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Carbon Footprint Management Systems in South Africa

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Carbon Footprint Management Systems in South Africa

Kent Diepraam

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

Johannesburg, 2010

ABSTRACT

South Africa is not mandated by the Kyoto Protocol to respond to the implications of climate change. The purpose of this research is to gain an understanding of why and how South African organisations are voluntary responding.

This research conducted structured telephonic interviews for the collecting of cross-sectional data. The data were then analysed through exploratory factor analysis and a Kruskal-Wallis significance test.

The results from the normative survey design indicate that organisations are creating Carbon Footprint Management Systems in an attempt to mitigate strategic risks, in anticipation of future regulation and financial gains, and due to an increase in overall environmental innovation and importance. The elements contained within these systems include risk assessment tools, reporting mechanisms and platforms, and long-term strategic interventions.

DECLARATION

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

Kent Diepraam

Signed at ……

On the …….. day of …… 2010

DEDICATION

Life is a continuous journey. This is dedicated to all those who have shaped the person I am today.

ACKNOWLEDGEMENTS

I would like to thank the following people and organisations for making this research possible:

- My supervisor, Anthony Stacey, for all the valuable contribution and direction;
- To Research International South Africa for conducting the interviews, and in particular Elrina Calitz the Field Director, for the precious guidance and support in co-ordinating the interviews;
- The participating organisations, for the time and insight into your motivations; and
- To my significant other, for all the unconditional love, understanding and encouragement.

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CHAPTER 1: INTRODUCTION

> "Given the current globalising world economy, it would not be economically, socially, environmentally or politically sustainable for South Africa to continue to grow along a 'business-as-usual' path, without a carbon constraint" Van Schalkwyk (2007:3), South African Minister of Environmental Affairs and Tourism at the launch of the South African Carbon Disclosure Report.

1.1 Purpose of the research

An environmental development is the voluntary abatement strategies of organisations whereby commitments to improve environmental performance are achieved that is beyond government regulation (Lyon and Maxwell 2002). It is argued that research needs to understand organisations' motivation for the creation of such programmes for further advancement (Koehler 2007).

As South Africa is not mandated by international treaty to respond to the implications of climate change, the purpose of this research was to gain an understanding of why and how South African organisations are strategically responding. This was done by analysing organisational behaviour in relation to Carbon Footprint Management Systems.

1.2 Context of the research

There is a consensus that climate change has increased in importance across all levels within organisations (Hunt and Auster 1990; Porter 1991). The United Nations Intergovernmental Panel on Climate Change (IPCC) declared that some degree of climate change is inevitable in the 21st century despite all international attempts at curbing greenhouse gas (GHG) emissions (IPCC 2001). This eventuality has led to a plethora of interest in current and future organisations' adaptation to climate change (Dlugolecki and Loster 2003; Kolk and Pinkse 2004).

Van der Merwe (2007a) confirms that climate change is now a genuine concern for organisations and is explained by the prominence on the agendas of South African politicians and regulators. South Africa has been placed in the Annex II under the Kyoto Protocol and as a result, the author explains that these countries are not legally mandated to any specific emission reduction targets by reducing organisational carbon footprints. Additionally, it has been argued that the Kyoto Protocol has forced organisations to acknowledge potential climate change risks (Grubb, Vrolijk and Brack 1999; Packard and Reinhardt 2001).

Further, Van der Merwe (2007a) elaborates that due to South Africa having the largest GHG emissions in Africa, along with holding the current custodianship of the World Summit on Sustainable Development, there is growing moral pressure for a comprehensive climate change response to be developed. Mingay (2008) adds that South African industry will be obliged to act on the effects of climate change due to increased pressure from global markets. Recent global climate developments have lead to carbon management being regarded as a key lever impacting organisation performance (Van der Merwe 2008). This can be achieved by management's voluntary disclosure on carbon strategies, their management systems thereof, and the organisation's GHG emissions performance.

1.3 Problem statement

1.3.1 *Main problem*

The main problem is to identify the reasons for implementation of Carbon Footprint Management Systems in South Africa. Additionally, the research attempts to describe elements of current Carbon Footprint Management Systems.

1.3.2 *Sub-problems*

The first sub-problem is to identify the reasons for implementation of Carbon Footprint Management Systems in South Africa.

The second sub-problem is to describe elements of current Carbon Footprint Management Systems in South Africa.

1.4 Significance of the research

The study fills a gap. There has been extensive debate on calculating, explaining reasons for, and reducing the carbon footprints of organisations (Muller 2007; Brown, Southworth and Sarzynski 2008), and measuring subsequent financial performance (King and Lenox 2001; Schaltegger and Synnestvedt 2002; Clemens 2006) with less focus on the strategic aspects around the organisation's efforts.

Van der Merwe (2007b) explains that organisations' environmental investments have long-term impacts on both organisation and environment, and predicts that organisations' strategies will increasingly include carbon emission abatement policy and management dynamics as environmental concerns increase. Mingay (2009) asserts that organisations should now be constructing Carbon Footprint Management Systems as pressure will soon emanate from supply chains for transparency regarding their GHG emissions. Darnall, Henriques and Sadorsky (2008) contend that research has failed to measure the comprehensiveness of these environmental management programmes within organisations.

In researching management principles of carbon footprints in the South African context, no published academic literature or case studies were found. However, Mingay (2008) believes that the Eskom power disruptions early in 2008 were a catalyst for many organisations to at least start investigating energy efficient practices and processes.

The results of this research provide an initial insight into South African environmental management practices of organisations that have not been selected for the Carbon Disclosure Project (CDP) Report for South Africa in

2008. This research report is not a duplicate of the CDP regarding GHG measurements, rather, the focus is isolated to the creation and management of carbon footprints in organisations.

The findings of this report aid in matching to the South African government's awareness that if no action is taken to challenge the global climate problems, the consequences will impact negatively on the economy and undermine all current government investments (Van Schalkwyk 2007).

The study will provide guidance. Vitousek (1994) states that there are multiple components of global change interacting that was caused initially by industrialisation. Two centuries later, there is warning that global climate changes will influence the economy, potentially damaging industrial performance (Dlugolecki and Loster 2003).

With the growing consensus among scientists regarding the potential impacts of climate change, Dunn (2002) argues that the pressure varies from one country to another and across industrial sectors. Jeswani, Wehrmeyer and Mulugetta (2008) state that little is known about developing countries organisational efforts and responses, and the factors influencing these.

This research guides decision makers in enhancing their knowledge of both analysing their organisation's carbon footprints, along with highlighting areas for improvement in current management systems in order to manage their carbon emission processes effectively. Mingay (2008) asserts that South African organisations need to develop climate change programmes to measure, manage, and increase carbon efficiency.

The insights into management levels that are enhanced by this research include financial planning, organisational development, and operational sustainability. The sectors that will gain would include the private sector, industry at large, government agencies responsible for environmental policy formulation, and academics. The information from this research would be valuable to government, as in only fully comprehending all aspects of reducing and managing GHG emissions, can fair sustainable policies and legislation be formulated for both organisation and the environment.

1.5 Delimitations of the research

This research highlights the reasons for organisations engaging in Carbon Footprint Management Systems and the elements contained within.

For the purposes of this research, the following delimitations apply:

- This research is focused on the management of carbon footprints, not on the quantification of, or how GHG emissions are being reduced;
- Management systems relating to GHG emissions are targeted. Excluded from this research are corporate social responsibility efforts and similar initiatives targeted at uplifting South African society;
- Excluded from this research are the Top 100 organisations listed on the JSE Securities Exchange as defined in the CDP 2008 report. These can be viewed in APPENDIX C: JSE Securities Exchange Top 100. Two organisations were excluded from the Top 100 due to changes in corporate standing (CDP South Africa 2008). Section 3.3.1: Population deals with the justifications of this delimitation; and
- Climate change and the emergent global response need to be a driver of action in targeted organisations. Excluded from this research are organisational efforts solely in response to legislature that all business entities in South Africa are legally bound to. The current legislature delimited from this research includes the National Environmental Management Air Quality Act 39 of 2004 (Republic of South Africa 2004) and the National Environmental Management Act 107 of 1998 (Republic of South Africa 1998).

1.6 Definition of terms

Below is Table 1 which reflects terms and abbreviations used throughout this research report to aid the reader in understanding its contents.

Table 1: Definitions and explanations of terms and abbreviations

Term	Meaning	Reference
CDP	Carbon Disclosure Project. Provides information on climate change related issues, GHG emissions, their disclosure thereof, and corporate awareness of managing climate change. It started globally in 2002 and was instituted in South Africa in 2007.	(CDP 2002) (Van der Merwe 2007b)
CO_2	Carbon Dioxide. The principle GHG in the atmosphere.	(Muller 2007)
DEAT	South African Department of Environmental Affairs and Tourism. This government department's mission is to lead sustainable development of the environment.	(DEAT 2007)
EPA	Environmental Protection Agency. Has responsibilities for licensing, enforcement, monitoring and assessment activities associated with environment protection.	(EPA 2008)
GHG	Greenhouse gas emissions. These are the gases that blanket the atmosphere and absorb radiation that is reflected from the earth's surface, thus warming it.	(Muller 2007)
GHG Protocol	Greenhouse Gas Protocol. An international accounting tool for government and business leaders to understand, quantify, and manage GHG emissions.	(GHG Protocol 2009)

Term	Meaning	Reference
IEA	International Energy Agency. An intergovernmental energy policy advisor organisation to 28 member countries.	(IEA 2009)
IPCC	Intergovernmental Panel on Climate Change. Provides decision makers with objective views. Its role is to assess scientific, technical and socio-economic literature to understand the risk of human induced climate change.	(IPCC 1988) (Schmalensee, Stoker and Judson 1998)
Kyoto Protocol	The Kyoto Protocol is an internationally legally binding agreement under which 37 industrialised countries and the European community have committed to reduce their collective emissions of greenhouse gases by 5.2% compared to the year 1990 to the first commitment period of 2012.	(Kyoto Protocol 1997)
UNFCCC	United Nations Framework Convention on Climate Change. Formed with the goal of preventing dangerous human interference with the climate system, and has the responsibility of generating rules and goals for confronting climate change.	(UNFCCC unknown-a)
WRI	World Resources Institute. Environmental think tank that creatively solves the earth's climate problems.	(WRI 2009)

1.7 Assumptions

For the purposes of this research, the following assumptions apply:

- The research instrument used measures that which it is intended to measure. Efforts regarding this assumption and this research's efforts to overcome this point are discussed in Section 3.8: Validity and reliability;
- The targeted respondents within the organisations have adequate knowledge to answer the research instrument. This assumption is highly reasonable as the targeted respondents are being chosen based on their work proximity to Carbon Footprint Management Systems. This assumption has great sensitivity to the outcomes of this research as it is only through the correctly targeted respondents that the required information will be given; and
- It is assumed organisations situated in the areas of Johannesburg, Cape Town, Durban, and Bloemfontein emit behaviours, intentions, and project interventions that are reflective of organisations across South Africa.

CHAPTER 2: LITERATURE REVIEW

> "The global energy system sits at the nexus of some of the deepest dilemmas of our times: the development dilemma – prosperity versus poverty; the trust dilemma – globalisation versus security; and the industrialisation dilemma – growth versus the environment" Shell Energy Scenarios to 2050 (Shell 2008:6).

2.1 Introduction

The purpose of a literature review is to provide past and current academic knowledge and to highlight emerging theoretical issues (Bryant, Campbell, Chan, Devonshire, Hughes, Mahony et al. 2003). The purpose of this literature review is to provide detailed insight and a thorough review of the relevant academic sources relating to climate change, and defining the management of carbon footprints. Literature regarding voluntary organisational interventions is considered as opposed to behaviour emanating from mandated legislation.

The literature review starts with a discussion on recent global temperature change where the corresponding implications for organisations are listed. This is followed by a description of the harmful GHG in the atmosphere. Carbon dioxide (CO_2) is seen as the principle GHG that affects global temperatures and an insight into the global increase is discussed. Increased trends and levels of CO_2 in South Africa are also listed. This introductory section is included as it provides evidence of the importance of climate change and the current relevance of the chosen research topic.

The definition of a carbon footprint is then scrutinised and a chosen definition for this research is presented. The literature review then focuses on the reasons for Carbon Footprint Management Systems in organisations and ends with a description of the first proposition. The elements that define such systems, relevant to the second sub-problem, are then discussed. The chapter concludes with a review of the research propositions.

2.2 Global temperature change

This section provides the reader with key foundational principles that are useful for understanding this report. The detail will provide an explanation on how climate change is becoming a global problem and the implications affecting organisations.

The warming effect of GHG was first recognised in 1827 by French scientist Jean-Baptiste Fourier (Houghton 1994). The term greenhouse-effect was formed as he noticed the behavioural similarity between the atmosphere and the glass of a greenhouse. As far back as 1896 the effect on global temperature by increasing GHG emissions in the atmosphere was calculated, Houghton (1994) explains that Svante Arrhenhius estimated that doubling the CO_2 in the atmosphere would raise global temperatures 5 to 6°C. In 1940 the global warming effect, due to increased CO_2 from the burning of fossil fuels, was established by Guy Callendar (Houghton 1994).

The first reference regarding the concern of increased CO_2 levels on the global climate was forwarded in 1957 by Roger Revelle and Hans Suess. They warned that, “Human beings are now carrying out a large scale geophysical experiment of a kind that could not have happened in the past nor reproduced in the future ..... this experiment, if adequately documented, may yield a far-reaching insight into the process of determining weather and climate” (Revelle and Suess 1957:19).

Climate change is a more appropriate term for global warming as some areas may become colder, despite the overall temperature of the earth rising (Putt del Pina and Bhatia 2002). This research report incorporates this ideology.

2.2.1 *Implications of climate change for organisations*

Dlugolecki and Loster (2003) quantify the impact of climate change on the economy by predicting that global economic losses due to climate change and natural disasters double every ten years. Lash and Wellington (2007) explain by stating that due to climate change and a warming planet, organisations face

effects such as emission reduction legislation and possible damaging brand equity value due to environmentally concerned customers.

Busch and Hoffman (2007) provide a divided view of these effects by differentiating between direct and indirect implications on macroeconomic, sectoral, and organisational levels. Direct effects are listed as long-term impacts on entire economic sectors, extreme weather conditions causing reduced output from production facilities, and reducing urban infrastructure growth. Indirect effects include formation of environmental policies, increased risk taking by organisations due to strategic policy changes, change in consumer preferences, and organisations becoming compliant in the short-term.

2.3 GHG growth rates

After an introductory note on climate change, this section provides an insight into GHG in order to facilitate a deeper understanding of Carbon Footprint Management Systems and what they incorporate. An introduction into GHG is discussed along with global and South African levels of CO_2.

2.3.1 *Types of GHG*

The Kyoto Protocol (UNFCCC 1998) lists the four GHG in the atmosphere: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfurhexafluoride (SF_6), and two groups of gases called hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), that nations under Annex I are legally bound to reduce if their government has ratified the Protocol. Despite South Africa being listed in Annex II, the Protocol has been recognised by the South African government (DEAT 2005b).

2.3.2 *Increasing worldwide levels CO_2*

The theory that the earth's climate is sensitive to an increase in GHG is more than a century old. Interest has gained momentum due to scientists' discovery that CO_2 will be responsible for more than half of the expected climate change over the next century (Lashof and Ahuja 1990; Rodhe 1990).

Global consensus is that there is an increasing atmospheric concentration of CO_2 as well as other GHG, due in part, to the combustion of fossil fuels, thus raising the earth's temperature and leading to climate change (Vitousek 1994; Schmalensee et al. 1998; Putt del Pina, Levinson and Larson 2006; Baldwin, Cladwell, Oldenburg, Reinholtz and Valenta 2007; IPCC 2007). Hansen and Sato (2004) explain that increasing GHG cause the largest positive warming effect and is a result of increases in CO_2 emissions. Currently, the global increase of CO_2 since the industrial era has reached 35% due mainly to the human activities of burning fossil fuels and of deforestation (IPCC 2007). Putt del Pina et al. (2006) state that CO_2 is the most significant GHG making up 77% of total GHG emissions. Figure 1 below represents the portion of each main GHG to total GHG emissions clearly indicating the CO_2 dominance.

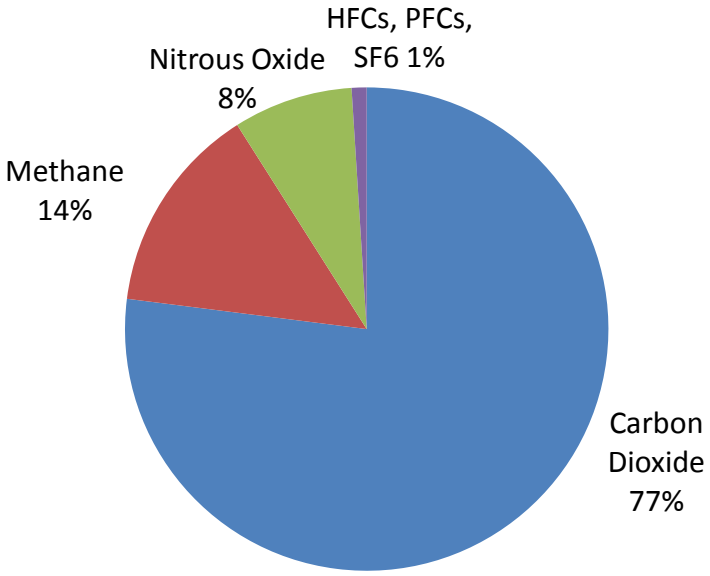


Figure 1: GHG emission contribution to global emissions (WRI 2006)

UNFCCC (unknown-b) state that the natural occurring levels of CO_2 within the atmosphere are being supplemented by:

- The burning of coal, oil, and natural gas;
- Methane and nitrous oxide are produced by changes in land use and farming activities; and
- Industrial gasses that do not occur naturally are being released into the atmosphere.

In addition, Schelling (1992) established the positive correlation between increased CO_2 and population growth. Brown et al. (2008) supplements this list with increased economic output, and energy and CO_2 intensity of the economy.

Data from the Antarctic ice core indicate that CO_2 concentration levels are presently higher than at any time during the previous 650 000 years and has resulted in the build-up of GHG in the atmosphere that Lash and Wellington (2007) argue is changing the earth's climate at an increased rate. The argument is strengthened by 2005 being the warmest year on record since measurements began and the 10 warmest years all occurring since 1980 (Lash and Wellington 2007; NASA Goddard Space Institute for Space Studies 2007).

2.3.3 *CO_2 levels in South Africa*

DEAT (2005a) states that the high energy intensive South African economy makes it one of the highest CO_2 emitters in the world and the largest in Africa. Sebitosi and Pillay (2008) quantify this output by citing that the US Department of Energy currently ranks South Africa as the 7th largest emitter of GHG per capita. Figure 2 below represents the CO_2 levels per capita and on a total level in 1995 compared to the other main emitters. At this point, South Africa was the 8th largest emitter of CO_2.

