitors became ISO 14001 EMS certified (Ofori et al., 2002).

Pull Factors:

The ISO 14000 series of standards offers a framework for construction companies to manage their operations in order to improve their environmental performance and to achieve tangible results without compromising their corporate goals (Ofori et al., 2000). As such, once it is recognised that the environment is a key criterion which construction organisations integrate into operations, implementing an EMS will assist the organisation in managing environmental aspects in a structured and systematic fashion such that other internal efficiencies and results may be achieved. For example, a study of Hong Kong contractors found that the contributing to environmental protection, reducing environmental risks, improving environmental image and cost saving due to the reduction of environment-related convictions were considered the most important benefits of implementing environmental management in construction (Shen & Tam, 2002). Contractors in Singapore identified reduced operating costs, improved environmental image and credibility, demonstrated compliance with regulations, improved trust and satisfaction with clients and employee satisfaction through up-skilling and improved environmental performance as the most significant benefits (Ofori et al., 2000). There are also

benefits to a the community from implementing EMS result from the reduction of waste, and the materials and techniques used lessen the environmental burden on the climate and surrounding area in the long term (Shen & Tam, 2002).

Valdez and Chini (2002) identified key benefits of implementing ISO 14001 in the US construction sector as improving public image, improving relations with regulators and providing a competitive advantage.

Role of Government:

Tse (2001) stated that since the Government is a very dominant client, the extent to which the Government wishes to restrict its choice of tenderer to those firms that have an environmental management system in placed will demonstrate its commitment to environmentally responsible operations. The public sector clients play a critical role in driving the construction industry to improve its operations through contractual requirements.

The significant impacts of construction activities on the environment have been a contributor towards policies and regulations within sustainable development (Liyin, Hong, & Griffith, 2006). For example, Singapore has stated that it wishes to be a 'model environmental city' and has instituted measures including statutes, regulations codes, incentives, taxes, charges, administrative systems and public education programmes to achieve this(Kein et al., 1999; Ofori, 1992).

In China the government has issued a series of laws, including the environment protection law, the cleaner production promotion law, the pollution prevention law, and reproducible energy law. In terms of energy saving and discharge-decrease, the government has set various objectives in a plan named "Eleventh Five Year Plan", by stipulating three obligatory indexes: Reduction of energy consumption per unit of GDP by 20%, reduction of water consumption per unit of GDP by 30%, reduction of total major pollutants emission by 20% and an anticipated index (Qi et al., 2010).

The literature identifies government as a key stakeholder responsible for ensuring the implementation of sustainable development practices in the

construction industry through the enactment of policy and legislation. Kein et al. (1999) showed that 40% of the contractors surveyed take up environmental protection mainly to avoid infringing statutory regulations, of which there are many in Singapore.

However the literature also shows that a lack of government presence is often responsible for a lack of implementation of environmental management and EMS either through poor enforcement of current regulations, or failure to promote improved regulations in line with country's overarching environmental agenda. Surveys conducted in Hong Kong and Singapore on the implementation of ISO 14001 EMS found that contractors would not implement if there were insufficient governmental command-and-control regulations accompanying it. Further, it was established that potential influential reasons for indifference towards it were a lack of governmental administrative requirements on adoption and a lack of governmental financial subsidies such as tax deductions (Chen et al., 2004; Kein et al., 1999; Ofori et al., 2000; Tse, 2001). Zainul Abidin (2010) noted from interviews with Malaysian construction industry practitioners that a lack of enforcement and monitoring of laws and legislation is identified as one of the reasons for a poor level of implementation of sustainable building practices, whilst all respondents in a survey in China agreed that there was not a structured legal framework in place for regulating environmental protection (Zeng et al., 2003).

As such the survey findings in previous literature vary in the nature of the government's role. For example, although the survey conducted by Ofori et al. (2000) in Singapore found that Government making ISO 14001 EMS compulsory ranked as the highest motivator which would compel organisations to implement ISO 14001 EMS, another survey carried out by Ofori et al. (2002) in Singapore showed that a lack of Government legal enforcement ranked very low as a barrier to ISO 14001 EMS implementation. In a survey of the top 200 South African companies, 83 % of respondents held the view that Government policy and legislation would bring the most significant pressure to bear on organisations and/or industries to display greater environmental responsibility (KPMG & IEF,1997). Sakr et al. (2009) also found that that government was

found to be the main push factor in Egypt by putting strict laws and continuous monitoring in place.

Professional bodies and institutions

To an extent, professional institutions and other industry bodies can help to instil a greater sense of accountability among industry participants by stimulating acceptable standards of behaviour and establishing a supportive regulatory framework (Tse, 2001). Institutions and related bodies have also been identified as instrumental in assisting awareness and adoption (Ofori et al., 2000)

Kolln and Prakash (2002) investigated factors which affect the uptake of EMS in Germany, UK and the US. It was found that the UK and Germany had higher adoption rates than the US due to the ability of certain institutions to promote them. Similarly, Tse (2001) found that collaboration between the government, professional bodies and training institutions played a crucial role in spurring facilitation of standardised EMSs in the construction industry in Singapore. Similarly, Ofori et al. (2002) further suggests that government, professional and trade organisations, and certified bodies should exploit all the resources of the media to promote awareness of ISO 14001 in the construction industry.

CIRIA, the Construction Industry Research and Information Association, is an example of such an industry body in the UK. It delivers a programme of business improvement services and research activities for its members and those engaged with the delivery and operation of the built environment. It urges clients' consultants, in preparing a select tender list, to consider the extent to which the client wishes to restrict his or her choice of tenderer to those firms that have an environmental management system in place, or can in some other way demonstrate their commitment to environmentally responsible operations.

The South African government established the Construction Industry Development Board (CIDB) in 2000 to promote a regulatory and developmental framework that builds the construction delivery capability for South Africa's social and economic growth, and "a proudly South African" construction industry that delivers to globally competitive standards (CIDB, 2014)**.** As such, the CIDB

is a guiding body in the industry which can play an important role in providing strategic direction to the construction in order to meet international best practice, such as ISO 14001 EMS.

In South African the Green Building Council of South Africa (GBCSA) was developed in 2007 and its mission is to drive the adoption of green building practices in the South African property industry and move the industry towards sustainability. The Green Star SA-rating tool sets standards and benchmarks for green building and enables an objective assessment as to how 'green' a building is.

Whilst certain South African Bureau of Standards (SABS) standards attend to quality issues, it is widely accepted that they encompass a very narrowly defined quality regime. For example, SANS 204 specifies the requirements for the design and operation of energy-efficient buildings with artificial or natural environmental control and their sub-systems. Although these standards are currently being implemented, they are not part of the National Building Codes (van Wyk, 2009)

South African regulatory environment

Currently the available Acts and regulations which govern the South African construction industry are numerous and robust. These Acts and regulations are available from the CIDB (CIDB, 2014) for practitioners and are summarised below.

The White Paper: Creating an Enabling Environment for Reconstruction, Growth and Development in the Construction Industry (Republic of South Africa, 1999) contained provisions dealing with environmental concerns in Chapter 4 'Enhancing industry performance', a goal was defined to enhance environmental protection through procurement leverage. This entails the enforcement of existing environmental requirements on all public sector contracts, the adaption or development of minimum and best-practice standards such as ISO 14001 and the inclusion thereof as a condition of contract on selected number of prime public sector contracts.

The ‘Bill of Right’s’ – Chapter 2, enshrined in the National Constitution (Republic of South Africa, 1996) states that everyone has the right to an environment that is not harmful to their health or wellbeing, and makes the commitment to protect the environment for the benefit of present and future generations through legislative and other methods.

The Environment Conservation Act (Republic of South Africa, 1989) addresses general environmental policy, creates protective measures for the natural environment, includes policy relative to hazardous waste disposal and addresses certain areas ‘noise control areas’

The Environmental Impact Assessment (EIA) Regulations (Republic of South Africa, 1997) require the conducting of EIA’s.

The National Environmental Management Act (NEMA)(Republic of South Africa, 1998) sets principles for decision making relative to environmental management and aims to engender sustainable development through integrated environmental management (IEM) including in design and construction processes.

The Hazardous Substances Act (Republic of South Africa, 1973) provides for the control of substances that may cause ill health, or death.

2.2.5. Barriers to ISO 14001EMS implementation in the construction sector

For a management system to be considered and effective, it must provide certain base-line benefits to an organisation. All management systems should provide a defined and organised approach to relevant activities, while also meeting bottom-line business needs (Jackson, 1997)**.** The literature reveals that there are number of real and perceived obstacles which deter organisations in the construction sector from implementing EMS. The major obstacles to implementation of EMS in the construction sector include: increased management costs, lack of qualified personnel, lack of subcontractor cooperation, lack of client support, lack of governmental legal enforcement,

time-consuming features of improving environmental performance (Shen & Tam, 2002).

Cost-benefit implications

Contractors' commitment to the environment is often handicapped by their cost-benefit concerns. Implementation of environmental standards involves investing resources and thus presents challenges, particularly to contractor's profit making. A survey conducted in Hong Kong showed that there was a perception amongst construction contractors that an EMS results in more costs than benefits (Shen & Tam, 2002). The construction sector has been identified as one where profitability is low and competitive edge is crucial to winning contracts (Sha & Lin, 2001).Therefore the upfront implementation costs of ISO 14001 EMS are a major deterrent for construction organisations (Tse, 2001; Zeng et al., 2003). For example, in a survey conducted in Singapore it was discovered that satisfying the client's specifications, and cost minimisation were accorded the highest priorities by the construction enterprises, whilst evaluation of the project's impact on the environment ranked lowest among the firm's project priorities (Kein et al., 1999). In the USA similar research study revealed that that the costs and risks associated with the adoption of environmentally friendly practises and technologies, either real or perceived, were found to increase the probability of environmental violations and decrease the probability of environmental over-compliance (Wu, 2009).

Implementation of the full EMS requires a comprehensive integration of the environmental agenda into the development life cycle, not merely a short term address of environmental protection. However, where a holistic, Life-cycle Assessment (LCA) of the costs of a structure's lifetime may reveal it cost affective and environmentally sensible to construct with 'green' processes and materials, construction organisations will generally make decisions on a short term horizon where benefits and trade-offs are assessed on their immediate implications. For example, contractors in Singapore were found to have a narrow view of the cost-benefit considerations of ISO 14001 EMS, and they expect direct short-term benefits (Ofori et al., 2002). Similarly, Shen and Tam (2002) found that contractors in Hong Kong placed much more value on short

term benefit with less counting on long term benefits that could be gained from investments such as in environmental management systems

Cost concerns can also be exacerbated in a developing economy; for example Sha and Lin (2001) found that Chinese construction firms were handicapped in resourcing an EMS as a result of the symptoms of being a developing nation, such as low profit rates, a planned economy, low education level of workers and poor and obsolete equipment.

Roles and responsibilities of role players

The responsibility for incorporating environmental management into project planning from the outset, and ensuring it is implemented during the entire project lifecycle, is not always clear. The design of a construction project may be collaboration between architects, quantity surveyors, developers and even the client

In Egypt it was found that although all contractors considered construction activities to have a negative impact on the environment, 41% of the non-certified contractors felt that contractors had no responsibility in decreasing this impact (Sakr et al., 2009) This survey suggested that contractors who were not looking to enter international markets would not seek certification as it was not required in the bids they entered since they were located in developing countries with no environmental concern.

Ultimately, in order for the environment to become a serious consideration in the construction sector, it will need to be incorporated into the culture amongst industry stakeholders. However, challenges with sub-contractors' awareness of environmental management and skillsets in environmental practice are often found to be lacking. For example, interviews with contractors in Hong Kong revealed that contractors found it difficult to control the environmental performance of subcontractors (Shen & Tam, 2002).

Resource requirements

There are significant resource requirements for implementing ISO 14001 EMS. There is increased management and staff time required when developing plans, documenting the EMS, undertaking training, accomplishing EMS tasks and undergoing environmental audits (Kloepfer, 1997; Krizan, 1999). A major emphasis of ISO 14001 is continuous improvement through the planning-do-check-review cycle. In implementing EMS construction firms are required to provide continuous training in order to increase environmental awareness, which will also translate into increased personnel costs.

The low levels of education inherent in the construction sector have been identified as an obstacle to implementation. For example in China it was found that 50% of frontline workers only possessed a primary school education and are literate (Zeng et al., 2003). This will negatively affect a firm's willingness to implement ISO 14000 due to the processes and documentation required by the monitoring nature of the EMS. A lack of trained staff and expertise skilled resources has emerged from the findings as barrier to implementation (Shen & Tam, 2002), whilst (Ofori et al., 2002) found that one of the biggest problems respondents expected to face in implementing EMS are a shortage of qualified personnel. Interviews with contractors in Hong Kong revealed that contractors found it difficult to control the environmental performance of subcontractors (Shen & Tam, 2002).

(Zainul Abidin, 2010) noted that although environmental issues were not as pertinent in the past and therefore not given a priority in education, the younger generation has been exposed to sustainable construction in their higher education studies. They are however, unable to translate that knowledge into practice due to a lack of real world understanding.

2.2.6. 2.4.3 Research Question 2

What are the drivers and barriers to adoption of Environmental Management Systems (EMSs) in the South African construction sector?

2.4. Conclusion of Literature Review

The body of literature reviewed suggests that most construction firms are aware of the trends in sustainable development and of the importance of improved environmental performance in the construction sector. However, the adoption of environmental practice, which typically takes the form of ISO 14001 EMS, is influenced by number of perceived benefits and barriers to implementation. The literature also identified contractors, sub-contractors, clients, government and industry bodies as key stakeholders in the decision making in the uptake of Environmental Management Systems.

