

ACHIEVEMENT OF SELECTED A21SCDC ACTIONS FOR SUSTAINABILITY BY SOUTH AFRICAN CONTRACTORS: A REVIEW (2002 - 2012)

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Declaration by student

I, the undersigned, hereby confirm that the attached treatise is my own work and that any sources are adequately acknowledged in the text and listed in the bibliography

Signature of acceptance and confirmation by student

Abstract

Treatise Title	: Achievement of selected A21SCDC actions for sustainability by South African contractors: A review (2002 - 2012)
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Unfortunately, the detrimental impact of the built environment on the achievement of worldwide sustainability is enormous. Therefore, this study considers the progress made by the leading South African building contractors in achieving selected actions proposed in the Agenda 21 for Sustainable Construction in Developing Countries.

William McDonough (2004) said: "Doing a bad thing less bad doesn't make it good". This research was driven by the search for true and effective changes in South Africa's construction industry towards sustainability. In order to establish the progress being made by the construction industry it is necessary to look back and evaluate changes made.

The "Big Five" construction contractors in South Africa were interviewed and completed a survey to establish what they have done and changed, within a ten year period, to operate more sustainable construction businesses. The main focus of the study is on contractors' internal housekeeping and site operations. Internal housekeeping entails the drafting of strategic organisational plans, implementing sustainable organisational values and business conduct, reducing the organisational impact on the environment and efficient resource use in offices. Site operations entail environmentally aware construction practices, construction and demolition waste management and reducing the use of natural resources on sites.

“Only when the last tree has died
and the last river been poisoned
and the last fish been caught
will we realize that we cannot eat money.”

- 19th century Cree Indian Prophecy -

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List of abbreviations

A21SCDC:	Agenda 21 for Sustainable Construction in Developing Countries
CDP:	Carbon Disclosure Project
CIDB:	Construction Industry Development Board
EIA:	Environmental Impact Assessment
EMS:	Environmental Management System
EPA:	United States Environmental Protection Agency
GHG emissions:	Greenhouse Gas emissions
GRI:	Global Reporting Initiative
HVAC:	Heating, Ventilation and Air-Conditioning
ISO:	International Organisation for Standardisation
JSE – SRI:	Johannesburg Stock Exchange Social Responsibility Investment Index
LCA models:	Life Cycle Assessment models
LEED:	Leadership in Energy and Environmental Design (Green building rating system)
NEMA Act:	National Environmental Management Act 1997
NPRI:	National Pollutant Release Inventory
Project EMP:	Project Environmental Management Plan
SA:	South Africa
SHEQ:	Safety, Health, Environment and Quality
UNEP-SBCI:	United Nations Environment Programme – Sustainable Building and Climate Initiative
US:	United States (of America)

Chapter 1: Introduction

1.1 Introduction and background

It has become a well-known statistic that the construction industry has the largest impact of all the different sectors of a country, on the environmental, social and economic pillars of sustainability. (Some of the other impacting sectors of a country are agriculture, mining, manufacturing, trade, energy, transport, services and finance). According to UNEP-SBCI (2012), buildings use approximately 40% of global energy, 25% of water resources globally, and 40% of global natural resources. Furthermore, buildings are the largest contributor to anthropogenic Greenhouse Gas (GHG) emissions as they are responsible for about one third of the total emissions worldwide. Ahn et al. (2010:355) notes that construction processes affect the environment through energy consumption, air emissions, raw material demands, waste generation and natural resource usage, to name but a few.

The built environment's impact unfortunately does not stop at construction; it reaches far beyond the construction phase. Many of the life-cycle impacts of the built environment are being encountered after the construction process, during the building life-cycle. A case study done in Helsinki proved that the CO₂ emissions during the use of buildings can be reduced by more than 20% if the user behaviour and consumer habits were changed. (Airaksinen, et al. 2010:855)

The building cycle repeats itself as buildings are demolished or refurbished due to changes in building uses, city rearrangements, demographic changes, clients' investment aims, natural disasters, etc. (Malesev, et al. 2010:1205). During demolition, too much demolition waste are created and often illegally dumped or disposed at landfills instead of the materials being recycled or reused. (Couto, et al. 2010:429-432)

One of the motivating factors for this study is the concern regarding the progress that has been made towards sustainability in the construction industry. Gasparatos et al. (2008:287) reports that "planning for and assessing the progress towards

sustainability inevitably becomes a complicated task". Thus, the scope and assessment methodologies for this research is limited and of a simplistic nature.

This study looks at the progress made by the "Big Five" leading South African building contractors in achieving selected actions proposed in the Agenda 21 for Sustainable Construction in Developing Countries (A21SCDC). The A21SCDC looks at the construction industry regarding environmental-, social- and economic impacts on sustainability. (Du Plessis, et. al., 2002:13) This study will only focus on environmental aspects.

An extensive research process has been followed since the formulation of the 1992 Agenda 21 as a sustainability blueprint on international level, followed by The Habitat Agenda in 1996, then the 1999 publication of the Agenda 21 on Sustainable Construction, resulting in the delivery of the Agenda 21 for Sustainable Construction in Developing Countries during 2002, of which Africa forms part on a regional level, and South Africa in its turn on a local level (Du Plessis, et. al., 2002:iii). The reasoning behind the different challenges faced by the developed world and developing countries is explained in Du Plessis, et al. (2002:iii). The developing world faces underdevelopment and many social challenges, but it also has the opportunity to learn from the developed world and avoid the problems they encounter. The developing world still has the opportunity to decide how its future developments will function, whilst the developed world has to use and work with what they have. (Du Plessis, et al. 2002:1) The actions required for making progress in sustainability differ greatly for the developed and developing countries. South Africa is seen as a developing country. Therefore the A21SCDC is chosen as a framework to evaluate progress made towards sustainability by some leading South African contractors.

Refer to table 1 for a summary of the A21SCDC strategy for action that served as the framework for this study. The strategy for action is based on six elements. For the purposes of this study, only the "internal housekeeping" and "encouraging and supporting implementation" elements are considered. The element "encouraging and supporting implementation" is only studied through contractor's site operations. Initially the intention was to review all the A21SCDC proposed actions for

contractors, but the research field became too broad. The scope was narrowed to the two actions only, mainly because it seems they are not being researched as often as the other actions.

A21SCDC strategy for action - summary of research background		Framework used for this study
STRATEGY ELEMENTS	PROPOSED ACTIONS FOR CONTRACTORS (Private sector and utility companies)	A21SCDC SELECTED ACTIONS (Literature study and "Big 5" contractors' data)
Capacity building	Enabling continued organisational learning Supporting external capacity development	<i>Studied briefly at the training of site workers and sustainability induction as a part of site operations</i>
Access to funding	Funding for research and development for internal organisational benefit Funding for research for the common good through corporate social responsibility budget contributions	<i>Not studied - future research opportunity</i>
Partnerships and cooperation	Supporting the implementation of the A21SCDC research and development agenda Forming partnerships with research organisations Participating in industry coalitions for funding of research projects and developing enabling mechanisms for effective research	<i>Not studied - future research opportunity</i>
Internal housekeeping	Risk assessment of non-compliance with internal housekeeping regulations, and assessment of the benefits of compliance Establishing internal strategic organisational plans suitable for the construction industry Organisational value changes Improving resource efficiency Reducing organisational impacts and resource consumption	<i>Briefly considered in each sub-section of internal housekeeping (2.1.1-2.1.4 and 4.1.1-4.1.4) Opportunity for further research The ISO 14001 EMS plan was studied in detail (refer to section 2.1.1 and 4.1.1) Sustainable organisational value changes, codes of ethics and business conduct were studied (2.1.2 and 4.1.2) Efficient resource use in office environments were considered (sections 2.1.3 and 4.1.3) Recycling policies for office waste were studied (2.1.4; 4.1.4; Annexure A and B)</i>
Encouraging and supporting implementation	Making use of new technologies and processes Creating a market demand Assist and mentor emerging market niches	<i>Environmentally aware construction site operations were studied in detail as well as actions by contractors to create a demand for deconstruction, recycled building materials, efficient resource use and environmentally aware subcontractors Not studied - future research opportunity</i>
Monitoring and evaluation	Adopting corporate social responsibility reporting Participating in certification schemes Capturing and collecting information for monitoring and assessment of organisational impacts	<i>Not studied - future research opportunity</i>

Table 1: A21SCDC Strategy for action - Research framework (Du Plessis, et.al. 2002:72)

1.1.1 Research question:

The main question this study aims to answer is whether South African contractors have achieved some of the A21SCDC actions towards sustainability.

This question relates to section 5.3 in A21SCDC. The A21SCDC identified key areas of action required from different stakeholders. This study is based on the section of the agenda that looks at actions for the private sector, utility companies and other service providers, of which building contractors form part.

1.1.2 Sub-questions:

The first sub-question aims to answer whether South African contractors have adopted sustainable internal housekeeping actions in terms of A21SCDC.

The second sub-question aims to answer whether South African contractors have adopted A21SCDC sustainable principles through site operations.

1.2 Aim and purpose

The aim of the research is to identify if there has been any progress towards sustainability by some of the leading contractors in South Africa over the past ten years. The aim is not to redefine sustainability, nor to make new suggestions on how to achieve a sustainable construction industry. This study rather looks at the state of achievement of the actions proposed in A21SCDC.

A large amount of research has been done on the barriers to sustainability, the impact of different sectors on sustainability, determination of sustainability enablers and action plans. The purpose of this study is to review published literature discussing actions that have been implemented across the industry worldwide, and then by means of questionnaires and interviews establish what some of the leading South African contractors have implemented and changed in their construction practices. The literature and data is structured according to the same framework.

The aim of the research is not to arrive at a specific measured outcome, but to get an indication of, and deliver a simplistic analysis, of the raw data and feedback received from a selected group of contractors. Many researchers have assessed

and measured sustainability over recent years. The application of the various assessment models and methods being used falls outside the scope and purpose of this study.

1.3 Importance of the study

William McDonough (2004) said: “Doing a bad thing less bad doesn’t make it good”. This research was driven by the search for true and effective changes in South Africa’s construction industry towards sustainability.

The rationale behind the research evolved from the following questions:

Are we really making progress? Does most of the ‘green talk’ stop at talking or does it actually go into action? Is green construction a money making scheme, or are there real actions taken to create a sustainable world? Does the private sector commit to being more sustainable? Is the South African construction industry implementing changes that are making as big a difference as is needed?

From the abovementioned questions, the idea emerged to look at a selected group of South African construction contractors and to establish what they have done and changed, within a ten year period, to operate their businesses to be more sustainable.

In order to establish the progress being made by the construction industry, it is necessary to look back and to monitor and evaluate the changes made. Capturing information on a regular basis will help organisations to create in-house measurements of the impact and benefits of their sustainability policies. Assessment of sustainability achievement will provide early warning systems regarding future problems, risks and major barriers for implementation. (Du Plessis, et. al., 2002: 66) In Singh, et al. (2011:281) the importance of sustainability assessment is discussed, and it is mentioned that; sustainability assessment is said to give short and long term indications to assist decision makers on what actions they should or should not take to create sustainable environments. It is important to constantly review progress made towards sustainability, “we measure what we value, and value what we measure” (UN, 2001)

An important aspect of the study is the natural resource use by contractors in South Africa (in their office- and site environments). In the A21SCDC weak and strong sustainability is discussed in the context of the resource capitals as listed hereunder. Turner (1993) describes weak sustainability as the idea that different capitals can be fully interchanged and be of comparable value, whereas strong sustainability sees the essential functions that the environment performs as “critical natural capital”. This capital is seen as a necessity for human survival and cannot be traded for other capital, because it is irreplaceable and cannot be substituted. If the building industry’s stakeholders look at the capitals from a weak sustainability point of view, we will end up with depleted natural resources that cannot be reproduced. This study will look at actions taken by contractors to reduce natural resource depletion in their day-to-day operations.

Four types of resource capital have been identified by Hawken, et al. (1999):

1. Natural capital: natural resources and services provided by the environment
2. Human capital: labour, education, skills, intelligence, culture and organisation
3. Manufactured capital: buildings, infrastructure, goods, information resources
4. Financial capital: cash, credit, investments and monetary instruments

1.4 Scope/ delimitations

The specific actions to be taken by contractors as proposed in the A21SCDC are used as a platform for this study. As mentioned before, only two actions were selected to be reviewed. Section 5.3 “Actions for the private sector, utility companies and other service providers” of the A21SCDC is used, and “internal housekeeping” and “encouraging and supporting implementation” are the two elements considered. (Du Plessis, et. al., 2002: 63-66, 72)

The timeframe used to establish if contractors implemented any of the proposed changes ranges from the year 2002 to 2012.

This study forms part of a broad research field. An integrative research project can be launched to determine whether South Africa currently finds itself to be in line with the A21SCDC as a whole and, if not, what the major barriers thereto are. This study was executed within limited time and scope, with its main focus on the five leading

construction firms in South Africa. The study attempted to get an indication of these contractors' current sustainability views and involvement.

The actions studied are limited to the environmental impact of the built environment life-cycle operations. (Only a small number of the various impacts of the built environment will be considered for the purposes of this study). The social and economic pillars of sustainability are not the focus of the study, but rather environmental sustainability. The following issues, by way of example, do not form part of the scope of this study: construction material studies, corporate social responsibility, partnerships and co operations, research funding, training and capacity building, labour intensive construction methods, creating a market demand for sustainable products and materials, gender equity and aspects regarding health and safety do not form part of the scope of this study. The legislation and regulatory efforts available to enforce implementation of environmentally aware business and site operations are not part of this study.

1.4.1 Sample selection:

The "Big Five" building contractors in South Africa were selected as the sample for the study. Thus, the following five contractors were approached to collect data, Aveng Grinaker LTA, Group Five, Murray & Roberts, Stefanutti Stocks, and WBHO.

1.5 Definitions

1.5.1 Sustainable development

The most commonly used definition for sustainable development is found in the United Nations Brundtland Report "Our Common Future".