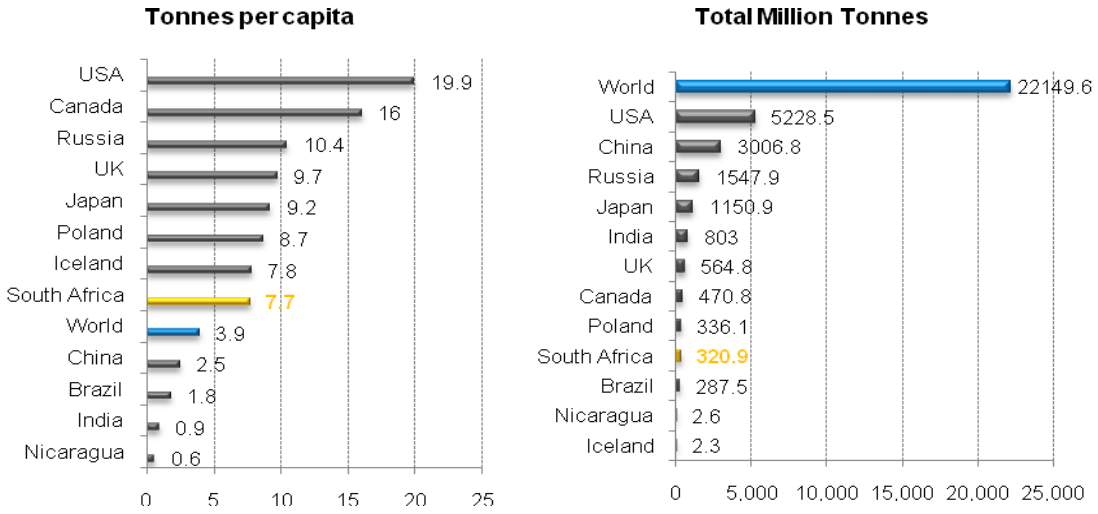


Figure 2: South African CO_2 total and per capita levels in 1995 (IEA 1996)

DEAT (2005a) explains that the current South African Gas Inventory only includes information for the years 1990 to 1994 and is due to be updated. From the 1994 South African Gas Inventory, the published CO_2 figures are 379.842 Gg CO_2 equivalents (DEAT 2005c). It is Mingay (2008) who estimates that current emissions would be close to 410 Gg CO_2 equivalents. Figure 3 below represents the breakdown of CO_2 equivalent emissions by economic sector. The economic sector with the largest emissions is the energy sector, followed by the agricultural, industrial processes, and waste sectors.

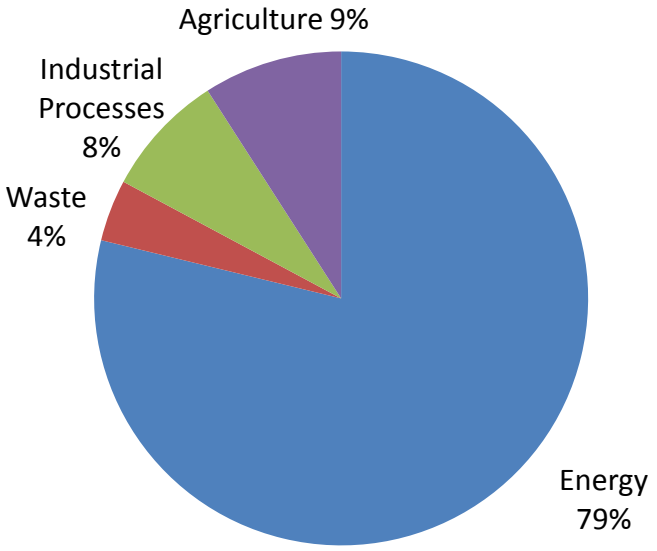


Figure 3: South African CO_2 equivalent emissions contribution by economic sectors 1994 (DEAT 2005c)

The dominance of energy emissions is explained by the high energy intensity and dependence on large-scale primary extractions during mining and subsequent processing (Mingay 2008). Sebitosi and Pillay (2008) have stated that due to the energy crisis that gripped South Africa early in 2008, the monopoly power utility Eskom has responded with plans to increase its coal power generating capacity. Mingay (2008) explains that South Africa's reliance on coal is unlikely to change significantly in the next decade due to the lack of suitable alternatives. Further, the author states that South African industry has an awareness of the need to start acting on climate change by becoming energy efficient.

2.4 Definition of carbon footprint

With the fundamentals of climate change and environmental descriptions thoroughly reviewed, this section details the elements of carbon footprints. Appropriate literature is reviewed and integrated to form a definition that was used for the purposes of this research.

William Rees, an environmentalist and ecologist, first termed carbon footprint in 1992 (Rees 1992). The study attempted to measure the ecological costs of human fossil fuel consumption and to establish how much of the earth's resources would be needed if humanity was more engaged in environmental activities (Rees 1992).

2.4.1 *Defining carbon footprint*

The primary reasons for defining and calculating carbon footprints are to actively manage carbon footprints and reduce emissions over time, as an input into the ongoing energy and climate change management of the organisation, and identify opportunities for financial cost savings (Carbon Trust 2007b). These definitions apply to organisations, governments, processes, industry sectors, and products and services (Wiedmann and Minx 2007).

Despite the term carbon footprint being used increasingly around the globe in an attempt to raise awareness and mitigate climate change (Hammond 2007), there is little consensus and commonality between defining and establishing boundaries of carbon footprints and the respective GHG emissions (Wiedmann and Minx 2007; Murray and Dey 2009). The one commonality among many definitions is the prevalence of certain GHG emissions, relevant to increasing climate change, as a result of increasing human consumption (Wiedmann and Minx 2007; Forden, Wilson and Bright 2008).

Literature suggests differences in three distinct paradigms for explaining carbon footprints: formulation, reach, and measurement.

Formulation – to include or not to include all key GHG. Wiedmann and Minx (2007) question whether to define carbon footprints in terms of CO_2 exclusively

or whether to incorporate other GHG emissions that affect climate change. In understanding these measures the importance of CO_2 emissions on carbon footprints is highlighted, as it is this singular GHG that has the most significant effect on the earth's biosphere's regenerative capacity, which is strained due to human demands for growth and its appetite for burning fossil fuels (Kitzes, Galli, Bagliani, Barrett, Dige and Wiedmann 2007). Added to the importance of CO_2, is that the other GHG emissions are not based on carbon and are more difficult to quantify due to data unavailability (Wiedmann and Minx 2007).

Despite the arguments for the sole inclusion of CO_2, Wiedmann and Minx (2007) admit that in the majority of cases CO_2 measurement is used as a generic synonym for emissions of CO_2 and other GHG expressed in CO_2 equivalents.

Reach – primary versus secondary quantification. Wiedmann and Minx (2007) and Forden et al. (2008) explain that the primary and secondary quantification of carbon footprints is rooted in whether the definition encompasses direct GHG emissions from an organisation or indirect full cycle activities throughout the supply chain. Sinha and Flederbach Jr (2008) state that direct GHG emissions are a result of activities that are owned or controlled by the organisation directly, with indirect GHG emissions including activities that are a consequence of the organisation's activities, but physically occur at other organisations. For the purposes of reporting in the CDP, a distinction is made between two types of indirect GHG emissions, those relating to the generation of purchased electricity at the organisation's premises, and those relating to the generation of purchased electricity not owned or controlled at the organisation's premises (CDP South Africa 2008).

Measurement – area versus pressure indicator. Forden et al. (2008) describe this paradigm as how to measure carbon footprint influence, and the disagreement set in whether to use an area based measurement such as hectares or a pressure indicator such as tonnes. Hammond (2007) suggests the source of this confusion emanates from the actual wording used. Footprints are spatial indicators that are traditionally measured in hectares or square meters. Further, Hammond (2007) suggests the politically correct term for a carbon

footprint is actually a carbon weight of kilograms or tonnes that is a result of human or organisation activity.

In reviewing the literature, the following discussion on carbon footprint definitions encompasses these three aspects.

Wiedmann and Minx (2007) largely believe that academia has neglected the definition specifics, and that consultancies, NGOs and governments have moved forward in defining the parameters. Starting with the secondary broader definition on carbon footprints, The Carbon Trust (2007a) believes it to be a methodology estimating the total GHG emissions of an activity right across its life cycle from its beginning through to its end.

In an organisational sense, the carbon footprint is the amount of CO_2 directly and indirectly emitted through the combustion of fossil fuels by organisation's everyday activities and measured in mass units, kilograms, or tonnes (Forden et al. 2008). Wiedmann and Minx (2007) define carbon footprints in terms of CO_2 only where their argument emphasises that if other GHG emissions were to be included, the terminology should change to reflect a climate footprint.

Lynas (2007) holds a different view in that a carbon footprint should include all elements of an individual's or organisation's contribution to climate change. The argument is therefore that both CO_2 and other GHG emissions should be included by way of CO_2 equivalents. However, it has been argued that definitions that include both direct and indirect emissions, double count portions of the carbon footprint due to various personal and organisational entities each counting along the supply chain (Lenzen, Murray, Sack and Wiedmann 2007; Wiedmann and Minx 2007). This creates complications in the Kyoto Protocol's trading mechanisms (Wiedmann and Minx 2007).

For the purpose of this research report a carbon footprint is defined as: all elements of an organisation's contribution to climate change. This includes all direct and indirect GHG emissions, measured as a pressure indicator, listed under the Kyoto Protocol.

2.5 The role of Carbon Footprint Management Systems

This section provides the reader with insight into the reasons that organisations create Carbon Footprint Management Systems and is directly related to the first sub-problem referenced in Section 1.3.2: Sub-problems. This section begins with an introductory note detailing organisational value and commitment in terms of the defined sub-problem and defining what Carbon Footprint Management Systems are for the purposes of this research. This is followed by a description of a transition process that organisations evolve through in creating an environmental strategy where the model of Giurco and Petrie (2007) is presented. The model is presented as it sets the format for the rest of this section by separating out the organisational motivational reasons relating to an organisation's behaviour.

The main driver for corporate strategic change and Carbon Footprint Management System development was the drafting of the Kyoto Protocol (Grubb et al. 1999). The authors explain by stating this event was a catalyst for the development of regulations by governments worldwide and increased pressure on organisations to take appropriate steps to address climate change.

In assessing GHG emission strategies Feldman, Soyka and Ameer (1996) suggest key indicators for organisational commitment, and it were these that aided in the identification of organisations to interview for this research:

- Whether the organisation has formally developed an environmental strategy;
- Whether there is a demonstrated commitment to executing the environmental strategy. Evidence includes top management commitment, responsibility and accountability roles clearly defined, measurable goals being established, and adequate resources being allocated for programme implementation and management; and
- Whether there are other organisational projects that assist in the management of environment policies such as environmental reporting and monitoring systems to track emissions, the usage of raw materials and energy amounts transferred into other inputs of production.

Martin (1998) states that a climate change management programme is a collection of systematic management processes with the goal of continual improvement of overall environmental performance. Karmali (2006:259) defines the management of carbon footprints as, “a holistic, systematic and analytical rigorous thinking about the impact of GHG emissions on strategy, asset values, investments and the commercial activities of the firm”. For the purposes of this research report, the same definition will apply to Carbon Footprint Management Systems.

The transition and process through which organisations evolve in creating an environmental strategy is outlined in Figure 4 below. Organisations progress from a pre-compliance reactive phase, then embark on compliance regulations, and move into a proactive post-compliance and integrated strategic phase.

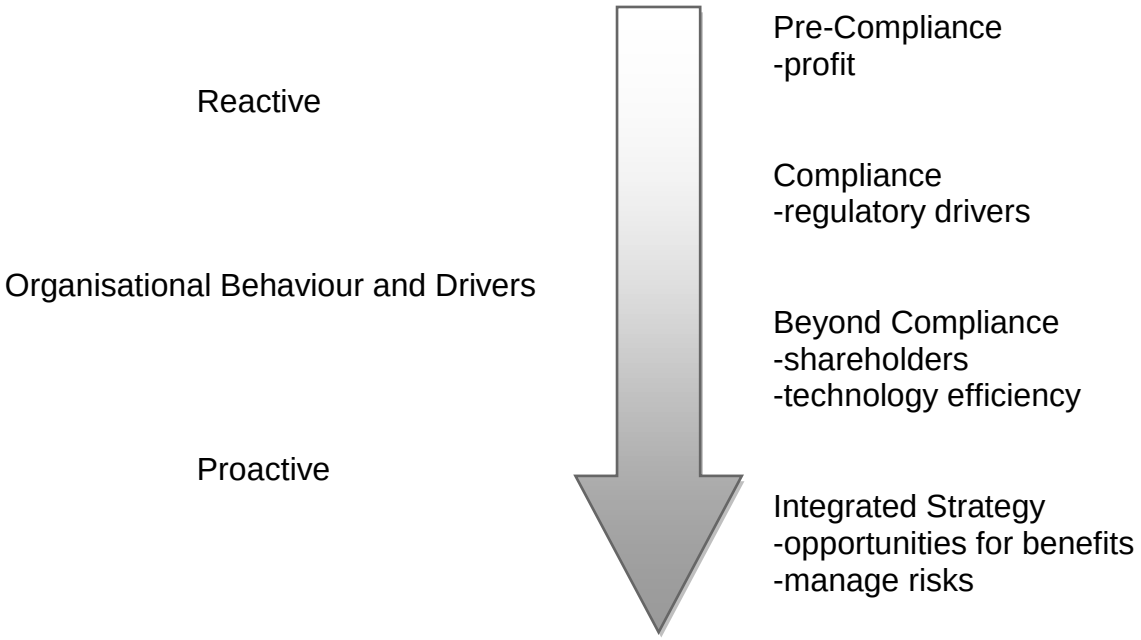


Figure 4: Approach to environment strategy (Giurco and Petrie 2007)

Literature is clear on why organisations engage in systems that focus on climate change concerns. Warhurst and Mitchell (2000) state that environmental, regulatory, and societal drivers are leading organisations to become engaged with increased environmental concerns. Delmas and Toffel (2004) add an internal view by arguing that organisations adopt Carbon Footprint Management

Systems in response to organisation specific internal factors along with institutional pressures from external stakeholders.

The rest of this section is dedicated to reasons why organisations actively seek and manage Carbon Footprint Management Systems. The model forwarded by Giurco and Petrie (2007) guided the formation of these themes.

2.5.1 *Pre-compliance: financial performance*

Economic literature argues that profit maximising organisations have no incentive to control pollution from environmental regulations or progress beyond the minimum required standards as prices and regulations within markets are regarded as a given (Cropper and Oates 1992). However, current management literature disagrees (Morgenstern and Pizer 2007).

Karmali (2006) states that maximum financial return is derived from actively managing carbon assets and, conversely, minimising carbon liabilities at the least cost. Lash and Wellington (2007) argue that management's ability for creating new opportunities for financial growth is an important ingredient in the organisation's environmental strategy.

According to Levy (1995), organisations that are constrained by profitability and liquidity engage in environmental policies and procedures less frequently, and that stronger involvement in these does not lead to improved financial performance. Further, it has been added that an organisation focused on climate change impacts can simultaneously reduce GHG emissions along with operating costs (Sinha and Flederbach Jr 2008) and in changing the environmental responsibility of the organisation, cost minimisation can be achieved (Clemens 2001).

Literature offers mixed results regarding financial performance and an organisational involvement in environmental strategy.

There is literature to support a positive correlation between these elements by Hart and Ahuja (1996), Russo and Fouts (1997), Khanna and Damon (1999)

and Stanwick and Stanwick (2001), and literature in support of insignificant findings by Fogler and Nutt (1975), Rockness, Schlachter and Rockness (1986) and Levy (1995), and literature in support of a negative relationship between climate change efforts and financial performance by Gray and Shadbegian (1993).

2.5.2 *Compliance: regulatory environment*

Levy (1995) argues that regulatory pressures have a strong influence on climate change programmes within organisations. Further, Hutchinson (1996) and Pratt and Fintel (2002) state that government regulation represents the single most important reason for organisations creating climate change programmes, with Rugman and Verbeke (1998) suggesting that societal concerns over the climate change consequences have led to sharp increases in environmental legislation.

The Kyoto Protocol was created by UNFCC and was initially signed by several nations in Kyoto on 11 December 1997 and came into effect on 16 February 2005 (UNFCCC unknown-c). The Kyoto Protocol is currently the strongest binding global action plan developed to tackle climate change by reducing GHG emissions by 5% compared with 1990 levels (Carbon Planet 2008; UNFCCC unknown-c).

Dlugolecki and Loster (2003) debate the effectiveness of the Kyoto Protocol. They point out that the actual GHG emission reduction targets are modest and stress that not all countries are included. Bosetti and Buchner (2008) further elaborate that despite the Kyoto Protocol being in force for a number of years, they believe its effectiveness is low in global terms; this is due to the world's largest producer of GHG emissions, the United States of America, still refusing to ratify the Kyoto Protocol. Further, they argue that due to the rapid economic growth of China and India, the Kyoto Protocol should be a preceding step engaging countries to commit to reducing GHG emissions beyond 2012 when the Kyoto Protocol commitments expire. The regulatory environment and the way forward beyond 2012 were recently debated in Copenhagen during December 2009.

Kolk and Pinkse (2004) state that regulation can be seen as both a business risk and opportunity for organisations. The consequence is that organisations need to understand and manage these risks if they are to succeed and adapt in an environment that increasingly prepares for regional, national, and global climate policies (Carbon Planet 2008). Table 2 below reflects these initiatives for regional, national, and global policies. The table portrays the recent interest in global regulation, the diverse sector coverage, and the prominence of mandatory compliance over voluntary abatement policies.

Table 2: Global regulatory landscape (Carbon Planet 2008)

Region	Name	Dates	Coverage	Nature
Australia	Carbon Pollution Reduction Scheme	2010 start	Direct emissions from large facilities and upstream fuel. Initially excludes agriculture and land use	Mandatory
California	TBA under Assembly Bill 32	2012 start	TBA	Mandatory
Europe	EU Emissions Trading Scheme	2005-2007(Phase I) 2008-2012(Phase II)	Energy generation, refineries, ferrous metals, minerals, pulp, paper and others	Mandatory
Japan	Japanese Voluntary Emissions Trading Scheme	2006-present	Food, drink, buildings, textiles, pulp, paper, metals, and ceramics	Voluntary
New South Wales	Greenhouse Gas Abatement Scheme	2003-present	Electricity Generation	Mandatory
New Zealand	Emissions Trading Scheme	was 2008 start, has been postponed	Forestry initially, all sectors by 2013	Mandatory
North East USA	Regional Greenhouse Gas Initiative	2009 start	Fossil fuel electricity generation above 25 MW, burning >50% fossil fuel	Mandatory
Norway	Emissions Trading Scheme	2005-2007 (Phase I) 2008-2012 (Phase II)	Large direct emitters, linkage to EU ETS in 2008	Mandatory

Region	Name	Dates	Coverage	Nature
Switzerland	National Emissions Trading system	2008-2012	Large direct emitters expected to participate	Voluntary
United Kingdom	UK Emissions Trading Scheme	2002-2006 (closed)	Any sector	Voluntary
United Kingdom	Carbon Reduction Commitment	TBA	Non-energy intensive business and public sector entities with electricity consumption above a threshold level	Mandatory
United States	TBA under Lieberman-Warner Bill	2012 start	TBA	Mandatory
United States	Chicago Climate Exchange	2005-2007 (Phase I) 2008-2012 (Phase II)	Any sector	Voluntary
Western USA	Western Climate Initiative	TBA	TBA	Mandatory
Worldwide	Kyoto Protocol 'flexible mechanisms'	Entered 2005, first commitment period 2008-2012	All sectors except international aviation and shipping	Mandatory developed countries, voluntary developing countries

As previously noted, South Africa has been placed under Annex II under the Kyoto Protocol and as a result, Van der Merwe (2007a) explains that South Africa is not legally mandated to any specific emission reduction targets by reducing organisational carbon footprints. However, Van Schalkwyk (2007) warns that the South African government will increasingly assess and monitor carbon footprints, regulate GHG emissions, and that industries will soon encounter a carbon constrained environment. Contrastingly, Mingay (2008) believes that pressure on organisations to reduce GHG emissions will not come from newly instituted government regulations, but rather from international supply chains, international investors, and increasingly ethical consumers and tourists.