2.2.7. Research Question 1:

What is the scale of adoption of Environmental Management Systems and environmental practice amongst South African construction organisations?

2.2.8. Research Question 2:

What are the drivers and barriers to adoption of Environmental Management Systems (EMSs) in the South African construction sector?

CHAPTER 3: Research methodology

This section outlines the methodology used to carry out this research. The attributes of a mixed methods approach to research will be discussed as well as the applicability of the chosen research design to the topic.

The population and sampling methods, as well as the detail of the research instrument will be described which will be used to gather the data. The section will conclude on the possible limitations of the study, and a discussion of the validity and reliability issues of the report.

3.1 Research methodology /paradigm

The study made use of mixed methods research. A mixed methodology was initially used by Campbell and Fiske (1959) to study the validity of psychological traits wherein a multi-trait, multi-method matrix was used. Although qualitative and quantitative methods were initially considered incompatibility, the notion of converging or triangulating different quantitative and qualitative data sources was initially used by Jick (1979). Mixed methods is now recognised to enhance the understanding of a topic typically studied from just a qualitative or quantitative perspective(Kalof, Dan, & Dietz, 2008), and collecting diverse types of data can provide a better understanding of a research problem(J. Creswell, 2008). Mixed methodology is more than simply collecting and analysing both types of data; it involves using both approaches in tandem so that the overall strength of the study is greater than either qualitative or quantitative research (J. W. Creswell & Clark, 2007). Mixed methodology is also used in research which is interested in both narrative and numeric data and their analyses (Tashakkori & Teddlie, 2003). It was therefore a suitable option for this study in order to quantify and rank factors affecting the presence of Environmental Management Systems in the construction sector, as well as to converge and gaining deeper understanding on key themes from the opinion based, open-ended questions.

A Concurrent Nested Mixed Methods Strategy was used (Cresswell,2008). A concurrent nested model is often used to allow the researcher to gain a broader perspective as a result of using the different methods as opposed to using the

dominant method alone (Cresswell,2008). For example Morse (1991) noted how qualitative data could be used to describe an aspect of a quantitative study that cannot be quantified. This was an appropriate strategy to use it allowed the researcher to collect the two types of data simultaneously during a single data collection phase, whilst also enhancing the depth of findings emanating from the research from using both methods. Unlike the traditional triangulation model, a nested approach has a predominant method that guides the project, and the less-dominant method which is embedded within the dominant method. In practical terms priority occurs through strategies such as whether quantitative or qualitative information is emphasized first and the extent of the treatment of one type of data (Cresswell,2008). In this study, quantitative data may be described as the dominant form of the instrument testing the research questions, and key themes to emerge on the topic from the literature review, whilst the qualitative data was used to enhance and triangulate themes through open-ended, opinion based responses. The data collected from the two methods are mixed during the analysis phase of the project.

Triangulation is a mixed methods and validity procedure where researchers search for convergence among multiple and different sources of information to form themes or categories (Creswell & Miller,2000). Across-method triangulation is where quantitative and qualitative methods of data collection are used in the same study (Casey & Murphy, 2009). The advantage of this method is that it yields confirmation and completeness of data and has the potential to unveil any irregularities that may reveal a different perspective (Duffy, 2006). In the study open ended questions were used to reaffirm the outcomes of the analysis of the quantitative data, as well as identify incongruities.

3.2 Research Design

The study made use of descriptive survey research in which information is gathered from a population about characteristics, attitudes, opinions or previous experiences (P. D. Leedy & Ormrod, 2005). Surveys are useful for estimating the prevalence of attitudes and behaviours in a population, examining relationships among variables and determining causal links between variables

(Kalof et al., 2008). This approach is therefore appropriate for this research as it will allow for the researcher to identify the prevalence of environmental features and the relationships and links with the factors which influence them. It will further allow for enhancement of findings through sharing of additional attitudes, opinion and insight by key industry practitioners.

Elite interviews with industry experts from the Construction Industry Development Board and the Council for Scientific and Industrial Research were also conducted in order to gain additional input and opinion of the major themes, and to validate the interview protocol. An advantage of this is that it lessens the potential of bias in the results(Kalof et al., 2008).

3.3 Population and sample

The research investigated the presence of Environmental Management Systems in the South African construction sector. The population and sampling method are described below

3.3.1 Population

The survey targeted active construction companies in South Africa. Due to the nature of development in South Africa, the firms' head offices where largely located in the Gauteng province. Where possible, senior management with environmental portfolios were consulted, however if this position was not existing, environmental specialists were surveyed.

3.3.2 Sample and sampling method

A stratified sampling procedure was used to select a sample of contractors within the South African Construction Sector. In stratified sampling the researcher identifies subgroups or strata within the population (Teddlie & Tashakkori, 2009). This study was interested in the leading and most prevalent construction organisations in South Africa, and which are likely therefore to be at a more advanced stage of environmental management implementation relative to their peer group. This was accomplished in conjunction with the

CIDB's contractor grading designations; the CIDB's register of contractors offers a convenient reference point for developers to source contractors, who are required to register the nature of work they perform, for example civil construction, and the scale of projects they are capable of executing. This study only looked at active contractors with a grading of 8 and 9:

- Grade 8; capable of executing contracts from R 40 million – R130 million
- Grade 9; capable of executing contracts of R130 million and upwards

Additional contractors not registered with CIDB, however also prevalent in the construction industry and known to the researcher were also selected.

Elite interviews were conducted with two specialists on environmental aspects in the construction industry in order to validate the content of the interview protocol; the program manager for the Construction Industry Performance(CIP) program at the CIDB, and an environmental specialist from the Built Environment sciences at CSIR. These two respondents were selected based on their reputation and experience in environmental issues in the construction sector.

3.4 The research instrument

The research instrument included both open-ended and close-ended questions in an interview protocol. Design of the questions was guided by the themes and criteria in the consideration of environmental management emerging from the literature review.

The interview protocol was administered through face-to-face interviews with respondents and where this was not possible a questionnaire was administered electronically after making telephonic contact with the appropriate respondent in the organisation.

The interview protocol was subject to a "test run" through the elite interviews with specialists from the CIDB and CSIR prior to execution. Comments and

suggestions on structure and content resulting from these interviews were used to update and enhance the interview protocol.

A combination of structured and open-ended questions was made use of in order to enhance the findings and observations. Structured questions required respondents to rank environmental issues in the industry, as well to rate factors on a 5-point scale (from 'insignificant' to significant'), whilst the open-ended questions allowed the respondents to articulate further their views on environmental strategies in construction. Open ended questions have been found to be effective in interviews where the respondents generally prefer to articulate their views(Aberbach & Rockman, 2003).

3.5 Procedure for data collection

Once the list of construction firms were selected, contact was made in order to establish the appropriate person within the organisation under whom the environmental policy and expertise resides. Where possible, face-to-face interviews were arranged with the respondents in which the questionnaire was completed.

Not all respondents were able to meet for the face-to-face interviews due to work commitments, and the construction sites often requiring them to be in remote locations. In such instances the questionnaire was sent to the respondent via e-mail to complete unassisted, and if necessary, a follow up teleconference was arranged to elaborate or clarify responses.

The closed and open-ended questions were collected simultaneously; the first section of the questionnaire consisted of closed ended questions which the respondents were able to complete largely unassisted. The second section contained open – ended questions which allowed the respondents to express opinion and elaborate on themes in the first section. In the face-to-face interviews this information was taken down by the interviewed and transcribed after the interviews. In instances where the questionnaire was filled out unassisted the respondents typed their responses which were later captured and coded by the interviewer.

3.6 Data analysis and interpretation

Both quantitative and qualitative questions were used in the survey in order to extract both opinion and narrative, as well to allow for quantitative data analysis. This section describes the method of data analysis and representation for both subsets of data collected.

3.6.1 Descriptive Statistics

Descriptive statistics is the discipline of quantitatively describing the main features of a collection of data. The initial questions in the survey explored the organisation's status quo vis-à-vis environmental management and policies, as well as their opinion on EMS in the construction sector. Here histograms and frequency tables were used to depict the trends in the responses.

3.6.2 Rank ordered data

Full rank order data was used to analyse Question 13, as it required respondents to rank by priority the full list of key criteria in the planning of construction projects, Respondents did not give a magnitude of the difference between the consecutively ranked items, and there is therefore no basis for any assumptions that the differences between the consecutively ranked items are equal, or constitutes interval data (Stacey)(2006) cautions that researchers should not draw inferences that are consistent with ordinal level data and further puts forward an algorithmic approach to estimate underlying parameters in data that has been ranked. This algorithm was used to analyse the responses for question 13.

3.6.3 Normal distribution fitting algorithm

Questions 14 – 18 collected ordinal responses from respondents. Categorical data is ordinal if there is a natural ordering of its values(Albright, Winston, & Zappe, 2010). The survey made use of such a 5 point rating scale, using the criteria never – always (question 14), and insignificant – significant (question 15 -18).

When analysing ordinal data there are mixed opinions on the methodology that should be adhered to; a popular approach has been to accept the data at an interval level in order to carry out analysis. However Stacey (2005) cautions against this approach and illustrates that survey results may be flawed if ordinal level scales are assumed to be interval. Stacey demonstrates that rescaling the data by applying a distribution-fitting algorithm before performing analysis on it is found to be more accurate with enhanced validity. As such, Stacey's normal distribution fitting algorithm was used rank the data sets.

3.7 Limitations of the study

The study is only interested in the major construction companies in South Africa, with project sizes of grade 7 (R 13 million and above). The construction sector in South African reflects the global structure of the sector insofar as the majority of construction enterprises fall within the definition of Small, Medium and Micro Enterprise with only a small percentage rated as large (van Wyk, 2009). This may weaken the ability to make inferences on the entire construction sector, and hence the external validity.

A relatively low number of respondents participated in the survey, and therefore it is difficult to draw inferences and statistical significance and extrapolated over the larger population.

The study will only use respondents from major construction companies. There are numerous other members of the construction industry, such as the architects or designers, sub-contractors and clients or end-users, which may have a different perspective to add to the issues investigated.

The study only contacted firms with head office presence in South Africa, therefore foreign firms which may be active in construction sector for projects were not included in the results.

3.8 Validity and reliability

3.8.1 External validity

External validity is concerned with the ability to generalise from the study to a larger population (Kalof et al., 2008). One commonly used strategy of ensuring external validity of a research project is that of obtaining a representative sample. Ideally participants in a research study should be a representative sample of the population about which the research draws conclusions from(P. D. Leedy & Ormrod, 2005). Thus, although selecting only the prevalent construction organisations is a limitation in gathering data and opinion representative of the entire industry, the SA construction sector is representative of the global sector. Therefore external validity is created as the organisations surveyed represent the majority of organisations executing large construction projects in SA.

External validity was maintained through the replication of the themes on environmental management in the Global construction sector prevalent in the previous studies carried out on the subject.

3.8.2 Internal validity

Internal validity relates to the appropriateness of the instrument in measuring the data, and that the researcher ensures that they are confident that the conclusion drawn are warranted from the data collected (P. Leedy & Ormond, 2010) One of the strategies that may be used to ensure internal validity is triangulation (P. Leedy & Ormond, 2010). This study made use of the triangulation of quantitative and qualitative methods to ensure that observations and findings made were the most likely ones, and the validity of representations was therefore enhanced.

Internal validity is especially of concern in experimental designs (P. D. Leedy & Ormrod, 2005). As such, internal validity is further ensured in this study as the topics under investigation, as well as the research instruments used to obtain the data, have been used in previous studies where validity was not a concern.

Finally elite interviews with two industry experts were conducted prior to the commencement of the survey release in order to verify and validate questions in the research instrument.

3.8.3 Reliability

Reliability is the consistency with which a measuring instrument yields a certain result when the entity being measured hasn't changed (P. D. Leedy & Ormrod, 2005). Reliability can be ensured in several ways: the research instrument is administered in a consistent fashion, and, to the extent that subjective judgements are required, specific criteria should be established that dictate the kinds of judgements the researcher makes. In this study reliability was ensured as only the researcher conducted interviews with respondents, and administered the questionnaire in cases where respondents were not available for a face-to-face interviews, in which case the nature of the questionnaire was communicated by telephone first, where it was also explained that questions where there was any uncertainty could be clarified by the researcher.

Further, similar studies have been conducted on the construction industry in other parts of the world (Sakr et al., 2009; Shen & Tam, 2002), thus pertinent questions and research methods were replicated from previously successful studies.

CHAPTER 4: PRESENTATION OF RESULTS

4.1 Introduction

This chapter presents and describes the results and analysis of the responses to the survey. The layout will follow the sequence of the questionnaire, i.e. the organisations' and respondent's profiles will be presented initially, followed by a detailed analysis and description of the various sections as they relate to the two research questions.

4.2 Profile information relating to respondents

Twenty one responses were obtained over a three month period in the Gauteng province of South Africa. The sample represented organisations registered with the CIDB with a grade of 8 and higher, and construction organisations known to the researcher who carry out large scale construction projects but are not registered with the CIDB.

Table 1 lists the organisations which took part in the survey, the name and title of the representative which answered the survey questions, and the estimated number of employees in the organisations. Although the number of employees was requested, it was noted that this is noted during the interviews that this may not be an accurate gauge on the size of the organisation's operations as most organisation outsource various aspects of their projects, typically where a large part of the labour force is located.

Where possible, persons with an environmental specific role, and a more senior respondent were preferred. Table two summarises respondent designations

Table 1: Summary of respondent designations:

Designation	Function	Frequency
Directors	Environmental	4
	Other	1
Group Managers/ Officers	Group SHEQ Manager	3
	Group Environmental Officer	2
Managers / Officers	SHE Manager	4
	Environmental Manager	3
	Project Manager	1
Practitioners / Specialists	SHEQ Specialist	1
	Environmental Practitioner	1
	Integrated Business System Coordinator	1

The study was interested in the degree of environmental awareness and the adoption of environmental management systems in construction organisations.