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (WCED, 1987)

In the A21SCDC it is stated that **"sustainable development** is not merely development that can be sustained, but rather it is the kind of development we need to pursue in order to achieve the state of sustainability." (Du Plessis, et al., 2002:6)

Sustainable development is thus an ongoing process of maintaining a balance between the demands of people and what the environment is capable of providing. (Du Plessis, et al., 2002:6)

1.5.2 Construction

In the context of A21SCDC, Du Plessis, et al. (2002:3-4) defined four different meanings of construction, of which only the following two are relevant to this study:

“**Construction** defined as site activities that lead to the realisation of a specific building, where construction is viewed as a specific stage in the project cycle”.

“**Construction** defined as the comprehensive cycle of a building project, covering key stages such as feasibility, design, build, operation, decommissioning, demolition and disposal”.

The A21SCDC also defines two other meanings of construction, i.e. “construction as a sector of the economy” and “construction as the broad process/mechanism for the realisation of human settlements”, which goes beyond the scope of this study.

1.5.3 Sustainable construction

“**Sustainable construction** is a holistic process aiming to restore and maintain harmony between the natural and built environments, and create settlements that affirm human dignity and encourage economic equity.” (Du Plessis, et al. 2002:8)

As explained in the A21SCDC, sustainable construction involves holistic thinking and applying a life cycle perspective to construction and the management of the built environment. It implies not only new building designs, but also new environmentally aware building operations and maintenance procedures. Construction materials and components must be produced in a sustainable manner and material use should be adapted to suit the requirements of sustainable development. (Du Plessis, et al. 2002:9)

Chapter 2: Literature study

The literature study briefly captures information from publications about the selected A21SCDC actions. The implementation of these actions across the industry worldwide is studied to create a background for the assessment of the data received from the South African contractors. (Refer to Chapter 4 for the data discussion). Various sources are used to give a background of current practices in the industry. The literature is studied with the aim of obtaining an overview of actions taken and changes implemented by contractors in the overall construction industry within the framework of this research (Refer to Table 1 for research framework).

2.1 Internal housekeeping

2.1.1 In-house strategic plan

The A21SCDC prompts contractors, nationally and internationally, to develop their own sector-specific strategy on how to address the requirements of sustainable construction and development. (Du Plessis, et al. 2002:65)

As an example of a strategic organisational plan, the literature reviewed will specifically focus on ISO 14001 EMS, discussing the purpose, background, benefits, barriers and the basic components thereof. The selection of ISO as an example EMS is due to the finding that ISO 14000 is the internationally accepted standard and it is also accepted and used by South African construction companies.

An effective way for companies to evaluate their day-to-day footprint can be through the establishment of an Environmental Management System (EMS) plan. By using an EMS, organisations can identify in-house opportunities to reduce their impact on the environment. The International Organisation for Standardisation (ISO) provides an effective standard for organisations to implement EMS plans. (Ahn, et al. 2010:361-362)

The ISO 14000 EMS emerged in 1996, primarily as a result of the Rio Summit in 1992. The whole series of environmental management standards are known as ISO 14000. (Raymond 2001:178) The cornerstone of the ISO 14000 family is the

specification document ISO 14001 Environmental Management Systems which aims to improve the environmental performance of businesses through coherent resource allocation, responsibility assignment, and ongoing evaluation of practices, procedures and processes. The end purpose of construction firms implementing the EMS is to improve the built environment by good environmental organisational management, thereby reducing the industry's negative impact. (Zhang, et al. 2000:140)

The ISO 14001 EMS aims to investigate an organisation's activities and the environmental impact thereof. An EMS forms the platform to measure an organisation's progress of reduction in waste generation, energy consumption, air emissions and material use. (Ahn, et al. 2010:361-362) The implementation of an EMS should be done with the intent to establish the basic systems which will lead to effective environmental management and then integrating these systems with other organisational and management requirements. The purpose of an EMS is to provide assistance to companies in reducing their environmental impact through a systematic internal control system. (Raymond, 2001:178) A survey done during 2010 indicated that many organisations have adopted a few components of an EMS, but not many have a full and effective system in place. (Ahn, et al. 2010:361-362)

Raymond (2001:183) suggests the following five potential benefits of implementing the ISO 14000 EMS for construction firms in Hong Kong:

- “Monetary savings through energy efficiency and waste minimisation. Although some initial costs are required to implement and get certification of EMS, the result will be long term savings through the reduction of waste, emissions, fuel consumption and energy consumption
- Healthy competition in tendering. The ISO 14000 EMS enables a company with good environmental management practices to add a competitive edge to the tendering process
- Less chemicals and hazardous waste on-site, thus a decrease in the number of employees injured by these substances. Having an ISO 14000 EMS ensures the availability of a system to track current laws and ensure compliance with these laws

- Reduced insurance premiums, due to the lower environmental impact and less risk involved. An effective EMS can encourage lower insurance rates and better access to capital based on the firm's environmental track record. In the USA for example, the World Bank takes the environmental performance of a company as one of the criterion for obtaining a bank loan
- Improved upper management attention. The process of obtaining ISO 14000 certification is likely to give the upper management an increased and more positive appreciation of environmental management. A core concept of EMS is to enhance environmental performance through periodic review and evaluation”

Apart from the many benefits, one should note that there are many barriers to implementation of an EMS. The unique nature and characteristics of each project makes it difficult for construction firms to implement a compliant ISO 14001 EMS, because the continuous monitoring of improved construction processes cannot be repeated under the same conditions for different projects over time. (Ahn, et al. 2010:361-362)

The Hong Kong case study by Raymond (2001:190) reflected four major obstacles to ISO 14000 implementation. These were: “lack of government pressure; lack of client requirement or client support; expensive implementation cost; and subcontracting systems, which create difficulties in managing the EMS”.

The multilayered subcontracting system complicates the application of EMS for contractors. Main contractors struggle to carry out the EMS control requirements because subcontractor's labourers are usually reluctant to follow their instructions. Besides the labourers, the subcontractors themselves might not be willing to comply with the working procedures of the contractor's EMS, since these are usually costly and time-consuming. Therefore, implementing the control requirements under the ISO 14000 seems to impose great difficulties for construction companies. (Raymond, 2001:186)

From an administration point of view, contractors might encounter obstacles with their own workers, as the ISO 14000 standards require all working procedures to be

traceable and capable of being audited. Workers need to complete a lot of documentation, written procedures, check lists, control forms and other paper work which are required in order to meet ISO 14000 standards. (Raymond, 2001:185)

The basic elements and functions of an effective EMS are outlined by ISO 14001. This includes the establishment of an internal environmental policy, determining impacts of activities/services/products, formulating planning objectives, identifying measurable targets, implementation and operation of the plans, checking, corrective action, and management review. (Zhang, et al. 2000:140) The figure hereunder illustrates a framework for implementing an EMS in a construction company. The framework relies on the “Plan-Do-Check-Act” approach for continuous improvement.

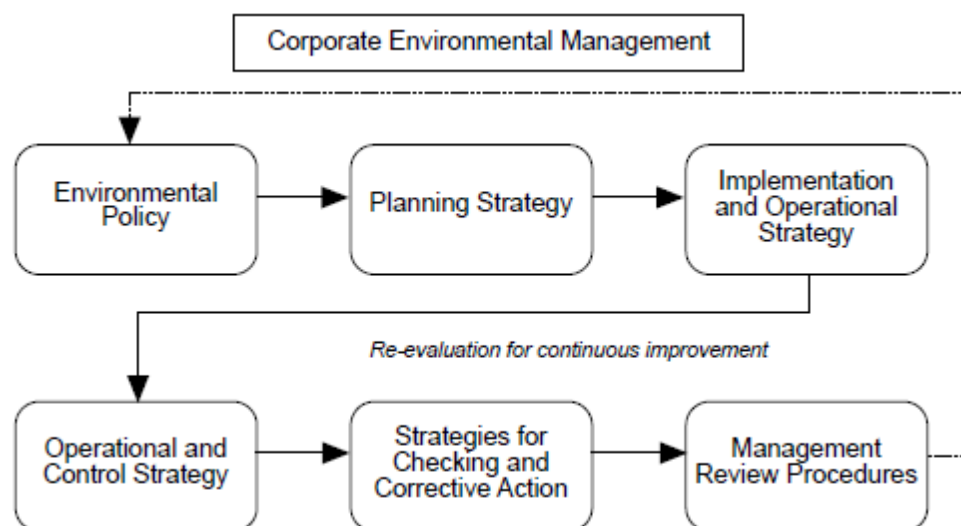


Figure 1 : Framework for implementing an EMS in a construction company (Zhang, et al. 2000:144)

As a starting point, a construction company can ask the following questions to evaluate its environmental impact. This will guide the EMS formulation process and help establish the organisation’s environmental policy. (Zhang, et al. 2000:145)

- “Does the company train its employees to understand and deal with environmental aspects and impacts, including hazards?”
- Does the company have a system to prevent negative impacts from occurring?

- Could the failure of the company's equipment or facilities result in a release to the environment that would have a significant environmental impact?
- Do the company's construction sites and offices have facilities that are already contaminated or the subject of environmental concern?
- Will any intended changes to activities, products, or services, alter the environmental aspects and impacts?
- What state of affairs needs to exist for an environmental impact to occur?"

Zhang, et al. (2000:145-147) and Pun, et al. (2001:113) explains the six key components of an EMS as discussed below.

Environmental policy:

According to Zhang, et al. (2000:145) this is the starting point of the EMS. The company should draft an environmental policy for setting targets and objectives. The main objective of the policy is that the top management makes a conscious decision about how their services and products impact the environment. The overall environmental management intention is set in the policy, and this includes the undertaking to continuously review and improve the system. (Zhang, et al. 2000:145) In short, the policy relates to the current and potential environmental impact of the organisation's products, services, consumed material, pollution prevention and waste reduction. All employees should be aware of the company's environmental policy. (Pun, et al. 2001:113)

Planning:

Planning is the component through which the company determines their controllable environmental aspects. (Pun, et al. 2001:113) Prior to preparing the plan, the company needs to review its operations, activities, products, and services to identify the company's interaction with the environment. After determining the environmental aspects, the company should gather all relevant legal requirements and evaluate which aspects have, can have, or will have, negative impacts. Subsequently a programme must be developed to achieve targets and objectives in respect of the impacts and aspects integral to the specific environmental plan of the company. Targets are short-term goals, for example to reduce construction waste by 30%

during one year. Objectives are long-term goals, such as reducing solid landfill waste within five years. (Zhang, et al. 2000:145-146)

Implementation and operation:

According to Pun, et al. (2001:113) the implementation and operation stage includes defining and communicating roles, responsibilities and authorities of employees, employee training and raising awareness. Zhang, et al. (2000:146) advises top management to appoint a “management representative for sustainable construction”. The representative must report on the EMS performance to top management and also ensure that the EMS is ISO 14001 compliant and effectively implemented. The identification of training requirements of employees whose work have significant environmental impact is important, as well as ensuring that the relevant workers receive adequate training. Awareness by all employees is important for the success of the EMS. All employees should understand how they affect the environment and what changes they should make. The competence of employees performing activities with significant environmental impacts must be ensured. Documentation reflecting the EMS basics and company practices should be developed, reviewed and updated in order to provide clients, consultants and government bodies with the company’s environmental plan. (Zhang, et al. 2000:146)

Operational control:

Organisational processes and activities integral to the construction company that poses a potential significant environmental impact need to be identified. For example, a significant impact can be construction waste, energy consumption, or GHG emissions, depending on the company’s operations. It is then required of the company to ensure that these operations are carried out under controlled conditions such as documented procedures, operational norms and standards. Evaluation of potential accidents and emergency situations is very important. The company should establish effective procedures in response to accidents and emergencies. Prevention and mitigation of air and noise pollution form part of the company’s emergency plans. (Zhang, et al. 2000:146-147)

Checking and corrective action:

Companies should regularly monitor and measure their operations for continuous improvement. (Pun, et al. 2001:113) Records of the monitoring and measurement results should be kept as these are required to track performance, review effectiveness of operating controls, prove conformance with objectives and targets, and comparison with legal requirements to ensure compliance. Corrective and preventative action strategies should be in place in the case of non-compliance. The abovementioned EMS records that should be maintained include employee training records, EMS audit results, management reviews, as well as monitoring and measurement results. (Zhang, et al. 2000:147)

Management review:

Audits and review procedures are necessary to establish if the EMS is operating as planned and if the company's environmental targets and objectives are being met. Top management must review the EMS on a regular basis to keep it in line with the company's overall environmental intention (as formulated in the environmental policy and plan). Middle management also needs to review the effective operation and identify possible improvements or changes required at operational level. Any necessary changes to policies, objectives and targets should be made to improve the EMS. (Zhang, et al. 2000:147) According to Pun, et al. (2001:113) the ultimate purpose of EMS review is to ensure continuing suitability, improvement and effectiveness of the plan.

[2.1.2 Code of conduct/ value system](#)

The A21SCDC suggests that action should be taken at an organisational level, where businesses are required to adopt internal codes of conduct and formulate value systems that support sustainability. Employees should be encouraged to reflect the values required for a sustainable world in their day-to-day business activities. (Du Plessis, et al. 2002:1,65)

Below, as an example, are some of the company, Aecom's, values as published in their 2011 sustainability report:

- "Integrity (Honest and ethical business operations, employee commitment and trust)

- Mutual employee respect (Individual ideas, diversity, culture)
- Excellence (Technical, operational, administrative)
- Innovation (Creativity, best business practice, imagination, exploration)
- Agility (Flexibility to change, adaptation)
- Safety (Injury prevention, minimal environmental damage)”

Employees should regularly be encouraged to adopt the value system of the company and they should strive to reflect values in their every day business operations. Employees should not only be inundated by documentation and words without meaning, but they should be encouraged by witnessing the top management actually living and practising the company’s value system.

As suggested by Booyesen (2012) it might be that the majority of an organisation’s employees may not even understand what is meant by sustainability or what a sustainable world implies. Due to this probable lack of knowledge it might be a very challenging task to implement some of the sustainable values.