2.5.3 *Compliance: parent company obligations*

Climate change efforts by multi-nationals operating in developing countries were highlighted in 1992 during the United Nations Conference on Environment and Development (Hansen 2003). The following was stated as recommendations to follow: recognise climate change management as a key priority, encourage world-wide standardisation regarding policies, establish climate change management systems, and share experiences with local authorities and government.

Levy (1995) states that the behaviour of multi-nationals differs from purely national organisations in that the former is faced with regulations and enforcement practices that span various countries. Rugman and Verbeke (1998) add that parent company obligations are of importance due to multi-national organisations dominating the pollution intensive industries of chemicals, petroleum, and heavy manufacturing. The authors explain that creating Carbon Footprint Management Systems at a multi-national level often highlights the location advantages for organisations, and environmental regulations obligate the organisation to develop green resources and capabilities.

Magretta (1997) explains that multi-nationals adhere to the most stringent environmental regulations where the higher degree of multi-nationality is associated with superior climate change performance and compliance (Levy 1995). Kolk and Pinkse (2004) confirm that climate change initiatives are occasionally part of broader climate change programmes already in place in international markets that are subject to legislation.

2.5.4 *Beyond compliance: stakeholder pressure*

Schaltegger and Burrit (2000) state that shareholder pressure regarding climate change performance forces organisations to be accountable, while Jose and Lee (2007) later add that shareholders expect organisations to actively manage their own Carbon Footprint Management Systems.

Pressure also emanates from organisations reporting to shareholders regarding the systems and programmes that are being implemented to manage business risks associated with climate change (Karmali 2006), thus forcing these systems and programmes into the mainstream delivery process throughout the organisation (Pfeifer and Sullivan 2008).

Literature suggests the presence of other stakeholder pressures in organisations regarding climate change interventions. Henriques and Sadorsky (1996) state that stakeholder pressure is associated with organisational motivations for creating Carbon Footprint Management Systems. They classify stakeholder pressure as internal and external pressures and suggest customer, shareholder, and government pressure, along with regulatory influence and community group pressure as all being responsible for organisations formulating climate change systems.

Buysse and Verbeke (2003) support the distinction between internal stakeholders such as employees, shareholders, and financial institutions; and external stakeholders such as customers, government, and suppliers. However, the authors conclude that only internal stakeholders of employees, shareholders, and financial institutions provided motivational pressure for organisations.

Gonzalez-Benito and Gonzalez-Benito (2006) believe that stakeholder pressure defined by them, as comprising internal and external forces, is the central determining factor in climate change proactivity. Jeswani et al. (2008) in studying organisations in the United Kingdom and Pakistan, found that the three stakeholders of shareholders, management, and governmental agencies had a strong influence on the climate change efforts by organisations.

2.5.5 *Beyond compliance: technological and competitive advantage*

Henriques and Sadorsky (1996) found that organisations viewing climate change as important in the short-term were more likely to have a developed structure and strategy for dealing with climate change. Nearly a decade later,

Kolk and Pinkse (2004) challenge that the interest sparked by global climate change has seen a shift in competitive strategies adopted. They argue that in the last decade, the shift has occurred from political and non-competitive strategies, towards market competitive advantages.

Literature states that organisations with Carbon Footprint Management Systems enjoy a competitive advantage due to:

- Better stakeholder relationships (Dechant and Altman 1994; Russo and Fouts 1997);
- The possibility of increased and sustainable technology contributing to competitive advantage (Groenewegen and Vergragt 1991; Shrivastava 1995);
- Competitive effects such as changes in costs, changes in demand, and the development of new technologies (Kolk and Pinkse 2004); and
- Increased competitiveness through process innovation and product development within organisations (Walley and Whitehead 1994; Kolk and Pinkse 2004).

2.5.6 *Integrated strategy: proactive stance*

Literature suggests two domains for proactive stances on climate change programmes (Darnall et al. 2008).

Firstly, there are aspects of institutional theory to explain why organisations proactively adopt Carbon Footprint Management Systems (Bansal and Roth 2000; Davidson III and Worrell 2001; Khanna and Anton 2002). Institutional theory describes organisations as social frameworks with similar norms, values, and missions. They behave similarly to gain social approval (Meyer and Rowan 1977).

Secondly, there is a resourced-based explanation for adopting Carbon Footprint Management Systems (Aragon-Correa and Sharma 2003). These resources could include quality management systems, health and safety management systems, employee commitment, environmental research and development,

and export orientation (Darnall et al. 2008). The authors explain that by taking a proactive stance regarding the environment, organisations could gain competitive advantages by reducing mandated reporting requirements, eliminate installing pollution gauges, promote environmental learning, and having greater opportunity to influence the environmental drafting process.

Kolk and Pinkse (2004) have observed that as climate change debates have matured, so too has the degree of organisational involvement in proactive climate change strategies. They claim that climate change has attracted increasing attention due to its potential strategic impact on organisations. Karmali (2006) adds that there is sufficient commercial and reputational reasons for organisations engaging in a proactive approach in actively managing their GHG emissions. The author further confirms a strong rationale for implementing, developing, and managing emissions of GHG through a proactive approach.

2.5.7 *Integrated strategy: mitigating risk*

Dlugolecki and Loster (2003) believe that governments have delayed in creating environments conducive to Carbon Footprint Management Systems, partly due to the regulator's confusion around the binding reduction of GHG targets and the lack of enforcement. Sinha and Flederbach Jr (2008) believe this has lead to regulatory uncertainty which places increased business risk on organisations.

The business risk Sinha and Flederbach Jr (2008) describe can be treated as any strategic issue to anticipate and manage, despite GHG emissions impacting global climate change. Pfeifer and Sullivan (2008) list the risks that could affect strategic decisions as: physical risks, public policy risks, competitiveness impacts, legal risks, and reputational risks.

According to Lash and Wellington (2007), climate change risks are managed as a threefold management problem by conforming to regulatory compliance, mitigating potential liability from workplace accidents, and GHG emission mitigation. Sinha and Flederbach Jr (2008) advise that mitigating risk should be proactive and that organisations who are leaders in actively managing the

carbon footprint emissions, will be able to adapt better in a future constrained carbon environment.

2.5.8 *Proposition for the first sub-problem*

The literature discussed in this section reviews the possible reasons for organisations to create Carbon Footprint Management Systems.

Research proposition 1:

One or more of these factors:

- Financial performance (Section 2.5.1);
- Regulatory environment (Section 2.5.2);
- Parent company obligations (Section 2.5.3);
- Stakeholder pressure (Section 2.5.4);
- Technological and competitive advantage (Section 2.5.5);
- Proactive stance (Section 2.5.6); and
- Mitigating risk (Section 2.5.7)

are reasons for the implementation of Carbon Footprint Management Systems in South Africa.

2.6 The elements of Carbon Footprint Management Systems

With the reasons for implementing Carbon Footprint Management Systems reviewed, this section details the crucial elements that these systems comprise and is directly related to the second sub-problem referenced in Section 1.3.2: Sub-problems. This section begins with an explanation of what Carbon Footprint Management Systems contain within their structures. This is followed by a step sequence of elements proposed by the WRI, which guided the format of the remaining section.

Netherwood (2001) defines that a climate change management system should contain a written environmental policy, training of employees regarding

environmental concerns, conducting internal environmental audits, and developing environmental performance indicators and goals. Lash and Wellington (2007) suggest that the quantification of the organisation's carbon footprint, assessment of the strategic climate to risks and opportunities, and adaptation of the organisation to these factors, also be included.

In Figure 5 below the following steps are suggested for designing and implementation of a Carbon Footprint Management System (WRI unknown).



Figure 5: Designing and implementing a GHG programme (WRI unknown)

In reviewing the literature, these collective views were incorporated with standard protocols that exist to determine the key components of Carbon Footprint Management Systems below. In accordance with the purpose of a literature review, the aim is not to summarise each section with relevant inclusions, rather, the focus is to provide a holistic approach for organisational direction.

2.6.1 *Assess organisational position*

Kolk and Pinkse (2004) suggest before organisations spend resources on climate change programmes, management need to assess the current situation within the organisation. Karmali (2006) elaborates by stating that climate change implications affecting the organisation need to be considered in a broader strategic sense, along with the organisation's need to assess the positive and negative impacts that the strategic management of carbon footprints will have.

Lash and Wellington (2007) add to this assessment list by suggesting the organisation delve into the following risk assessments:

- Regulatory risks, assess the possibility and impact of mandatory GHG emissions reduction legislation;
- Supply chain risks, assess the possibility of suppliers transferring their higher carbon related costs;
- Product and technology risks, assess the possibility of competitors' new product developments being more carbon efficient;
- Legal risks;
- Reputational risks, assess the possibility of environment friendly stakeholders; and
- Physical risks, assess the possibility of climate change weather events inflicting damage to the organisation's assets.

2.6.2 *A GHG Inventory*

Sinha and Flederbach Jr (2008) state that after an organisation has strategically decided to manage its GHG emissions, the starting point of the climate change programme is the establishment of a GHG Inventory. Putt del Pina et al. (2006) define a GHG Inventory as a tool that lists the organisation's GHG, its sources, and quantities. Kolk and Pinkse (2004) state only half of organisations who measure GHG emissions measure gasses other than CO_2, and nearly all organisations measure CO_2 although the authors fail to quantify this statement.

Literature clearly states using a GHG Inventory that has generally accepted accounting practices for measuring and reporting GHG emissions such as the GHG Protocol, contains benefits (Putt del Pina et al. 2006; Lash and Wellington 2007; Sinha and Flederbach Jr 2008). Most notably, this allows the platform to be compatible with other GHG Inventory programmes such as World Wildlife Fund Climate Savers, the Climate Neural Network, the Business Leaders Initiative on Climate Change, World Economic Forum Global GHG Registry, national and regional industry initiatives, and GHG trading programmes (WRI 2004).

The following benefits are gained from establishing a GHG Inventory:

- The GHG Inventory will allow organisations to differentiate between direct and indirect GHG emissions (Lash and Wellington 2007);
- Putt del Pina et al. (2006) believe that a GHG Inventory will aid in the determination of the most optimal GHG emission reduction opportunities;
- GHG inventories can be used for creating additional climate change programmes and appropriate targets (Kolk and Pinkse 2004);
- By tracking GHG emissions overtime, organisations can create awareness through all levels in the organisation (Lash and Wellington 2007); and
- As the GHG Inventory is the foundation for the Carbon Footprint Management System, the organisation can further assess the risks and opportunities, follow their progress, and create GHG emission reducing strategies (Putt del Pina et al. 2006).

According to Kolk and Pinkse (2004), the dominating GHG emission reducing strategies are to reduce or stabilise GHG emissions, defining a goal to reduce energy consumption, or as an objective to reduce only fuel consumption. Putt del Pina et al. (2006) recommend that organisations should decide on a GHG emission reduction target from their GHG Inventory to demonstrate to all stakeholders the organisation's commitment and the ability for tracking and reporting the organisation's carbon footprint.

2.6.3 *Reporting mechanisms*

Ramus (2002) provides a clear view that written environmental policies indicate the organisational commitment to the environment through provision of environmental targets and objectives.

In less than a decade, organisational efforts regarding written environmental policies and training programmes seemed to have changed. Kirk (1995) was disappointed with the total number of organisations with such interventions, whereas Hansen (2003) found the opposite true. Hansen (2003) states that

formulating an environmental policy is one way of addressing organisational climate change challenges and that the vast majority of organisations had adopted both written environmental policies and training programmes in the conducted research.

2.6.4 *Long-term strategy planning*

Dlugolecki and Loster (2003) deem climate change dynamics should be given adequate consideration in organisations by creating Carbon Footprint Management Systems that are included in a long-term carbon strategy. Karmali (2006) believes in order to maximise organisational and shareholder wealth, organisations need to incorporate GHG emissions and climate considerations into the business strategy. Further, the author elaborates by including all strategic decisions relating to capital expenditure, due diligence for financial transactions, and operational requirements. The following list of strategic planning exercises is highlighted: scenario planning, and assessing supply and demand for carbon.

Scenario planning. Karmali (2006) asserts that organisations should commence with an analysis of organisational value at risk in various scenarios. The author contends that successful organisations are integrating climate change considerations into both short and long-term strategic views.

Lash and Wellington (2007) allude to scenario planning by stating that the insight should focus on conducting assessments on how climate change could affect the organisation. They contend that the insight needs to include strategies to actually combat GHG emission reduction, the maximisation of opportunities, and reduction of exposure to climate related risk.

Assess supply and demand for carbon. Karmali (2006) states that organisations need to assess the longer-term supply and demand for carbon. The author elaborates that organisations need to include carbon pricing into the investment appraisal process.

2.6.5 *Implementation platform*

There are two implementation processes of Carbon Footprint Management Systems, the top-down and bottom-up approach (Kolk and Pinkse 2004). A key ingredient for the successful implementation of a plan is matching to the appropriate organisational structure (Hall 1999).

WRI (unknown) contend that the implementation process be transparent, inclusive of all stakeholders, and engages multiple stakeholders in the design and implementation of the chosen Carbon Footprint Management System. Organisations have the option of incorporating global quality systems designed for climate change management system standards, such as the International Organisation for Standardisation (ISO) 14001 (Corbett and Kirsch 1999).

2.6.6 *Propositions for second sub-problem*

The literature discussed in this section reviews the elements that Carbon Footprint Management Systems incorporate.

Research proposition 2:

One or more of these elements:

- Assess organisational position (Section 2.6.1);
- A GHG Inventory (Section 2.6.2);
- Reporting mechanisms (Section 2.6.3);
- Long-term strategy planning (Section 2.6.4); and
- Implementation platform (Section 2.6.5)

are being used in the structure of Carbon Footprint Management Systems by South African organisations.

2.7 Conclusion of literature review

With all the appropriate literature covered, this section provides a summary view of the propositions emanating from the literature. The summary below reflects the propositions for this research report.

2.7.1 *Proposition 1*

One or more of these factors:

- Financial performance (Section 2.5.1);
- Regulatory environment (Section 2.5.2);
- Parent company obligations (Section 2.5.3);
- Stakeholder pressure (Section 2.5.4);
- Technological and competitive advantage (Section 2.5.5);
- Proactive stance (Section 2.5.6); and
- Mitigating risk (Section 2.5.7)

are reasons for the implementation of Carbon Footprint Management Systems in South Africa.

2.7.2 *Proposition 2*

One or more of these elements:

- Assess organisational position (Section 2.6.1);
- A GHG Inventory (Section 2.6.2);
- Reporting mechanisms (Section 2.6.3);
- Long-term strategy planning (Section 2.6.4); and
- Implementation platform (Section 2.6.5)

are being used in the structure of Carbon Footprint Management Systems by South African organisations.

CHAPTER 3: RESEARCH METHODOLOGY

> "Three voluminous reports have been issued by the Intergovernmental Panel on Climate Change, a panel of more than 2000 of the world's experts, which conclude that humans are having an impact on the earth's climate and detail many of the terrible consequences that are occurring now and the indefinitely worse consequences that will happen in the future if nothing is done to address the climate crisis" Gore (2000:xii).

This chapter describes the methodological considerations that are relevant in conducting this research. The chapter begins with an introduction to the research paradigm and design. Next is a detailed view of the population and sampling method followed by the research instrument description, data collection, and specified data analysis. The chapter is concluded with a discussion around validity and reliability issues and how this research overcomes the concerns.

3.1 Research methodology

This section aims to provide justifications for the chosen research methodology with particular reference to Leedy and Ormrod (2001).

The aim of this research is to discover the reasons why organisations create Carbon Footprint Management Systems and the elements contained within them. The paradigm used in this approach is logical positivism or quantitative in nature.

The suitability of this paradigm for this research proposal is captured by Bogdan and Biklen (1998) who state this method of research focuses on the causes of behaviour, while Leedy and Ormrod (2001:102) confirm that with quantitative research, "the intent is to establish, confirm, or validate relationships and to develop generalizations that contribute to theory".

3.2 Research design

Having covered the methodological framework, this section details the appropriate research design essentials. The section begins with an overview of the principle functions of statistics followed by the survey design description of this research. This is followed with a discussion around the chosen design.

Leedy and Ormrod (2001) state that statistics have two principle functions that are descriptive and inferential in nature. They explain that descriptive statistics summarise the measures and spread of data, and display the data as an organised whole, whereas inferential statistics guide the researcher in making decisions about that data.

The methodological approach this research adopts is descriptive or normative survey design through structured telephonic interviews collecting cross-sectional data. Leedy and Ormrod (2001) assert that this design method involves identifying a problem, analysing and interpreting data for findings, and resolving the research question.

This design method is frequently used in business, sociology, and government studies (Leedy and Ormrod 2001; Bryman and Bell 2003) and describes the incidence, frequency, and distribution of attributes within the population. Further, Leedy and Ormrod (2001) explain that this method does not alter the research situation or intend to discover cause-and-effect relationships.

The advantage of this method as pertaining to this research, is gaining an understanding of the present situation in organisations' climate change strategic efforts. Additionally, this research design allows the consideration of the importance of measurement standardisation, in terms of asking questions and recording answers. As with all descriptive or normative survey design research, care needs to be exercised in extrapolating the results of this research in perpetuity (Leedy and Ormrod 2001).

3.3 Population and sample

With the fundamentals of the research methodology and design thoroughly reviewed, this section details the population, sample, and sampling method employed during this research.

3.3.1 *Population*

The population included in the research comprises of South African organisations ranging from small and medium enterprises through to large corporate entities, that have recognised the implications of climate change on a strategic level and have developed, or in the process of, Carbon Footprint Management Systems. Included in this definition are a wide range of industries ranging from low carbon emitters of the most basic services through to heavy carbon emitters of energy, mining and manufacturing organisations.

As mentioned in Section 1.5: Delimitations of the research, organisations that were part of the South African CDP 2008 report were excluded. The benefit of this delimitation to this research, and value gained for academic research, is that the South African CDP 2008 report only focuses on the 100 largest organisations, and an understanding of the rest of the market within South Africa will be invaluable.

3.3.2 *Sample and sampling method*

For simplicity and cost constraints convenience sampling was deployed. The convenience sampling technique is appropriate for use when there is extreme difficulty in obtaining true probability (Bryman and Bell 2003), as in the case of this research, regarding true probability sampling for organisations within South Africa. This implication further dictated that the data used within this research report remained un-weighted.