A possible indicator of this is the extent to which specialist environmental positions are in place, and at what level of management are environmental criteria represented.

Table 3 represents a summary of designations illustrating the number of dedicated environmental positions, and organisations where environmental policy and tasks are handled by the general positions in the organisation. Many organisations were found to have a Health, Safety and Quality (SHEQ) manager / official. One respondent indicated that the environmental portfolio had been lumped under Health and Safety in their organisation; however he was not sure of the role or the accountability involved.

Table 2: Summary of environmental roles:

Designation	Frequency	Percentage
Dedicated environmental positions	7	34%
SHEQ positions	8	38%
General positions	6	28%
TOTAL	**21**	

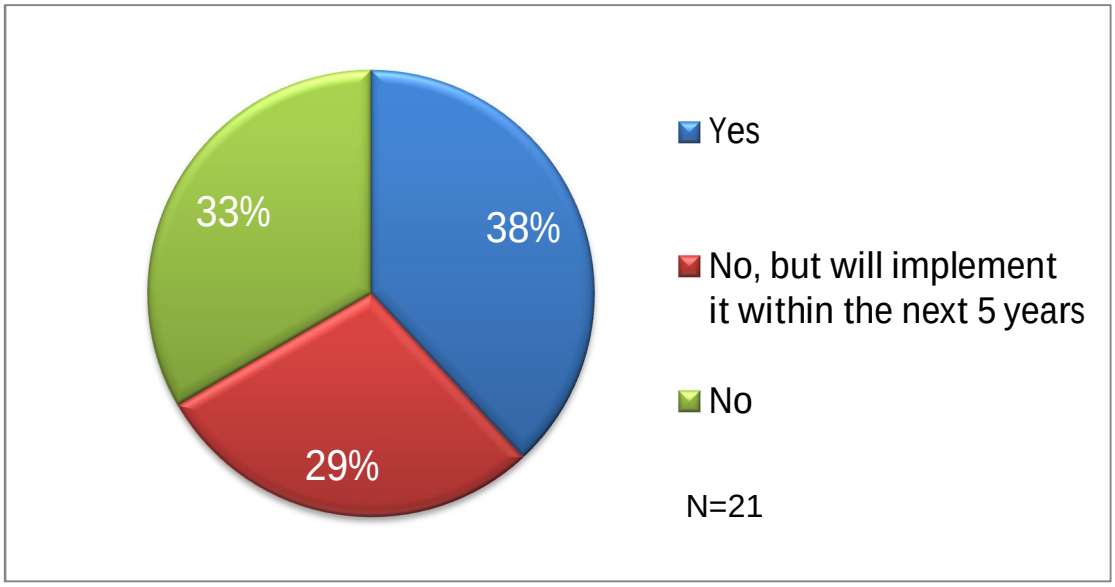
4.3 The degree of adoption of Environmental Management Systems in the construction sector

The first research question focusses on the scale of adoption of ISO 14001 EMS, environmental policy and awareness within the South Africa's construction sector. The results related to this issue are presented in this section.

ISO 14001 EMS Certification or Equivalent

The results obtained related to the scale of implementation of ISO 14001 EMS are as follows and shown in figure 3.

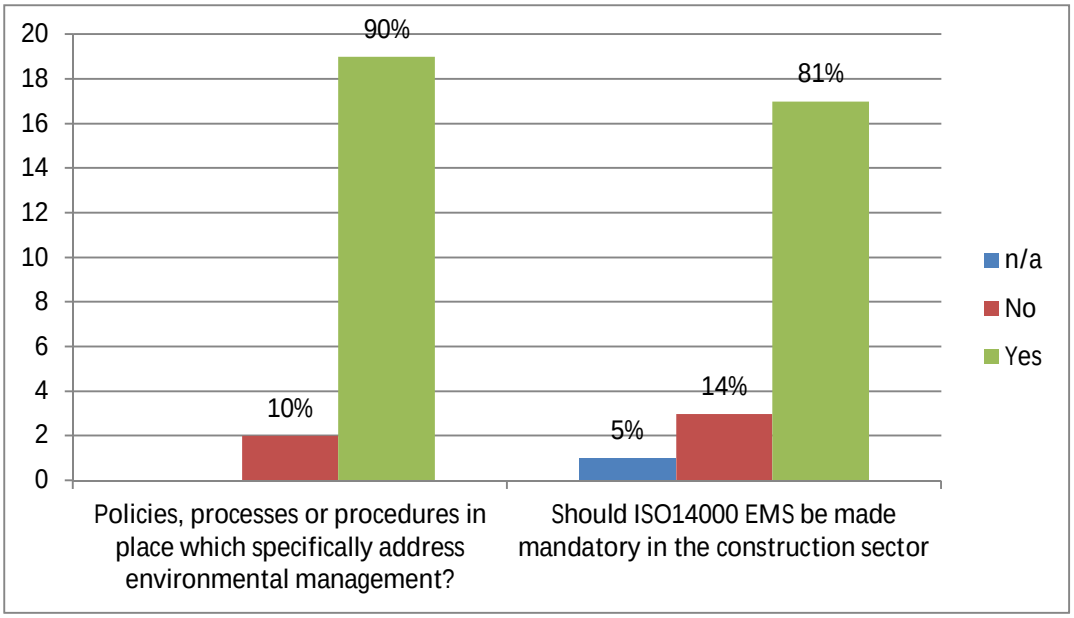
Figure 3: ISO 14001 EMS or equivalent implementation



Of the twenty one organisations which participated in the survey, eight (38%) were ISO 14001 certified, whist six (29%) indicated that would implement within

the next 5 years, two of which indicated that they were currently implementing it. No organisations indicated that they had an equivalent EMS certification.

Figure 4: ISO 14001 EMS implementation



The results of the study in terms of the extent of environmental management showed that 90% of organisations surveyed indicated that they had a policy, process or procedure in place which specifically addressed environmental management; one interviewee indicating that their internal management policy was aligned to ISO 14001. Another organisation indicated that it had, “specific codes of Practice that deal with specific environmental management issues within the system, i.e. integrated waste management, environmental monitoring, rehab, etc.”

81% of respondents reported that ISO 14001 should be made mandatory in the construction sector; one respondent indicated that it was dependent on the size of project, whilst one respondent expressed the view that it was not relevant to the construction projects they were undertaking.

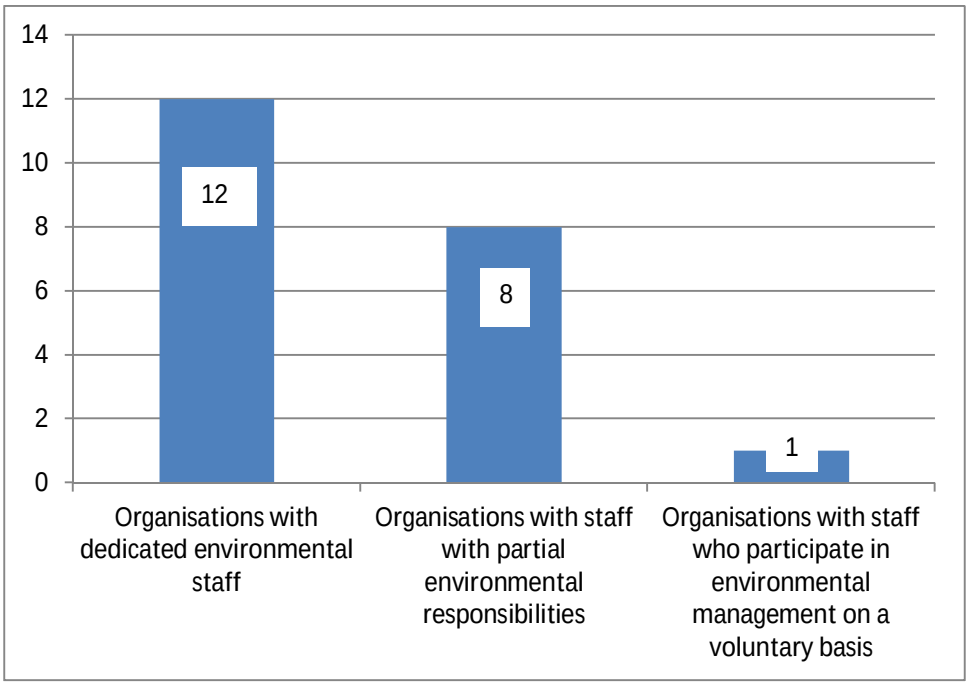
Table 3: Mandatory ISO14000 EMS or equivalent requirements

YES	NO	n/a
17	3	1

Employee Involvement on a typical construction project

Respondents had varying degrees of staff with environmental responsibility. According to the sample of respondents, this was dependent on the project and extent to which the client provided resources to monitor the Environmental Management Plan initiated at the beginning of the project. Typically, dedicated environmental staff consisted of an Environmental Officer or a SHEQ officer, whilst staff with partial environmental responsibilities consisted of SHEQ practitioners or representatives who monitored the minimum requirements of environmental criteria. This was mainly dependent on the client's specifications, and to what extent the client would provide environmental personnel on the project.

Figure 5: Employee involvement on a typical construction project



Environmental Training Provided

For the sample firms only three (14%) did not provide environmental training with the remainder split equally between occasional (43%) to frequent (43%) training on environmental management. In clarifying these categories it was understood that training was typically carried out during induction and during "toolbox talks." The main purpose was to align the employees' activities to the statutes in Environmental Management Plan. There were however only 2 respondents indicated that they provide additional training on environmental management and awareness.

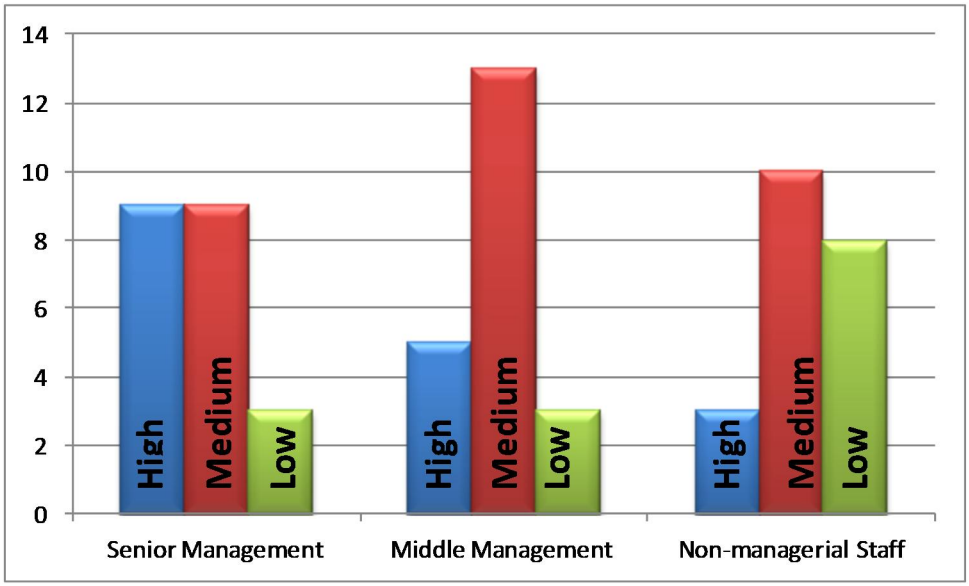
Table 4: Environmental training provided

Frequent Training	9
Occasional Training	9
None	3

Environmental Awareness within the Organisation

As shown in Figure 6, perceptions from respondents surveyed indicated that environmental awareness was highest amongst senior management, moderate within middle management and relatively low amongst non-managerial staff with highest frequency of low levels of awareness.

Figure 6: Environmental awareness within the organisation



Priority at planning stage of projects

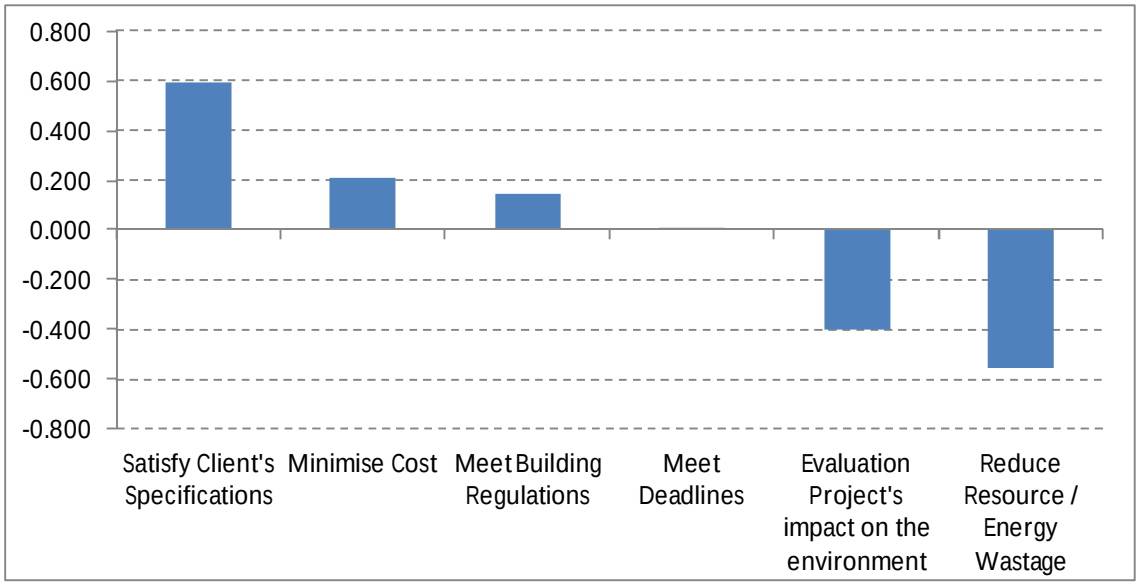
Respondents were asked to rank considerations at the planning stage of a project from highest priority (1) to lowest priority (6). The criteria were taken from the themes arising from the literature review and respondents were required to rank the entire list. These criteria and summary of the ranking exercise is below in table 7.