In Aecom’s 2011 sustainability report, it is mentioned that companies should strive to adapt their day-to-day operations to reflect sustainable business values such as:

- Growing the economy
- Reducing energy and resource consumption
- Adaptation to environmental requirements
- Building local communities
- Health improvements (Internal and public)
- Risk management
- Resilience
- Reduce, re-use, recycle attitudes

A company in Belgium made the following statement in their sustainability report: “We included planet Earth as a stakeholder in our strategic planning and vowed to create a sustainable management system”. As can be inferred from this statement, sustainability should become the centre of focus in the process of establishing sustainable values and business conduct. (NBBC, 2011:3)

Below is an extract of an inspirational value system done by the New Belgium Brewery Company (2011:4). When reading this company's sustainability report one can see that they put their heart, mind and soul into making their business sustainable as far as they can by selecting their company values. "At New Belgium, striving for sustainability is the energy source that turns our company's purpose and core values and beliefs from high-minded notions into daily affirmative practices. Our value system states our beliefs about what needs to happen to achieve environmental sustainability." (NBBC, 2011:4)

Although the value system referred to below is not that of a construction company, it can serve as inspiration for contractors to see how they can incorporate sustainable values.

"With regard to environmental sustainability, we (NBBC, 2011:4) believe in:

- Lovingly caring for the planet that sustains us
- Leadership through environmental stewardship
- Stewarding natural resources by closing the loops between waste and input
- Minimizing the environmental impact of our operations
- Reducing our dependence on coal-fired electricity
- Protecting our precious water resources
- Focusing our efforts on conservation and efficiency
- Supporting innovative technology
- Modelling joyful environmentalism through our commitment to relationships and continuous improvement"

The construction company, Balfour Beatty (2009), titles their value system as follows: "How we work, what we value – our code of conduct – the behaviour we expect from everyone". The company's CEO, Ian Tyler addresses his employees in the code of conduct to not only follow the rules as laid down by the framework, but to think at all times and in all operations. He guides his employees with the following statement: "I want you at all times to ask yourself, is it the right thing to do? Is this what we stand for?"

Thus, it can be said that the main objective of a sustainable value system is to inspire and influence employees to adapt their personal behaviour and then it can over time result in sustainable businesses. “The power to drive social change comes from within”. (SKANSKA, 2009:73)

2.1.3 Efficient resource use (in office environments)

By making a few changes to office environments, energy and water usage can be reduced and these essential resources can be applied more efficiently. The A21SCDC makes it clear that we need to change our consumption habits. If we persist with our current consumer patterns, we and our future generations will be left with nothing. We should realise that there are finite resources which cannot be duplicated and when these are depleted we will have no way out. (Du Plessis, et al. 2002:10,11,65) The following section will look at different ways available to use resources, e.g. energy and water, more efficiently in office environments, as well as the impact of office buildings on energy and water consumption.

2.1.3.1 Energy

The energy consumption by buildings keep rising due to population growth, continuous enhancement of building services and comfort levels, more time spent inside buildings, etc. Lombard (2007:396) found that office and retail are the most energy intensive building types. Some of the reasons for the high energy consumption in office buildings is said to be the substantial increase in the newly built office areas, the kW/m² energy use ratio, the amount of artificial lighting used, IT equipment, air-conditioned areas, thermal comfort levels and in some cases the reason is simply due to human luxury. (Lombard, 2007: 396)

There is a significant increase in energy consumption through the use of HVAC (heating, ventilation and air-conditioning) systems; it has become the largest energy end use in buildings. The end uses of energy consumption in offices during 2007 are shown in table 2, comparing USA, UK and Spain statistics.

Energy End Uses	USA (%)	UK (%)	Spain (%)
HVAC	48	55	52
Lighting	22	17	33
Appliances & Equipment	13	5	10
Food preparation and refrigeration	4	10	-

Table 2: Energy consumption in offices by end use (Lombard, 2007:395, sourced from EIA, BRE, IDAE)

Energy consumption in non-residential buildings is influenced by use, design factors and climate. Typically, in South African commercial buildings, HVAC equipment accounts for around 30% of electricity use and lighting around 35%. (UNEP-SBCI, 2009:30)

According to UNEP-SBCI (2012) statistics, residential and commercial buildings are responsible for about 60% of the world's electricity consumption. However, the UNEP-SBCI suggests that buildings offer the greatest opportunity for reduced consumption by implementing technologies for efficiency. When considering existing buildings' energy efficiency, frequently one will find that their energy saving potential is significant. This is due to the fact that most existing, i.e. older, buildings operate at performance levels that are far below the current efficiency potentials. (UNEP-SBCI, 2012)

The EPA (2011) prompts office managers to implement energy saving policies such as activating the power management features on all computers and monitors, unplugging laptop power cords or battery extensions when not in use, turning off equipment and switching off lights at the end of the day, using energy efficient equipment, (copiers, printers computers, heating and cooling equipment, etc.) and energy efficient products (light fittings, commercial appliances, etc.). The EPA (2011) suggests that a great solution is to involve facility management companies to evaluate and provide specialised solutions to improve office energy efficiency.

The best way to improve the energy efficiency in buildings is to have an efficient building design that incorporates elements of sustainability. (Asvat SAICA, 2009) For this study we assume contractors have existing office buildings and are not looking at the option of designing new buildings. There are numerous small changes

that can be made in existing buildings that can have a cumulative effect on electricity saving.

Efficient energy use in office environments can be achieved by taking small steps. Some of these are mentioned below as proposed by Asvat SAICA (2009).

- Ensure the air conditioned spaces are closed off from all non air conditioned spaces by closing doors, installing automatic doors, or self closing door mechanisms, etc
- Install blinds and awnings to control the amount of sunlight entering through windows. In summer the sunlight can be kept to a minimum making the air cooling more effective and in winter sunlight can be allowed to enter buildings thus reducing the need for heating
- Where areas have high levels of natural light, switch off electric lights if possible
- Replace incandescent light bulbs with compact fluorescent lamps. In areas where intense lighting is unnecessary, make use of low energy bulbs
- Wall and ceiling insulation is a good retro fit option to reduce heat loss
- Although double glazed windows are expensive to install, it effectively controls temperatures inside the building as it reduces heat loss in winter and heat gains in summer

The report published by the UNEP-SBCI and the CIDB (2009:62) suggests that energy efficient opportunities for the building sector in South Africa include the following:

- Retro fitting
- HVAC variable speed drives
- Energy efficient lighting
- Solar water heating and heat pumps
- Energy efficient appliances
- Behavioural changes

The promotion of energy efficiency, new energy production technologies, limiting energy consumption and raising social awareness on the efficient use of energy is essential. (Lombard, 2007:398)

2.1.3.2 Water

SKANSKA (2009:43) makes the statement “In a world of water shortages, why use drinking water to flush the toilet?” This is indeed an important question to ask oneself.

If one looks at a picture of Earth taken from out of space, it might seem as if there is plenty of water. However, 97% of the water on Earth is in the oceans, while an additional 2% is in frozen ice caps and glaciers. Only a fraction (about 1%) is available as drinking water. Drinking water supply is already insufficient in many parts of the world. It is vital that we start saving water and use it more wisely. (SKANSKA, 2009:43)

SKANSKA (2009:43) suggests that by installing water-saving appliances, recycling by redirecting water from sinks and showers to flush toilets (known as grey water systems) contractors can radically reduce their water consumption in office buildings. SKANSKA (2009,43) also mention that harvested rainwater can be used in buildings, or to maintain office gardens.

2.1.4 Recycling policies

The A21SCDC suggests that contractors should introduce recycling policies for their office waste. (Du Plessis, et al. 2002:65) Discussed below are a few recycling options available, and innovative solutions for managing office waste.

Office waste management and recycling policies:

CalRecycle (2012), the California Department of Resources Recycling and Recovery, recommends that businesses should combine recycling and waste prevention programmes instead of implementing a recycling programme only. This will bring about not only recycling practices but will also create an environment for reduced consumption and waste prevention.

In Ireland, Repak started the “Recyclemore” initiative in 2010. The information that follows is relevant for offices worldwide and is provided by Recyclemore (2010) to assist companies on how to set up a recycling system in the workplace.

- “Step 1: Do a rough audit of the amount of waste generated, separating the types of waste and their associated costs
- Step 2: Get a sustainable waste management organisation involved to assist with the design of a system that will reduce the waste generated in your office, and efficiently recycling or disposing of the unavoidable waste
- Step 3: Setting up the system by installing and providing the necessary waste and recycle bins
- Step 4: Appoint an office coordinator to take responsibility for implementing and monitoring the office recycling programme
- Step 5: Get employees involved by providing brief training on how the system works, what the rationale behind the system is, and what is required of each individual
- Step 6: Ensure the system is not too complicated. Make it as easy as possible for employees to participate by placing bins in convenient positions
- Step 7: Regularly review the system; evaluate progress made and barriers encountered by the office members”

The United States Environmental Protection Agency (EPA) published a document “What you can do at the office” (2011), in which guidelines are given to companies in the US to manage their office waste and how to participate in recycling.

Some of the EPA (2011) office recycling guidelines includes:

- Two-sided printing and copying
- Only printing necessary documents
- Buying supplies made with recycled contents
- Recycling paper and other frequently used office products
- Recycling batteries and used printer cartridges
- Getting involved in manufacturer and retailer take-back programmes
- Participation in government grant initiatives
- Donating old electronic equipment and furniture to schools
- Apply for tax incentives on the programme implemented in your office

By recycling and not simply dumping the office waste into the normal waste bins, the amount of municipal waste generated is reduced, less carbon pollution is caused and in the long run energy and resources is conserved by reducing, re-using and recycling office waste. (EPA, 2011)

Leijnieks (2009) raises the issue that many recycling policies are not effective due to a lack of individual employee participation. Every small step and single action taken by individuals collectively makes a big difference to the environmental impact caused by office environments.

In alignment with the EPA office recycling guidelines, Leijnieks (2009) discusses simple, yet effective ways to start a recycling programme in an office environment. As an example on how to implement a “reduce, re-use and recycling” attitude in the office environment, Leijnieks (2009) makes the following suggestions regarding paper:

- Reduced usage: Employees should be prompted to only print what they really need and at the same time to print on both sides of the paper.
- Re-use options: Use blank back-sides for “scrap” paper for individual use and taking notes.
- Recycling: Place the re-used paper and unwanted documents in the specific provided recycling bins and not in normal office dust bins.

(This “reduce, re-use, recycle” system can be applied to most of the waste generating products encountered in office environments).

It is important for office managers to investigate sustainable purchasing opportunities and to buy recycled products. CalRecycle (2012) makes the statement that “You are not recycling if you send your waste to be recycled, but you do not buy products made from recycled content”.

There are a few ‘fun ideas’ that can be used to get employees involved in the recycling and waste management system in offices. Recyclemore (2010) suggests

office managers should host a 'recycling day' or an 'environmental event' to launch the recycling programme to be implemented. An example of such an environmental event is to get employees to participate in a desk recycling competition. Whoever recycles the most from their desks will get an award. This can be a monthly event during a lunch hour. Another way to get employees involved is by allowing them to bring their household recyclable content to work. Even this can result in an annual event where small awards are given for the employees that recycled the most waste from their households. Recyclemore (2010) also gives the advice to make it simple and easy for employees to participate and understand the system. Clearly mark the different recycle bins and place them in convenient positions. Clients and others can be encouraged to save paper by placing the following foot note on your company's emails "Please consider the environment before printing this email". (Recyclemore, 2010)

In South Africa for example the company, Aecom, has an electronic filing system on their internal server that works very efficiently. (This is also known as paperless filing). All documentation is stored in the same structure for different projects, and over and above that advantage, it saves paper and ink by reducing the amount of paper files required.

In an office environment the following materials can be recycled; paper, paper and carton products, packaging materials, plastic products and containers, metal cans for cool drinks and food products, glass products, batteries, used printer cartridges, canteen and kitchen wastes. Refer to Annexure A and B for information regarding different office items, their material contents and the reasons for recycling these items and guidelines on how to recycle office waste.

In conclusion, as stated by the CalRecycle (2012) initiative, "Waste is a symptom of an inefficient process, preventing waste increases efficiency, increasing efficiency increases profits". It is therefore better practice to reduce and prevent waste than it is to recycle. The main office goal should be to prevent waste as far as possible, and then only recycle the waste that employees failed to prevent and thereafter the balance of waste that is non-recyclable can be discharged as municipal waste. (CalRecycle, 2012)

2.2 Site operations

Contractors are strongly addressed by the A21SCDC to take action and make changes to their construction processes. Contractors should reduce their environmental impact and commit to follow environmentally aware construction practices. Waste generation should be reduced, waste should be recycled, and water and energy consumption during construction should be reduced. Attention should be given to the demands placed on natural resources and the effects of GHG emissions. (Du Plessis, et al. 2002:1,65) The A21SCDC stresses the importance to reduce water, air, dust and noise pollution caused during construction activities. Construction and demolition waste management holds great opportunities for contractors to improve their sustainability. (Du Plessis, et al. 2002:14-15)

Thus, there are many opportunities for contractors, as well as manageable actions to be taken by contractors to improve their construction site operations. The sections that follow will discuss environmentally aware construction practices, natural resource use on sites, construction waste and, demolition waste.

2.2.1 Environmentally aware construction processes/ practices

There are many reasons for the slow transformation towards more sustainable construction practices. Probably the main reason at this stage is that it costs contractors money to change their practices to environmentally aware construction. Contractors' motive in operating their businesses is surely to make profit and they might not see the reason and need of their contribution. (Whitaker, 2012) Another reason is said to be the decentralised nature of construction processes, involving a number of subcontractors and participants, all with different views and priorities. The unique characteristics of each project and site are also a limiting factor on the continuous improvement of sustainable construction processes. Furthermore, it is difficult to establish laws and regulations for sustainable construction practices, and the assessment of internal company progress is not an easy task. (Ahn, et al. 2010:358)

Environmental issues like GHG emissions and energy use are incorporated into standards and regulations to enforce implementation in the construction industry and especially on sites during construction operations. However, most construction

practices are dealt with by means of “best-practice guides” to contractors. (Cole, 2010:949) For instance, Cole (2010:949) states that water use, stormwater control, etc. are not governed by law or regulations. The problem with this is that compliance to the “best-practice guides” by contractors is on a voluntary basis only. (Cole, 2010:949)

Protecting sites from unnecessary damage to soils and vegetation, preventing stormwater contamination, controlled stormwater run-off, conservation of natural vegetation, site rehabilitation, and controlled GHG emissions will be looked at in more detail below.