In determining an appropriate sample size where the confidence interval is 95%, with the width of the confidence interval (margin of error) being 5%, the recommended sample size would be 384 organisations. However, due to cost

constraints the ideal sample size was restricted to 205 organisations. Organisations were drawn from the major metropolitan areas of Johannesburg, Cape Town, Durban, and Bloemfontein. This sample was sufficient to account for the large heterogeneity of the population and there was no evidence to indicate that a convenient sample, within the different locations would not be representative of the population due to the geographical concentration of industries within the metropolitan areas.

The 205 organisations were sourced and interviewed by Research International South Africa, a custom market research agency. Due to possible sampling bias that could be present in using numerous lists of organisations within South Africa, sampling from any published business list was not explored.

The organisations were identified by a filter question regarding the organisation's climate change strategic efforts. The qualifying criteria, in accordance with the carbon footprint definition contained within the literature review, were that the organisation had to currently measure GHG, or were either creating or in the process of finalising a climate change programme measuring GHG. If the organisation did not qualify, the questionnaire was terminated at this point. If qualifying, the individual respondents were further filtered to represent either sponsors or direct line management involved in these climate change programmes within organisations. They were encouraged to participate by having the option of receiving a copy of the research results, and guaranteeing that their voluntary participation would be anonymous.

3.4 The Research instrument

Following on from the population and sample, this section details the actual research instrument used during the interviewing process. A broad overview of the research instrument is given, followed by a detailed explanation of each section within the research instrument.

A structured telephonic questionnaire containing both open and closed questions was administered to the organisations and can be viewed in APPENDIX A: Research Instrument. Leedy and Ormrod (2001) explain that

telephonic interviews have the advantage of being less time consuming, and achieving reasonable response rates. These advantages are well suited to the research instrument design, in terms of delivering a short questionnaire and individual respondents within the organisations largely comprising time-bound high level executives.

A de-brief of the research problem, profile of the targeted organisations, and checking of the questionnaire wording, routing and coding was held by Kent Diepraam at the Johannesburg office of Research International South Africa with all the interviewers on the 18th May 2009. Each interviewer conducted a maximum of ten interviews to minimise the effect of any interviewer bias.

The first section of the questionnaire included questions relating to overall size of the organisation in terms of number of employees and the appropriate industrial sector of that organisation, followed by the filtering section.

The third section of the questionnaire was dedicated to the reasons for implementation of Carbon Footprint Management Systems. This section was measured by individual respondents being asked to rate their perceived importance of each statement on a 10-point scale with 1 representing, “Not at all Important” and 10 representing, “Extremely Important”. If the statement was not applicable to that organisation, the individual respondents were asked to indicate this to the interviewer. Respondents were also given the opportunity to indicate any additional reasons in the open-ended section at the end of the question. Few answers were given in the open-ended section, suggesting a comprehensive statement list. These open-ended responses were excluded from any analysis.

The fourth section dealt with the elements contained within Carbon Footprint Management Systems that South African organisations are using. The same scale was used as in the previous question and respondents once again had the opportunity to indicate any additional inclusions in the open-ended section at the end of the question. A similar pattern occurred with the open-ended responses as in the previous question. Again, these open-ended responses were excluded from any analysis.

The questionnaire is ended with the section asked only to the pilot organisations regarding their understanding of the question instruction, the question wording for each question, and any ambiguity on the question statements.

All individual respondents were asked if they would prefer receiving a covering letter for the interview that provided an introductory note to the research. These were then sent to the individual respondent by facsimile or electronic mail after the interview was concluded.

3.5 Procedure for data collection

This section provides facts into the interview process and subsequent data collection and capture.

As the business language in South Africa is English, the 20 minute long interviews were conducted in English between 21 May 2009 and 12 June 2009. Once the questionnaires were completed, they were returned to Research International South Africa and collected by the researcher where they were transcribed into Microsoft Excel. Checking of this process was conducted for verification and auditing purposes.

3.6 Data analysis and interpretation

The data analysis and interpretation section indicates what statistical software packages were used during this stage, and is followed by a detailed view of the statistical procedures conducted for this research.

The data were analysed using SPSS Version 17.0 (Statistical Package for Social Science) and NCSS (Number Cruncher Statistical system). Each software package was chosen for its available options that suited this research. The analysis included exploratory factor analysis (EFA), summary statistics, and the non-parametric Kruskal-Wallis significance test. Confirmatory factor analysis was not appropriate for this research as the aim was not to test the validity or support of any academic theoretical model, but rather to establish which motivational constructs were important in the South African context.

As organisations were given the option during the interview to indicate if a statement was not applicable, the missing values were not replaced with any estimation technique due to the underlying distribution of the data being changed. Additionally, the verbal scale ordinal data for the two main questions were not re-scaled as the ten scaling categories were enough to assume that the data were continuous (Hintze 2007b).

3.6.1 *Exploratory factor analysis*

EFA is a technique used to, “examine the correlations among a number of variables and identify clusters of highly interrelated variables that reflect underlying themes, or factors, within the data” (Leedy and Ormrod 2001:278).

The aim of using factor analysis is to identify any possible latent variables within the survey questions and not as a data reduction tool. This distinction toward the research objectives is seen as crucial to ensure the correct use of statistical procedures (Fabrigar, Wegener, MacCallum and Strahan 1999). An EFA was conducted on each of the two main proposition statements, one for the reasons why organisations create Carbon Footprint Management Systems, and the second on the elements contained within them.

When conducting an EFA, measures of association among variables need to be explored before proceeding with the factor computations. EFA literature lists three such measures critical for analysis validity and which this research report included: correlations between variables, Bartlett’s test of sphericity, and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy.

Correlations between variables. Gorsuch (1983) states that correlations are the basis for most factor procedures, while Hintze (2007b) argues that some correlation structure needs to be present within the data to proceed with an EFA. Hintze (2007b) recommends that most of the correlations be greater than 0.30 to proceed with factoring.

Bartlett's test of sphericity (Bartlett 1950) is used to test the null hypothesis that the correlation matrix is an identity matrix. A probability value less than 0.05 indicates that the correlation matrix does not originate from an identify matrix and the EFA can proceed. However, Hintze (2007b) cautions this tests use for samples less than 150.

KMO measure of sampling adequacy (Kaiser 1974) is an index with high values indicating the appropriateness of an EFA due to patterns of correlations being relatively compact, which yield distinct and reliable factors. Kaiser (1974) states that values above 0.50 represent adequacy for factoring. Further, the author quantifies that values in the 0.60s are mediocre, in the 0.70s middling, in the 0.80s meritorious, and in the 0.90s marvellous.

All these measures are the minimum standard that needs to be ascertained in order for the EFA to proceed. Additionally, the assumptions for conducting an EFA were also all tested and are presented in the results chapter, along with the above measures of association results.

An additional measure to consider during the EFA is the variable communalities. Gorsuch (1983) defines the communality of a variable the proportion of the variance that each variable can account for by the created factors. The author explains that high communality solutions contain less error and the number of factors may be easier to estimate. Fabrigar et al. (1999) recommends that the average of the variable set be greater than 0.70.

Regarding the minimum sample size required for EFA, Gorsuch (1983) recommends a minimum sample size of 100. Cattell (1978) recommends a ratio of three to six observations for every variable included, with Gorsuch (1983) being more specific and recommending a minimum of five observations for every variable measured.

For the first factor solution conducted on the reasons for creating Carbon Footprint Management Systems, 102 observations were left after missing

values were taken into account and with the input of 20 variables into the analysis, the above recommendations were met.

For the second factor solution conducted on the elements contained within Carbon Footprint Management Systems, there were 96 observations left after accounting for missing values. Although this falls below Gorsuch's (1983) recommendation of a minimum sample size of 100, there were less (19) variables inputted into the analysis and the ratio of observations to variables still remained high at over five. Additionally, Fabrigar et al. (1999) state that sample sizes of less than 100 can be used to obtain accurate estimates when the communalities for the variable set are high. The high communalities results for this solution, meeting the above stipulation, are presented in the following chapter.

The varimax rotation was used to rotate the factors orthogonally as it aids in the easier interpretation and utility of the factor solution (Fabrigar et al. 1999). The authors explain that this rotation attempts to maximise the variance of squared loadings on a factor to produce high and low loadings for each factor.

The initial factor solutions for each question were analysing with a scree plot (Cattell 1966). In determining the final factor solution, the number of factors included in the model requires a balance between parsimony and plausibility (Fabrigar et al. 1999). The final factor solutions were chosen by investigating several techniques for investigating the number of factors as suggested by Hair, Anderson, Tatham and Black (1995) and Fabrigar et al. (1999).

Factors were strongly considered if the eigenvalues were greater than or equal to one, based on Kaiser's Criterion that eigenvalues less than one provide less information than a single variable (Kaiser 1960). However, Jolliffe (1972) disagrees, and suggests that the Kaiser criterion be set at 0.70 provided that the correlation matrix yields high correlations. The results of this research adopted this view. Fabrigar et al. (1999) concurs that Kaiser's Criterion is set to high.

At this stage the total variance explained by the factor solution was taken into account. Gorsuch (1983) provides a view that total variance explained not be

set at the beginning of the analysis, rather, the factor solution ended when a large portion of the variance has been achieved and new factors added to the solution add little to the total variance. The results of the factor solutions of this research were interpreted in this light.

Finally, the factor solutions were considered based on interpretability with rotated factor loadings greater than 0.40 defining the factor (Hair et al. 1995). If a statement had two rotated factor loadings greater than this value, the highest loading was considered.

3.6.2 *Summary statistics*

In order to provide a deeper understanding of the data, summary statistics were conducted for the two EFA solutions using the original data. This included a discussion around descriptive statistics to provide an initial view on the data. This is followed with an insight into measures of central location with a focus on the mean, median, and modal values. Measures of variability then explained the data around the mean and together with measures of central location, the data distribution takes meaningful shape. Finally, measures of dispersion completed the picture for the data distribution with a discussion on skewness and kurtosis.

3.6.3 *Non-parametric Kruskal-Wallis significance test*

Hypothesis testing at a 5% significance level was conducted to highlight any significant findings by conducting a non-parametric Kruskal-Wallis significance test (Kruskal and Wallis 1952) on the creation reasons for Carbon Footprint Management Systems. This test compares the medians of two or more groups to determine if any differences exist in data that is non-normal (Hintze 2007a).

The test is non-directional, hence a two tailed test was used in that the null hypothesis states that all medians are equal in importance, with the alternative hypothesis stating that at least one median is different on importance.

3.7 Limitations of the research

The limitations of the research are presented in this section. These limitations are the result of decisions made during the course of this research that may have an impact on the overall results obtained. Leedy and Ormrod (2001) state that the researcher is unable to avoid all biases. The following potential limitations of this research are discussed:

- Generalisability, it could be argued in the theoretical sense that the proposed sample is not representative of the population due to a non-probability sampling technique being favoured. The implication is that the sample statistics from this research, and from this particular sample chosen, may lack overall generalisation beyond this research (Bryman and Bell 2003). However, Tan and Peng (2003) argue that this may be less of a limitation if the sample is targeted at multiple industrial sectors and organisational sizes, as in the case of this research. Additionally, included is that un-weighted data were used throughout the analysis due to the difficulty in obtaining the true organisational universe;
- Social responsibility bias, this refers to the situation in which individual respondents attempt to answer the questions in ways that they deem socially desirable (Darnall et al. 2008). This research attempted to address this limitation by assuring guaranteed anonymity;
- Exaggerated climate change commitment, Darnall et al. (2008) argue that self-reported environmental survey data may be exaggerated regarding the organisation's climate change activities and commitment. The authors explain that this bias would overstate the variance contained within the data and a significant result would seem less likely; and
- Characteristics of the organisation, this research does not attempt to identify the role of characteristics specific to the organisation in Carbon Footprint Management Systems such as context, design, flexibility, size, economic sector, quality of existing management systems, and organisational learning, rather, the focus was on managerial views and organisational behaviour.

3.8 Validity and reliability

Finally, this section details the validity and reliability aspects of the research. Definitions of each construct are given, followed by a discussion of what this research achieved to overcome these issues.

Leedy and Ormrod (2001) state that validity and reliability refers to the extent that the researcher can draw meaningful, significant conclusions from the data. The authors state that validity refers to the extent that an instrument measures that which it is intended to measure. Bryman and Bell (2003) explain that reliability and validity are analytically distinguishable with validity presuming reliability. Each of these elements is discussed below.

3.8.1 *External validity*

Leedy and Ormrod (2001) define external validity as the extent that the results of the research can be generalised to other contexts, and is of particular concern to quantitative studies using cross-sectional data designs (Bryman and Bell 2003). This research attempted to increase external validity by choosing a large enough sample for the proposed data analysis given the constraints, by choosing an appropriate research design, and conducting statistical analysis that is appropriate to the data collected and research propositions and hypothesis.

Finally, by including a full spectrum of organisations from small and medium enterprises, through to large corporate organisations in numerous regions within South Africa, greater generalisation and application for this research is hoped for South African organisations.

3.8.2 *Internal validity*

Internal validity can be described as the degree to which the measuring instrument allows inferences about the cause-and-effect relationships present in the data (Leedy and Ormrod 2001). To increase internal validity in any

research, the researcher needs to eliminate potential influences that could explain the results (Leedy and Ormrod 2001).

For the purposes of increasing internal validity, Leedy and Ormrod (2001) suggest conducting research blindly for both interviewers and individual respondents. The overall objectives and purpose of the research were explained and contained on the questionnaire covering letter, but the finer detail of disclosing the sub-problems was not shared with the interviewers or individual respondents.

Bryman and Bell (2003) indicate that content validity should be established, which they defined as the measure reflecting the content of the concept in question. This was tested by ensuring individual respondents from the organisations were correctly targeted by the filter questions at the beginning of the questionnaire and through pilot interviews that targeted the questionnaire content.

The piloted organisations were asked to report any difficulties and ambiguities that they encountered in answering the questionnaire, along with their understanding of each question instruction and question meaning. There were six pilot interviews conducted within the metropolitan areas around South Africa, with the interview administered in the same conditions as the intended research. The comments were recorded and subsequent changes on certain instructions made to the questionnaire before interviewing the sample. The time required for completion of the pilot questionnaire was kept for future reference.

3.8.3 *Reliability*

Leedy and Ormrod (2001) define reliability as the consistency of outcomes when the research remains unchanged.

Reliability for this research was enhanced by the briefing of the interviewers in a central location to ensure the structured interview followed the same routing process, along with the same instrument administered to all participating

organisations. This also ensured that equivalence was minimised and the same conditions were produced for each organisation.

Additionally, reliability was enhanced by editing the questionnaire to ensure careful wording of the questions for mitigating ambiguity and double-barrel statements, and to guarantee what was asked in the questionnaire was understood by the individual respondents verbatim.

During the interviews, the third and fourth section statements were chosen at random by the interviewers to minimise the risk of any interaction order-effect between the statements. Winer (1971) suggests that the order of multiple statements be randomised independently for each interview. This aids in minimising any sequential effect between statements and ensuring that the latter statements are not always rated last with possible respondent fatigue (Winer 1971).

Finally, reliability was enhanced by the use of Cronbach's Coefficient Alpha, which is a reflection of internal reliability of multi-statement measures (Cronbach 1951). This measure was used for the EFA results to gain an indication of the reliability of the chosen solutions.

CHAPTER 4: PRESENTATION OF RESULTS

> "Copenhagen must produce a fully workable action plan to meet head-on the biggest challenge we have ever faced as a civilisation. Global warming is a problem with major ramifications, there are plenty of solutions to hand, and the need to decarbonise our economies will create new challenges for innovation from the private sector. This will stimulate economic growth in a new sustainable direction fit for the twenty first century" Professor Sir David King (CDP South Africa 2008:13).

4.1 Introduction

This chapter presents the results that pertain to this research. The chapter begins with a demographic summary of the organisation's size and economic sector. Next the EFA solution is presented detailing the reasons for creating Carbon Footprint Management Systems which incorporates an investigation of the correlation matrix, factor analysis assumptions, additional pre-EFA tests, discussions on the communalities, eigenvalues, and rotated factor loadings. The factor choice and a brief description of each factor follows. Summary statistics and subsequent discussion of these statistics for this factor solution's results is then presented, along with the appropriate hypothesis test to ascertain if any significant differences exist for the reasons for creating Carbon Footprint Management Systems.

The second EFA solution is then presented, detailing the elements contained within Carbon Footprint Management Systems for participating organisations and follows the same format as the previous EFA solution. Summary statistics and subsequent discussion of these statistics for this factor solution then follow.

This chapter is then concluded by reviewing the results for each EFA solution and the hypothesis test.

4.2 Demographic profile of participating organisations

This section provides a summary view of the organisational size and sector of the participating organisations.

A total of 205 interviews were conducted in the major metropolitan areas of Johannesburg, Cape Town, Durban, and Bloemfontein. Due to three interviewers mistakenly using the pilot version of the questionnaire during the interview, the final qualifying count of interviews that were used was 177. Figure 6 below represents the breakdown of organisations by size.

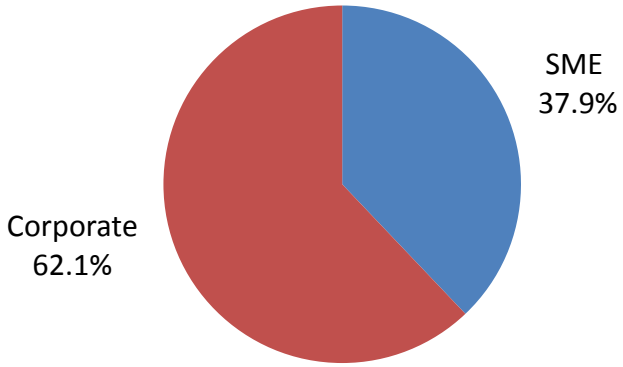


Figure 6: Summary of organisational size

The total sample comprises 37.9% SME with corporate organisations totalling 62.1%, this is not surprising given the financial outlay of environmental programmes. The breakdown by economic sector is presented in Figure 7 below.

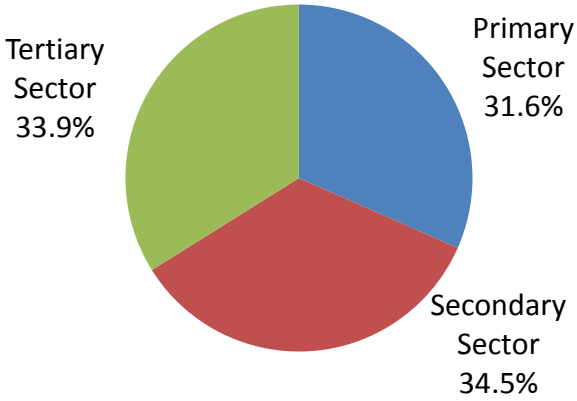


Figure 7: Summary of organisational sector

The total sample is split fairly evenly regarding organisational sector with 31.6% of organisations residing in the primary sector, 34.5% in the secondary sector, and 33.9% in the tertiary sector.

The organisational size and sector groupings were not set out in a sampling frame, rather, the choice was left to the convenient sampling nature of the interviewer. In reviewing the groupings, due to the diverse mix of organisations across these groupings, a greater generalisability of the results is anticipated.