Table 5: Frequency of criteria during planning phase of projects

Ranking	1st	2nd	3rd	4th	5th	6th
Minimise Cost	4	6	3	3	1	4
Meet Deadlines	1	5	5	4	4	2
Meet Building Regulations	3	3	8	4	1	2
Satisfy Client's Specifications	9	2	3	4	2	1
Reduce Resource / Energy Wastage	0	3	2	3	6	6
Evaluation Project's impact on the environment	3	2	1	3	6	6

Using the algorithm offered by Stacey (2006) it is possible to estimate the population item means and standard deviations of the frequencies. The means were ranked and presented in Figure 7 below.

Figure 7: Means of ranked criteria considered during the planning phase of a project



The data suggests that satisfying clients' specifications is given the highest priority by respondents during the planning phase of a project, whilst minimising cost and meeting building regulations are similar in their level of importance. Evaluating the project's impact on the environment and reducing resource / energy wastage are given the least consideration.

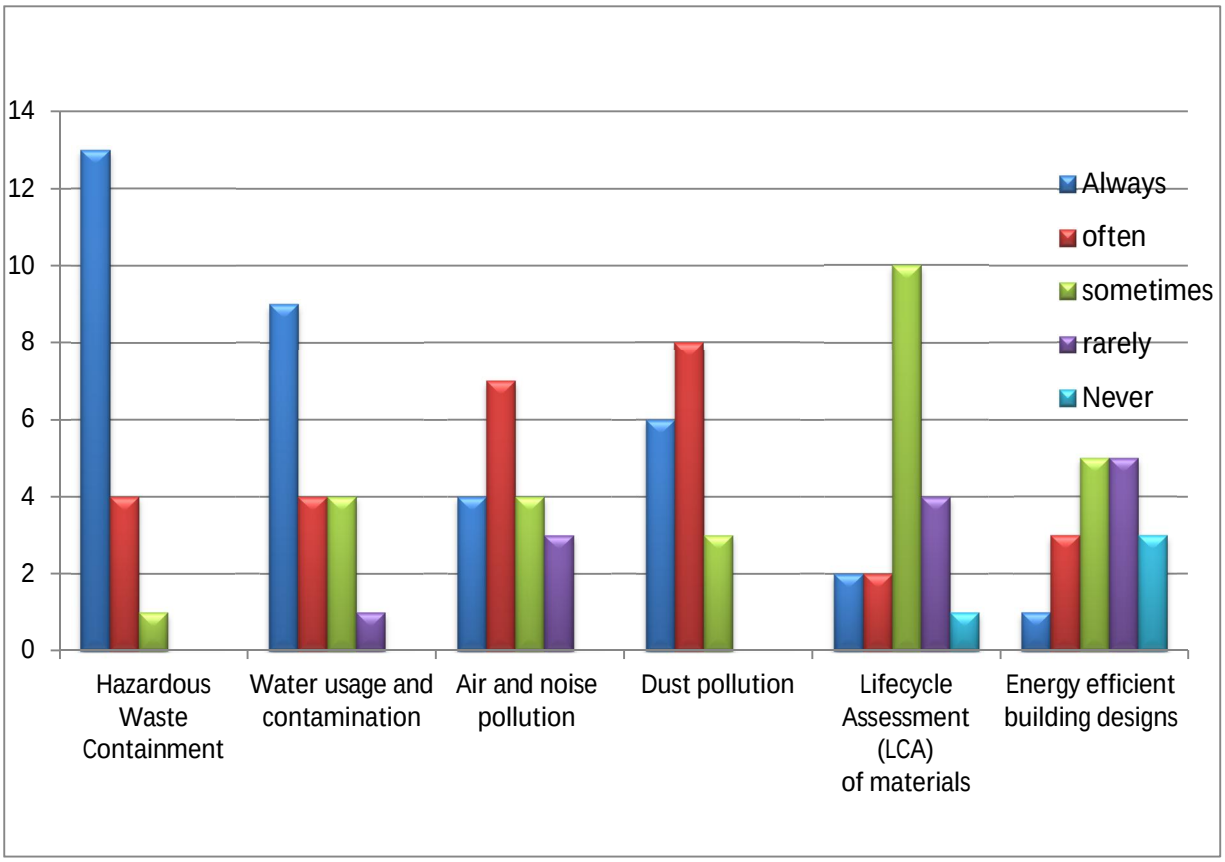
Consideration of environmental aspects on construction sites

Respondents were asked to indicate how often they give consideration to environmental factors on their construction sites on a 5 point scale from 'always' to 'never'. Table 7 illustrates the frequency of ratings given to the factors.

Table 6: Frequency of responses on environmental considerations on constructions sites:

	Hazardous Waste Containment	Water usage and contamination	Air and noise pollution	Dust pollution	Lifecycle Assessment (LCA) of materials	Energy efficient building designs
Always	13	9	4	6	2	1
often	4	4	7	8	2	3
sometimes	1	4	4	3	10	5
rarely	0	1	3	0	4	5
Never	0	0	0	0	1	3

Figure 8: Consideration of environmental criteria on construction sites



It is evident from the graph that Hazardous waste containment and water usage and contamination received the most counts for 'always' responses, dust pollution and air and noise pollution achieved a medium amount of often responses. It was noted that performing a lifecycle assessment of materials

received a large amount of sometimes responses, with a few respondents indicating that this is very much dependent on the client's wishes.

A normal distribution-fitting algorithm (Stacey 2005) was used to rescale the ordinal level data to interval level, and to generate the item means (μ) and standard deviations (σ). An alpha of 5% was selected with a corresponding confidence level of 95%. Table 8 below depicts the relative rankings of the means of environmental aspects considered by contractors on construction sites.

Table 7: Ranking of consideration given to environmental aspects on a construction site

Ranking	Environmental aspects	μ	σ2	σ	t-value	p-value	Significance at 5%
1	**Hazardous Waste Containment**	**0.8556**	0.3991	0.6318	5.7456	0.0000	+
2	**Water usage and contamination**	**0.4600**	0.9206	0.9595	2.0342	0.0589	NO
3	**Dust pollution**	**0.2989**	0.2345	0.4843	2.5451	0.0224	+
4	**Air and noise pollution**	**-0.1008**	0.6495	0.8059	-0.5308	0.6029	NO
5	**Lifecycle Assessment (LCA) of materials**	**-0.5849**	0.5810	0.7622	-3.3446	0.0038	-
6	**Energy efficient building designs**	**-0.9289**	0.9671	0.9834	-3.8944	0.0014	-

The data indicates that hazardous waste containment, water usage and contamination, and dust pollution is given consideration on construction sites. Lifecycle assessment of materials and energy efficient building designs were given considerably less consideration on construction sites.

4.4 Drivers and Barriers of ISO14001 EMS Implementation

The second research question investigated the factors affecting the implementation of EMS ISO 14001 or equivalent. This section presents these

results on the drivers and barriers to implementation, as well as a final section of narrative which presents the reported opinions from the open-ended questions on the Environmental Acts and the regulations.

4.4.1 Drivers of ISO 14001 EMS Implementation

The drivers of the implementation of EMS ISO 14001 or equivalent where classified into push of pull factors.

Push Factors

Respondents were asked to rate on a scale of 1, being insignificant to 5, being significant, the push factors which may compel construction organisations in the South African construction industry to seek ISO 14001 EMS or equivalent. The means taken from the rescaled data were then ranked and are tabulated below.

Table 8: Push factors affecting ISO 14001EMS implementation or equivalent

Ranking	Push Factor	μ	σ^2	σ	t-value	p-value	Significance
1	**If clients demand it**	**0.8948**	0.8890	0.9429	4.2443	0.0005	+
2	**If the government makes it compulsory through regulation**	**0.3372**	0.0665	0.2578	5.8494	0.0000	+
3	**If reporting on environmental performance is made mandatory and made available to the clients and the public**	**0.1124**	0.9096	0.9538	0.5271	0.6046	NO
4	**If financial support/incentive for implementation is offered**	**-0.1663**	1.1831	1.0877	-0.6839	0.5028	NO
5	**If their major competitors become certified**	**-0.3290**	0.9381	0.9685	-1.5192	0.1461	NO
6	**If professional institutions and trade associations promote it**	**-0.8491**	0.2298	0.4793	-7.9220	0.0000	-

The data shows the client demands and governmental pressure through regulation were considered to be the strongest measures which would push construction organisations to obtain ISO14001 EMS or equivalent, whilst

endorsement or promotion by professional institutions and trade associations were seen as the least likely to encourage organisations to seek certification.

Four respondents cautioned against involuntary enforcement of ISO 14001 EMS or equivalent and further commented that it should be specific to the scale, type and location of the construction project. Two of these respondent comments are stated below:

> *"We are aware of the need for environmental management and that regulation and Environmental Management Systems will become more prominent; however this should not take a generic policy, and should be category, sector specific."*

> *"If government makes in compulsory there should be a time frame to ease the impact on operations. It needs to be based on criticality of project; for example what is the impact on social and environmental impact?"*

Pull factors to ISO 14001 EMS Implementation

Respondents similarly rated the factors which would entice contractors to implement ISO 14001 EMS or equivalent on a 5 point rating scale, from significant to insignificant, which are presented in Table 10.

Table 9: Pull factors of ISO 14001 EMS or equivalent implementation

Rank	Driver	μ	σ^2	σ	t-value	p-value
1	Enable company to avoid infringing statues and regulations on construction	0.475	1.434	1.197	1.7737	0.0930
2	ISO 14000 or equivalent soon will be insisted upon by construction clients	0.352	2.105	1.451	1.0855	0.2920
3	Enhance company's public image	0.313	0.603	0.777	1.7998	0.0887
4	Increase company's competitiveness	0.191	0.454	0.674	1.2694	0.2205
5	Improve company's procedures	0.150	0.619	0.787	0.8547	0.4039
6	Help improve workers' health, safety and welfare	0.087	0.503	0.709	0.5454	0.5922
7	Help company to contribute to efforts to protect the environment	0.070	0.339	0.582	0.5395	0.5961
8	Enable company to reduce material waste	-0.020	1.098	1.048	-0.0852	0.9330
9	Reduce company's operating costs	-0.051	0.565	0.752	-0.3060	0.7631
10	ISO 14000 or equivalent EMS will soon be made mandatory	-0.085	1.636	1.279	-0.2987	0.7686
11	ISO 14000 or equivalent EMS will be essential in company's overseas drive	-0.100	1.890	1.375	-0.3266	0.7478
12	Help to enhance company's productivity	-0.177	0.816	0.904	-0.8743	0.3935

The data indicates that the top two pull factors similarly related government and the client. Avoiding infringing statutes and regulations was deemed to be the most relevant pull factor, followed by ISO 14001 EMS or equivalent will soon be insisting upon by construction clients.

Enhancing the company's public image, increasing the company's competitiveness and improving the company's procedures were also according a fairly significant influence as pull factors to implementation.

The factors which are not considered to be significant in inducing construction organisations to implement ISO 14001 EMS or equivalent were that it will soon be made mandatory, it will be essential in the company's overseas drive and it will help to enhance the company's productivity.

4.4.2 Barriers to ISO 14001 EMS Implementation

Respondents were asked to rate on a scale of 1, being insignificant to 5, being significant barriers which would deter contractors from seeking ISO 14001 EMS or equivalent implementation. The results are presented in the table 11.

Table 10: Barriers to ISO 14001 EMS or equivalent implementation

Rank	Barriers	μ	σ^2	σ	t-value	p-value	Significance
1	**High implementation, management and operating costs**	**0.2492**	1.4012	1.1837	0.9416	0.3589	NO
2	**Clients are not willing to pay more for environmental management to be incorporated into a project**	**0.2305**	0.6579	0.8111	1.2707	0.2200	NO
3	**Lack of sub-contractor co-operation**	**0.1987**	1.6558	1.2868	0.6906	0.4986	NO
4	**Lack of trained staff and expertise**	**-0.0320**	1.0920	1.0450	-0.1367	0.8928	NO
5	**Lack of general client support**	**-0.1498**	0.7897	0.8887	-0.7540	0.4606	NO
6	**Lack of governmental pressure**	**-0.1519**	0.9385	0.9687	-0.7014	0.4920	NO
7	**Weak environmental culture within industry**	**-0.1753**	0.8184	0.9046	-0.8667	0.3975	NO
8	**Lack of tailor made training on environmental management**	**-0.4372**	0.8315	0.9119	-2.1441	0.0459	-
9	**Lack of regulatory framework**	**-0.5010**	0.6992	0.8362	-2.6797	0.0153	-
10	**Lack of available environmental technology within organisation**	**-0.5357**	0.9010	0.9492	-2.5237	0.0212	-
11	**Lack of environmentally friendly materials**	**-0.7115**	0.6705	0.8188	-3.8858	0.0011	-

Although the first two factor's p-value fell outside of the confidence interval range of 95%, costs associated with implementation were viewed as the highest barrier to implementation. Table 12 shows that not only are the implementation

and operating costs the primary deterrent to implementation, but also clients are also not willing to pay extra to support the absorption of this costs. As one respondent noted:

> *"It is still very expensive; it's considered an add on to construction projects."*

As such, Table 12 suggests that Lack of sub-contractor co-operation was also considered to be a barrier to an organisation's implementation. The below comments illustrate the challenges which respondents observe with sub-contractors,

> *"The bulk of construction sub-contractors are unaware of legislative requirements."*

> *"B-BBEE is resulting in large amounts of subcontractors in tenders and contracts who are often not environmentally aware of or follow environmental methods. We need to get everyone on board; clients and subcontractors in order for this to work."*

Lack of environmentally friendly materials and environmental technology within the organisation were also seen as least likely to impede organisations' ability to implement. The lack of regulations was also not seen a barrier to organisations seeking certification, as was a lack of tailor made training.