[2.2.1.1 Site clearance & rehabilitation procedures](#)

Topsoil:

One of the important aspects to look at when implementing environmentally aware construction practices, is how contractors should handle top soil. Cole (2010:953) proposes preventive action to be taken against soil damage by locating and marking off the storage areas on site, by directing vehicle access in ways that reduce soil compaction by workers and vehicles, and finally the handling of topsoil during site clearance. Top soil should be carefully removed, stockpiled, moved around minimally and kept dry.

Trees and vegetation:

Any existing condition on a piece of land will be disturbed by construction in some degree. Depending on the type and size of project, entire ecosystems can be destroyed by construction operations. (Cole, 2010:952) Thus, when implementing environmentally aware construction practices, contractors should aim to limit the extent of site clearance impacts on the natural trees and vegetation. As far as possible, natural vegetation should be retained to be re-used as part of the landscaping or on green roofs, etc. By so doing, the site is rehabilitated with it's own natural vegetation.

The following preventive actions are proposed by Cole (2010:953) to limit the detrimental impact on trees and vegetation when performing site operations:

- Prepare an inventory of current vegetation on the site prior to construction.
- Prepare a site plan indicating locations of vegetation to be removed, retained and salvaged.
- Clearly mark or enclose the trees, shrubs and plants to be retained on site.
- Set aside and secure/protect shrubs and associated top soil for reuse after construction.
- Locate storage areas and vehicle access in order to protect existing vegetation from being trampled.
- Block unauthorised vehicle access with barriers.
- Clearly mark and limit on-site parking.

Stormwater Control:

SKANSKA (2009:43) discusses the concept of sustainable drainage systems in their Green Thinking Book. Sustainable drainage systems can reduce the quantity of water lost by runoff and at the same time reduce water pollution. A sustainable drainage system entails the promotion of natural drainage, filtration and biological treatment processes. By allowing water to penetrate the ground, sustainable drainage replenishes groundwater supplies in stead of the water being lost or directed to sewer mains. A case study by SKANSKA showed that a sustainable drainage system has reduced the site discharge by almost 35% after construction, despite an increase in the extent of impermeable surfacing (SKANSKA, 2009:43)

Stormwater run-off increases when the natural surfaces are replaced by hard construction platforms and needs to be managed. Run-off from construction sites in many cases contains a significant amount of contaminants. These contaminants comprise of sediment, concrete fines, lubricants, fuels, solvents, fertilizers, pesticides, etc. If the polluted stormwater runs into stormwater drains, water systems may be polluted with silt. The silt content can change the water's chemical balance and it can even remove the dissolved oxygen from the water. (Cole, 2010:953)

Cole, (2010:953) suggests that stormwater contamination can be mitigated by taking steps to retain run-off on the site during dry season and minimising the effect during the rainy seasons. The following strategies can be followed to achieve this (Cole, 2010:953):

- Daily remove any sediment present on the site.
- Cover soil piles until it is removed or used.
- Prohibit washing of vehicles adjacent to, or on a construction site (unless washing water can be collected by a disposal contractor in sealed tanks.)
- On-site stormwater collection and settling
- Emergency plans for rainstorms (sandbags or other barriers and swales to manage water flow)

2.2.1.2 Emissions control

Through the life cycle of a building CO₂ is emitted by; the production of building materials, during the construction phase itself, during the building's day-to-day operations, utilisation of the building, the possible renovation at some stage and finally through demolition of the building. (Joseph, 2010:401)

In Canada, they have an emissions database prepared by the National Pollutant Release Inventory (NPRI). The NPRI provide data on fugitive and exhaust emissions from the construction sector. The operation of off-road construction equipment was studied, and it was found that the use of construction equipment results in high fuel consumption and emissions. These are referred to as exhaust emissions. Fugitive emissions on the other end are those resulting from rock crushing, building demolitions and other dust emissions during construction. (Ahn, et al. 2010:358-360) From the NPRI's investigations it is suggested that bottom-up assessment and implementation for each single construction project will result in the most successful emissions control. However, in Canada and the U.S. the efforts from the voluntary private sector have been far less than the various governmental regulatory efforts that successfully resulted in more sustainable construction processes. (Ahn, et al. 2010:360)

Some regulatory programmes have sections focussing specifically on emission reduction requirements. For example, with regards to energy consumption and

fugitive and exhaust emissions from construction processes, the LEED system looks at fugitive dust emission prevention and material transport reduction. There is no section of the system that looks at the exhaust emissions resulting from operating construction equipment, which is estimated to produce the most GHG emissions in the construction process. (Ahn, et al. 2010:361)

According to UNEP-SBCI (2012), although the construction industry is responsible for approximately one third of GHG emissions globally, it also offers the greatest opportunity for reduction in the amount of GHG emissions in both developed and developing countries.

EPA (2011) suggests that all construction companies should take the first step towards managing their environmental impact by developing a GHG inventory. A GHG inventory is a list of emission sources and their associated quantified emissions relevant to the company. A GHG inventory is a great starting point to measure and manage the environmental impact caused on sites by electricity use, employee travel, every day construction activities, as well as tool, plant and equipment operations. (EPA, 2011)

Another option available to construction companies to reduce their GHG emissions related with site operations is to provide group transportation for site workers. This can be done by making use of buses that commute workers from a central point to the site they are working on. Each site can have an allocated bus that provides convenient transport to the site workers and at the same time control GHG transport emissions. (EPA, 2011)

[2.2.1.3 Offset programmes](#)

According to (Du Plessis, 2012) there are many ways in which contractors can offset their carbon footprint. The first step to engage in an offset programme would be to calculate the organisation's carbon footprint. Thereafter the organisation can begin to take actions that will set off against its GHG emissions. The offset programme works on a basis of donation where trees can be bought to be planted, or contractors can donate trees to be removed from sites to offset their carbon footprint. There are many offset projects available to participate in. The South

African airlines also introduced the project where companies can donate 25 Rand towards carbon offset programmes when buying plane tickets.

2.2.2 Natural resource use (on construction sites)

The South African Department of Environmental Affairs (2011) refers to the section 24(b) constitutional right in their National Strategy for Sustainable Development:

“Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.”

The Living Planet Report of 2012 contains the following forewarning statement: “Demand on natural resources has doubled since 1966. We are living as if we have an extra planet at our disposal. We are using 50% more resources than the Earth can provide, and unless we choose to make a difference that number will grow very fast; by 2030, even two planets will not be enough. We do have a choice. We can create a prosperous future that provides food, water and energy for the estimated 10 billion people who will be sharing the planet in 2050”. (Leape, 2012: ii)

Research information regarding the use of natural resources on construction sites is scarce. There seems to be a vast amount of literature about natural resources, but not specifically regarding their use through construction activities. Not enough relevant literature or statistics were found to study the impact of construction activities on natural resources in detail. In the following sections some environmental aspects concerning water, energy, materials and pollution are briefly mentioned to show why contractors should consider and monitor their impacts on non-renewable natural resources.

Natural capital (as outlined in Chapter 1) must be preserved and, where necessary, restored as the foundation of human societies. “We can reduce our footprint by producing more with less, and consuming better, wiser and less”. (Leape, et al., 2012: ii)

2.2.2.1 Water

According to the CSIR (2011:6) South Africa has an enormous range of natural resources, with one important exception which is fresh water. The CSIR Annual report discusses the South African water shortages, impacts of acid mine drainage,

inadequate service delivery and sanitation requirements, water pollution and poor water resource management. None of these are discussed in terms of the impact of construction activities on water. The main focus is on the mining sector and its direct impacts such as pollution and acid mine drainage.

The Finnish Environment Institute (2011) implemented permit policies for the use of water resources. Official permission for the use of natural water resources must be obtained prior to the use thereof wherever it might lead to environmental damage. Anyone intending to use water resources should first contact the regional environment centre to find out whether the planned activity is subject to permits. If so, the water use permits are obtainable from the Finnish environmental permit authorities. The usage of water resources is regulated in detail by Finland's water legislation and South Africa can be well encouraged to implement similar regulations.

Leape, et al. (2012) suggests that we can still ensure that there is enough water for our future needs by conserving the rivers, lakes and wetlands. Smarter irrigation techniques and better resource planning, for example, are more ways that we can adopt to help us use water more efficiently.

[2.2.2.2 Materials](#)

A policy that taxes the consumption of virgin natural resources can be a way of conserving limited resources. A study conducted by Söderholm, (2011:915) examined the impact of taxes on natural raw materials, such as gravel, sand and stone aggregate in Sweden, Denmark and the UK as a way of promoting alternative or recycled materials. The study found that aggregate taxes have reduced the use of natural aggregates and to some extent encouraged the use of substitute materials in the three countries. The South African National Strategy for Sustainable Development suggests that the implementation of fiscal incentives is part of the strategy to achieve transition (Department of Environmental Affairs of South Africa, 2011)

2.2.2.3 Energy

The Millennium Development Goals Report, (2011:74) published data regarding energy consumption in Africa as part of Target 7.A of the millennium development goals. “Target 7.A states: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources”. South Africa and Zambia have recently introduced carbon tax policies to obtain the goal of reducing their carbon footprints. Thus, regulations and environmental taxes can be introduced as a mechanism to reduce GHG emissions and the use of natural resources such as energy.

The African Development Bank has introduced a Clean Energy Investment Framework that aims to increase the access to clean energy and low carbon development in Africa. This framework is based on the fact that Africa has vast renewable resources, such as hydro-potential (approximately 1,750 terawatt hour), geothermal potential (approximately 9,000 megawatts), as well as great opportunities for wind and solar power. (Millennium Development Goals Report, 2011:75)

According to Leape, et al. (2012:18) we should aim to meet all our energy needs from sources like wind and sunlight that are clean and more importantly, abundant. One of the first goals to achieve is to get much more out of the energy we currently use through increasing the efficiency of buildings.

2.2.4 Construction waste

A major barrier to reaching sustainability in the construction sector is the large amount of construction- and demolition waste generated by the industry. (Couto, et al. 2010:429) Multi-country surveys indicate that 20 to 30% of waste dumped at landfills worldwide is the result of construction and demolition activities. (Couto, 2010:429)

Kibert and Chini (2000) illustrate a waste management hierarchy as depicted in Figure 2 below. The approach of the waste management process is to reduce the waste dumped on landfills to an absolute minimum. The idea is that all possible routes of waste absorption must be followed before dumping waste to a landfill site.

(Couto, et al. 2010:432) Deconstruction discussed in 2.2.5 is suggested as one of the alternative routes in the hierarchy.

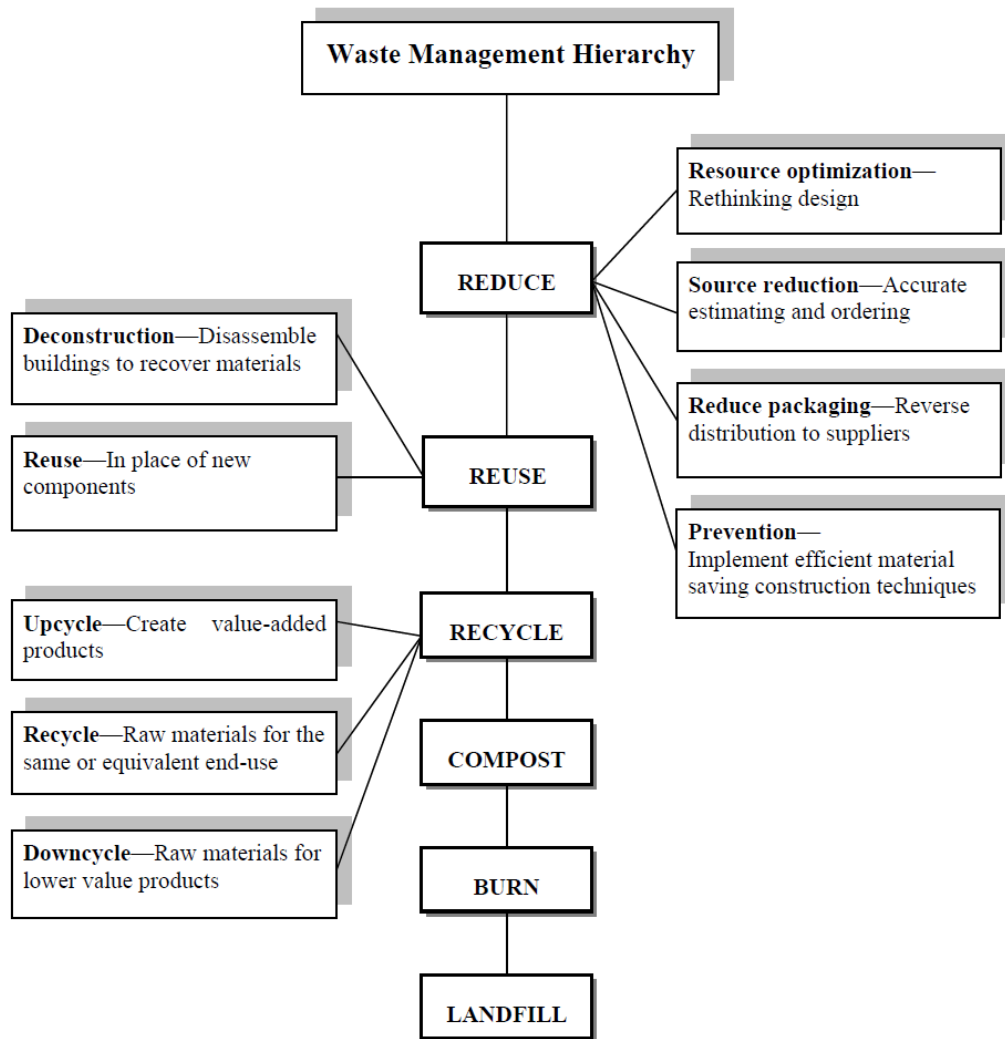


Figure 2: Waste management hierarchy (Kibert and Chini, 2000)

It is important to note that not all wastes should be burned. For example, treated wood should not be burned as it releases harmful dioxin emissions. It is better to reuse and upcycle treated wood products than to burn it.