4.3 Implementation reasons for Carbon Footprint Management Systems

The following section presents the analysis undertaken during this research pertaining to the investigation into the reasons for creating Carbon Footprint Management Systems. This section begins with a comprehensive scrutiny regarding the statistical assumptions present for EFA. This is followed with a systematic presentation of the EFA beginning with the measures of association of the correlation matrix, KMO, Bartlett's test, and the variable communalities. Directly following is a discussion and presentation of the chosen factor solution. This section is concluded with a brief introductory view and understanding of each factor.

The results below indicate the chosen factor solution for the first proposition for establishing one or more of these reasons from the literature review: financial performance, regulatory environment, parent company obligations, stakeholder pressure, technological and competitive advantage, proactive stance, and mitigating risk, are reasons for implementing Carbon Footprint Management Systems.

The analysis was conducted on observations with non-missing values and the full output for the chosen solution can be viewed in APPENDIX D: Creation Reasons EFA Output. An EFA with varimax rotated factor loadings was carried out 11 times with these solutions analysed using the EFA techniques discussed above. These solutions were then narrowed down to a small number of workable solutions for further investigation and appear below.

4.3.1 *EFA assumptions*

The first assumption for an EFA, which the data in this research satisfy, is that the data reflect at least on an ordinal scale with several interval levels.

Secondly, the results assume that the measured responses are based on the underlying factors with some collinearity among the variables, along with the relationships between the variables being linear.

Thirdly, as EFA is sensitive to outliers, each variable was analysed for potential outlier data points through descriptive statistics. None were found.

4.3.2 *EFA output for creation reasons*

The first step in ascertaining the relevance of EFA is to determine if there is any correlation structure in the data by analysing the correlation matrix (Hintze 2007b). The correlation matrix for the creation reason statements appears in APPENDIX D: Creation Reasons EFA Output. The bolded figures represent all correlations greater than 0.30 in support of Hintze's (2007b) view that the majority of correlations need to be greater than 0.30 to proceed with a EFA.

The matrix indicates clear patterns of inter-correlation between the variables and these patterns of inter-correlated variables provided initial clues as to where, if any, latent variables might be found. The patterns of inter-correlation appear with the following sets of variables:

- Between Increase_Profit, Decrease_Cost and Pass_Regulation variables;
- Increase_Profit, Decrease_Cost, and Pass_Regulation with the Forefront_Innovation, Relationship_Suppliers, Increase_Technology, and Competitive_Advantage variables;
- Increase_Profit, Decrease_Cost, and Pass_Regulation with the Environ_Important, Increase_Prod_Service, Physical_Risk, Policy_Risk, Competitive_Risk, Legal_Risk, and Reputational_Risk variables;
- The variables of Forefront_Innovation, Relationship_Suppliers, Increase_Technology, and Competitive_Advantage;

- The variables of Pressure_Directors, Pressure_Consumers, Pressure_Employees, Pressure_EnvironGroups, and Pressure_Government;
- The Environ_Important, Increase_Prod_Service, Physical_Risk, Policy_Risk, Competitive_Risk, Legal_Risk, and Reputational_Risk variables; and
- Environ_Important, Increase_Prod_Service, Physical_Risk, Policy_Risk, Competitive_Risk, Legal_Risk, and Reputational_Risk with the Forefront_Innovation, Relationship_Suppliers, Increase_Technology, and Competitive_Advantage variables.

Table 3 below presents the KMO, Bartlett's test, and the variable communalities. The KMO is reflected as meritorious at 0.839 and similarly Bartlett's test yields a significant probability value. Both measures indicate that an EFA is appropriate for this data. Given that the correlation matrix indicated multi-dimensional results with clear patterns of inter-correlation, the strong KMO and significant probability value is not surprising. The majority of the variables communality values are above the threshold of 0.70 with only the five variables of Pass_Regulation, Multi_National, Competitive_Advantage, Reputational_Risk, and Increase_Prod_Service, falling below this mark. The highest communality was Pressure_Consumers at 0.839, with the average being 0.73.

Table 3: KMO, Bartlett's test and communalities for creation reasons

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.839
Bartlett's Test of Sphericity	Approx. Chi-Square	1669.462
	df	190
	Sig.	.000
Communalities		
Var	**Initial**	**Extraction**
Increase_Profit	1.000	0.738
Decrease_Cost	1.000	0.749
Pass_Regulation	1.000	0.595
Multi_National	1.000	0.492
Forefront_Innovation	1.000	0.749

KMO and Bartlett's Test		
Relationship_Suppliers	1.000	0.726
Increase_Technology	1.000	0.751
Competitive_Advantage	1.000	0.649
Pressure_Directors	1.000	0.798
Pressure_Consumers	1.000	0.839
Pressure_Employees	1.000	0.768
Pressure_EnvironGroups	1.000	0.767
Pressure_Government	1.000	0.760
Environ_Important	1.000	0.810
Increase_Prod_Service	1.000	0.668
Physical_Risk	1.000	0.743
Policy_Risk	1.000	0.803
Competitive_Risk	1.000	0.729
Legal_Risk	1.000	0.825
Reputational_Risk	1.000	0.644

After an initial investigation applying Kaiser's Criterion (Kaiser 1960), the first three factors were provisionally retained. This solution was confirmed with the scree plot (Cattell 1966). This decision was kept as an initial option from the 11 different solutions.

After analysing the table further, the fourth factor's eigenvalue was 0.997 and only 0.003 below Kaiser's Criterion (Kaiser 1960), but added an additional 4.986% of variability explained. As the correlation matrix indicated clear patterns of inter-correlation between the variables and the eigenvalue was greater than 0.70 (Jolliffe 1972), this factor solution was retained and kept as a second option.

For the choice of the best workable solution, the rotated factor loadings above 0.40 were considered and interpreted for each option (Hair et al. 1995). Where a statement had two rotated factor loadings greater than this value, the highest loading was considered. The four factor solution was considered the most practical solution creating clearer interpretable latent variables. The four factor solution below in Table 4 represents a total cumulative percentage of variance explained at a respectable 73.008%.

Table 4: Eigenvalues after varimax rotation for creation reasons

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.845	44.223	44.223	8.845	44.223	44.223
2	3.411	17.053	61.275	3.411	17.053	61.275
3	1.349	6.746	68.022	1.349	6.746	68.022
4	0.997	4.986	73.008	0.997	4.986	73.008
5	0.803	4.015	77.022			
6	0.766	3.832	80.855			
7	0.602	3.009	83.863			
8	0.508	2.541	86.404			
9	0.484	2.421	88.826			
10	0.413	2.067	90.893			
11	0.358	1.789	92.682			
12	0.284	1.421	94.103			
13	0.262	1.309	95.412			
14	0.205	1.025	96.436			
15	0.165	0.825	97.261			
16	0.154	0.769	98.031			
17	0.134	0.668	98.699			
18	0.106	0.529	99.228			
19	0.086	0.432	99.660			
20	0.068	0.340	100.000			

Extraction Method: Principal Component Analysis.

4.3.3 *EFA description for creation reasons*

This section describes each factor from the four factor solution. The statement description for each factor is included along with the factors individual Cronbach's Coefficient Alpha measuring data reliability. This measure is a reflection of internal reliability of multi-statement measures (Cronbach 1951).

Carmines and Zeller (1990) suggest that an alpha of at least 0.80 should be achieved for widely used instruments, with Hair et al. (1995) considering values above 0.70 acceptable. The measure is based on the assumption that the scaling used on the questions are all in the same direction, which the data in this research satisfy.

Two of the four factors had a Cronbach's Coefficient Alpha greater than 0.70 as recommended by Hair et al. (1995). The remaining two factors had a Cronbach's Coefficient Alpha of 0.69, and despite this being lower than the

recommended value by Hair et al. (1995), due to the value being on the cusp of 0.70 the solution was viewed as being sufficient.

4.3.3.1 *Mitigating risk and proactive thinking*

This factor is named as such due to the contributing underlying statements loading onto this factor dealing with mitigating risk and an organisation's proactive stance towards environmental programmes. Table 5 below presents the variable name, statement in the questionnaire, and rotated factor loading. The Cronbach's Coefficient Alpha for this factor is 0.9204 which is well above the recommended minimum.

Table 5: Creation Factor 1 Mitigating Risk and Proactive Thinking

Variable	Statement	Rotated Factor Loading
Relationship_Suppliers	My company wanted better relationships with	**0.727**
Increase_Technology	My company saw an opportunity to increase our technological processes	**0.671**
Competitive_Advantage	My company wanted to create a competitive	**0.748**
Increase_Prod_Service	We wanted to further our company through product/service development	**0.775**
Physical_Risk	My company wanted to mitigate physical risks	**0.805**
Policy_Risk	My company wanted to mitigate public policy risks	**0.839**
Competitive_Risk	My company wanted to mitigate competitive impacts	**0.820**
Legal_Risk	My company wanted to mitigate any possible legal	**0.864**
Reputational_Risk	My company wanted to mitigate any possible reputational risks	**0.729**

4.3.3.2 *Stakeholder pressure*

This factor is named due to the contributing underlying statements loading onto this factor concerning organisational stakeholder pressure that organisations encounter. Table 6 below presents the variable name, statement in the questionnaire, and the rotated factor loading. The Cronbach's Coefficient Alpha for this factor is 0.9130 which is well above the recommended minimum.

Table 6: Creation Factor 2 Stakeholder Pressure

Variable	Statement	Rotated Factor Loading
Multi_National	We are a multi-national and our parent/holding company is bound by environmental legislation such as the Kyoto Protocol	**0.600**
Pressure_Directors	My company came under pressure from the directors	**0.866**
Pressure_Consumers	My company came under pressure from consumers	**0.884**
Pressure_Employees	My company came under pressure from our own employees	**0.873**
Pressure_EnvironGroups	My company came under pressure from environmental groups	**0.850**
Pressure_Government	My company came under pressure from the government	**0.839**

4.3.3.3 *Financial and regulatory*

This factor is named as such due to the contributing underlying statements loading onto this factor comprising organisational financial and regulatory aspects. Table 7 below presents the variable name, statement in the questionnaire, and the rotated factor loading. The Cronbach's Coefficient Alpha for this factor is 0.6912.

Table 7: Creation Factor 3 Financial and Regulatory

Variable	Statement	Rotated Factor Loading
Increase_Profit	My company saw an opportunity to increase profits	**0.779**
Decrease_Cost	My company saw an opportunity to decrease costs	**0.703**
Pass_Regulation	My company believes that the government will pass environmental legislation limiting Greenhouse Gas emissions in the next few years	**0.462**

4.3.3.4 *Environmental innovation*

This factor is named due to the contributing underlying statements loading onto this factor concerning innovation and increasing environmental importance. Table 8 below presents the variable name, statement in the questionnaire, and the rotated factor loading. The Cronbach's Coefficient Alpha for this factor is 0.6905.

Table 8: Creation Factor 4 Environmental Innovation

Variable	Statement	Rotated Factor Loading
Forefront_Innovation	My company is forward thinking and likes to be involved in the forefront of innovation	**0.697**
Environ_Important	My company views environmental issues as increasingly important	**0.804**

4.3.4 *Summary statistics for creation reasons*

Table 9 below presents the summary statistics for the chosen factor solution described above for the reasons why organisations create Carbon Footprint Management Systems.

This summary includes descriptive statistics, measures of central location, variability, and dispersion. This is followed by a discussion of the factor solution. The insights from this analysis provide initial clues as to the data distribution and variance.

Table 9: Summary statistics for creation reasons

Descriptive Statistics	Mitigating Risk Proactive	Stakeholder Pressure	Financial and Regulatory	Environmental Innovation
Minimum	1	1	1	1
Maximum	10	10	10	10
Range	9	9	9	9
Q1	6	1	6	7
Q3	10	8	10	10
5th-Percentile	1	1	1	4
95th-Percentile	10	10	10	10
Inter-quartile Range	4	7	4	3

Measures of Central Location	Mitigating Risk Proactive	Stakeholder Pressure	Financial and Regulatory	Environmental Innovation
Mean	7.44	5.10	7.39	7.96
Median	8.00	5.00	8.00	8.00
Mode	10.00	1.00	10.00	10.00
Measures of Variability	**Mitigating Risk Proactive**	**Stakeholder Pressure**	**Financial and Regulatory**	**Environmental Innovation**
Standard Deviation	2.66	3.40	2.78	2.21
Variance	7.09	11.55	7.72	4.87
Mean Absolute Deviation (MAD)	2.11	3.06	2.29	1.72
Measures of Dispersion	**Mitigating Risk Proactive**	**Stakeholder Pressure**	**Financial and Regulatory**	**Environmental Innovation**
Skewness	-1.11	0.05	-0.94	-1.27
Kurtosis	0.34	-1.52	-0.15	1.47

The descriptive statistics section is useful in analysing and providing an initial insight into the data. Starting with the minimum, maximum and range values, all factors portray the same values as is to be expected. The first quartile for Stakeholder Pressure scores 1, whereas the other factors score higher at 6 or 7. Similarly, the third quartile for Stakeholder Pressure is lower with a score of 8, with the other factors scoring a maximum 10. These insights provide initial clues as to the distribution shape for the factors, with a larger percentage of the total scores being lower values for Stakeholder Pressure compared to the other three factors. Also noteworthy is that the 5^{th} percentile for Environmental Innovation is somewhat higher at 4, compared to the other factors that score 1. The inter-quartile range indicates the middle 50% of the data, and Environmental Innovation has the smallest range at 3 implying that the middle 50% of the data for this variable is in fact over the shortest scaled difference. In contrast, the range of Stakeholder Pressure is higher and more spread out scoring 7, with Mitigating Risk and Proactive Thinking, and Financial and Regulatory between these two factors.

Measures of central location provide a more detailed view of the central tendency of the data. In comparing the mean and median, a clearer view of whether the distribution is symmetrical or not is gained. For Financial and

Regulatory, Mitigating Risk and Proactive Thinking, and Environmental Innovation, the mean is less than the median which implies that these distributions are negatively skewed. This is confirmed by these distributions having negative skewness figures. The opposite is true for Stakeholder Pressure, where the mean is greater than the median causing the distribution to be positively skewed. After analysing the descriptive statistics and the positive skewness figure this result is to be expected. The factor with the highest mean is Environmental Innovation scoring 7.96, followed by Mitigating Risk and Proactive Thinking with 7.44, Financial and Regulatory with 7.39, and finally, Stakeholder Pressure with 5.10. Noteworthy is that the median for Financial and Regulatory, Mitigating Risk and Proactive Thinking, and Environmental Innovation is much closer to the maximum value for 10 than Stakeholder Pressure, which is also subsequently the only factor with a modal value of one. All other factors have a modal value of 10.

Measures of variability provide information regarding the variability about the mean of the data. Environmental Innovation has the lowest standard deviation of the four factors, with Stakeholder Pressure the largest. This is to be expected given the discussion above on the inter-quartile range of these factors. The MAD indicates, on average, how much the values differ from the mean. Once again, Environmental Innovation has the lowest score at 1.72, with Stakeholder Pressure the highest at 3.06.

Environmental Innovation has the highest kurtosis score at 1.47, which is expected due to this factor having the lowest standard deviation and inter-quartile range. This is followed by Mitigating Risk and Proactive Thinking with a kurtosis score of 0.34 that also indicates that this distribution has more peakedness than predicted by a normal distribution. Stakeholder Pressure, and Financial and Regulatory, both display negative kurtosis figures which indicate that there is less peakedness than what is expected for a normal distribution. This is confirmed with these factors having higher standard deviations and MAD scores.

4.3.5 *Conclusion for creation reasons*

The results for this proposition indicate that the reasons for organisations' creating Carbon Footprint Management Systems are summarised by the following statements:

- The factors represent creation reasons for South African organisations. The summary statistics suggest that all are present to some degree with a total of 73.008% of the variance explained contained within the chosen factor solution;
- The factors of Environmental Innovation, Mitigating Risk and Proactive Thinking, along with Financial and Regulatory Pressures are all strong motivations for organisational behaviour. Evidence is presented by these factors scoring higher overall means, median, first quartile, third quartile and modal values, a smaller inter-quartile range, along with these distributions being negatively skewed; and
- The factor of Stakeholder Pressure was seen as a less motivated aspect for organisational behaviour. This was evident by comparing a lower mean, median, first quartile and modal values, along with the distribution being positively skewed.

4.4 Significance test for creation reasons

Once the factor solution was finalised, a hypothesis test was conducted to review if any significant differences exist between the factors for an additional layer of insight onto this research and to relate back to the academic literature. This section details the Kruskal-Wallis significance test and begins with an explanatory note into the procedure. This is followed by inspecting the assumptions for this particular hypothesis test. The results to this test and interpretation thereof conclude this section.

Before the hypothesis test was run, the data were tested for normality and were rejected at the 5% significance level. The skewness normality of residuals, kurtosis normality of residuals, and omnibus normality of residuals can be

viewed in the output in APPENDIX F: Kruskal-Wallis Significance Test Output. The appropriate hypothesis test for ordinal non-normal data is the non-parametric Kruskal-Wallis significance test (Hintze 2007a).

Before this test was performed, the data were log and square-root transformed, to ascertain if the normality would improve so that a more powerful parametric test could be administered. The transformations did not improve normality of the data. Additionally, the data were checked for outliers. Although the factor Environmental Innovation presents a long tail, the data points were legitimate and subsequently were not deleted.

The assumptions for the non-parametric Kruskal-Wallis significance test include the following (Hintze 2007a):

- Independence of groups, the factors contained within this significance test have no influence on one another and each factor is unaffected by the others;
- Random sample of population, organisations had equal chance of inclusion during the convenient sampling methodology employed by Research International South Africa;
- Continuous random variables, as stated previously, verbal scale ordinal data for the two main questions were not re-scaled as ten scaling categories were enough to assume that the data were continuous (Hintze 2007a); and
- Measurement scale of at least ordinal, the data scales contained on this data satisfy this assumption.

When testing the medians of the different groups for significant differences, Hintze (2007a) recommends the procedure of the Kruskal-Wallis multiple comparison z-value, that is referenced to Dunn's test (Dunn 1964), as the assumption of normality is not necessary. This aligned with the data for this research.

Further, Hintze (2007a) argues that when conducting multiple comparisons to establish exactly which pairs are different, the significance level of the multiple comparison procedure be adjusted to account for the increase in at least one

erroneous result as the number of comparisons increase. Hintze (2007a) recommends that the Kruskal-Wallis multiple comparison z-value procedure be conducted at a significance level of 1% to account for the multiple comparisons as this will yield an overall experiment significance level of 5%, which is the intended significance level for this research. This research adopted this view for the analysis.

For the Kruskal-Wallis significance test the following hypothesis at a 5% significance level applies:

H_0 = All medians of importance are equal

H_A = All medians of importance are not equal

The results of the Kruskal-Wallis significance test appear in Table 10 below.

Table 10: Kruskal-Wallis significance test

Method	DF Decision (0.05)	Chi-Square (H)	Prob Level	Decision
Not Corrected for Ties	3	325.6178	0.000000	Reject H_0
Corrected for Ties	3	334.7659	0.000000	Reject H_0

Number Sets of Ties	10
Multiplicity Factor	9.493834E+08

As there are repeated values in the underlying data, the corrected for ties result is the correct version to use for this analysis (Hintze 2007a).

Due to the probability level being less than 5%, a significant result is presented and the null hypothesis is rejected in favour of the alternate hypothesis. The conclusion is that at a 5% significance level, there is enough evidence in the sample data to support that there is a significant difference between the median scores of the factors.