Comments from the open-ended questions also pointed to a greater need for training courses available to increase environmental management knowledge and awareness amongst staff and sub-contractors. One respondent also noted that there is a disconnect between young graduates coming through who have studied sustainable development, to what is practically required in the industry,

> *"Tertiary institutions do not prepare candidates for the construction industry. Most of our "young employees" expect to conserve the environment. Much more emphasis is needed on the responsible development and rehabilitation of construction sites."*

4.5 Environmental Acts and regulations

Open ended questions were used to gauge opinion and perspective on the regulations in SA, and to assess opinion on environmental responsibilities on a given construction project. The following section presents the findings from these questions and provides a summary of report.

Description of the policy landscape:

Most respondents (80%) considered the acts and regulations which govern the construction industry to be comprehensive. These arrangements were considered to provide guidelines to industry practitioners on steps to take in order to ensure compliance. Respondents also viewed the acts and regulations in a positive light, one respondent stating they were excellent. The following comment from one of the respondents captured views of most responses to this question

"The main acts and regulations are robust in SA, including many guidelines to aid the industry with determining the way to manage environmental aspects of projects; these include the NEMA, Conservation Act, Water Act, Construction Regulations etc. and guidelines such as those brought out by the Western Cape Provincial Government and CSIR."

Three respondents (15%) considered the Environmental Acts not to be applicable to their specific industry niche. These were organisations that operate exclusively in residential developments and considered their construction projects as ones which do not have a major effect on the surrounding environment.

Only one respondent (5%) considered the Environmental Acts to be outdated. The respondent felt that environmental legislation had been left behind by the proliferation of Health and Safety acts which were deemed to be more important during the progression in the construction industry.

Table 11: Opinion on Acts and regulations

Acts viewed positively; well written and comprehensive	16
Average; not applicable to specific industry sector	3
Thought to be outdate	1
Not Answered	1

Most respondents (90%) viewed the enforcement of SA laws and regulations in a negative light, which was stated to be non-existent, weak, poor, ad hoc or inconsistent. Respondents with ISO 1400 accreditation stated that monitoring of compliance to acts and regulations is self-imposed due to the audit requirements of the accreditation.

Three respondents commented on an apparent lack of resources, experience and poor overall knowledge of environmental affairs by site inspectors, as the following quote illustrates:

"SA has great laws, regulations and easy guidelines to follow but lacks the commitment from the Government, private sector and society to regulate environmental systems."

Only two respondents (10%) marked N/A to the question, stating that monitoring of compliance was not relevant in their sphere of the industry.

Further to the above, none of the respondents had received a penalty as a result from infringements to the Environmental Acts and regulations in the past 12 months.

It was also stated by a respondent that only large organisations are subject to site inspections, and that there is a large amount of smaller operators in the industry who fall under the radar.

67% of organisations mentioned that they were aware of, or affiliated with relevant institutions and/or bodies in the construction sector. Table 13 shows a

breakdown of intuitions and bodies mentioned by respondents and the frequency each was mentioned. When categorising these institutions and bodies it was noted that three were auditors or consultants with a focus on Health, Safety and Quality, and three were general building association and intuitions within the construction sector. Two out the nine mentioned were specific to environmental affairs. Only three institutions mentioned had a focus on environmental issues and factors in the construction industry, and it was noted by one respondent the general institutions, such as the Master Builders Association, do not push the green agenda, but rather Health and Safety considerations.

Table 12: Industry bodies and associates frequency table

Institution / Body	Frequency
Master Builders Association (MBA)	3
Building Industry Federation of South Africa (BIFSA)	1
Safety and Security Consultants (SAFSEC)	4
Southern African Auditor and Training Certificate Authority (SAATCA)	1
Southern African Bitumen Association (SABITA)	1
International Association for Impact Assessment (IAIA)	1
Construction Industry Development Board (CIDB)	1
Green Building Council of South Africa (GBCSA)	4
ISOQAR (ISO accredited certification body / ISO auditor)	2
Institution / Body not specified by respondent	2

Survey results show that although respondents are aware of a number institutions and bodies active in the industry, they are not actively promoting the environmental agenda, and where environmental aspects and topics are

covered, they are lumped under the Health and Safety umbrella. The below statement represented the opinion of a number or respondents:

> *"Construction health and safety (H&S) has long been the focus of attention in construction industry without much due consideration to the Environment. The name Environment has been long associated with EHS but much emphasis was placed only on two; health and safety."*

Respondents were asked to offer opinion as to where the responsibility for the implementation of Environmental Management Systems within the construction sector lies and the results are presented in Table 14. The data indicated that there no single opinion that typifies contractor's in the construction sector. Six respondents (29%) stated that the client is ultimately responsible, and three of these six respondents indicating the importance of defining environmental criteria by the client at the design stage of a construction project. Five respondents (24%) stated the contractor is responsible for EMS implementation, with two of the five stating that their ISO EMS certification requires them to ensure subcontractors are compliant, and therefore the onus is on them to ensure implementation.

Table 13: Stakeholder environmental responsibility

Stakeholder responsible	Frequency
Client	6
Contractor	5
Both contractor and Client	3
All Stakeholders	3
Government	2
Not applicable	2

Three respondents (15%) stated that both the client and contractor are responsible to implement EMS. One respondent stating the acts hold the

contractors accountable, whilst the client should be responsible for enforcing them.

Three respondents (15%) were of the opinion that all the stakeholders within a construction project should be responsible for environmental management during a construction project, and not the responsibility of any one player.

Two respondents (10%) felt that implementation would need to come from Governmental pressure through regulation. This was said to serve as a push factor, as if organisations are aware that non-compliance will have an effect on profit, they will be more likely to implement.

Four respondents also highlighted the importance of senior management in adopting environmental practices, with one respondent stating:

> *"Top management should take the lead in terms of insuring that the ISO 14000 EMS is adopted and implemented. Getting a buy in and participation from top level management will set the ball rolling in terms of the whole organisation towing the line."*

Two organisations felt that the question was not applicable to their organisation.

4.6 Summary of the results

This section summarises the key findings. Of the 21 companies which participated in the survey, 34% of them had dedicated environmental positions responsible for looking after the strategy, policy or on-site management of environmental aspects during a project. 38% of organisations had grouped the environmental role together with the Health, Safety and Quality function. 28% of organisations address environmental management implication through other existing roles.

Approximately a third of organisations (38%) have ISO 14001 EMS certification, and 29% stated the organisation would implement it within the next 5 years. No organisations had an equivalent certification

However most organisations stated that there was some sort of policy or procedure in place which specifically addressed environmental management. Most respondents (81%) felt that ISO 14001 EMS should be made mandatory in the construction sector.

Although most organisations (95%) had staff involved in environmental management on a typical project, ranging between dedicated environmental staff and staff with partial environmental responsibilities, this was often noted to be in compliance of the Environmental Management Plan agreed to at the outset of the project, and was therefore also dependent on the client to a certain extent. Similarly, although most organisations (86%) carried out training to different degrees, this was noted to be mainly at the initial stages of a project in order to on-board staff on compliance requirements relative to the Environmental Management Plan. Only two respondents indicated that carried out training for the purposes of up skilling staff in the area on environmental management.

Evaluating a project's impact on the environment and reducing resource and energy wastage ranked as the lowest priority items during the planning stage of a project, whilst satisfying client's specifications, minimising costs and meeting building regulations were given the highest priority.

Generally, respondents do consider immediate, project related environmental criteria on a given project, such as hazardous waste containment and water usage and contamination, however they do not give consideration to the long term, and non-project related factors such as energy efficient building designs and lifecycle assessment of materials

The factors most likely to push organisations to obtain ISO 14001 EMS certification were considered to arise from clients demanding it, and the government making it compulsory, whilst the least likely to influence implementation was regarded to be if professional institutions promoted it.

Similarly, the most beneficial factors were regarded to be assist the company avoid infringing statutes and regulations, and to allow organisations to respond to their clients, who are likely to insisting upon it. The factors which are least likely to entice construction organisations to seek ISO 14001 EMS certification were that it will soon be made mandatory, that it will be essential in the company's overseas drive and that its ability to improve firms' productivity.

The factors regarded as the highest barriers to implementation were high implementation, management and operating costs, clients not willing the additional costs associated with implementation and a lack of sub-contractor co-operation.

Lack of environmentally friendly materials, lack of available environmental technology within the organisation, a lack of regulations and a lack of tailor made training on environmental management were also considered the lowest barriers to implementation

Most respondents (80%) considered the relevant environmental acts and regulations to be robust with guidelines available for industry practitioners; however most respondents (90%) also considered the enforcement of the acts and regulations to be weak and inconsistent. Organisations with ISO14001 EMS implemented monitored their environmental performance themselves in accordance with their compliance requirements in order to achieve certification.

67% of respondents were aware of, or affiliated with, industry bodies and institutions. However of these nine organisations, only two were mentioned to push the "green" agenda, Green Building Council of South Africa and the International Association for Impact Assessment.

There were mixed opinions on the responsibility amongst contractors on where the responsibility for implementing environmental management systems in the construction sector, with opinion mainly divided between the client being responsible (29%) and the contractor (24%), whilst Government was considered to play less of a role of ensuring implementation (2%).

CHAPTER 5: ANALYSIS OF THE RESULTS

5.1 Introduction

This chapter discusses and explains the results with reference to the literature. The chapter is structured in the same order as the results in order to follow a logical step wise development of the outcomes. The most prominent construction companies in the South African construction sector were selected as these would be most likely to have environmental policies and management systems implemented. As such, a breakdown of the demographic profile is presented first.

5.2 Demographic profile of respondents

This study investigated the current state of environmental aspects of construction companies in the South African construction sector. In order to achieve this the research endeavoured to target the major players which would be a good representation of the status quo in the South African construction sector. As such, companies registered within the top 2 echelons of the CIDB grading system were selected, i.e. able to complete projects of R130 million and above. This provides an indication of financial and works capabilities, and therefore size of organisation. Other prominent construction companies known to the researcher were also selected based on their presence and size of operations in the Gauteng area.

Directors, senior and middle management, as well as environmental or SHEQ practitioners participated in the survey. Of the 21 organisations which participated in the survey, 7 had specific environmental roles, 8 organisations had included the function under SHEQ responsibilities, and 6 managed environmental criteria under general functions within the organisations. Although not investigated further, larger organisations appeared to have more focus on environmental factors; smaller contractors not having the necessity to have a specialist environmental position with relative smaller operations.

5.3 Extent of adoption of EMS certification

The results of the study indicate that there is a low level of ISO 14001 EMS adoption. Only 8 of the 21 companies (38%) had implemented ISO 14001 EMS and no companies indicated that they had an equivalent system. This is unexpectedly low considering only the top echelon of construction sector were surveyed where the prevalence of environmental management would be expected to be above the industry average and considering a total of 24 of the ISO 14001 EMS certificates issued in South African in 2012 for ISO 14001 EMS. This is a low level of implementation when compared to other sectors. In a survey completed on top 200 South African companies across various industries (KPMG & IEF,1997), 54% of companies used an Environmental Management System. This is however consistent with other research which has found the construction sector generally to be slow to adopt ISO 14001 EMS or equivalents (Zeng et al., 2003). For example, Rodríguez et al. (2011) found that contractors take a wait and see approach to ISO 14001 EMS implementation. Sakr et al. (2009) also found that the construction industry in Egypt was also slow to adopt ISO 14001 EMS, with only contractors certified in 2002.

This study suggests that most construction companies in South Africa believe that ISO 14000 EMS should be made mandatory in the construction sector. This is indicative of the effect of construction on the environment and the need to ensure proper management of the environmental factors on projects. Similar patterns within other construction industries were discovered in similar research, where although implementation and monitoring of environmental criteria may be low, most believed that that it should be a mandatory the industry. In Singapore 73% of respondents believed that ISO 14001 should be a core requirement to the construction sector (Ofori et al., 2002)**,** and in Egypt 91% of non-certified firms surveyed believed that it is necessary for construction organisations to be ISO 14000 certified (Sakr et al., 2009).

Almost all the companies in the study reported that they incorporated environmental management into their operations, most having some sort of environmental management policy or procedure in place. In addition 57% of the sample had dedicated environmental staff and 37% with staff with partial

environmental responsibilities. These measures of environmental management were put in place to meet the minimum compliance requirements of the statues of the Environmental Management Plan (EMP) agreed to with the client at the outset of the project. The extent of the company's involvement in executing the statues of the EMP could also vary depending on the extent of environmental resources provided by the client, e.g. in some instances the client hired environmental consultants who are permanently on site ensuring environmental management and compliance are maintained. In these instances the organisation would have fewer procedures and staff involved in environmental management. Therefore, although the results suggest that there are adequate structures and policies in place to address environmental management, upon closer inspection this was determined to be minimal in practice. Similar observations were identified in a survey in Spain where the application of EMSs was found to be more a means of meeting the requirements for submitting a tender to contracting organisations rather than an indicator of any real commitment to improving the environmental performance of construction companies (Rodríguez et al., 2011)

This informal and ad hoc manner of addressing environmental management is not new in the South African construction sector; Smallwood (2000) found that contractors in the Western Cape, South Africa generally adopt an informal approach to the management of environmental issues, and inter-relate environmental related actions with that of Health and Safety

This attitude was also true for the nature of environmental training offered to staff within the organisation. Most respondents indicated that their organisations provided training for their staff on environmental management, whether frequent (43%) or occasional (43%). However, further examination confirmed that this training was mainly induction training on the provisions of the EMP agreed to for the project. Only two companies stated that they provide training aimed at up-skilling staff on environmental management best practice. As such, there is a very little up skilling and transferring of knowledge on environmental management to the construction firm's employees taking place This is similar to previous findings in other countries; in a similar survey in China it was found

that 8% of respondents provide frequent training and 37% provided occasional training on environmental management (Zeng et al., 2003), and Rodríguez et al. (2011) found that environmental supervisors generally did not possess adequate training in construction work and the environment.