According to Hagen (2005), when comparing new construction- with refurbishment projects, it is found that more than 80% of the waste generated by construction projects as a whole is caused by refurbishment activities. According to Couto, et al. (2010:249) the total weight of demolition waste is approximately two times heavier

than the weight of construction waste. Refer to 2.2.5 for an alternative sustainable deconstruction process to demolish buildings and thus creating less waste.

According to Cole (2010:951) about 80% of construction waste can be recycled or reused, but the construction waste streams are often disordered and contaminated to such an extent that the recycling process is made difficult or impossible.

Cole (2010:951) suggests that construction waste recycling can be done successfully by taking the following actions:

- Train employees (site workers and managers) on what materials are recyclable and what separation process they should follow
- Brief employees on the importance and reason for recycling construction waste
- Provide separate bins for recyclable construction waste and engage with registered recycling organisations for collection and removal to recycling plant
- Employees to clean and properly separate construction waste on a daily basis
- Appoint a site waste manager (responsible for training of site workers and effective operation of the system)
- Make use of reusable formwork systems (steel or plastic in lieu of wood systems)
- Purchase recycled products and consider the renting of scaffolding, fencing and hoarding

Construction waste recycling programmes are most effective when included as a specification in the construction contract. A corporate commitment is required to adopt environmental aware construction practices. (Cole, 2010:951)

The following section gives an overview of construction waste materials that can be recycled and reused on construction sites.

Recycled concrete as aggregate for concrete production:

A comparative analysis of concrete properties with different ratios of recycled concrete aggregate was undertaken by Malesev, et al. (2010,1204-1225).

Laboratory test cubes and precast columns were crushed and used as recycled aggregate for the experimental concrete mixtures. The recycled aggregate concrete mixes showed satisfactory performance, and had no major difference from the traditional concrete mix. Although the experiment indicates that the use of recycled concrete can be used as aggregate for structural concrete production, it is very important to note that quality waste concrete must be used, and very specific rules for design and production of the recycled concrete type must be followed. Only coarse recycled concrete aggregate should be considered as an admixture for structural concrete, fine recycled aggregate is not recommended. Screening and removal of contaminants (such as reinforcement, metal, paper, wood, plastics and gypsum) during the crushing process is important for obtaining the right quality recycled aggregate. (Malesev, et al. 2010:1204,1205,1207) Recycled concrete as an aggregate for structural concrete production provides a great sustainable solution for demolition and alteration projects. Contractors and Engineers are encouraged to experiment with this type of concrete only in structural elements where little deformation is expected to occur. (Malesev, et al. 2010:1204,1205,1207)

Broken bricks on site:

In a recent construction project, the Maseru Mall shopping centre, the professional team together with the contractors utilized broken bricks to do decorative paving to parking areas and pedestrian walkways. With a little innovation and positive attitudes toward sustainability, a project team can make significant contributions to make site operations more sustainable. Not only is waste reduced, but the client's money is also saved by reusing construction waste in the project.

Broken tiles:

In the same project as mentioned above, the team considered to use broken tiles for mosaic features. Alternatively the broken tiles can be donated or sold to organisations or communities that can use these for mosaic wall or floor features. Some entrepreneurs might have very effective uses for broken tiles in stead of simply dumping the tile waste in landfills. Coffee shop owners can for instance tile coffee tables, or do decorative wall features. Local churches and schools can involve children to design and tile a floors or walls in order to improve the community

and at the same time teach the children new skills and maybe this can result in children discovering artistic talents.

2.2.5 Demolition waste and deconstruction

An efficient way to anticipate in environmentally responsible demolition is to prepare a demolition plan and audit prior to commencement of works for demolition projects. (Cole, 2010:951)

Cole (2010:951) suggests that a site demolition plan should:

- Identify types of hazardous materials that might be encountered (asbestos, lead, etc)
- Estimate the quantities of the expected hazardous materials
- Determine the possibility and extent of soil contamination
- Identify materials that might be salvaged or recycled
- Plan to protect soil, vegetation and watersheds during demolition
- Maximise the recovery of materials by scheduling the removal of reusable and recyclable materials prior to demolition

Deconstruction is defined by Couto, et al. (2010:428-429) as being “The process of taking a building or structure apart, carefully dismantling a building in the reverse order to that in which it was constructed, so as to make possible the recovery of construction materials and components, promoting their reuse and recycling.”

Rehabilitation of buildings, its materials and demolition waste are key principles of deconstruction practices. Whether buildings are refurbished and modified or completely replaced, the success of incorporating deconstruction in these processes depends greatly on the employer and project team’s attitude towards sustainability. In many cases the rehabilitation will only reach as far as the preservation of the building façade, giving no consideration to the opportunities of reusing the internal materials in the new building. (Couto, et al. 2010:429)

It seems as though the use of deconstruction rather than demolition of buildings are rarely done, although there are many opportunities for it, clients seem somewhat

reluctant to adapt to the sustainable deconstruction practice. (Couto, et al. 2010:428-429) This might be due to the perception of costs associated with deconstruction. Deconstruction is a labour-intensive process involving a higher level of manual work than a demolition project. Workers are needed for removal of materials that can be salvaged, taking building components apart, preparing and sorting of reusable/ recyclable materials. However, it should be taken into account that the higher labour cost can be off-set against; the lower cost for demolition equipment rent, lower transportation and landfill disposal charges due to less waste generated, revenues from sales of salvaged material, or even the savings from reusing in stead of new material purchasing. (Couto, et al. 2010:434)

In Couto, et al. (2010:430) it is suggested that authorities might have a positive influence on the use of deconstruction in the building industry, by providing fiscal incentives like a fixed price for materials recovered, or even an increased waste disposal cost through landfill taxes. Incorporation of deconstruction techniques into material specifications and design codes will improve the use of deconstruction by designers and project teams.

The current effect is not significant due to the rare use of deconstruction, but it holds great advantages if effectively adopted in the industry. Deconstruction reduces; raw material procurement, the need to process and transport raw materials, the impact on natural resources for material manufacturing, the amount of demolition waste and landfill use, and it creates jobs for the local communities. The detrimental impact to the local site is reduced, for example damage to the soil and vegetation, and less dust and noise pollution is created when deconstructing a building in lieu of demolition. (Couto, et al. 2010:430-431,434)

The following is a summary of barriers to the use of deconstruction in the UK according to Hurley and Hobbs (2004):

- A lack of tools, skills and knowledge on how to deconstruct and how to design for deconstruction
- Lack of an established market for the materials sourced from deconstruction
- Products not designed for deconstruction
- Manufacturer's reluctance - prefer new products to be purchased

- Many building components designed to be permanent, thus being damaged too extensively during deconstruction
- Time constraints and financial pressure as business considerations
- Labour- and tool intensive operations
- Building codes not allowing for the re-certification of used materials
- A lack of confidence in deconstruction due to a lack of data and assessments of the strength and durability of deconstructed materials for reuse
- A lack of confidence and knowledge on accepted and tested deconstruction techniques

In order for deconstruction to be successfully incorporated in the construction industry, all stakeholders will have to contribute and adapt to this sustainable alternative. The most important success factor might be people's attitudes and innovative thinking. Designers will for instance need to incorporate certain deconstruction guidelines to design more adaptable and easily reusable building components. Clients might have to change their business views and expectations by allowing greater time scopes. Contractors will possibly need additional teams to execute and manage the deconstruction works. Training of site workers and foremen will play an important role in the deconstruction process. Cost control might become a more intensive process to offset increased labour and time against recovered materials and/or the sale thereof. Clients would like to see the difference in estimated cost of the project with or without the deconstruction process being followed. In Portugal it is seen that the traditional construction process are more likely followed and the adaptation to deconstruction is slow. (Couto, et al. 2010:437)

As mentioned before, the waste generated by demolition of buildings, and the dumping thereof to landfill sites is a major barrier to sustainable construction. A great alternative is to make use of deconstruction rather than the traditional habit of demolition. Incorporating demolition waste into new designs rather than generating more waste to be packed off at landfill sites should be the aim of construction project teams. (Couto, et al. 2010:429) Deconstruction clearly holds many advantages and improved sustainable conditions for the construction industry. (Couto, et al. 2010:430-431,434)

Chapter 3: Methodology

3.1 Introduction

As discussed in Chapter 1, only two of the A21SCDC actions for contractors will be reviewed to try and evaluate if changes were made from 2002 up to 2012. Section 5.3 of the A21SCDC is used for the basis on which data is collected, reflected in parallel with the literature review. (Du Plessis, et. al., 2002: 63-66, 72) Refer to A21SCDC background summary table in Chapter 1 for an outline of the proposed strategy for action to be undertaken by contractors.

The A21SCDC strategy for action used as a framework for this study comprises of six elements; namely capacity building, access to funding, partnerships and cooperation, internal housekeeping, encouraging and supporting implementation, and monitoring and evaluation. For the purposes of this study, only the “internal housekeeping” and “encouraging and supporting implementation” elements are studied in more detail. The element “encouraging and supporting implementation” is only studied through contractor’s site operations. Initially the intention was to look at all the actions as proposed by the A21SCDC, but the research field became too broad. The scope was therefore narrowed to these two actions only, mainly because they are not being researched as often as the other actions.

3.1.1 Research question

The main question this study aims to answer is whether South African contractors have achieved some of the A21SCDC actions towards sustainability.

This question relates to section 5.3 in A21SCDC. The A21SCDC identified key areas of action required from different stakeholders. This study is based on the section of the agenda that looks at actions for the private sector, utility companies and other service providers, of which building contractors form part of.

3.1.2 Sub-questions:

The first sub-question aims to answer whether South African contractors have adopted sustainable internal housekeeping actions in terms of A21SCDC.

The second sub-question aims to answer whether South African contractors have adopted A21SCDC sustainable principles through site operations.

3.2 Data collection

The population comprised of the “Big Five” South African contractors. A qualitative research method was followed. In depth interviews were held in person and telephonically; supported with a review of company reports. The data collected during the interviews is published confidentially. Contractors signed consent forms in acknowledgement of the study and to protect the confidentiality of the respondents.

In the process of collecting the data, the “Big Five” construction companies in South Africa were approached by contacting each company’s environmental manager or SHEQ representative. Interviews were arranged with the company representatives. Where interviews were not possible at all, the questionnaire was discussed via telephone conversations, or sent via e-mail to the respondent. Only three companies out of the selected sample of five responded successfully.

A questionnaire was used to serve as a guide for the interviews with the selected contractors. The interview questionnaires were formulated according to the same framework as used for the literature study in chapter 2. The emphasis of the questionnaires is on contractors’ “Internal Housekeeping” and their “Site Operations”. The results obtained is used to establish what the “Big Five” South African contractors have implemented and changed in their practices to be more sustainable in these two areas. Refer to Annexure C for the questionnaire template that was utilised to obtain data during the interviews with contractors.

3.3 Data analysis

A qualitative data analysis was done. The data was critically discussed to provide an overview of what the “Big Five” construction companies are doing in terms of sustainability. The researcher provided the data as received from the respondents without forming a personal opinion about the results. The reader is given an overview of what was found and can form opinions based on the raw data.

Chapter 4: Data discussion

The results obtained are generally discussed below in accordance with the framework used for the literature study. Refer to Chapter 2 for an overview of what is being done in the construction industry worldwide in a comparison to what the three South African contractors are doing.

4.1 Internal housekeeping

4.1.1 In-house strategic plan

All three respondents have an active in-house plan for sustainability. It was found that since 2008 there was an increasing awareness about sustainability and the relation of sustainability issues to the three companies' operations. Two of the respondents implemented their in-house plan during 2012, and the other respondent implemented their in-house sustainability plan during 2011.

The following aspects were found to be the main drivers why the companies established in-house sustainability plans as a part of their businesses:

- Legislation (upcoming in 2013 – The Green Paper on GHG Emissions)
- Integral to company values
- World trend & the direction that the construction industry is moving towards
- Responsibility (social, environmental and economic)
- Protection of the environment
- Cost saving, cost management

All three respondents have a summary of their EMS plans published on their company websites. It seems that the EMS/ SHEQ/ environmental/ sustainability plans are integrated as a part of the companies' overall business policies. To give an overview of what the companies' plans entails, the summary below were done by extracting the key concepts that were similar in the three plans and that formed the main focus of the EMS plans. In general, the plans outline the methods and guidelines of the reporting strategy, capturing of data, analysis and interpretation of the companies' applicable environmental indicators.

Overview of what the three in-house sustainability plans entail:

- Top management commitment to implement and enforce the plans
- Management committees responsible for effective and practical implementation of plans
- Risk identification and management of operations
- Continuous improvement
- Minimising & limiting environmental impacts
- Monitoring the usage of natural resources
- Measuring of the carbon and general environmental footprint
- Reporting on power, water and fuel utilisation
- Waste management & pollution prevention (oils, scrap metal, fuel consumption, builder's rubble)
- Disposing of and where possible recycling materials in an environmentally friendly manner
- Health and Safety on sites
- In-house employee training
- Leaving a positive and lasting legacy
- Well being of communities
- Skills development in communities in which the companies operate (corporate social investment)
- Encouraging a culture of environmental awareness amongst employees and clients
- Focus on long term sustainability throughout businesses
- Implementation of international best practice
- Environmental legal compliance
- Obtaining ISO 14001 certification by fully complying to their requirements
- Review and auditing of the environmental performance
- Conducting business as a responsible corporate entity
- Cost management, efficiency improvement and quality improvements
- Joining sustainability reporting protocols and achieving specific company requirements pertaining to the reporting initiatives (GRI Global Reporting Initiative, JSE – SRI Johannesburg stock exchange social responsibility investment index, CDP Carbon Disclosure Project)

All three respondents have a full EMS in operation throughout their business units. There is a difference between having an operational EMS system based on the ISO 14001 EMS plan, and to be ISO 14001 certified. It is possible to implement the ISO 14001 EMS without going through the certification process. Only one of the respondents are not fully ISO 14001 certified, and is currently in process to do the certification after rewriting their EMS to be compliant. The reason why all three respondents are using ISO 14001 as a basis for their EMS and for certification is because this is the internationally accepted standard and it is the current industry trend. The respondents are of the opinion that the ISO 14001 EMS is easy to apply to a construction company. As explained by one of the respondents, the establishment of an EMS is fairly simple, contrary to how it may seem. One literally identify your company's specific aspects and impacts; decide how you can mitigate these by taking actions, establish plans to monitor the major impacts; the EMS will indicate long and short term goals, performance will be reviewed and audited; with the end result of the EMS being continuous improvement.