The results of the Kruskal-Wallis multiple-comparison z-value test identify which factors are significantly different, and appear in Table 11 below.

Table 11: Kruskal-Wallis multiple-comparison z-value test (Dunn's test)

Variable	Environmental Innovation	Financial and Regulatory	Mitigating Risk Proactive	Stakeholder Pressure
Environmental Innovation	0.0000			
Financial and Regulatory	2.1470	0.0000		
Mitigating Risk Proactive	2.6844	0.1919	0.0000	
Stakeholder Pressure	13.3078	12.4019	16.2095	0.0000

Regular Test: Medians significantly different if z-value > 2.5758
Bonferroni Test: Medians significantly different if z-value > 3.1440

The results of the Kruskal-Wallis multiple comparison z-value indicate that all pair comparisons with a z-value greater than 3.1440 are significantly different. The z-value of the Bonferroni test is used, as the interest is in all paired comparisons only and this is known in advance of conducting the test (Hintze 2007a). Two conclusions can be drawn from this procedure. Firstly, that the factors of Financial and Regulatory, Environmental Innovation, and Mitigating Risk and Proactive Thinking are not significantly different from each other, and secondly, Stakeholder Pressure is significantly different from the other three factors. This result is verified by the box-and-whisker plot in APPENDIX F: Kruskal-Wallis Significance Test Output.

4.4.1 *Conclusion*

The results indicate that the reasons for organisations' creating Carbon Footprint Management Systems are summarised by the following statements:

- Financial and Regulatory, Mitigating Risk and Proactive Thinking, and Environmental Innovation factors are not significantly different from each other. Using the summary statistics these factors can be interpreted as being statistically more important for the participating organisations; and
- Stakeholder Pressure is significantly different from the other three factors, and using the summary statistics this factor can be interpreted as being statistically less important for the participating organisations.

4.5 Elements contained within Carbon Footprint Management Systems

This section presents the analysis undertaken during this research pertaining to the investigation into the elements contained within Carbon Footprint Management Systems. This section contains a review of the statistical assumptions regarding an EFA analysis. This is followed with a systematic presentation of the EFA beginning with the correlation matrix, KMO, Bartlett's test, and the communalities. Next is the discussion and presentation of the chosen factor solution, ending with a brief introductory view and understanding of each factor.

The results below indicate the chosen factor solution for the second proposition for establishing if one or more of these elements emanates from the literature review: assess organisational position, a GHG Inventory, reporting mechanisms, long-term strategy planning, and implementation platform, are used in the structure of Carbon Footprint Management Systems.

The analysis was conducted on observations with non-missing values and the full output for the chosen solution can be viewed in APPENDIX E: Elements Contained EFA Output. The EFA was carried out 11 times and of these options, a small number of workable solutions for further investigation were chosen and appear below.

4.5.1 *EFA assumptions*

The assumptions for this factor solution regarding the elements contained within Carbon Footprint Management Systems are identical to the first factor solution for the creation reasons.

4.5.2 *EFA output for elements contained*

The first step in ascertaining the relevance of EFA is to analyse the correlation matrix to determine if there is any correlation structure in the data (Hintze 2007b). The correlation matrix for the elements contained statements appears

in APPENDIX E: Elements Contained EFA Output. The bolded figures represent all correlations greater than 0.30 in support of Hintze's (2007b) view that the majority of correlations need to be greater than 0.30 to proceed with an EFA.

The patterns of inter-correlation amongst the variables portray an interesting result for the second EFA. Contrary to the creation reason statements, where specific patterns of inter-correlation were present, the matrix for this EFA reflects a high inter-correlation between most of the variables. These patterns of inter-correlated variables provided initial clues as to where, if any, latent variables might be found. High correlations appear on the following:

- Assess_RegulatoryRisk, Assess_SupplyChainRisk, Assess_PhysicalRisk, Assess_TechnologicalRisk, Assess_LegalRisk Assess_ReputationalRisk, GreenhouseProtl_Inventory, and Other_Inventory variables; and
- ISO_14001, Review_ClimateRisk, Company_Strategy, Scenario_Planning, Supply_Demand, and Drive_Senior variables.

Table 12 below presents the KMO, Bartlett's test, and the variable communalities. The KMO is meritorious at 0.880 and similarly Bartlett's test yields a significant probability value. Both measures indicate that an EFA is also appropriate for this data. Given that the correlation matrix indicated multi-dimensional results on most variables, the stronger KMO and significant probability value is expected. The majority of the variables communality values are above the threshold of 0.70 with only four variables of Other_Inventory, Inhouse_Inventory, Design_Store_Data, and Drive_Junior falling below this mark. The highest communality was Assess_LegalRisk at 0.876, and the average being 0.74.

Table 12: KMO, Bartlett's test and communalities for elements contained

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.880
Bartlett's Test of Sphericity	Approx. Chi-Square	1485.362
	df	171
	Sig.	.000

KMO and Bartlett's Test		
Communalities		
Var	**Initial**	**Extraction**
Assess_RegulatoryRisk	1.000	.757
Assess_SupplyChainRisk	1.000	.812
Assess_TechnologicalRisk	1.000	.836
Assess_LegalRisk	1.000	.876
Assess_ReputationalRisk	1.000	.830
Assess_PhysicalRisk	1.000	.753
GreenhouseProtl_Inventory	1.000	.750
Other_Inventory	1.000	.699
Inhouse_Inventory	1.000	.633
Design_Store_Data	1.000	.680
ISO_14001	1.000	.727
Review_ClimateRisk	1.000	.746
Company_Strategy	1.000	.734
Scenario_Planning	1.000	.756
Supply_Demand	1.000	.768
Drive_Senior	1.000	.708
Drive_Junior	1.000	.504
Training_Programmes	1.000	.722
Written_Policy	1.000	.813

Kaiser's Criterion (Kaiser 1960) was firstly applied and the first three factors were provisionally retained. The scree plot (Cattell 1966) then confirmed this solution and it was kept as an initial option.

After analysing the table further, the fourth factor's eigenvalue was 0.986 and only 0.014 below Kaiser's Criterion (Kaiser 1960), but added an additional 5.189% of variability explained. Due to the strong KMO, eigenvalue greater than 0.70 (Jolliffe 1972), and clear patterns of inter-correlation between the variables in the correlation matrix, the fourth factor solution was kept as a second option.

All rotated factor loadings above 0.40 were considered for each option and the factor solution interpreted to decide which option best reflected a workable solution (Hair et al. 1995). Where a statement had two rotated factor loadings greater than this value, the highest loading was considered. The four factor solution was considered the most practical, creating clearer defined latent variables. The four factor solution below in Table 13 represents a total cumulative percentage of variance explained at a respectable 74.240%.

Table 13: Eigenvalues after varimax rotation for elements contained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.625	50.658	50.658	9.625	50.658	50.658
2	2.359	12.415	63.073	2.359	12.415	63.073
3	1.136	5.978	69.052	1.136	5.978	69.052
4	0.986	5.189	74.240	.986	5.189	74.240
5	0.756	3.978	78.219			
6	0.573	3.014	81.232			
7	0.565	2.973	84.205			
8	0.536	2.818	87.024			
9	0.453	2.385	89.409			
10	0.365	1.919	91.329			
11	0.342	1.802	93.130			
12	0.274	1.440	94.570			
13	0.244	1.284	95.854			
14	0.202	1.064	96.918			
15	0.148	0.779	97.698			
16	0.143	0.753	98.451			
17	0.127	0.671	99.122			
18	0.103	0.540	99.662			
19	0.064	0.338	100.000			

Extraction Method: Principal Component Analysis.

4.5.3 *EFA description for elements contained*

Each factor description appears below for the chosen factor solution. The statement description for each factor is included along with the factors individual Cronbach's Coefficient Alpha. Each factor had a Cronbach's Coefficient Alpha well above 0.70 as recommended by Hair et al. (1995).

4.5.3.1 *Risk assessment*

This factor is named due to the contributing underlying statements loading onto this factor dealing with the assessment of organisational risk. Table 14 below presents the variable name, statement in the questionnaire, and the rotated factor loading. The Cronbach's Coefficient Alpha for this factor is 0.9467 which is well above the recommended minimum.

Table 14: Elements Factor 1 Risk Assessment

Variable	Statement	Rotated Factor Loading
Assess_RegulatoryRisk	My company assesses regulatory risks	**0.780**
Assess_SupplyChainRisk	My company assesses supply chain risks	**0.784**
Assess_TechnologicalRisk	My company assesses product and technology risks	**0.878**
Assess_LegalRisk	My company assesses legal risks	**0.892**
Assess_ReputationalRisk	My company assesses reputational risks	**0.889**
Assess_PhysicalRisk	My company assesses physical risks	**0.829**

4.5.3.2 *Reporting mechanisms*

This factor is named due to the contributing underlying statements loading concerning reporting mechanisms the organisation faces. Table 15 below presents the variable name, statement in the questionnaire, and the rotated factor loading. The Cronbach's Coefficient Alpha for this factor is 0.8609 which is well above the recommended minimum.

Table 15: Elements Factor 2 Reporting Mechanisms

Variable	Statement	Rotated Factor Loading
ISO_14001	My company uses the ISO 14001 for our Greenhouse Gas emissions strategy	**0.613**
Review_ClimateRisk	My company conducts a review of the climate change risks	**0.720**
Training_Programmes	My company includes environmental training programmes	**0.676**
Written_Policy	My company has a written environmental policy	**0.847**

4.5.3.3 *GHG Inventory*

This factor is named as such due to the contributing underlying statements focusing on the GHG Inventory. Table 16 below presents the variable name, statement in the questionnaire, and the rotated factor loading. The Cronbach's Coefficient Alpha for this factor is 0.7950.

Table 16: Elements Factor 3 GHG Inventory

Variable	Statement	Rotated Factor Loading
GreenhouseProtl_Inventory	My company uses a Greenhouse Gas Inventory such as the Greenhouse Gas Protocol	**0.647**
Other_Inventory	My company uses another Greenhouse Gas Protocol for the Greenhouse Gas Inventory	**0.771**
Design_Store_Data	My company has designed a system to collect and store the Greenhouse Gas emission data	**0.546**
Drive_Junior	Our company's Greenhouse Gas emissions programme is driven from the lower rank employees up to senior management	**0.641**

4.5.3.4 *Long-term strategic intent*

This factor is named due to the contributing underlying statements loading onto this factor comprising top management's commitment and long-term direction for the organisation. Table 17 below presents the variable name, statement in the questionnaire, and the rotated factor loading. The Cronbach's Coefficient Alpha for this factor is 0.8754 which is well above the recommended minimum.

Table 17: Elements Factor 4 Long-Term Strategic Intent

Variable	Statement	Rotated Factor Loading
Inhouse_Inventory	My company developed our own Greenhouse Gas Inventory	**0.649**
Company_Strategy	My company includes the Greenhouse Gas emission programme into the company strategy	**0.574**
Scenario_Planning	My company conducts scenario strategy plans for our Greenhouse Gas emissions programme	**0.611**
Supply_Demand	My company assesses the supply and demand for carbon in our Greenhouse Gas emissions programme	**0.625**
Drive_Senior	Our company's Greenhouse Gas emissions programme is driven from senior management down to lower rank employees	**0.769**

4.5.4 *Summary statistics for elements contained*

Table 18 below presents the summary statistics for the chosen factor solution described above. This section includes a summary of descriptive statistics, measures of central location, variability, and dispersion. A deeper insight into these measures is then discussed.

Table 18: Summary statistics for elements contained

Descriptive Statistics	Risk Assessment	Reporting Mechanisms	GHG Inventory	Long-Term Strategic Planning
Minimum	1	1	1	1
Maximum	10	10	10	10
Range	9	9	9	9
Q1	5	4	1	4
Q3	10	9	9	9
5th-Percentile	1	1	1	1
95th-Percentile	10	10	10	10
Inter-quartile Range	5	5.25	8	5
Measures of Central Location	**Risk Assessment**	**Reporting Mechanisms**	**GHG Inventory**	**Long-Term Strategic Planning**
Mean	7.20	6.33	5.21	6.53
Median	8.00	7.00	5.00	7.00
Mode	10.00	10.00	1.00	10.00

Measures of Variability	Risk Assessment	Reporting Mechanisms	GHG Inventory	Long-Term Strategic Planning
Standard Deviation	2.91	3.26	3.49	3.20
Variance	8.45	10.63	12.20	10.21
Mean Absolute Deviation (MAD)	2.40	2.85	3.19	2.73
Measures of Dispersion	**Risk Assessment**	**Reporting Mechanisms**	**GHG Inventory**	**Long-Term Strategic Planning**
Skewness	-0.89	-0.45	0.01	-0.60
Kurtosis	-0.35	-1.20	-1.60	-1.02

An initial insight into the data is gained from analysing the descriptive statistics. Starting with the minimum and maximum values, all factors portray the same values as is to be expected. The first quartile for GHG Inventory scores 1, whereas the other factors score higher at 4 or 5. Contrastingly, the third quartile for the four factors is similar either scoring a 9 or 10. The 5^{th} percentile and 95^{th} percentile values are the same for all four factors, with GHG Inventory having the largest middle 50% of the data by having the largest inter-quartile range score, thus being more spread out than the other factors. These insights provide initial clues as to the distribution shape for the factors which do not seem to have such large differences as the first factor solution.

Measures of central location provide a more detailed view of the central tendency of the data and a clearer view of whether the distribution is symmetrical or not, is gained. For Risk Assessment, Reporting Mechanisms, and Long-Term Strategic Planning, the mean is less than the median implying that these distributions are negatively skewed. This is confirmed with the negative skewness scores. The opposite is true for GHG Inventory where the mean is greater than the median, causing the distribution to be positively skewed. After analysing the descriptive statistics these results are to be expected. The factor with the highest mean is Risk Assessment scoring 7.20, followed by Long-Term Strategic Planning with 6.53, followed by Reporting Mechanisms with 6.33, and GHG Inventory with 5.21. Noteworthy is that the Risk Assessment median is much closer to the maximum value for 10 than the other factors. GHG Inventory has a modal value of one with the other factors modal value being 10.

Measures of variability provide information regarding the variability about the mean of the data. Risk Assessment has the lowest standard deviation of the four factors with Reporting Mechanisms the largest. This is to be expected given the discussion above on the Measures of Central Location. The MAD indicates on average, how much the values differ from the mean. Once again, Risk Assessment has the lowest scoring 2.40, with GHG Inventory the highest scoring 3.19.

All the factors on this solution have negative kurtosis figures which indicate that there is less peakedness than what is expected for a normal distribution. This is supported by larger inter-quartile ranges for these factors in comparison to the first EFA solution.

4.5.5 *Conclusion for elements contained*

The results for this proposition indicate that the elements contained within Carbon Footprint Management Systems are summarised by the following statements:

- The factors of Risk Assessment, Reporting Mechanisms, and Long-Term Strategic Intent are all strong inclusions within Carbon Footprint Management Systems. This is portrayed by these factors scoring higher on the mean, median, first quartile and modal values, along with these distributions being negatively skewed; and
- GHG Inventory was seen as an element that was less prevalent in organisations. This was evident through lower mean, median and modal values, along with this distribution being positively skewed.

4.6 Summary of the results

This section provides a summary of the results chapter. The result of each proposition and the hypothesis is re-iterated with the next chapter providing an interpretation and possible explanation of these results. Included in the discussion below is an understanding of the margin of error for the results and the implications for this research.

Four reasons for creating Carbon Footprint Management Systems were identified through EFA for the participating organisations' responses. These factors are Mitigating Risk and Proactive Thinking, Stakeholder Pressure, Financial and Regulatory, and Environmental Innovation. The results of the hypothesis test indicated that Mitigating Risk and Proactive Thinking, Financial and Regulatory, and Environmental Innovation, were significantly different and more important for the participating organisations than Stakeholder Pressure.

The main factors contained within Carbon Footprint Management Systems for the participating organisations were recognised as Risk Assessment, Reporting Mechanisms, GHG Inventory, and Long-Term Strategic Intent. A hypothesis test was not performed on the elements although summary statistics did indicate that GHG Inventory was seen as an element that was less prevalent in organisations compared to the other factors. This was evident through lower mean, median and modal values, along with this distribution being positively skewed. The other three elements scored in a similar range with Risk Assessment scoring the highest summary statistics.

As mentioned in Section: 3.2.2 Sample and sampling method, the appropriate recommended sample size with a margin of error of 5% was 384 organisations, with this section dealing with the constraints and justifications for reducing the sample size to 205 organisations. In performing the EFA for each proposition the following needs noting:

- The first proposition was conducted on 102 organisations' responses after accounting for missing responses. With a confidence interval of 95% the margin of error is approximately 9.7%; and
- The second proposition was conducted on 96 organisations' responses after accounting for missing responses. With a confidence interval of 95% the margin of error is approximately 10%.

The realisation is that a larger margin of error exists in the propositions and hypothesis test than originally hoped for at the start of the research. This is due to the missing values decreasing the overall responses used in the analysis.

CHAPTER 5: DISCUSSION OF THE RESULTS

> "In the past, many in the South African institutional investment community and the business media have appeared to treat climate change as purely an environmental issue, arguably failing to appreciate the profound economic and business significance of the issue" CDP South Africa (2007:12), in the launch of the first issue.

5.1 Introduction

The chapter begins with a review and deeper insight into the first proposition that investigates the reasons for creating Carbon Footprint Management Systems. This is followed by a review of the hypothesis results and a subsequent discussion evaluating the literature in an attempt to explain the results. The results of this research are compared to similar studies and where appropriate, any differences and similarities highlighted. Lastly, the second proposition detailing the elements contained within Carbon Footprint Management Systems is considered and appropriate literature comparisons made. All academic references to authors in this chapter emanate from Chapter 2: Literature Review with no new sources and constructs being introduced.

5.2 Implementation reasons discussion for Carbon Footprint Management Systems

This section begins with a brief overview of the EFA results for this proposition, followed by a detailed discussion of each factor. Aspects covered are analysing the underlying statements on each factor and providing concluding remarks where appropriate.

The results for this proposition indicate that the reasons for organisations creating Carbon Footprint Management Systems are summarised in the four factor solution chosen during the factor analysis. The EFA approach indicated clear patterns of inter-correlation between the variables with the final solution containing a respectable 73.008% of the variability explained within the data.

The Cronbach's Coefficient Alphas for the factors were all acceptable which indicates that the underlying statements portray the chosen constructs reasonably. Further, the average communality for each statement was satisfactory at 0.73, thus indicating a high level of reliability.

Although the purpose of this research was not to validate or support any academic model, however, it is interesting that the factor result from this research does somewhat resemble the approach forwarded by Giurco and Petrie (2007) in Section 2.5: The role of Carbon Footprint Management Systems. The authors' view was that organisations progress from a pre-compliance reactive phase, then embark on compliance regulations and move into a proactive post compliance and integrated strategic phase. The results of this research indicate that the important reasons incorporate a regulatory and financial component, a mitigating risk and proactive component, and a strategic environmental innovation component. The implications and discussion of these are discussed in Section 6.2: Conclusions of the research.

5.2.1 *Mitigating risk and proactive thinking*

This factor provided strong summary statistics with a median of 8, mean of 7.44, and small inter-quartile range with a distribution heavily negatively skewed. This factor is comparable to the integrated strategy phases of mitigating risk and proactive stance identified through the literature review.