This study indicated that environmental awareness is highest amongst senior management, with reduced awareness amongst middle management, and the least awareness amongst non-managerial staff. This is comparable with the research conducted on the top 200 South African industrial companies which found that environmental awareness is high amongst senior management (92%), and lowest amongst non-managerial staff (56%) (KPMG & IEF,1997). This does suggest that leadership amongst construction organisations are aware of environmental matters, and however may not prioritise them due to other factors influencing the organisation.

These factors which took preference on projects were identified in the report as relating to the clients' cost, time and quality requirements. This is consistent with similar research carried out in Singapore which found that satisfying client's specifications, minimising costs and meeting deadlines were accorded the highest ranking by construction companies, whilst reducing resource/energy wastage and evaluating the project's impact on the environment were given the lowest priority (Kein et al., 1999).

It was noted from respondents' comments that environmental impacts are most effectively eliminated or reduced at the planning and design phase of projects and few respondents also stressed the importance of getting buy-in from all project stakeholders and approval of the environmental strategies at the beginning of a project**.**

As shown in chapter four in Figure 6 on pp 48, and Table 8 on pp 51, the environmental aspects which are given more consideration on projects are more short term in nature and directly related to the projects, such as hazardous waste, water usage and water contamination, which will typically have immediate consequences on the environment. They are therefore more easily visible and therefore easier to monitor and penalise. These are also

aspects which are more often incorporated into the EMP and monitored throughout the project. The aspects which would have more long term benefits on the environment, such as lifecycle Assessment (LCA) and Energy efficient building designs, are conversely more difficult to monitor and penalise, and therefore given less attention.

These results are also comparable with similar research; Smallwood (2000) found that that general contractors in the Western Cape paid more attention paid to hazardous waste containment and water usage, with 61.5 % and 42.9% of respondents always addressing these criteria on site, whilst only 16.7% indicated that they always put in measures to mitigate energy wastage, a more long-term environmental consideration.

5.3.1 Summary

This study shows conclusively that there is generally a low level of adoption of ISO 14001 EMS or equivalent amongst the construction firms surveyed. The sampled firms adopted an informal approach to environmental management; particularly those without certification have a reactive, wait-and-see approach to improving their environmental performance beyond that of the immediate requirements of the Environmental Management Plan and complying with relevant Environmental Acts and regulations. This is of particular concern and significance as the sampled firms represented the largest firms in the South African construction sector.

Although respondents were aware of an increased requirement for better environmental performance and the necessity to make EMS mandatory in the construction sector, broad environmental consideration is not being incorporated into project objectives, especially when considering long-term, full life cycle assessment of environmental considerations. Rather, environmental management is addressed in an informal manner and often grouped under the general SHEQ responsibilities; Safety, Health, Environment and Quality.

According to scholars in the field and practices around the world, in order to successfully implement EMS in a construction project will require far more than just the apparent prevention and reduction of adverse effects. It necessitates a

complete transformation of construction management in an environmentally conscious organisation, such as changes in management philosophy and leadership style, creation of an adaptive organisational structure, adoption of a more progressive organisational culture, revitalisation of the relationship between the organisation and its customers(Chen et al., 2004). The results from this study strongly indicate that this shift has not taken place; organisations still have some way to go towards becoming completely environmentally conscious. It is important that the construction industry in South Africa becomes fully environmentally conscious, and responses from the environmental practitioners indicated that they shared this opinion.

5.4 Factors affecting implementation

This section examines the analysis of factors relating to drivers and barriers to implementation. The major drivers which would compel organisations to implement ISO 14001 EMS result from the influence of the organisations' external stakeholders; the client and Government.

Push Factors:

The statistical analysis presented in Chapter four showed that the most prevalent factors which would compel organisation to seek certification arose from pressure from clients and government; clients demanding certification and government enforcement through regulation. This is aligned with the earlier results which found that satisfying client's specifications ranked highly at the planning stage of a project. This is also consistent with the findings of similar research in Singapore which found that the Government making certification compulsory and clients demanding certification ranked as the top two factors which would compel organisations to implement (Ofori et al., 2000)**.**

Scholars suggest that clients are therefore a key role player in the construction sector and have the ability to influence decision making, and therefore the implementation of EMS. In a key report on the topic, Ofori (1992) stated that, since the activities of industry practitioners are aimed at achieving the three major objectives of the client, namely time, cost and quality, that adopting the

environment as a fourth project objective would be the best way for the environment to be brought into consideration in a conscious manner. This prognosis is accurate for the findings of this study; client specifications and requests are paramount for construction organisations when planning project objectives and deliverables, and therefore by adopting the environment criteria as one of these objectives would be an effective method of stimulating environmental management and creating awareness around EMS in the construction industry.

Government's role as an enforcer of EMS through regulation emerged as a major push factor. This is closely aligned with much of the research which highlights the importance of government's role as an enforcer and advisor in the adoption of ISO 14001 EMS. A survey on the top 200 South African companies found that 83 % of respondents held the view that Government policy and legislation would bring the most significant pressure to bear on organisations and/or industries to display greater environmental responsibility (KPMG & IEF,1997). Sakr et al. (2009) also found that that government was found to be the main push factor in Egypt by putting strict laws and continuous monitoring in place.

It was noted that there were respondents with concern over government involvement and the possibility of blanket instruction regarding EMS in the construction industry. These respondents acknowledged the role of EMS in the industry, however considered it not be applicable to their niche in the industry, and therefore highlights the challenge in the complexity required for government in enforcing EMSs.

Firms also perceived benefits related to ISO 14001 EMS implementation and these serve as "pull factors." These similarly are related to clients and government.

EMS and associated standards serve as tools which assist organisations by helping align construction operations and management processes to the overarching regulations, and therefore in avoiding infringing statues and regulations. Further, the Environmental Acts, policies and legislature which

govern the SA construction sector were identified to be robust, comprehensive and well written, and therefore respondents welcome management tools which assist in adhering and complying with them. This has been noted in other countries; Kein et al. (1999) showed that contractors in Singapore take up environmental protection mainly to avoid infringing statutory regulations.

There is a move towards clients of construction firms requiring EMS certification on projects. This suggests that the construction organisations were drawn to EMS certification by a desire to be proactive and feel that the environment will soon be an evaluation criterion and potentially a fourth client objective together with cost, time and quality. This is a noteworthy result as the study has also established that the client is a key decision maker for project objectives and deliverables, and therefore likely to be a key determinant in increasing the level of environment management amongst all industry practitioners in the future.

Anton et al. (2004) found that liability threats and pressures from consumers, investors and the public are motivating EMS adoption and that consumer pressures are particularly effective in increasing the comprehensiveness of EMSs of firms. The results of this study lend some support to the view since public image ranked fairly highly as a motivator to implementation. This suggests that construction organisations feel that managing their reputation through the environmental management is a factor to be taken into consideration. .

In other countries implementation of ISO 14001 EMS has been shown expected to yield competitive advantage in the market place as increasing the company's competitiveness. (Tse, 2001) Studies of the USA, where environmental management is at a more advanced state, showed that ISO 14001 EMS create meaningful advantage and certified firms have therefore pulled ahead of their competition (Christini & Fetsko, 2004; Valdez & Chini, 2002). However, the findings of this study do not confirm this claim, with the South African construction sector not as mature as the developed countries. The South African construction industry may also be described as oligopolistic, with a limited number of major players. There have also been recent findings of collusion by South Africa's Competition Commission against the major South

African construction organisations. These factors suggest that market conditions may be impeded in creating a competitive environment, and therefore adopting an EMS may not yield a meaningful competitive advantage.

South African respondents differed from other countries surveyed in the importance of ISO 14001 EMS in the company's overseas drive, where it ranked very low as pull factor. This is in contradiction to much of the literature where, for example 70% or respondents in a survey of construction firms in China ranked, to enter the international markets first in a list of motivators (Zeng et al., 2003). In Egypt many international, regional and bilateral agreements have been signed by the government in order to promote international trade within the construction sector. As such, 60% of respondents felt it would be essential in their overseas drive being a minimum requirement in securing tenders across member states. Organisations surveyed therefore, whose operations lie predominately in Southern Africa and therefore in developing economies in which environmental awareness and adoption of EMS are still at a low level of maturity. This finding is in line with other recent studies of environmental practice for South African firms. The study shows that low adoption of ISO14001 EMS amongst electronic design firms in South Africa was found to be as a result of a large proportion of their export market constituting developing countries where keeping costs at a minimum was paramount and therefore an overriding factor on ISO 14001 EMS implementation (Wiggett & Marcelle, 2013).

Role of Government and Industry Bodies

A slight divergence appeared in the results, where although the role of government was highlighted as important in enforcing EMS implementation through policy and regulation, it was also noted that a lack of Government pressure did not rank highly as a barrier to implementation relative to other factors such as costs and client support (Ofori et al., 2002) . This may be an indicator that Government is not considered to be capable of applying the necessary enforcement to create adoption of ISO 14001 EMS. Indeed, none of the organisations surveyed have received a fine in the recent past, which is low when compared to other countries, for example although government

enforcement was also found to be lacking in China, 38% of respondents had still received punishment due to violation of environmental protection regulations (Zeng et al., 2003). It has however been noted in other countries; in Singapore a lack of government legal enforcement also ranked very low as a barrier to ISO 14001 EMS implementation (Ofori et al., 2002).

As the respondents noted, government did not provide sufficient advice and guidance on interpretation and implementation of relevant Acts and regulations, and appears not to be promoting or encouraging the implementation of ISO 14001 EMS. The construction industry also did not expect these standards to be made mandatory. Under these circumstances levels of adoption are sluggish. This is consistent with similar research where for example Chen et al. (2004) found that contractors in Shanghai were indifferent to ISO 14001 EMS because there were insufficient government command-and-control regulations in place. Tse (2001) also found that a major obstacle to implementation in Hong Kong was a lack of Government pressure and the importance of Government's role as a client is highlighted as a means to influencing the adoption of ISO 14001 EMS.

The lack of capacity to be effective in enforcement of existing regulations has been previously noted by the Department of Environmental Affairs and Tourism in reports stating that a lack of government capacity means that the enforcement of existing legislation is frequently unfocussed, especially with regards to waste disposal (Department of Environmental Affairs and Tourism, 2000). Government skills and capacity would therefore need to be assessed before a plan for EMS enforcement through government bodies is feasible.

A survey in Malaysia by Zainul Abidin (2010) identified that government is a key party that could redress the poor levels of implementation through stronger enforcement of legislation, devising new policies, or giving incentives to developers who want to pursue sustainability in their projects. This is in alignment with the findings in the study; respondents were positively in favour of governmental support with 29% expressing that the need for greater government support in the form of training, incentives and enforcement. These methods of government support are common to the construction industry and

have been shown by scholars to be the most effective. Ofori et al. (2000) also found that offering financial incentives for ISO certified organisations was the most effective measure to promote adoption of ISO 14001 EMS, and Zeng et al. (2003) practitioners require government support in supplying training, establishing effective information channels, improving legal systems and providing financial aid.

Government's role as a client in stimulating EMS implementation has been highlighted previously where it was revealed that EMS was expected to be widely adopted in the Hong Kong construction industry since the government had been actively promoting the adoption of the ISO 14000 series in all government units, such as the Hong Kong Housing Authority and Civil Engineering Department (Tse, 2001) Although government was considered ineffective in supporting and creating increased adoption of environmental practice, it is also that through divisions such as the Department of Public Works, government is ensuring it is effecting implementation as client requiring all government building erected to be Green Star rated, of which ISO 14001 EMS is one requirement.

The study identified a variance between South Africa's Environmental Acts and regulations to that of other developing countries. Respondents comments presented in Chapter show a resounding agreement that these Acts and regulations are robust, well written and comprehensively cover a myriad of environmental components. This is considered a deviation from those of other developing economies, where environmental legislation is generally found to be limited, ambiguous and poorly enforced (Hilson, 2000)

Although such bodies have been found to be successful in increasing adoption (Kolln & Prakash, 2002), there is also research, particularly in the developing economies, which shows a lack of involvement and effectiveness of such industry bodies (Sakr et al., 2009). This was the state identified in the study where the role of professional institutions and trade associations in promoting ISO 14001 EMS was considered to be the least effective method of increasing implementation. Industry bodies, such as the Masters Builders Association,

were said to mainly focus on Health and Safety, and the environmental agenda was not given as much focus.

Although the majority of respondents were registered with the CIDB, only one respondent mentioned the CIDB as an industry body which they were affiliated with which promoted environmental consideration in the South African construction sector. The mandate of the CIDB includes: promoting improved performance and best practice amongst industry practitioners, providing strategic direction and developing effective partnerships for growth reform (CIDB, 2014). This suggests that the CIDB is not promoting improved environmental performance in the construction sector; further evidence that the South African construction industry at a basic level of environmental maturity.