Main focus of the EMS plans currently being used:

- Overall sustainability awareness
- Waste management
- Environmental protection

Based on the above, the respondents are of the opinion that waste management, pollution prevention and overall sustainability awareness are the three actions of their EMS plans that have been the most successfully adopted by the company and its employees at this stage.

[4.1.2 Code of conduct/ value system](#)

All three companies have adopted an internal code of ethics and value system to reflect and encourage sustainable business practices. It has been found that usually the company policy and value system are integral to one another.

The following are some of the core values as described by the respondents' value systems:

- Innovation
- Adaptability
- Honesty
- Integrity
- Trust
- Mutual respect
- Accountability
- Best practice
- People empowerment
- Transformation
- Equality
- Performance & result driven
- Leadership
- Safety

Other than the values listed above, there is a certain manner in which sustainable businesses should strive to conduct their business operations. This is usually captured in a company's code of ethics.

One of the survey respondents stated: "The King Report on Corporate Governance to which all JSE-listed companies should comply with, specifically states that all enterprises should have a 'Code of Ethics' which must embrace all stakeholders. The 'Code of Ethics' of a company should therefore form the basis of its business practices as well as its relationship with shareholders, customers, business partners, employees, suppliers, communities and government."

The three respondents all mentioned that top management leadership and individual employee participation and attitudes are vital to the successful implementation of a code of ethics and a value system.

An extract from one of the sustainability reports from the sample selection companies explains the purpose of their code of ethics: "We want this Code to be

more than a collection of high-sounding statements. It must have practical value in our day-to-day business and each one of us must follow these principles in the spirit as well as the letter.”

Below is a combination of what the three respondent companies have incorporated as a part of their sustainable business conduct or in other words their ‘Code of Ethics’.

Sustainable business principles:

- Generating business through timeous delivery of quality products and services and by building sound client relationships
- Acting in good faith and in the best interests of the company, with application to both external and internal business dealings and working relationships
- Operate within the laws and custom of other countries where business is done
- Declaring any conflicts of interest that may arise, including employment of family members and any business conducted with related parties

Sustainable employee relations:

- Adherence to company Policies and Procedures
- Continued pursuance to the group’s transformation objectives
- Employees to operate within a framework of authority and operating guidelines
- Strict conformance to safety, health, environmental and quality standards
- Investment in the development of employees
- Employee performance to be rewarded
- Professional relationships and respect for one another’s religious, ethnic and cultural backgrounds

Sustainable community ethics:

- Consulting with the communities on matters where business operations may affect them
- Respect for the values, culture and beliefs of the communities in which business operations take place

Sustainable environmental conduct:

- Respect and care for all life (people, animals and plants)
- Educate staff on environmental issues
- Improved protection of soils, water and air against damage caused through business operations
- Environmental rehabilitation wherever possible
- Controlling and monitoring emissions resulting from business operations
- Strict management of waste disposal

All three respondents highlighted the fact that it is imperative that all employees should abide by the company's code of behaviour for it to make a difference and to enable a company to progress towards achievement of its sustainability goals. On a scale of one to ten, the respondents described the employee's current attitudes and change of their values to adapt the companies' sustainable business practices to be in the range of five to seven. The general feeling is that employees are becoming aware that sustainability is forming part of the way that they have to do business. It has been found that it works effectively to appoint a few environmental champions to promote, report and implement sustainable business practices throughout the company.

4.1.3 Efficient resource use (in office environments)

One of the respondents was of the opinion that the use of water in office environments is usually only small quantities and is mainly for domestic use. Therefore, the reasoning that it is unlikely that water usage in offices will be identified as an environmental impact that needs to be monitored in terms of a construction company's EMS plan.

However, the other two respondents mentioned that they are in actual implementing a few strategies to limit their water use in offices, for example:

- Rainwater harvesting to wash employees' cars, water the gardens, etc
- Bottled water are no longer served at meetings, they are using a reverse osmosis water filtration system and serve the filtered water in glasses to employees and visitors
- Preventative and regular maintenance of all water pipes and taps

All three companies have replaced their offices' lights with energy efficient fittings. Timers and light sensors are currently only used at head offices and only in certain areas. There was too little response to make a statement about the energy efficiency of HVAC systems being used.

4.1.4 Recycling policies (office waste management)

One of the respondent companies is currently only recycling paper and they do not have a comprehensive recycling system for other office waste. The other respondents reported that they do have full and comprehensive recycling systems. They separate and recycle materials such as paper, plastic, metal, wood, used oil, printer cartridges, etc.

4.2 Site operations

In general, the contractors that participated in the survey are of an opinion that most of the changes towards sustainable site operations started in 2008. It appears that the major driver that caused the "Big Five" construction companies to adapt and change their site operations to be more sustainable was the media. There are a few possible reasons why 2008 was a significant year for sustainability awareness in South Africa. The CIDB report on GHG emissions in conjunction with the UNEP-SBCI was compiled in 2008; the United Nations Climate Change Summit during 2008 raised construction industry sustainability issues, Eskom power limits emerged and major clients were restricted on their power usage.

Respondents mentioned that the large construction companies no longer have a choice as to whether they will implement sustainable measures or not, it became the way in which business is being done.

The survey response with regards to awareness of environmental regulations and legislation to comply with in South Africa was very broad. Each respondent mentioned different acts or regulations. Respondents mentioned they are aware of the OHS Act (Occupational Health and Safety Act), National Water Act, Green building principles (The green building council's rating system), local by-laws and the environmental practice legislation under the N.E.M.A Act (National Environmental Management Act 1997).

4.2.1 Environmentally aware construction processes & practices

4.2.1.1 Site clearance procedures

Each company has an internal procedure to be followed on all sites if there are no specific client requirements or a project EMP (environmental management plan) or prescribed EIA (environmental impact assessment) stipulations. The procedure generally comprises the following; the removal of top soil, storing of top soil in stockpiles, stockpiles only to prescribed heights, re-used after construction to rehabilitate the site where possible and as part of the landscaping works. The finding was made that even though the contractors put aside the top soil to be re-used, it more often than not turns out that there is not enough top soil and they have to buy and cart in additional soil to fully rehabilitate the site. One of the respondents made an important comment that it is vital to consider and confirm that new and additional top soil needed is bought from reputable suppliers. Where top soil are not to be re-used on the site, one of the contractors mentioned that they have lately been involved in offset programmes where the topsoil are either sold or donated to improve local community circumstances. None of the respondents mentioned anything about illegal dumping of surplus site clearance soils, etc.

4.2.1.2 Off-set programmes

Only two of the contractors taking part in the survey have been involved in off-set programmes on recent projects. It seems like this is still a new concept that has not yet developed to its full potential in South Africa. The one contractor made reference to an off-set programme where the indigenous plants on the site were protected and conserved to the best of their ability. The other respondent mentioned that they have been involved in off-set programmes where they have negotiated with nurseries to store the trees and natural vegetation from their sites on their premises and then it is reinstated on the sites in the landscaping phase.

4.2.1.3 Site rehabilitation

Site rehabilitation should be done in accordance with the project EMP requirements, which is generally a requirement of EIA. The site rehabilitation is dependent on the client's requirements and the intended future use of the site. The client will agree the extent and nature of rehabilitation to be done on the respective site. As a part of ISO

14000 requirements, all three contractors have their own in-house EMP to be followed on sites where there were no EIA done and no EMP exists.

An example of site rehabilitation is where the natural vegetation and indigenous plants that was removed during site clearance procedures are set aside and protected to be re-used for the landscaping, green roof, green wall or other sustainability innovation on the site after construction. The idea is to rehabilitate the site by reinstating the natural habitat that was initially disturbed by the construction operations.

4.2.1.4 Emission control

Only two of the companies are currently measuring and monitoring their carbon footprint. The one company measure and monitor their scope 1 and scope 2 emissions on a monthly basis (i.e. emission reduction limitations, diesel reduction, electricity usage). The other construction company produces an annual carbon footprint where scope 1, 2 and 3 emissions are assessed. This is done through their participation in the CDP (carbon disclosure project). This company's main focus is to introduce initiatives and implement operating procedures that ensure plant and equipment is being operated and maintained in a manner that limits the CO₂ emissions produced.

The company that is not currently monitoring their CO₂ emissions is in the process of implementing a procedure. This respondent raised the fact that the industry can expect the launch of government legislation in 2013 (the Green Paper on GHG Emissions) that will force contractors to report on their emissions. CO₂ reporting also forms part of the requirements to obtain ISO 14000 certification and is one of the aspects and impacts that companies should measure and monitor as part of their EMS.

4.2.1.5 Pollution

All three respondents put a very big emphasis on the importance of pollution and its prevention as a key aspect that forms part of their reporting requirements. Waste management is found to be one of the first steps taken to prevent pollution, especially hazardous waste management. Each company assess and monitor their

pollution streams according to ISO 14001. An aspects and impacts register is kept for land pollution, water pollution, and air pollution through emissions. These are then managed by implementing mitigating measures specific to each pollution aspect and its environmental impact.

If noise is raised as an environmental complaint by the public community or employees, it will be dealt with as one of the aspects of the EMP, but usually noise (and noise pollution) is a health and safety issue rather than an environmental one.

The training of employees that temporarily stay on sites is another measure taken to prevent pollution. Site workers are trained in terms of the very basics of maintaining the site in an environmentally friendly way. Chemical toilets are provided where no ablution services exist on the site. Littering by the workers can become a problem, and is generally prohibited when sustainability or environmental induction is done. Workers are also prohibited to make any fires on the construction sites.

4.2.2 Natural resource use (on construction sites)

All three of the respondents have policies to reduce the use of natural resources during site operations. The policies they have established are in accordance with their EMS procedures and the carbon footprint initiatives they partake in. The use of natural resources on sites is also dependant on a project's specific EMP requirements. Below are examples of how the three contractors manage natural resource use on construction sites:

4.2.2.1 Water

- Rainwater harvesting (not for potable water use, but for various uses in construction operations), only two respondents make use of rainwater harvesting
- Recycled water used for dust suppression (i.e. water used to wash trucks is collected and the sediment contents are allowed to settle, where after the recycled clean water will be re-used for site operations such as dust suppression)
- Use chemical toilets for site workers (reputable suppliers used)

- Water metering (one of the sustainability indicators, very difficult to monitor due to often having one water point that is being used by different parties)
- Water run-off is controlled

4.2.2.2 Materials

- Only one respondent specifically stated that they source aggregates from a lawful vendor. The others reasoned that it is not so much the sources, but rather the waste and cradle to grave concept that they focus on
- Off loading and storage is done at laydown areas under control of a manager
- There is a guiding procedure for operations such as material handling, storage, transportation, etc. to be used on all sites
- All subcontractors are being audited against ISO 140001

4.2.2.3 Energy

- Fuel consumption gets metered (this is easier to measure and monitor, because it is an internal company expense and the fuel usage can be linked to cost)
- Energy consumption is monitored and controlled to operate at maximum efficiency levels as per ISO 14001 and as per the carbon footprint reporting requirements
- One of the respondents said that they use generators on most sites, especially on remote sites; this is an aspect that needs careful attention due to the air pollution caused
- Equipment, tools and machinery are serviced on a regular basis and monitored to ensure efficient operation

4.2.3 Construction waste

Two of the respondents were of the opinion that it is becoming a common practice for contractors to re-use material waste by adding it to raw materials as recycled components. The other respondent felt that this is not becoming common practice.

When asking the question “which construction materials generally account for the most waste on sites?” the response were diverse and did not provide a conclusive answer. All three respondents mentioned different materials. The materials named

by the respondents were concrete, steel and wood. One of the respondents stated that he thinks it can be said that 'builder's rubble' is what the bulk of construction waste consist of.

Construction waste separation receives great attention and is part of the site operations of two of the responding companies. Construction waste are said to be separated into different waste skips that gets disposed in the most environmental friendly manner. The different skips are a hazardous waste skip that gets collected and disposed by certified organisations, a general scrap metal skip that is usually sold to a scrap metal dealer, timber wastes are reused, and domestic waste is removed through municipal waste disposal. The contractors aim to re-use or recycle as many of the waste as possible and then only the remaining materials get dumped at landfill sites.

The use of landfill sites in South Africa has become very expensive and contractors are taxed for their disposal of waste at landfill sites. The contractors pay per weight for landfill waste dumping, so the heavier the waste is that they dump, the more expensive it becomes. It is therefore important to train site workers on the importance of accurate waste separation. If steel and other materials that could have been recycled or re-used is not separated from the builder's rubble that will be dumped at landfills it is more expensive for contractors. Construction waste management is probably one of the environmental sustainability aspects that get the most attention at this stage.

All three companies arrived at the same outcome that their plan to reduce construction waste is to reduce, re-use and recycle where and whatever possible.

[4.2.4 Demolition waste & deconstruction](#)

The same principles that apply for construction waste also apply to demolition waste. One of the ways in which demolition waste can be reduced, re-used and recycled is through the process of deconstruction. The survey indicated that the practice of deconstruction might still be very rare in South Africa, as not one of the companies that were interviewed has been actively involved in deconstruction. One of the only responses was that if asbestos would be present in the existing building,

it will be removed prior to demolition. All three respondents agreed that they think deconstruction is the more sustainable option and should be used rather than demolition where possible. However, they also mentioned that it is the client's directive whether demolition or deconstruction will take place. It seems that the time constraint involved with the deconstruction process will leave the client with demolition as the way to go.

4.3 General findings

In general it was found that one of the main drivers behind the changes made towards sustainability is current procurement requirements. Lately, when tendering for projects for major clients, the environmental rating for the tender adjudication counts as much as 15% of the tender scores. It comes down to the fact that sustainability has become an integral part of how major South African contractors are doing business. As one of the respondents said; "well, we are left with no choice, it has become the way in which we do business".