As can be seen from the results, this factor is strongly defined by all the mitigating risk statements that were asked during the interview. These include participating organisations' risk efforts regarding direct physical risks, public policy risks, risks associated with competitor advancement, legal risks, and reputational risks. Additionally, this factor includes participating organisations' drive for better relationships with suppliers and opportunity to increase their technological processes.

This factor therefore combines both these elements in a way that highlights the future strategic intent of the participating organisation. This is evident through the use of mitigating risk strategies and statements such as, "My company

wanted to create a competitive advantage" and "My company wanted better relationships with suppliers", with all these elements pointing towards a strategic organisational goal being set.

This factor, although referring to proactive thinking, does not make the explicit distinction between the institutional theory and resourced-based views presented in the literature review. This distinction was beyond the scope of this research.

5.2.2 *Stakeholder pressure*

This factor provided relatively weak summary statistics with a median of 5 and the lowest mean of 5.10. This factor is directly compared to the beyond compliance strategy phase of stakeholder pressure and compliance phase of parent company obligations that was presented in the literature review.

The results indicate that this factor is strongly defined by all the stakeholder pressure statements that were asked during the interview. These include both internal and external pressure from directors, consumers, employees, environmental groups, and government. This factor does not make the explicit distinction between the various types of stakeholders presented in the literature review but rather represents the combined stakeholder effect.

Further, this factor includes a parent company obligation which was evident through the statement, "We are a multi-national and our parent/holding company is bound by environmental legislation such as the Kyoto Protocol".

This factor therefore represents pressure emanating from both internal and external pressures of the participating organisations, along with the international pressure of the parent company obligation.

5.2.3 *Financial and regulatory*

This factor provided strong summary statistics with a median of 8, the mean of 7.39, and small inter-quartile range with a distribution heavily negatively skewed. This factor can be compared to the pre-compliance phase of financial

performance and compliance strategy phase of regulatory environment identified through the literature review.

This factor's results are strongly defined by the participating organisations' reason for creating an environmental programme being financially based. Added to this factor is the regulatory component of curbing GHG emission being added in the near future.

This factor suggests a view of participating organisations' motivations that occur early in the Carbon Footprint Management System development. This is evident through statements that highlight initial thoughts into climate change interventions. This is reflected by the organisations' motivations of profit maximisation being reflected with statements such as, "My company saw an opportunity to increase profits" and "My company saw an opportunity to decrease costs".

5.2.4 *Environmental innovation*

This factor provided strong summary statistics with a median of 8, mean of 7.96, and small inter-quartile range with a distribution heavily negatively skewed. This factor is directly compared to the beyond compliance strategy phase of technological and competitive advantage and integrated strategy phase of proactive stance.

The results indicate that this factor is strongly defined by participating organisations viewing environmental issues as important and their desire to be involved at the forefront of innovation.

The interpretation of this factor presents a motivational view that is exciting, dynamic, and competitive in nature. This is evident with statements such as, "My company is forward thinking and likes to be involved in the forefront of innovation" and "My company views environmental issues as increasingly important".

5.3 Significance test discussion for implementation reasons

The previous section attempted to explain each factor in detail. The purpose of this section is to review the result of the Kruskal-Wallis significance test and provide interpretation with reference to the literature review. Comparisons to previous research are made, and the discussion will attempt to explain where possible, the results in the South African context.

The results pertaining to this hypothesis indicated a significant difference in importance of the Mitigating Risk and Proactive Thinking, Financial and Regulatory, and Environmental Innovation factors for the creation of Carbon Footprint Management Systems. Stakeholder Pressure was perceived to be the least important factor for participating organisations. The discussion that follows presents an argument that explains these results with reference to the literature and the business environment in South Africa.

Mitigating Risk and Proactive Thinking. This factor was seen as being a significant influencing factor on organisational behaviour.

Organisations in South Africa are not mandated to reduce their GHG emissions, and as discussed in the literature review, Sinha and Flederbach Jr (2008) believe that the lack of regulation enhances uncertainty and places additional business risk on organisations. Therefore, it is not surprising that participating organisations place mitigating risk as an important creation motivator as they currently operate in an unregulated environment.

Further, it was presented that Van Schalkwyk (2007) warned that the South African government will increasingly assess, monitor and regulate GHG emissions, and that industries will soon encounter a carbon constrained environment. The details regarding contents thereof, direction and amount of carbon constraints are lacking which can create a vague future regulatory environment.

In Section 2.5.6: Integrated strategy: proactive stance, Karmali's (2006) argument around organisations' proactive efforts was presented. The author stated that commercial and reputational reasons were present for organisations'

voluntary management of GHG emissions. The author believes that the proactive stance delivers commercial value through integrating the organisational efforts through inclusion in the broader short and long-term strategic vision, and reputationally through increased investor relationships, branding, employee relationships, public affairs, and community relationships. Kolk and Pinkse (2004) believe that these strategic elements have increased awareness due to the potential strategic impact on organisations. This movement has gained momentum in South Africa recently, with Mingay (2008) substantiating that pressure on organisations will emanate from international supply chains, international investors, and increasingly ethical consumers and tourists. It is thus not startling for this strategic role of proactivity within organisations to emerge as significantly important for the participating organisations.

This factor's elements of mitigating risk and proactive thinking being combined substantiate the view held by Sinha and Flederbach Jr (2008). They believe that this combination of strategic focus will enable organisations to take leadership roles regarding climate change interventions and be in a better position to adapt in the future. The participating organisations in this research perhaps have realised this synergistic gain and possible competitive advantage when relating this construct to the other significant factors chosen from the EFA.

Stakeholder Pressure. This factor was found not to be a significantly important motivator for the participating organisations.

Contrastingly, Henriques and Sadorsky (1996) found that stakeholder pressure significantly influenced the creation of Carbon Footprint Management Systems. The authors presented that customer, shareholder, and government pressure, along with regulatory influence and community group pressure were all responsible for organisations formulating environmental systems with the study incorporating the 750 largest Canadian organisations. This may have influenced the contrasting result to this research where participating organisations comprised of 37.9% SMEs. The larger Canadian organisations would be listed on the appropriate stock exchange and have additional share price, director, and shareholder pressures that were absent in the SME organisations of this

research. Additionally, Henriques and Sadorsky (1996) differentiated between the various stakeholders in the results whereas this studies EFA results did not differentiate between internal and external stakeholders, but rather found that the latent variable represented all stakeholders. This insight might also have contributed to the explanation of the contrasting results.

Buysse and Verbeke (2003) also presented findings opposite to this research, with the authors differentiated between the various stakeholders similar to Henriques and Sadorsky (1996). Buysse and Verbeke (2003) concluded that only internal stakeholders of employees, shareholders, and financial institutions provided motivational pressure for organisations. In providing an insight into the difference in results, Buysse and Verbeke's (2003) study represented polluting organisations operating in a small, open economy that specialised in producing intermediary products with the organisations experiencing little consumer contact. In comparison, the participating organisations in this research comprised 31.6% in the primary sector, 34.5% in the secondary sector and 33.9% in the tertiary services sector. This diverse mix of economic sectors may be an explanation for the contrasting results.

The results of this research are also contrary to the view held by Gonzalez-Benito and Gonzalez-Benito (2006) who argued that stakeholder pressure, using a corresponding definition as this research comprising both internal and external forces, is the key determining factor in the creation of Carbon Footprint Management Systems. The authors explain that all other forces affect the intensity of the stakeholder pressure, or the organisation's capacity to perceive it. They describe these as both internal and external organisational characteristics. Further, they believe that the lack of independence of each variable and all the variables of motivators and organisational characteristics combined, affect the relationships between the variables. As this research limited the scope of the study to exclude internal organisational characteristics and economic sector views, this might offer an initial insight into the conflicting findings.

The additional stakeholder pressure of parent company obligations is present in the latent variable chosen during the EFA. The results of this research do not

support the view held by Rugman and Verbeke (1998) who state that parent company obligations are of importance. The organisations in their study were in the primary and secondary sectors and this provides clues as to the significance by validating the belief of Magretta (1997), that multi-nationals adhere to the most stringent environmental regulations. Many mining and larger manufacturing organisations have obligations from international markets that are subject to regulation and subsequently leverage off those climate change interventions. Although this research incorporated organisations from the primary and secondary sectors, there was also a component from the tertiary sector which was not present in the study of Rugman and Verbeke (1998).

Financial and Regulatory. This factor was seen as being a significant influencing factor on organisational behaviour.

The results of this research support the view held by Lash and Wellington (2007) that financial concerns are important for environmental strategy creation and sourcing of opportunities within organisations. The authors do not provide a quantitative study for direct comparison purposes, rather, they discuss how climate change affects organisational competitiveness. These research results correspond and could, in part, be explained to the current economic situation. Sinha and Flederbach Jr (2008) provide a recently published observation explaining that organisations focused on climate change can simultaneously reduce GHG emissions and operating costs. Therefore, it is not surprising that financial aspects are found to be significantly important in this research when participating organisations focus on reducing costs during an economic recession.

Literature was presented to support a positive correlation between financial performance and an organisation's involvement in Carbon Footprint Management Systems by Hart and Ahuja (1996), Russo and Fouts (1997), Khanna and Damon (1999) and Stanwick and Stanwick (2001). Although the direct quantification of this relationship was not an aim of this research, there could be an argument for stating that financial performance, being an important creation reason, could facilitate the participating organisations' focus to be

financially based. This could result in greater concentration on financial measurement and control.

In reviewing the regulatory component, the results of this research supported the views of Levy (1995) , Hutchinson (1996) and Pratt and Fintel (2002) which concluded that regulation has a strong influence on climate change interventions.

Environmental Innovation. This factor was seen as being a significant influencing factor on organisational behaviour.

Kolk and Pinkse (2004) argue that organisations' strategies are now increasingly moving toward market competitive strategies. The participating organisations in this research support this view by indicating that this factor is significantly important for the creation of Carbon Footprint Management Systems. This suggests that they desire competitive advantages and believe that their environmental strategic journey might provide the answer.

5.4 Elements contained within discussion for Carbon Footprint Management Systems

This section begins with a brief overview of the EFA results for the elements contained proposition, followed by a detailed discussion of each factor. Aspects covered include analysing the underlying statements on each factor and providing an interpretive view where appropriate.

The results for this proposition indicate that the elements contained within Carbon Footprint Management Systems are summarised in the four factor solution chosen during the factor analysis. An adequate 74.240% of the variability explained within the data was presented with the four factor solution during the EFA approach.

The Cronbach's Coefficient Alpha indicated that the underlying statements represented the chosen constructs reasonably with the lowest alpha value of the factors being 0.7950. Further, the average communality for each statement

was acceptable at 0.74, thus signifying a high level of reliability. Each factor is discussed below.

5.4.1 *Risk assessment*

This factor provided strong summary statistics with a median of 8, the highest mean of 7.20, lowest standard deviation, and small inter-quartile range with a distribution heavily negatively skewed which is reflected in the largest skewness score. This factor can be compared with assess organisational position element identified through the literature review.

As can be seen from the results, this factor is strongly defined by all the risk assessment statements that were asked during the interview. These include assessment of the following listed risks: regulatory, supply chain, product and technology, legal, reputational, and direct physical risks.

Due to the strong summary statistics for this factor, especially the measures of central location, risk assessment seems to hold a deep presence in the participating organisations. In this light, the results of this research would concur with Lash and Wellington (2007) who argue that organisations need to adequately perform risk assessments to identify opportunities and create value.

The importance of this factor corresponds with the first proposition results that stated mitigating risk was a significant motivator for creating Carbon Footprint Management Systems. It is therefore expected that participating organisations are acting on this creation reason by including the relevant mitigating risk assessments in their programmes. Additionally, all risk assessments portrayed high factor loadings which suggests the importance of the holistic approach to risk assessment. This would support Karmali (2006) who stated the risk assessments needed to be conducted in the broader strategic sense, only such a holistic view could be created with a review of all possible risks.

5.4.2 *Reporting mechanisms*

This factor provided strong summary statistics with a median of 7, the highest mean of 6.33, standard deviation of 3.26, and small inter-quartile range with a distribution negatively skewed which is reflected in a large skewness score. This factor can be compared to the reporting mechanisms element identified through the literature review.

This factor's results are strongly defined by the environmental programme comprising reporting compliance elements. These include compliance and reporting for the ISO 14001, having a formal written environmental policy and training programme, and conducting a review of the climate situation that can influence the organisation. This is evident through the use of statements such as, "My company has a written environmental policy", "My company uses the ISO 14001 for our Greenhouse Gas emissions strategy", and "My company includes environmental training programmes".

This factor portrays strong presence in the programmes in the participating organisations. This would imply that they have invested large amounts of focus and resources which would support the view provided by Ramus (2002) who stated that reporting mechanisms, specifically written environmental policies, indicate organisational commitment.

Although it was not the aim of this research to establish prevalence benchmarks for elements contained within Carbon Footprint Management Systems, due to this factor's strong summary statistics and resource investment, the research results could be favoured to the study conducted by Hansen (2003) that found the vast majority of organisations contained this element. However, admittedly, that study was conducted on multi-nationals that might have displayed a bias towards containing such an element.

There could be an argument for this factor to be a natural extension of the factor from the organisational creation reasons of Financial and Regulatory. Both display elements of compliance, reporting, and represent factual components.

5.4.3 *GHG Inventory*

This factor provided the weakest summary statistics with a median of 5, the lowest mean of 5.21, largest standard deviation of 3.49, and the largest inter-quartile range. This factor can be compared to the GHG Inventory element identified through the literature review.

As can be seen from the results, this factor is strongly defined by the GHG Inventory statements that were asked in a random order during the interview. These include the participating organisation using the Greenhouse Gas Protocol or a similar generally accepted measurement tool, along with an internal system for collecting the required information. Added into this factor is the employee drive for a GHG emissions programme.

This factor's GHG Inventory statements allow the participating organisations to get creative in their own processes of measurement. This suggests that the participating organisations either are not familiar with the international standards such as the GHG Protocol, or do not see the additional value prescribing to a mechanism over and above the ISO 14001.

In this light, Putt del Pina et al. (2006) have argued for the benefits of prescribing to an internationally accepted practice, and due, in part to current non-legislative compliance, participating organisations are not including this element in their Carbon Footprint Management System as frequently as the other factors.

5.4.4 *Long-term strategic intent*

This factor provided strong summary statistics with a median of 7, the second highest mean of 6.53, and small inter-quartile range with a distribution heavily negatively skewed which is reflected in the skewness score. This factor can be compared to the long-term strategy planning element identified through the literature review.

The results portray the statements relating to strategic intent by the incorporation of the GHG emissions programme into the overall strategy, along

with scenario planning, and supply and demand forecasting. The theme of strategic intent is also seen from the GHG emissions programme being developed internally and driven from senior management levels. This is evident through statements such as, “Our company’s Greenhouse Gas emissions programme is driven from senior management down to lower rank employees”, “Our company assesses the supply and demand for carbon in our Greenhouse Gas emissions programme”, and “My company includes the Greenhouse emissions programme into the company strategy”.

This factor combines the elements of implementation platform and long-term strategy in a way that highlights the need to incorporate GHG emissions and climate considerations into the business strategy, thus confirming Karmali (2006) and Lash and Wellington’s (2007) stance. These authors highlighted the strategic value and understanding gained from undertaking the exercise.

This factor also logically progresses from the Environmental Innovation factor representing the participating organisational creation reasons. Both factors display an element of incorporating climate change interventions within the broader organisational strategy.

5.5 Conclusion

This section summarises the discussion and interpretation chapter where the findings of this research were interpreted within the framework of academic literature. All conclusions regarding the propositions and hypothesis are re-affirmed, before the recommendations and suggestions for future research are offered in the subsequent chapter.

The results for this research indicated that mitigating risk and proactive thinking, financial and regulatory aspects, and environmental innovation were all important reasons for creating Carbon Footprint Management Systems.

The results of the hypothesis test indicated that mitigating risk and proactive thinking, financial and regulatory aspects, and environmental innovation were significantly different and more important for the participating organisations than

stakeholder pressure. When interpreting this finding against the literature review, mixed results emerged when direct comparisons were made. The results from this research supported the views and arguments of Levy (1995), Hutchinson (1996), Pratt and Fintel (2002), Dlugolecki and Loster (2003), Lash and Wellington (2007), and Sinha and Flederbach Jr (2008), but found contrary to the results of Henriques and Sadorsky (1996), Rugman and Verbeke (1998), Buysse and Verbeke (2003), and Gonzalez-Benito and Gonzalez-Benito (2006).

The results and discussion from the second proposition relating to the elements contained within Carbon Footprint Management Systems, supported the views and arguments of Ramus (2002), Hansen (2003), Karmali (2006), and Lash and Wellington (2007).

An interpretive holistic view of the results suggests a relationship between the important reasons for creation and the elements contained within. This was evident between the creation reason of financial and regulatory aspects with reporting mechanisms, and the creation reason of environmental innovation with long-term strategic intent, and the creation reason of mitigating risk and proactive thinking with risk assessment. The implications and effect for the organisation are discussed as a concluding remark in the following chapter.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

> "To waste, to destroy, our natural resources, to skin and exhaust the land instead of using it so as to increase its usefulness, will result in undermining in the days of our children the very prosperity which we ought by right to hand down to them" Theodore Roosevelt (1907:1).

6.1 Introduction

This chapter concludes this research report by summarising the findings from the research's propositions and hypothesis with concluding remarks to relevant academic literature. This is followed with recommendations, based on this research's outcomes, to the relevant stakeholders identified in Section 1.4: Significance of the research. The chapter is ended with a comprehensive view of suggestions for further research. To add to academic literature, each suggestion is divided into a context and purpose explanation followed by the relevant sub-problems where appropriate.

6.2 Conclusions of the research

This section begins with, and focuses on summarising the research findings with particular reference to the context of the research that was specified in Section 1.2: Context of the research. Any additional insight and value add to academic research is also included.

The results from this research indicate that organisations are creating Carbon Footprint Management Systems in an attempt to mitigate strategic risks, in anticipation of future regulation and financial gains, and due to an increase in overall environmental innovation and importance. The elements contained within these systems include risk assessment tools, reporting mechanisms and platforms, and long-term strategic interventions.

The reasons above are the driving forces behind the participating organisations' environmental efforts. In defining the context of this research earlier, Hunt and Auster (1990) and Porter (1991), provided a view that climate change has increased in importance across all levels within the organisation, and a review of the diverse significant factors of this research indicates that awareness of climate change interventions is present in multi-disciplinary aspects within the participating organisations.

The elements of Carbon Footprint Management Systems that this research highlighted, add to the argument by Grubb et al. (1999) and Packard and Reinhardt (2001) presented in defining the context of this research by concluding that organisations place importance in recognising potential climate change risks. This can be seen in the risk assessment exercises conducted, creating written environmental policies, and assessing the demand and supply of carbon, amongst others.