Further, Tse (2001) showed that in order for the implementation of standardised EMSs in the construction industry to be successful in Singapore, collaboration between the government, professional bodies and training institutions is crucial. This was also not observed in the study with scarce identification of industry bodies, and a complete lack of collaboration between them and government and the CIDB. This is therefore an identified gap in the current stakeholder landscape and will need to be addressed in order to encourage uptake of EMS by construction firms in the future, and it also noted that Smallwood (2000) has previously recommended that the CIDB should accelerate the implementation of interventions to protect the environment, and for contractor associations to evolve environmental guidelines.

The study revealed that environmental awareness amongst senior management is high, which is consistent with other countries. This is significant as it has also been proven to be a key platform on which environmental considerations such as EMS are implemented and cascaded down into an organisation. For example, the results of findings in a study conducted in China highlighted the importance of manager's personal value and belief for how they consider environmental issues. The study showed that the greater the importance given to environmental issues by managers, the more green construction practices the firms tend to adopt (Qi et al., 2010). Indeed, many respondents commented in the importance of

management buy for there to be successful implementation of environmental management in the organisation.

5.4.1 Barriers to implementation

Cost considerations emerged as the key primary factor which affects organisations' decision making on environmental management. The additional cost relating to implementing and running environmental management systems was considered to be the highest barrier to adopting ISO14001 EMS in the construction sector. The costs associated with implementation, such as training of staff and running periodic audits, which is a requirement for certification, are examples of additional costs associated with implementation. The study found that it was difficult for the contractors to justify implementation where cost is a vital criterion in winning tenders and ensuring that operating profits are maximised. Cost considerations were also interpreted in relation to benefits likely to offset these additional costs; a reduction in operating costs and productivity related benefits ranked very low as pull factors to implementation. As such the perceived costs implementation far exceeds the potential benefits.

This is a common obstacle in the research, cost considerations often emerging as the highest barrier to implementation. Shen and Tam (2002) found that contractors in Hong Kong are often concerned with short-term results in terms of costs and benefits, and they do not value the potential benefits or profits that may occur in the distant future, and therefore increased management and operating costs was ranked as the highest barrier to implementation. This is consistent with this study which found both cost to be the highest barrier to entry, and that contractors are more concerned with the immediate, short terms benefits on projects.

The results on barriers also indicate that clients are not willing to pay more to help absorb these additional costs. As such, the additional costs associated with implementation of EMS are not easily absorbed or transferable onto the client. This is significant as the client has previously been identified a key stakeholder with the ability to influence the adoption of ISO 14001 EMS, however will not materialise if clients do not deem it to feasible. It was also

noted by respondents that client are not always familiar or educated in environmental best practice and the long term benefits of improved environmental performance.

One of the other factors that is highly rated as a barrier is the lack of sub-contractor cooperation. Respondents' comments reported in Chapter four indicated that the sub-contractors, which represent the largest portion of companies in the construction sector, are often not adequately skilled with technical resources and are also operate under Government's radar. This challenge in managing the performance and skill levels of subcontractors was also found in a study in Hong Kong in which it was revealed that main contractors find it very difficult to control subcontractors' environmental performance(Shen & Tam, 2002).

There is also an additional challenge in the nature of the contractor and sub-contractor relationship in the South African context. Many construction tenders require a minimum threshold of involvement of companies which represent the previously disadvantaged sections of the economy, i.e. Broad-Based Black Economic Empowerment (B-BBEE). This has resulted in numerous B-BBEEE small-medium sized enterprises emerging which serve as subcontractors in the construction sector. Contractors therefore partner with these firms to comply with B-BBEEE thresholds. These sub-contractors are often not environmentally aware and do not follow environmental methods, which therefore requires investment from the main contractor in training and induction of environmental procedures.

Another barrier to implementation, and also associated with the challenges with sub-contractors, is a lack of trained staff and available expertise. ISO 14001 EMS requires all staff to be educated and aware of the environmental management principles for both implementation and the on-going monitoring and reporting in order to satisfy certification requirements. Therefore a lack of trained staff and expertise will require additional training and sourcing of environmental expertise necessary for ISO 14001 EMS certification. Shen and Tam (2002) similarly found that a lack of trained staff and expertise to be the

second most relevant barrier to implementation of ISO 14001 EMS in Hong Kong..

Zeng et al. (2003) found that only 50% of frontline construction workers in China are literate and possessed a primary school education, which proved to be a challenge to educating and up-skilling staff. It is expected that this would be a similar challenge in implementation of ISO 14001 EMS in the South African construction sector where the workforce is largely uneducated and the literacy rate is low.

Respondents' comments also indicated an apparent gap between educated youth with tertiary education; many young employees expecting to conserve the environment, whereas more emphasis is needed on responsible development and rehabilitation of construction sites. This has been noted previously in Malaysia by Zainul Abidin (2010) who found that that although the younger generation has been exposed to sustainable construction in their studies, they lack the real work understanding to disseminate it.

5.4.2 Summary

The results indicate that the push and pull factors which are most likely to influence and compel organisations to adopt ISO 14001 EMS or equivalent centre around the client and government. Clients have the final say when planning construction projects and clients insisting on an EMS was found to be the most compelling push factor which would lead to higher rates of adoption of ISO 14001 EMS. It was also found that clients are expected to start calling for ISO 14001 EMS or equivalent on projects in the near future, which will have an important impact on construction organisations, as they can expect the "greening" of the industry to accelerate in the near future.

Government's role in increasing the adoption of EMS was somewhat conflicting. Although the construction industry appears to regard incorporating EMS into regulations as a major factor which would push organisations to seek certification, and respondents further reported that avoiding infringing statues and regulations was the main benefit of implementing ISO 14001 EMS or equivalent, weak enforcement held back the implementation rates. Enforcement

was weak due to a lack of capacity which resulted in a lack of Government pressure.

The major barrier that hampered uptake of ISO 14001 EMS was the increased costs associated with implementation. Construction firms reported that they are not able to justify the increased costs associated with environmental certification as the increase in budgeted pricing would disadvantage them in tenders and render them less competitive. Further, clients are not willing to pay more for the associated costs if offered as an add-on on project.

5.5 Conclusion

Environmental awareness is on the increase in the South African construction industry with most respondents aware of the trend in the industry and their obligations to participate in environmental protection, as well as a sense that for their clients this is becoming a more urgent priority and will be requested in the near future. However this is not being translated into implementation of ISO 14001 EMS and improved environmental management. Ashley et al. (2003) noted that a widespread agreement on sustainable construction does not mean a widespread implementation and although many construction practitioners agree with the sustainability principles, many have still not grasped its meaning and even fewer have translated sustainability into action. These assertions were matched in the study; a low rate of ISO 14001 EMS certification amongst construction firms was identified, and organisational policy and procedures are mainly designed to ensure minimum compliance rather than increasing environmental management awareness. Construction organisations are typically adhering to the stipulations of the Environmental Management Plan agreed to with the client and training their staff in accordance these requirements. Further, the immediate environmental criteria more easily monitored and penalised are addressed, rather than long term, full life cycle elements of environmental management.

The study identified clients and government as having the ability to trigger the inception of increased environmental performance in the construction sector;

satisfying clients' requirements is given first priority by contractors at the planning stage of a project, and implementation of new policy and regulations is generally regarded to move contractors to implement EMS in order to avoid penalties.

However, clients are also not willing to pay more for better environmental standards, whilst the base of sub-contractors which service the industry do not have the required skills nor financial backing to implement is limiting uptake. Further, government does not have adequate skills and resources to enforce and monitor current environmental Acts and regulations, and it was therefore doubtful that they would be able to ramp up the resources and skills necessary to enforce additional legislation.

As such there is no single stakeholder driving the environmental agenda and non-certified firms generally have a reactive attitude to EMS implementation, either waiting for the client to start insisting on EMS, or for Government to develop regulations and increase enforcement of current environmental Acts and regulations. Further, there was no clear definition of where stakeholder responsibility vis-à-vis EMS lies, the view varied considerably, with a split between the client and contractor considered to be the responsible party, there is little consensus that the government is the responsible party.

In the next chapter, the research report considers these main conclusions and their significance.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the main conclusions of the study and analyses the significance of the findings of the study in relation to the theme of the topic, and in relation to the context of South African. Recommendations to the identified stakeholders are then put forward, as well as recommendations for future research in this field of study are then proposed.

6.2 Key Conclusions

Environmental management within the construction sector in South Africa is at a basic or developing level. There are low adoption rates of ISO 14001 EMS and environmental criteria are not given due consideration at the critical planning stage of a project; these are considered, if at all, after client, cost and regulatory requirements. Construction organisations are executing the minimum amount of environmental management and protection in order to comply with the Environmental Management Plan and the more prominent regulations. All of this suggests that organisations are merely performing an element of environmental protection rather than adopting EMS and further integrating the broader environmental agenda into development plans.

This is despite a general acceptance of the need for ISO 14001 EMS certification to become mandatory in order to ensure long-term environmental aspects are given due consideration and the reported high level of environmental awareness exists amongst senior management, the major decision makers within an organisation. Therefore, the South African construction industry has a reactive, wait-and-see attitude, which while consistent with other countries, is unhelpful. This suggests that environmental protection and long term benefits of EMS will not be experienced within the construction sector over the short term, and environmental degradation will

continue to be experienced and SA will continue to build with technologies and materials which drain natural resources and therefore continue to be the largest contributor to carbon emissions in Africa. This will ultimately compel Government to design and implement increased laws and regulations in a reaction to adverse environmental symptoms and the associated increased public pressure which results. This is reaffirmed by one respondents comment below,

> *"SA would have to go through similar devastating environmental degradation or disasters that have occurred in America and Europe for the creation of organisations such as the EPA and Environmental Agency that actually have the resources to monitor and to prosecute offenders."*

It is evident from study results that, construction organisations are not going to implement ISO 14001 EMS or equivalent if there is no significant pressure or demand from their clients, and without significant pressure and enforcement capacity in Government.

A major determinant in the reluctance of contractors to voluntarily implement ISO 14001 EMS or equivalent is the perceived costs of implementation, with neither the contractor nor the client willing to absorb them. This challenge to EMS implementation was articulated by the below response:

> *"Our organisation complies with legislation due to the fact that we have a certified system, and due to various internal and external audits that take place. I am well aware of construction contractors who price lower than we do, due to the fact that legal compliance is not taken into account."*

Meeting the objectives of clients is paramount for contractors. Therefore as long as clients are not willing to pay more for the additional costs associated with implementing ISO 14001 EMS and there is a lack of general client support, rates of adoption are likely to remain low. As one respondent noted on the influence of the client in the industry,

> *"A general industry perspective is, if the clients tells us to do x, we do x"*

This state of affairs is an indicator of the developing maturity of the SA market, where a lack of awareness and education of the benefits of EMS results in companies believing the associated costs outstrip the benefits resulting from improved processes, technologies and efficiencies that result. Technology, training and associated support may also not be readily available in a developing stage, and therefore currently not cost effective. An observation by one respondent summarises the situation,

> *"Within SA the available technologies, resources and alternatives are not readily available, or when available it is not at a cost benefit for implementation. I believe it will significantly change over the next couple of years, which will ultimately result in a very small window of opportunity to exploit competitive edge"*

There is a perception that government is not capable of enforcing current laws and therefore not likely to enforce more advanced criteria required for EMS certification. As one respondent noted on the enforcement of current Acts and regulations,

> *"When enquiring with government departments, the impression is that no-one is really an expert, so obtaining information is a tiresome process. None of the government departments are willing to commit to answers, which mean that no advice is given on paper."*

Government does not have adequate resources, skills and knowledge required to create the momentum for improved environmental management in the construction sector. Government, however, is identified as an important catalyst for implementation of environmental management in the future, and until such time as the relevant government arms are able to ramp up policy, resources and skills, there will be a wait and see attitude taken by contractors.

Government involvement should extend further than merely developing, implementing and regulating policy. As research presented in other countries illustrates, government also needs to play a critical role in enabling EMS implementation by providing incentives, training and promoting awareness

through collaboration with industry bodies. This is also the opinion of many respondents, their comments below illustrating this sentiment:

"Government must start with incentives for companies to comply with ISO 14000."

"There needs to be more support from Government; more implementation of penalties, further policing of legislation and more serious consideration of environmental matters within the construction industry."

"Government, should start at grass roots level and educate the youth, which will have a follow through effect when they grow up."

"More cost-effective entry level courses should be provided in order to create awareness for site staff and local labour"

The findings show that in South Africa, unlike in other countries, pressures from consumers, investors and the public are not important in motivating EMS adoption, nor was the necessity to implement in order to expand operations into other countries.

Therefore, the results from the study suggest that currently the cost-benefit of implementing ISO 14001 EMS is not favourable enough for the majority of contractors to implement. Further, although the pressure from clients and government was identified as the most effective mechanism of stimulating adoption, this is currently not taking place due to these cost constraints. Ultimately, the maturity of the construction sector is not advanced enough to the extent that the environment is given consideration equal to other considerations of development, e.g. cost and social implications. The quote below from a respondent illustrates this point,

"The question is, in a developing economy where the needs of people and development are high, the environment will take a back seat - we are maturing and are a couple of years away from an environmentally conscious industry."

Therefore, until such time as there is demand for improved environmental management on construction projects, contractors will not seek improved

technologies and invest in workforce training in order to overcome some of the barriers to implementation identified and ultimately achieve environmental international standards such as ISO 14001 EMS. However, as has been the case in other countries, increased adoption will ultimately take place, offering the early movers a competitive edge, whilst those organisations slow to adopt will be struggle to adapt to the new client and regulatory requirements. South Africa

6.3 Recommendations

The study revealed environmental management to be at early stage of development in the South African construction sector. There is no single stakeholder driving the environmental agenda and therefore the advancement of EMS and technologies has become stagnant and sluggish. Recommendations are made to stakeholder groups which would address gaps and stimulate momentum of environmental management and ISO 14001 EMS implementation.