It seems as though the larger construction companies will not get new work if they do not adapt to be more sustainable in their operations and business as a whole. ISO 14000 certification is receiving great attention in the South African construction industry. More and more of the large construction companies in South Africa is expected to get certified in the near future. ISO 14000 certification has become an industry trend and the international standard is well known and accepted in South Africa.

It was noted that the JSE listed companies are more likely to adapt to sustainable thinking as they are exposed to the media, investors' eyes are fixed on their every move and the JSE – SRI also puts pressure on the companies to report on their business operations.

Top management commitment plays a vital role in the successful transformation of a construction company to be more and more sustainable. The mind set of all employees begin to change when they realise that they don't have a choice because management is serious about it. Training of employees can also improve attitudes as it will help them to understand the bigger picture and why it is so important that

sustainability should become a lifestyle and not just something they have to do. When sustainability becomes part of the daily operations in a company, there will be more awareness and therefore more actions will be taken.

Chapter 5: Conclusion

“The signals are there for anyone to see. We have to change our society to protect the planet for future generations”. (SKANSKA, 2009:i)

This study was conducted with the aim of establishing what and if any changes have been made by the leading South African contractors to be more sustainable. The framework for the study was based on two of the proposed elements in the A21SCDC, namely, internal housekeeping and site operations. Relevant literature was studied from a global perspective by looking at what contractors are doing in other parts of the world. The literature was reviewed as a background setting of the sustainability actions taken within the overall construction industry in comparison to the data collected from the South African contractors.

The “Big Five” South African construction companies were approached, namely, Aveng Grinaker LTA, Group Five, Murray & Roberts, Stefanutti Stocks and WBHO. Only three of the companies responded successfully.

5.1 Research question & findings:

The main question this study aimed to answer is whether South African contractors have achieved some of the A21SCDC actions towards sustainability.

It was found that the three responding contractors have implemented many changes over the last ten years, especially since 2008. It seems as though the leading South African contractors are making progress towards achieving the selected A21SCDC actions for sustainability.

5.1.1 Sub-question 1:

The first sub-question aimed to answer whether South African contractors have adopted sustainable internal housekeeping actions in terms of A21SCDC.

This study considered the contractor’s internal housekeeping by collecting data on their strategic organisational plans, value systems and business conduct, efficient

use of resources in office environments and their recycling policies to manage office waste. It was found that all three respondents have implemented at least some changes in these areas of their businesses. There are still scope for improvement, but the contractors are making progress in achieving the A21SCDC proposed actions for internal housekeeping. The results obtained from the data showed a major awareness of the organisational sustainability requirements. A big emphasis was seen on the drafting and implementation of EMS plans as well as the aim to be ISO 14000 compliant. There are still much to be done to reduce the use of energy and water. At this stage the main change was that of energy efficient lighting. Office waste recycling seems to be at an early stage with paper recycling being the only effective component at this stage. Value systems are strongly encouraged by top management, but it might still take some time for adoption by all other employees.

5.1.2 Sub-question 2:

The second sub-question aims to answer whether South African contractors have adopted A21SCDC sustainable principles through site operations.

This study found that the respondents are definitely making changes to the way their site operations are conducted. There are numerous environmentally aware construction practices and processes that the respondents have been implemented or experimenting with on projects. Some of these are dependant on client requirements and project EMP's. All three respondents have their own site operation policies that applies to all projects (subject/ in addition to client requirements). Natural resource use is found to be a difficult aspect to monitor and control on sites due to the many stakeholders involved and a lack of knowledge of workers. It was found that currently construction waste management is the key focus of all three companies' sustainability plans. Although employee training and capacity building were not part of the actions studied, it appeared to also be two key focus areas for all three companies. It was found that the contractors are very rarely involved in deconstruction, and this seems to be an area to be considered for future progress.

5.2 The way forward:

The construction industry in South Africa still has a long way to go before it will be seen as a contributor to a sustainable future. However, the construction industry

poses great opportunities for improvement and there are solutions to many of the negative environmental impacts made.

There are many possibilities for future research in the subject of sustainability and the construction industry. The suggestions below are future research subjects that emerged out of this particular study:

- The progress made by more and other types (smaller) contractors in South Africa using the same framework for proposed A21SCDC actions that this study considered.
- An integrative research project can be launched to determine whether South Africa currently finds itself to be in line with the A21SCDC as a whole, and what the major barriers are.
- The A21SCDC holds a multitude of research possibilities. Each of the other elements and their proposed actions can be studied. (Capacity building, access to funding, partnerships and cooperation, monitoring and evaluation).
- It was found that the elements and their proposed A21SCDC actions chosen for this study (internal housekeeping and encouraging and supporting implementation) are broad enough research fields to be studied on their own. Some of the proposed actions under these two elements are broad enough for being a single research subject. In this study the actions were only briefly looked at, there is still a big scope of work to be researched in the specific actions of this study.
- Future researchers should note that the A21SCDC considered other industry stakeholders for which actions were also proposed. These are the research and education sector, the other private sector and utility companies, the industry clients and government and regulatory stakeholders.
- Legislation in South Africa that drives sustainable construction can be an interesting area of research in the coming years.

In conclusion, we have a long way to go, but a major awareness is rising towards sustainability as the new way to do construction and to conduct business in the South African construction industry. Refer to table 3 for a summary of the conclusion of this study in terms of table 2 that was used as the research framework.

A21SCDC STRATEGY FOR ACTION		RESEARCH CONCLUSION
STRATEGY ELEMENTS	PROPOSED ACTIONS FOR CONTRACTORS (Private sector and utility companies)	A21SCDC SELECTED ACTIONS (Literature study and "Big 5" contractors' data)
Capacity building	Enabling continued organisational learning Supporting external capacity development	<i>Future research opportunities</i>
Access to funding	Funding for research and development for internal organisational benefit Funding for research for the common good through corporate social responsibility budget contributions	<i>Future research opportunities</i>
Partnerships and cooperation	Supporting the implementation of the A21SCDC research and development agenda Forming partnerships with research organisations Participating in industry coalitions for funding of research projects and developing enabling mechanisms for effective research	<i>Future research opportunities</i>
Internal housekeeping	Risk assessment of non-compliance with internal housekeeping regulations, and assessment of the benefits of compliance Establishing internal strategic organisational plans suitable for the construction industry Organisational value changes Improving resource efficiency Reducing organisational impacts and resource consumption	<i>Future research opportunity</i> <i>The ISO 14001 EMS plan was studied in detail and it was found that all three respondents implemented an ISO 14001 compliant EMS plan</i> <i>Sustainable organisational value changes are found to be seen as important by top level management, but the other employees are not adopting all the values as yet</i> <i>Efficient resource use in office environments reflected the changes made to energy efficient lighting. Other actions are still to be taken to reduce energy and water usage</i> <i>The respondents' recycling systems were considered. Currently the only office waste being recycled is printing paper</i>
Encouraging and supporting implementation	Making use of new technologies and processes Creating a market demand Assist and mentor emerging market niches	<i>Contractors have implemented various environmentally aware construction site operations (like site clearance and rehabilitation, stormwater control, emissions controls, etc.) It seems as though the leading contractors are starting to create a demand for sustainable and recycled building materials, efficient resource policies and environmentally aware subcontractors. Construction waste management is the major focus of all three respondents in encouraging and supporting sustainability implementation on sites.</i> <i>Future research opportunity</i>
Monitoring and evaluation	Adopting corporate social responsibility reporting systems Participating in certification schemes Capturing and collecting information for monitoring and assessment of organisational impacts	<i>Future research opportunities</i>

Table 3: A21SCDC Strategy for action - Research conclusion (Du Plessis, et.al. 2002:72)

Bibliography

Ahn, C. et al. 2010. *Toward Environmentally Sustainable Construction Processes: The US and Canada's Perspective on Energy Consumption and GHG/CAP Emissions*, Sustainability, open access ISSN 2071-1050, www.mdpi.com/journal/Sustainability, accessed April 2012.

Airaksinen, M. et al. 2010. *Carbon Efficient Building Solutions*, Sustainability, open access ISSN 2071-1050, www.mdpi.com/journal/sustainability, accessed April 2012.

Asvat, N. 2009. *Practical Electricity Saving Tips*, SAICA, <http://www.Sustainabilitysa.org>, accessed 27 July 2012.

Balfour Beatty plc, 2009. *Balfour Beatty Code of Conduct*, Radley Yeldar, London, [www.pbworld.com/pdfs/other/Balfour Beatty Code of Conduct.pdf](http://www.pbworld.com/pdfs/other/Balfour_Beatty_Code_of_Conduct.pdf), accessed September 2012.

Booyesen, W.J. 2012. Personal conversation on 8 October 2012, Pretoria.

Cole, R.J. 2010. Building Environmental assessment methods: assessing construction practices, *Construction Management and Economics*, Issue 18:8, 949-957, <http://dx.doi.org/10.1080/014461900446902> accessed June 2012.

Couto, J.P. et al. 2010. *Analysis of Barriers and the Potential for Exploration of Deconstruction Techniques in Portuguese Construction sites*, Sustainability, open access ISSN 2071-1050, www.mdpi.com/journal/sustainability accessed June 2012.

CSIR Natural Resources and the Environment, 2011. *Annual Research Report*, <http://www.csir.co.za/nre/docs/NRE%20RESEARCH%20REPORT%202011%20low%20res%202.pdf>, accessed May 2012.

Department of Environmental Affairs of South Africa, 2011. National Strategy for Sustainable Development: *The ecological dimension Discussions in the context of*

Rio + 20 deliberations "The Future We Want", Mapungupwe Conference (Presentation reference 120423). <http://www.fes-southafrica.org/media/120423%20%20Rio%202020%20for%20Mapungupwe%20Conf.pdf>, accessed June 2012.

Du Plessis, C. et al. 2002. *Agenda 21 for Sustainable Development in Developing Countries*, Pretoria: CIB/UNEP, www.sustainablesettlement.co.za/policy, accessed March 2012.

Du Plessis, C. 2006. *Thinking about the day after tomorrow. New perspectives on sustainable building*, CSIR Built Environment, conference paper, Rethinking Sustainable Construction Conference, Sarasota, Florida, USA. http://researchspace.csir.co.za/dspace/bitstream/10204/956/1/Du%20plessis_2006_D.pdf, accessed March 2012

Du Plessis, C. 2012. Personal conversation on 24 October 2012, Pretoria.

(EPA) United States Environmental Protection Agency, 2011. *What you can do at the office*, Climate Science Research Group, <http://www.epa.gov/climatechange/wycd/office.html>, accessed 3 September 2012.

Finnish Environment Institute, 2011. *Water Resource Management: Exploitation often subject to permits*. <http://www.ymparisto.fi/default.asp?node=4077&lan=en>, accessed September 2012.

Gasparatos, A. et al. 2008. *A critical review of reductionist approaches for assessing the progress towards sustainability*, Environmental Impact Assessment Review 28, Elsevier.

Hagen, K. 2005. *Deconstruction as an Alternative to Demolition – Helping the Environment, Creating Jobs, and Saving Resources*, <http://voices.yahoo.com/deconstruction-as-alternative-demolition-12250.html?cat=30>, accessed 31 October 2012.

Hawken, P., Lovins, A and Lovins, L.H. (1999) *Natural Capitalism*. Snowmass, CO: Rocky Mountain Institute.

Hurley, J. Hobbs, G. 2004. *TG39 - UK Country report on deconstruction*, CIB Publication, Report 9, Rotterdam, The Netherlands.

Joseph, P., McNally, S.T. 2010. Sustainable non metallic building materials, *Sustainability*, 2, 400-427, open access ISSN 2071-1050, www.mdpi.com/journal/sustainability, accessed April 2012.

Leape, J. et al. 2012. *Living Planet Report 2012: Summary*, WWF International, Switzerland, http://awsassets.panda.org/downloads/lpr_2012_rio_summary_booklet_final_120509.pdf, accessed November 2012.

Leijnieks, C. 2009. *How to recycle at the office – Green offices raise the bar on office recycling*, Yahoo! Contributor Network, <http://voices.yahoo.com/how-recycle-office-2981211.html>, accessed 20 August 2012.

Lombard, L.P. 2007. A review on buildings energy consumption information, *Energy and Buildings*, Volume 40, Issue 3, 2007, p394-398, <http://0-dx.doi.org.innopac.up.ac.za/10.1016/j.enbuild.2007.03.007>, accessed May 2012.

Malesev, M. et al. 2010. *Recycled concrete as aggregate for Structural Concrete Production*, *Sustainability*, open access ISSN 2071-1050, www.mdpi.com/journal/Sustainability, accessed April 2012.

McDonough, W. (2004) 'All Sustainability is Local: A Global Strategy.' Keynote paper, *Sustainable Resources Conference*, 30 September 2004, Boulder Colorado.

Millennium Development Goals Report, 2011. *Assessing Progress in Africa toward the Millennium Development Goals: Section II tracking progress*. <http://web.undp.org/africa/mdg/report.pdf>, accessed October 2012.

NBBC (New Belgium Brewery Company Inc.), 2011. *Sustainability Management System, 2011 edition*, <http://www.newbelgium.com/Files/SMS%204th%20edition>,

[%202011%20for%20external%20release.pdf](#), accessed 5 October 2012.

Pun, K.F. et al. 2001. *An EMS approach to environmentally-friendly construction operations*, The TQM Magazine, Volume 13, Issue 2, p112 – 119, <http://dx.doi.org/10.1108/09544780110366024>, accessed June 2012.

Raymond, Y.C. 2001. *The implementation of EMS in construction firms: Case study in Hong Kong*, Journal of Environmental Assessment Policy and Management Volume 3, No. 2, June 2001, p 177–194, Imperial College Press, Hong Kong

Recyclemore, 2010. Repak Ireland Initiative, *Recycling Systems at Work*, <http://www.recyclemore.ie/recycle-at-work/recycling-system>, accessed 27 August 2012.

Singh, R.K. et al. 2011. *An overview of sustainability assessment methodologies*, Ecological Indicators, Volume 15, Issue 1, April 2012, p 281-299, Elsevier

SKANSKA, 2009. Skanska's Green Initiative, *Green thinking: there's more to building a green society than just building*, Lowe Brindfors, Ekotryck Redners, Stockholm. http://www.skanska.com/upload/About%20Skanska/Our_Green_Initiative/Green_thinking_book.pdf, accessed November 2012.

Söderholm, P. 2011. Taxing virgin natural resources: Lessons from aggregates taxation in Europe. *Resources, Conservation and Recycling*. Issue 55: p.911-922. <http://www.hallbaravfallshantering.se/download/18.7df4c4e812d2da6a41680004968/NaturalResourcesTax.pdf>, accessed August 2012.

Turner, R.K. and Pearce, D.W. (1993) "Sustainable economic development: economic and ethical principles." In Barbier, E. (ed), *Economics and Ecology: New Frontiers and Sustainable Development*. London: Chapman & Hall.

UN, 2001. Indicators of sustainable development: guidelines for methodologies, New York: United Nations Department of Economic and Social Affairs, Division for Sustainable development, <http://www.un.org/esa/sustdev/publications/indisd-mg2001>.

UNEP-SBCI, CIDB, 2009. Greenhouse Gas emission baselines and reduction potentials from buildings in South Africa, http://www.cidb.org.za/Documents/KC/cidb_Publications/Ind_Reps_Other/cidb_UNEP_SBCI_SA_Report_GHG_Buildings_Discussion_Document.pdf, accessed 25 October 2012.

UNEP-SBCI, 2012. Environment Programme, Why Buildings?, <http://www.unep.org/sbci/AboutSBCI/Background.asp>, accessed 2 September 2012.

Whitaker, S. 2012. Personal conversation on 12 July 2012, Johannesburg.

WCED, World Commission on Environment and Development, 1987. Brundlandt Report, *Our Common Future*, Oxford university Press, New York. http://www.regjeringen.no/upload/SMK/Vedlegg/Taler%20og%20artikler%20av%20tidligere%20statsministre/Gro%20Harlem%20Brundtland/1987/Address_at_Eighth_WCED_Meeting.pdf, accessed 29 October 2012.

Zhang, Z.H. 2000. A framework for implementing ISO 14000 in construction. *Environmental Management and Health*, Volume 11, Issue 2, p139-149, <http://dx.doi.org/10.1108/09566160010321541>, accessed July 2012.

Annexures

Annexure A - Reasons why office waste should be recycled

Annexure B - Recycling policies in office environments

Annexure C - Questionnaire template

Annexure A - Reasons why office waste should be recycled

OFFICE WASTE	INFORMATION & REASONS FOR RECYCLING
Paper and cardboard	Manufacturing recycled paper instead of new paper from virgin wood pulp, uses 54% less energy and 58% less water
	Each tonne of recycled paper saves 17 trees, 1700 litres of oil, three cubic metres landfill space, 4000 kilowatts energy and 31800 litres of water
	Paper products use up to 35% of the world's annual commercial wood harvest
	One tree filters about 25 kilograms of pollutants from the air each year
	For an office with 1000 employees, each person uses approximately 10000 sheets of paper per year, enough to stretch nearly 3200 kilometres and to create a pile of 500 metres high
Plastic	Plastic is made from crude oil which is a valuable and limited non-renewable resource
	Recycling plastic saves two thirds of the energy required to initially produce plastic from raw materials
	Every plastic bag takes up to 500 years before it will naturally break down
	27 Recycled soft drink bottles can be recycled into one fleece jacket
	One tonne of plastic is equivalent to 20,000 two litre beverage bottles or 120,000 carrier bags
	Manufacturers who once packaged their goods in glass have changed to plastics packaging for a variety of reasons <ul style="list-style-type: none"> • Lower Cost • Improved storage - clear glass allows goods such as milk to be adversely affected by sun light, losing vitamin value • Safety - plastic packaging is less hazardous if dropped
Metal	Using recycled metal in the manufacturing of new metal, results in a 75% energy saving
Aluminium (Food cans, beverage cans, foil containers, etc.)	Aluminium is made from bauxite ore, a non-renewable resource
	Recycling aluminium saves 95% of the energy required to produce aluminium from raw materials
	Steel and aluminium cans can be differentiated by using a magnet. Aluminium cans are not magnetic, but steel cans are
	Used aluminium cans can be recycled and returned to a store shelf as a new can in only 60 days
	It takes 670 recycled aluminium cans to make one bicycle
	Recycling one aluminium can conserves enough energy to run a television for 3 hours
	Aluminium never wears out, it can be recycled forever
Steel (cans, etc.)	Steel can be recycled indefinitely without any loss of material quality
	Tin cans can be recycled to make new tin cans, car parts and keys
	Steel is the most energy efficient metal used in can production, requiring only 50% of the energy needed to make a comparable aluminium can
	Steel is easy to extract from a domestic waste stream due to its magnetic properties
	Every tonne of recycled steel saves 1.5 tonnes of iron ore, half a tonne of coal and requires 40% less water than primary steel production
Glass	Glass can be recycled repeatedly
	Recycling 1 glass jar saves enough energy to power a small light bulb for nearly 1 hour or run a television for 15 minutes
	Glass cullet (crushed and sorted used glass) can be recycled into new glass jars and bottles; and it can be used in materials such as concrete, fibreglass, ceramic tiles, picture frames and in road construction as part of roadbed layers
	Using recycled glass requires 40% less energy than making glass from new raw materials
	Glass should be sorted by colour; clear, green or brown. (Once glass has been coloured the colour cannot be removed)
	Manufacturers package foods and beverages in green or amber coloured glass to protect sensitive products from degrading in sun light
	Unfortunately, you cannot recycle all glass products together. Light bulbs, ceramics, glass mirrors, window glass, and glass Pyrex dishes are different types of glass and should not be mixed in with traditional glass packaging
Fluorescent tubes	Energy efficient light bulbs are a type of fluorescent lamp and can be recycled (incandescent bulbs are not recyclable)

Annexure A is compiled according to guidelines published by Recyclemore (2010).

Annexure B – Recycling policies in office environments

WHAT TO RECYCLE:		HOW TO RECYCLE:	RECYCLE INITIATIVE IN SA:
Paper	General printing paper	Print on both sides then place in recycling bin, note that staples should be removed from documents prior to recycling	Paper Recycling Association of South Africa (Prasa), Mondi Recycling, Nampak Recycling, Sappi Refibre, etc
		Use blank back-sides for taking notes or scrap paper for personal use, thereafter recycle in bins	Not applicable - Done individually by employees
		Note that most recycling organisations prefer plain and colour paper to be recycled in separate bins	Not applicable - Done individually by employees
		Make scratch pads by gluing together paper used on one side	Scratch pads can be made internally by employees, or as a job creation initiative
	Envelopes	Re-use for non-confidential information	Individually by employees
	Construction drawings	Don't print or issue hard copies unnecessarily, rather use electronic drawings where possible	Individually by employees and construction consultants involved
	Newspapers & magazines	Place in recycling bin when outdated	Same as paper initiatives above
Donate to pre-primary schools for kids to use in class activities to cut and paste etc.		Initiated by office individuals in connection with principals of schools	
Cardboard	Packaging boxes	Works on the same basis as paper recycling. Clean cardboard packaging is collected and recycled	Same as paper initiatives above
Plastic	Plastic containers	Juice, milk, water and other bottles should be washed, dried and placed in plastic recycling bin	PET Plastic Recycling South Africa (PETCO), Plastics Federation of SA, Extrupet, Buyisa-e-Bag, South African Plastics Recycling Organisation, etc
		Best practice is to remove paper labels prior to recycling	By tea lady responsible to wash and recycle the containers
		Individual plastic water bottles should not be served at meetings or to employees, rather use glass water mug with glasses	By tea lady and person responsible for beverage supply
		Bottle tops and bread tags	Interwaste tops and tags initiative
	Coffee mugs	Employees can take re-usable glass mugs to cafeteria to buy coffee in stead of using the plastic/polystyrene mugs	Individual employees
Glass	Bottles	Wash, dry, place in glass container	The Glass recycling company
Metal	Cans	Wash and dry empty food and drink cans	Collect-a-Can, Resolution Recycling
Stationary	Pens	Use pens that take ink refills	By internal stationary manager
Electronics	Old computers	Trade in programs	Waste Plan, e-Waste Association of SA (EWASA)
		Donate to schools and needy communities or other educational institutions	Municipal tax incentives
Furniture	Old chairs and tables	When doing office refurbishments, office managers can consider re-using the old furniture and just upgrading it, or donating to charity organisations	Internal decision by CEO/executives
Printer cartridges		Return to supplier when empty for a small credit towards next purchase	Resolution Recycling, pikitup, Active enviro, Lexmark, Toner town
		Recycle	
		Buy recycled (refilled) printer cartridges	

Annexure B is a summary of information provided by (Recyclemore, 2010), (CalRecycle, 2012), (EPA, 2011), (Leijnieks, 2009). **Note: The National Recycling Forum (website: <http://www.recycling.co.za/>) provides comprehensive guidelines for South African companies and individuals on how to set up a recycling system in SA.**

Annexure C – Questionnaire template

Riané Reyneke (28069260) - Research Project

UNIVERSITY OF PRETORIA

Achievement of selected A21SCDC actions for sustainability by SA contractors - A review (2002 - 2012)

Questionnaires

<u>GENERAL</u>	<u>Date:</u> _____
a) <u>Construction Company:</u>	_____
b) <u>Details of respondent:</u>	
Name:	_____
Position of employment:	_____
Sustainability involvement in company:	_____
W:	_____
Email address:	_____
NOTE: All respondents to sign confidentiality and subject recognition statements	

The above is for record purposes only. Data will be treated confidentially and the identity of the company and respondent will be protected in publication of the results.

Sign below to acknowledge confidentiality statement and grant permission that the data herein provided may be used in fulfilment of a research project for an honours degree in Quantity Surveying at the University of Pretoria.

Respondent

Riane Reyneke (Student)

1 INTERNAL HOUSEKEEPING

1.1 In-house strategic plan

1.11 Does your company have an in-house action plan for sustainability?

YES	NO
-----	----

1.12 When was the sustainability plan implemented? _____

1.13 Why did your company prepare an in-house plan for sustainability? (Main driver) _____

1.14 Give a brief overview of what the plan entails: _____

1.15 Guidelines for discussion:

a) ISO 14001 EMS _____

b) ISO 14000 certification _____

c) Main focus of plan _____

d) Environmental components _____

Economic components

e) (money & quality) _____

Social components

f) (Health, Safety & Community) _____

1.16 Which actions of the in-house plan have been adopted most successfully in your day-to-day business practices?

1.2 Code of Conduct/ Value System

Did your company adopt an internal code of ethics to reflect values required to achieve sustainable business practices?

YES	NO
-----	----

In your opinion, what are your organisation's ethics and values in an attempt to have more sustainable business practices?

On a scale of 1 to ten, how would you describe the employee's attitudes and the change in their values w.r.t. sustainable business practices? (1=poor, 10=very good)

Elaborate on 1.23 by giving a few examples

What are your sustainability goals/objectives on organisational level?

1.3 Efficient Resource Use

What actions are being implemented to use natural resources more efficiently in your company's office environments? (Specifically looking at water)

Guidelines for discussion:

Meetings: (plastic) bottled water served? OR:

a) Make use of Glass water jugs with glasses?

Plastic water filters for employee's use? OR
b) water available in glass water jugs?

Plastic water filters for employee's use? OR
c) water available in glass jugs?

d) Consumer habits and individual participation

What actions are being implemented to make the company's office buildings more energy efficient? (Specifically looking at: HVAC, lighting, generators, etc.)

1.34 **Guidelines for discussion:**

- a) Consumer habits and individual participation _____

1.4 Recycling Policies (Waste Management)

1.41 What recycling initiatives do your company's offices participate in? _____

1.42 **Guidelines for discussion:**

- a) Paper _____
- b) Printer cartridges _____
- Employee participation (recycling of household waste at offices) _____
- c) _____
- d) Plastic _____
- e) Canteens: Waste food _____
- f) Canteens: Cooking oil disposal _____
- g) Name external organisations being used _____
- h) Employee awareness & attitudes _____
- i) Practical examples of implementation _____

2 SITE OPERATIONS

2.1 Environmentally Aware Construction Processes & Practices

2.11 Site Clearance Procedures _____

Guidelines for discussion: (Top soil - dumped / re-used / sold to be re-used)

2.12 Involvement in offset programs _____

Guidelines for discussion: (Indigenous plants, trees, site vegetation = sold & replanted elsewhere)

2.13 Site Rehabilitation Practices _____

Guidelines for discussion: (Indigenous plant conservation, plants and natural vegetation set aside during site clearance and re-used for landscaping, on green roofs, etc.)

2.14 Reduction of CO2 emissions on sites _____

Guidelines for discussion: (Plant & tool operations, etc)

2.15 Pollution _____

Guidelines for discussion: (Noise, dust, workers littering, hazardous waste management, etc)

2.16 What other changes has your company made over the last ten years to establish environmentally aware construction processes & practices?

Are you aware of any legislation regarding environmental aware construction processes & practices in SA?
2.17 Please state which legislation you are aware of and/or currently complying to.

2.2 Natural Resource Use

2.21 Does your company have policies to reduce natural resource use during site operations?

YES	NO
-----	----

Describe actions taken _____

2.22 Briefly describe how natural resource waste management are being done during site operations?

2.23 **Guidelines for discussion:**

a) WATER (rainwater harvesting, metering, etc) _____

b) MATERIALS (Off-loading, storage, efficient use, aggregate sources, etc) _____

c) ENERGY (lights on site, generators, tool and plant fuel consumption, etc) _____

2.3 Construction Waste

Is it in your opinion becoming a common practice for contractors to re-use material waste by adding it to raw materials as recycled components?

YES	NO
-----	----

2.32 Which materials generally account for the most waste on sites? _____

2.33 How is construction waste being disposed of? _____

2.34 Explain the use of landfill sites (cost, process, tax, etc.) _____

2.35 What is your company's plan/ procedure to reduce construction waste on sites? _____