Contractors

Despite an acknowledged requirement for the construction sector to improve environmental performance, contractors are taking a wait-and-see approach to environmental management. This is evidently to avoid the increased time and monetary costs associated with implementation of EMS. However, research in more developed markets has shown that it can be economically viable and can improve current operating procedures and processes(Hydes & Creech, 2000). It is therefore recommended that contractors actively investigate benefits that can be gleamed from adopting ISO14001 EMS. By performing a comprehensive due diligence exercise contractors will be able to determine actual cost-benefit implications which can be then discussed with the clients.

Further, the research notes that environmental values and beliefs of senior management affect a facility's choice of compliance level, and the importance of senior management buy-in was also mentioned by many of the respondents. Therefore, it is recommended that, in order for organisations to illustrate they

are incorporating the environmental agenda into their strategies and operations, that it is represented a board level, with a board member instated who drives and reports back on environmental progress of the organisation.

Further, considering the client is identified as a key decision maker with the ability to influence uptake of EMS on a project, it is recommended that contractors begin to take the initiative in educating their clients and build awareness for the benefits that can be achieved.

Government

The government was singled out as a key role-player by respondents that could stimulate the uptake of EMS, through the introduction of regulations, and by supporting and encouraging implementation including by making training and incentives available to stakeholders. This is significant in that it is closely aligned with the Global findings in the importance of government's role as both an enforcer and an advisor. This knowledge, together with that of previous studies, should be used to shortcut implementation challenges and lay out a pathway for implementation.

Many respondents however suggested that currently there is limited advice or guidance available from government, and enforcement of current regulations is poor due to a lack of resources, skills and general knowledge on environmental management. Government may address these gaps by up skilling current departmental staff via a "train the trainer" methodology. The aim of this training would be to facilitate the transference of environmental management knowledge into the industry. Training courses should then be offered to all industry practitioners who both transfer knowledge of environmental management, and promote awareness of trends and topics in environmental management.

In order to illustrate government's intention to lead the green agenda and education around of the necessity for improved environmental management, a program of incentives and support should be devised and made available within the industry. This program should encompass a tiered support structure within the industry which addresses the distinct challenges of contractors and sub-

contractors. Initiatives should also encompass collaboration between the government, trade associations and industry bodies.

A stronger presence is required from industry bodies and trade associations, particularly the CIDB. The CIDB was identified as an industry body which is not doing enough to promote environmental consideration within the industry, and is therefore not achieving its stated mandate. The CIDB should further elevate the level of the environmental agenda in the organisation's current mandate. The CIDB should add these applicable objectives and metrics to its budget and plans for the year to ensure progress is monitored and tracked, e.g. number of ISO 14001 EMS certificates in the construction sector. These discussions should be driven by Government and the CIDB however should also entail a collaborative process with other trade associations, such as the Master Builders Association, who should feedback information to other industry practitioners.

6.4 Suggestions for further research

A major theme which emerged from the study was the role of the client and their ability to influence decision making. This preliminary study investigated the prevalence of environmental practices among contractors in the construction sector. Similar research which focuses on the client may uncover opportunities for increasing implementation of environmental practices and EMS.

Similarly, although the additional cost associated with ISO 14001 EMS was identified as a major obstacle to implementation, research has been shown sustainable development to be economically viable (Hydes & Creech, 2000). As such, similar research is recommended in the South African context, the results of which may ultimately be used to educate the construction industry participants on the ISO 14001 EMS benefits and actual cost implications.

This was a preliminary study which was restricted to the major construction organisations in the South African construction sector –construction organisation capable of doing projects greater than R 130 million. A lack of subcontractor co-operation found to be a barrier to implementation of ISO 14001 EMS. Further, the number of small and medium sized organisations is

larger than the number of major players in the industry. As such, it is will be pertinent to carry out a comprehensive study which looks at the environmental status of all the construction organisations. Such a study should also aim to obtain deeper insight into current environmental skills and capacity available in the industry.

6.5 Overall Conclusion

There is a degree of environmental management taking place in the South African construction industry; however it was found to focus on the short term, rather than a long term, holistic approach encompassing all principles of sustainable development.

The major drivers and barriers influencing EMS uptake are emanating from clients and government, the net effect of which is that environmental management in South African construction sector is in a state of limbo. There is no single stakeholder being held responsible for the implementation of Environmental Management Systems, and no single stakeholder is currently driving the environmental agenda.

Therefore, with the current status quo of environmental management in South Africa it is apparent that any improvements and enhancements will only arise in response to negative impacts of construction which materials and which are likely to impact on the environmental, social or economic components of South Africa.

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APPENDIX A

Actual Research Instrument

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Wits Business School
Sculpting global leaders

Dear Madam,

I am currently completing my thesis as part of the degree requirements for an MBA at the Wits Business School. The thesis will investigate the status quo of environmental management in the construction sector. Specifically, I will be focusing on the scale of adoption of Environmental Management Systems, as well as the drivers and obstacles that influence implementation of these systems.

You have been identified as someone who is knowledgeable in the industry and involved in relevant work. I would be very grateful if I could arrange a 45 minute interview with you in order to understand how your organisation performs environmental management and to obtain your opinion on the key issues relating to environmental management in the construction industry.

The findings of this study are for academic purposes only. My analysis and conclusions will be published as part of my research report and I am more than happy to discuss these will all respondents once the study is completed. Respondent and company names participating in the survey will be non-attributable and strict confidentiality will be maintained throughout. With your permission, I may make audio recordings of your responses to the open ended questions in order to ensure accuracy upon transcription.

My research is supervised by Professor Gillian Marcelle who would be happy to answer any further queries that you might have.

I look forward to your response

Sincerely

Jordan Green

Profile Information

Certain profile information is required in order to classify the selected organisations and respondents of the research, allow for understanding of organisational factors that may influence consideration of the adoption of Environmental Management Systems in the construction sector.

1. **Date** _____
2. **Respondent Name** _____
3. **Title / designation** _____
4. **Company Name** _____
5. **Number of employees**_____
6. **CIDB grading (1-9)** _____

Environmental practices in Construction

These questions seek to get an understanding of the scale of adoption of environmental practices and the implementation of Environmental Management Systems in the construction industry:

7. **Does your organisation have ISO 14001 Environmental management certification?**
   a) Yes ☐
   b) No ☐
   c) No, but will implement it within the next 5 years ☐
   d) No, however our organisation has other EMS certification (please specify) ☐
   _____

8. **Does your organisation have any policies, processes or procedures in place which specifically address environmental management?**
   a) Yes ☐
   _____
   b) No ☐
   _____

9. Do you think that ISO14000 EMS or equivalent should be made mandatory for contractors in the construction industry?

_____
_____

10. On a typical construction project, please indicate the types of employee involvement in environmental management

a) Dedicated Environmental Staff – please specify designation/title ☐
_____

b) Staff with partial environmental responsibilities. ☐
_____

c) Staff who participate in environmental management on a voluntary basis_____ ☐

d) Other_____ ☐

11. What level of training does your firm provide on environmental management?

a) Frequent training ☐
b) Occasional training ☐
c) None ☐
d) Other, please specify ☐

_____

12. Would you say that environmental awareness among senior management in your organisation it high, medium or low? _____

Would you say that environmental awareness among middle management in your organisation is high, medium or low? _____

Would you say that environmental awareness among non-managerial staff in your organisation is high, medium or low? _____

13. Please rank in order of priority the following criteria at the planning stage of a project (post contract/tender award)

a) Minimise cost ☐
b) Meet deadlines ☐
c) Meet building regulations ☐
d) Satisfy client's specifications ☐
e) Reduce resource / energy wastage ☐
f) Evaluate project's impact on the environment ☐

14. Where applicable, indicate how often your organisation considers the environmental impacts of the following environmental aspects (Always, Often, Sometimes, Rarely, Never)

		Always	Often	Sometimes	Rarely	Never
a)	Hazardous waste containment,	□	□	□	□	□
b)	Water usage and contamination	□	□	□	□	□
c)	Air and noise pollution	□	□	□	□	□
d)	Dust pollution	□	□	□	□	□
e)	Lifecycle Assessment (LCA) of materials	□	□	□	□	□
f)	Energy efficient building designs	□	□	□	□	□

Drivers of EMS implementation

The motivators which may encourage construction organisation in South Africa to adopt ISO 14001 EMS or equivalent can be distinguished between push and pull factors. Push factors may are influential by virtue of the organisation's unwillingness to obtain penalties and a blemished public image

Push Factors of environmental management

15. On a scale of 1-5, from insignificant to significant, please rate the following factors which will compel construction contractors to seek ISO 14001 EMS or equivalent certification:

		Insignificant 1	2	3	4	Significant 5
a)	If the government makes it compulsory through regulation	□	□	□	□	□
b)	If clients demand it	□	□	□	□	□
c)	If their major competitors become certified	□	□	□	□	□
d)	If professional institutions and trade associations promote it	□	□	□	□	□
e)	If financial support/incentive for implementation is offered	□	□	□	□	□
f)	If reporting on environmental performance is made mandatory and made available to the clients and the public	□	□	□	□	□
g)	Other – please specify	□	□	□	□	□

Pull Factors of environmental management

*** For organisations without ISO 14001 EMS or equivalent certification**

16. On a scale of 1-5, from insignificant to significant, please rate the following factors which will compel your organisation to seek ISO 14001 EMS or equivalent certification:

		Insignificant 1	2	3	4	Significant 5
a)	Enable company to reduce material waste	□	□	□	□	□
b)	Enable company to avoid infringing statues and regulations on construction	□	□	□	□	□
c)	Help improve workers' health, safety and welfare	□	□	□	□	□
d)	Help company to contribute to efforts to protect the environment	□	□	□	□	□
e)	Enhance company's public image	□	□	□	□	□
f)	Increase company's competitiveness	□	□	□	□	□
g)	Help to enhance company's productivity	□	□	□	□	□
h)	Reduce company's operating costs	□	□	□	□	□
i)	Improve company's procedures	□	□	□	□	□
j)	ISO 14000 or equivalent EMS will be essential in company's overseas drive	□	□	□	□	□
k)	ISO 14000 or equivalent EMS will soon be made mandatory	□	□	□	□	□
l)	ISO 14000 or equivalent soon will be insisted upon by construction clients	□	□	□	□	□
m)	Other factors – please specify					

_____

_____

_____

*** For organisations <u>with</u> ISO 14001 EMS or equivalent certification**

17. On a scale of 1-5, from insignificant to significant, please rate the following benefits you have experienced as a result of ISO 14001 EMS or equivalent, certification:

		Insignificant 1	2	3	4	Significant 5
a)	Enable company to reduce material waste	□	□	□	□	□
b)	Enable company to avoid infringing statues and regulations on construction	□	□	□	□	□
c)	Help improve workers' health, safety and welfare	□	□	□	□	□
d)	Help company to contribute to efforts to protect the environment	□	□	□	□	□
e)	Enhance company's public image	□	□	□	□	□
f)	Increase company's competitiveness	□	□	□	□	□
g)	Help to enhance company's productivity	□	□	□	□	□
h)	Reduce company's operating costs	□	□	□	□	□
i)	Improve company's procedures	□	□	□	□	□
j)	ISO 14000 or equivalent EMS will be essential in company's overseas drive	□	□	□	□	□
k)	ISO 14000 or equivalent EMS will soon be made mandatory	□	□	□	□	□
l)	ISO 14000 or equivalent soon will be insisted upon by construction clients	□	□	□	□	□
m)	Other benefits – please specify					

_____

_____

_____

18. Barriers to EMS Implementation

On a scale of 1-5, from insignificant to significant, please rate the significance of the following obstacles to implementation of ISO 14000 or equivalent:

		Insignificant 1	2	3	4	Significant 5
a)	Lack of regulatory framework	□	□	□	□	□
b)	Lack of governmental pressure	□	□	□	□	□
c)	Lack of available environmental technology within organisation	□	□	□	□	□
d)	Lack of tailor made training on environmental management	□	□	□	□	□
e)	Lack of environmentally friendly materials	□	□	□	□	□
f)	High implementation, management and operating costs	□	□	□	□	□
g)	Lack of trained staff and expertise	□	□	□	□	□
h)	Clients are not willing to pay more for environmental management to be incorporated into a project	□	□	□	□	□
i)	Lack of general client support	□	□	□	□	□
j)	Lack of sub-contractor co-operation	□	□	□	□	□
k)	Weak environmental culture within industry	□	□	□	□	□

Regulatory framework and industry bodies

The regulatory framework and the role of industry and bodies is an important determinant to the success of environmental management in the construction sector. The following questions seek to determine the status quo of these factors in South Africa:

19. Describe the environmental acts and regulatory framework in South Africa?

20. Has this affected your decision on implementing EMS certification?

21. How would you assess the enforcement of South Africa's Environmental Acts and regulations which relate to your organisation?

22. Has your organisation received any penalties resulting from infringements of, or non-compliance to Environmental Acts and Regulations in the last calendar year?

23. Are there industry bodies or institutions that your company is affiliated with, or that you are aware of that are promoting environmental consideration in the South African construction sector?

24. When considering the all participants in the construction end-to-end supply chain (conception – close out of project) who do you feel should be responsible for ensuring the adoption and implementation of Environmental Management?

Other Thoughts

The questionnaire has been designed based on literature and research which is mostly international in nature. The following question seeks to understand South African thinking with regards to considering the environment in the design of product.

25. When considering the South African construction industry, do you have any additional thoughts, comments or opinions which you think is relevant in the discussion concerning consideration for the environment in the construction sector?