An insight of this research suggested a relationship between the significantly important creation reasons and the elements contained within their Carbon Footprint Management Systems. There was evidence to suggest that the creation reason factor of Financial and Regulatory corresponded with the element factor of Reporting Mechanisms due to the similar underlying nature of both containing compliance and due diligence aspects. Additionally, the suggested relationship comprising the creation reason factor of Environmental Innovation corresponded to the element factor of Long-Term Strategic Intent due to the future competitive strategic nature of both factors. Finally, the creation reason factor of Mitigating Risk and Proactive Thinking directly corresponded with the element factor of Risk Assessment. This is not surprising that organisations are matching the elements contained to their creation reasons. This suggests that the participating organisations are undertaking good management and insightful planning.

In analysing the results and conclusions, and interpreting them in the context of this research an additional conclusion could be suggested in that organisations are behaving in a way we would expect. Organisational behaviour is complex and hard to discern with the goal of profit maximisation in the forefront of most.

If organisations see the value of proceeding with environmental programmes, they would be created. This requires due diligence in risk assessments, regulatory compliance, and long-term strategic focus and goals. All these organisational behaviours are present in the participating organisations. Further, organisations are viewing climate change as a future strategic competitive advantage by investing in and integrating environmental programmes in the broader strategic view of the organisation.

Building on the research of Giurco and Petrie (2007), the results of this research suggest that the participating organisations progress from a pre-compliance reactive phase, then embark on compliance regulations, and move into a proactive post compliance and integrated strategic phase. These are represented by important creation reasons of a regulatory and financial component, a mitigating risk and proactive component, and a strategic environmental innovation component. This suggests that the participating organisations were located at different stages of the environmental journey with some organisations just beginning investigating and building their environmental programme while others were more advanced and capable of strategic environmental innovation. This argument is substantiated by the filter questions on the research instrument incorporating organisations that currently measure GHG, or were either creating or in the process of finalising a climate change intervention measuring GHG.

In the future carbon constrained world organisations will need to meet consumer needs producing less carbon emissions (Carbon Trust 2006), thus supporting the vision that carbon management will be regarded as a key lever impacting organisation performance (Van der Merwe 2008). Kolk and Pinkse (2004) state that affected organisations will range across industries from those that produce fossil fuels, through to those that are seeking market opportunities due to GHG emission dynamics. In South Africa these market opportunities can be achieved by management’s voluntary disclosure on carbon strategies, their management systems thereof, and the organisation’s GHG emissions performance.

6.3 Recommendations

This section introduces the recommendations of this research in accordance with the results of this research. The recommendations listed below are in reference to the stakeholders identified earlier in the report in Section 1.4: Significance of the research. Each recommendation is elaborated with appropriate validations and tasks to perform.

6.3.1 *Individual organisations*

Jeswani et al. (2008) state that little is known about developing countries organisational efforts and responses to climate change. The first recommendation for individual organisations is to combine the results of this research regarding the elements contained within a Carbon Footprint Management System with their intended or current strategy. This exercise would enable the organisation to develop a deeper insight as to the elements that are present in their approach, along with the elements that are absent or minimally covered.

Further, as Mingay (2008) believes that South African organisations should not wait for climate abatement policy from the government, but rather act speedily; this recommendation will ensure that organisations are better prepared for a future constrained carbon environment and ensure that all stakeholders from government to large investors' needs are met regarding GHG emission interventions. The best approach to complete this task might be a systematic review of each process in the programme to enable the full understanding of each element. Despite the GHG Inventory processes not being incorporated in the current programmes of participating organisations, there is additional value to be gained from incorporating world's best practice for GHG emissions.

The second recommendation for individual organisations is to conduct a comprehensive feasibility study regarding the financial commitment needed to create a Carbon Footprint Management System. Henriques and Sadorsky (1996) state that the costs associated with Carbon Footprint Management Systems include both monetary and non-monetary expenses. They elaborate

by listing costs comprising the acquisition and, or maintenance of market share, potential efficiency gains, an increased positive reputation, costs included for implementing the plan, regulatory compliance costs, and the associated economic opportunity costs.

Organisations now more than ever need to adequately cost for organisational interventions and ensure that resources are used optimally, and having a view of what is included provides a clearer path.

6.3.2 *Government*

Dlugolecki and Loster (2003) believe that governments have delayed in creating environments conducive to Carbon Footprint Management Systems, partly due to the regulator's confusion around the binding reduction GHG targets and the lack of enforcement.

Developing countries such as South Africa have acknowledged that they have a responsibility for the future of the planet and their participation to curb GHG emissions is crucial to developing sustainable solutions. This was evident through the active involvement of South Africa during the recent environmental debate in Copenhagen during December 2009.

According to Van Schalkwyk (2007), the South African government will increasingly assess and monitor, and regulate GHG emissions. The recommendations below are reflective of this position:

- The government can take the significant findings from this research and begin to understand what organisations are currently undertaking, and tailor legislation by providing more precise policies for organisations accordingly across the economic spectrum of both SME and corporate organisations. The legislation would need to be tailored to the effect that all affected stakeholders benefit equally;
- The results from this research will provide government with a clearer view of organisational motivation for creating voluntary Carbon Footprint Management Systems. This scrutiny will allow the understanding of other

ways that influence organisational efforts, apart from regulation, and what the effects are. Once an understanding of these is gained, the government can utilise these options as an alternative solution or to complement proposed environmental regulation. This can be achieved by instituting mandatory GHG emission reduction targets and additionally, allowing organisations other benefits such as financial incentives and access to innovative process and enhanced technology, amongst others; and

- The government needs to combine the results of this research with other current state investments to aid in their consistent message delivery and increased awareness to organisations of how they are affecting climate change and how the economy at large will be negatively affected.

It is only through a full understanding that sustainable policies and legislation are correctly formulated, for the benefit of the organisation, government, environment, and the economy.

6.3.3 *South African economy*

The first recommendation for the South African economy is to develop an asymmetric advantage in the battle against climate change. The economy can achieve this by developing a reputation for leading foresight, carbon abatement practices, and global leading regulation. As environmental concerns increase in importance globally, South Africa will be better placed as an environmental leader in a future global constrained carbon economy.

The second recommendation for the South African economy is to use the results of this research to provide insight into the newly developing niche of the specialised service providers of consultancy emission offsetting. The service providers will gain invaluable knowledge of the participating organisations' motivational behaviours and what is currently being undertaken by the organisations. Once this has been established, a needs framework could be developed where business solutions and products are created and targeted at appropriate organisations interested in GHG abatement policies. This could

include aiding organisations in general management of their Carbon Footprint Management Systems, outsourcing this to the service provider, or providing a general consultancy information approach.

6.3.4 *Management*

With the broader entities of organisations, the government and the South African economy covered, the recommendation for management is to create a learning journal based on the elements contained in Carbon Footprint Management Systems. This will ensure that adequate preparation for the multiple tasks, responsibilities and possible strategic challenges can be clearly defined. This will also ensure that commitment needed for a Carbon Footprint Management System is fully understood and that the appropriate roles are fully accountable. It is suggested that measurable goals be established and that adequate resources allocated for programme implementation and management.

This recommendation is designed to enable management to provide a level of sustainability. Emphasis for management during this journey should be that the skills level of conducting risk assessments, creating reporting mechanisms, and understanding the long-term strategic benefits, all need attention.

6.3.5 *Academics*

The recommendation is to use this research as a starting point for a foundation and knowledge base for South Africa within the academic structures. There needs to be a theoretical assessment of the climate change interventions that organisations establish due to the increase importance of environmental concerns and the future impact that organisations will endure.

6.4 Suggestions for further research

Finally, the suggestions for further research conclude this research report and are presented in detail in an attempt to add to academic literature. Most suggestions are divided into a context and purpose explanation, followed by the relevant sub-problems.

The following areas for future research have emerged both from the results of this research report and additional research topics that will further complement the findings of this research.

6.4.1 *Representative probabilistic sample*

A limitation of this research was that the sample chosen was through a non-probability sampling technique. A suggestion for further research would be to re-conduct this research with a pure probability sample in order to generalise about the population of South African organisations as the results from this research could not be generalised beyond the sample. Ideally the proposed sample should be larger than the sample conducted in this research to aid in reducing the margin of error.

6.4.2 *Competing green*

Porter and Van der Linde (1995) argue that the financial and environmental return is a classic trade-off of social benefits versus private costs, where they acknowledge the controversy surrounding social benefits from environmental initiatives and increased organisational competitiveness. Further, they state that environmental strategies should become a general management concern if the organisation is focused on innovation.

This research's results indicated that environmental innovation is a strong reason for organisations to embark on Carbon Footprint Management Systems. This factor comprised organisations' intention to be involved at the forefront of innovation underlying the need for creating competitive advantages. Kolk and Pinkse (2004) contend that the interest sparked by global climate change has seen a shift in competitive strategies adopted. They argue that in the last decade, the shift has occurred from political and non-competitive strategies, towards market competitive advantages.

Research in this area will aid in the greater understanding of the classic trade-off of social benefits versus private costs for South African organisations, along

with analysing their innovative competitive advantages and determining the importance of climate change as a competitive advantage domain.

The first sub-problem is to establish whether financial return or environmental return in organisations take precedence in South Africa.

The second sub-problem is to answer whether organisations' environmental efforts are the new way to compete for a competitive advantage in South Africa.

6.4.3 *Evolving environmental strategies*

The results of this research may suggest that the participating organisations progress from a pre-compliance reactive phase, then embark on compliance regulations, and move into a proactive post compliance and integrated strategic phase, similar to Giurco and Petrie's (2007) model. Post and Altman (1994) postulate that the environmental learning curve includes three phases. Firstly, adjustment defined as organisations' interventions to become compliance-oriented through reactive initiatives, secondly, adaptation-innovation where organisations strive for excellence and finally, innovation where business opportunities and sustainable development are sought. Clemens (2001) agrees that an organisation's environmental strategic journey changes over time. The author states that organisations progress through three phases of cost minimisation, cost effective compliance, and beneficial environmental controls. Buysse and Verbeke (2003) confirm the environmental strategic journey with phases including reactive behaviour, pollution prevention strategies, and environmental leadership.

Available literature is rich with views that stakeholder pressure is a significant driver for creating Carbon Footprint Management Systems, despite this research's contrary result. Buysse and Verbeke's (2003) research has provided a view into organisations' strategic position and stakeholder pressure as a driving force and a wider suggested view that incorporates other influential pressures will significantly add to academic literature. Further, Clemens (2001) believes that only through an understanding of current organisations'

environmental efforts can a deeper understanding be gained as environmental efforts need time to mature.

The first sub-problem is to establish the progression of the organisations environmental strategic journey.

The second sub-problem is to identify at what stage of the environmental strategic journey are organisations in South Africa.

The third sub-problem is to establish whether reasons for creating Carbon Footprint Management Systems change through the environmental strategic journeys of organisations in South Africa.

6.4.4 *Organisational size*

A limitation of this research was that it did not attempt to identify the role of organisational characteristics in Carbon Footprint Management Systems. Gonzalez-Benito and Gonzalez-Benito (2006) believe that organisational size, measured by the number of employees, is an important variable that influences the implementations of Carbon Footprint Management Systems in organisations. They argue that larger organisations:

- Have greater resource availability for environmental management;
- Are under greater pressure from social environments;
- Their larger scale allows investments into required infrastructure such as technology, human resources, and process development; and
- Have greater influence over customers.

Literature offers mixed results regarding organisational size and organisations involvement in environmental strategy.

There is literature to support a positive correlation between these elements by Arora and Cason (1996), Alvarez Gil, Burgos Jiménez and Céspedes Lorente (2001) and Min and Galle (2001). Organisational size was found to be a positive explanatory variable by Aragon-Correa (1998) with Levy (1995) stating that large multi-national organisations predisposed to more extensive Carbon

Footprint Management Systems. However, Russo and Fouts (1997) and Klassen and Whybark (1999) did not find positive correlations between organisational size and Carbon Footprint Management Systems.

Further, Gonzalez-Benito and Gonzalez-Benito (2006) indicate that additional organisational characteristics including degree of internationalisation, position in the value chain, managerial attitude and motivations, and strategic intent are influential in organisational motivation for voluntary climate abatement interventions. Research in this area will provide an additional layer for the understanding of organisations' motivations.

The first sub-problem is to establish the relationship between organisational characteristics and the organisation's involvement in voluntary environmental strategy in South Africa.

The second sub-problem is to identify the driving forces in organisations of different size for the creation of Carbon Footprint Management Systems.

6.4.5 *Organisational sector*

A further limitation of this research was that it did not attempt to identify the role of the organisational sector in Carbon Footprint Management Systems. As various industries and sectors have different polluting potentials, are subject to different legislative controls, and are scrutinised by social groups and customers, Gonzalez-Benito and Gonzalez-Benito (2006) argue that the industrial sector constitutes an essential variable in Carbon Footprint Management Systems due to the inherent nature of GHG emissions of each sector.

Literature is abound with industrial sector and Carbon Footprint Management System research. Banerjee (2002) found differences in each industrial sector, how organisations perceived the importance of environmental issues, and the subsequent strategy incorporation. Vastag and Melnyk (2002) show differences in industrial sector and the incorporation of the ISO 14001. Henriques and Sadorsky (1996) found that relative to the secondary sector, primary sector

organisations were more likely to have Carbon Footprint Management Systems and the tertiary sector less likely.

This suggestion will provide insight into the dynamics of high-carbon emitters from the primary and secondary sector versus low-carbon emitters from the services sector, and their subsequent driving forces.

The first sub-problem is to establish the relationship between the industrial sector and organisations' involvement in broad environmental strategy in South Africa.

The second sub-problem is to identify the driving forces in the primary, secondary and tertiary sectors for the creation of Carbon Footprint Management Systems.

6.4.6 *Strategy decisions and carbon footprint management*

Hart (1997) argues that the environmental revolution over the last three decades has changed how organisations strategise and challenges organisations to develop a sustainable global economy through realising the revenue potential of linking environmental initiatives to strategy and technological development. Kolk and Pinkse (2004) confirm that since 1990 organisational strategies have shifted by broadening their strategic scope.

As previously stated in Section 1.4: Significance of the research, Van der Merwe (2007b) predicts that organisations' strategies will increasingly include carbon emission abatement policy and management dynamics as environmental concerns increase. Additionally, Kolk and Pinkse (2004) believe that climate change creates strategic dilemmas for organisations and as a result, this suggestion also provides insight as to whether managers are prepared to deal with all aspects relating to climate change interventions. Lash and Wellington (2007) provide initial insights into managers' additional skills required by indicating that conforming to regulatory compliance, mitigating potential liability from workplace accidents, and GHG emission mitigation are all environmental risks that need management control.

The results of this research indicate the importance of long-term strategic intent in Carbon Footprint Management Systems. This motivation comprises senior management's commitment and long-term strategic direction for the organisation. Research in this area will aid in the greater understanding of strategy and environmental interventions, while providing insight into management abilities and hopefully aid in greater activity in this area.

The first sub-problem how are creating Carbon Footprint Management Systems affecting current strategy decisions in South African organisations?

The second sub-problem is to establish whether South African managers are adequately prepared for dealing with climate change interventions.

6.4.7 *Taking one step back*

Organisations exist for profit maximisation and most projects undertaken aid them in reaching this goal. A recent focus has been organisations' voluntary abatement approaches to GHG and it is through understanding the market pressures and dynamics currently faced by organisations, that new questions and avenues are pursued. Jeswani et al. (2008) believe that little is known about developing countries organisational efforts regarding organisations' response to climate change. Environmental interventions and carbon footprint management within organisations have only recently been developed in some organisations within South Africa.

Due to the recent emergence of environmental concerns in the South African industry this area of research is new, and thus a suggestion for further research is to conduct a qualitative research study with this research report as a guideline. It is hoped that this undertaking and format of investigation will highlight not only specific nuances relating to the South African context, but also account for the lack of published academic quantitative studies. Further, the suggested relationship from this research between the significantly important creation reasons and the elements contained within their Carbon Footprint Management Systems can be fully explored.

6.4.8 *Barriers for going green*

This research's results indicate that risk assessments and long-term strategic initiatives are strong elements contained within Carbon Footprint Management Systems. Both these elements require substantial financial, human and time resources from the organisation to ensure success.

Due to the high cost associated with such an endeavour the suggestion for further research focuses on the potential internal and external barriers present that could hinder progress for the organisation and environment. Post and Altman (1994) clearly distinguish between industry barriers such as capital costs, competitive pressures, regulatory restrictions, and information and technical knowledge; and organisational barriers such as employee attitudes, inadequate senior leadership, poor communication strategy, and past practice and learnings. Dlugolecki and Loster (2003) provide a different view and model of barriers. They contend that cognitive, political, analytical, and market operational barriers hinder organisations' environmental interventions.

The first sub-problem is to establish what barriers are present that prevent organisations in South Africa from establishing Carbon Footprint Management Systems.

The second sub-problem is to ascertain whether any barriers influence the degree of proactivity of the organisation's environmental efforts.

6.5 Closing remarks

The purpose of this research was to understand why and how South African organisations are strategically responding to the implications of climate change, by analysing organisational behaviour in relation to Carbon Footprint Management Systems. As a result, a deeper understanding into organisation's motivation was presented. As the chapter introductory quotes have hopefully created awareness to the climate change dilemma that our generation faces, it is through research that knowledge and further advancement for organisational interventions is created.

REFERENCES

Alvarez Gil, M., Burgos Jiménez, J. and Céspedes Lorente, J. (2001) An Analysis of Environmental Management, Organizational Context and Performance of Spanish Hotels, *Omega,* 29(6), pp. 457-471.

Aragon-Correa, J. (1998) Strategic Proactivity and Firm Approach to the Natural Environment, *Academy of Management Journal,* 41(5), pp. 556-567.

Aragon-Correa, J. and Sharma, S. (2003) A Contingent Resource-Based View of Proactive Corporate Environmental Strategy, *The Academy of Management Review,* 28(1), pp. 71-88.

Arora, S. and Cason, T. (1996) Why do Firms Volunteer to Exceed Environmental Regulations? Understanding Participation in EPA's 33/50 Program, *Land Economics,* 72(4), pp. 413-432.

Baldwin, A., Cladwell, C., Oldenburg, B., Reinholtz, B. and Valenta, T. (2007) *Sustainability: The Next Step Estimating the University of Wisconsin–Green Bay's Carbon Footprint,* (last accessed 05 January 2009), from http://www.uwgb.edu/fermanik/ES_P763/UWGB_Cfootprint_Summary_ESP2007.pdf.

Banerjee, S. (2002) Corporate Environmentalism: The Construct and its Measurement, *Journal of Business Research,* 55(3), pp. 177-191.

Bansal, P. and Roth, K. (2000) Why Companies Go Green: a Model of Ecological Responsiveness, *Academy of Management Journal,* 43(4), pp. 717-736.

Bartlett, M. S. (1950) Tests of Significance in Factor Analysis, *British Journal of Psychology,* 3(77), pp. 77-85.

Bogdan, R. C. and Biklen, S. K. (1998) *Qualitative Research in Education: An Introduction to Theory and Methods Third Edition*, Allyn & Bacon, Needham Heights, Massachusetts, United States.

Bosetti, V. and Buchner, B. (2008) Data Envelopment Analysis of Different Climate Policy Scenarios, *Ecological Economics,* 68(5), pp. 1340-1354.

Brown, M., Southworth, F. and Sarzynski, A. (2008) *Shrinking the Carbon Footprint of Metropolitan America*, Brookings Institution, New York, New York, United States.

Bryant, J., Campbell, A. J., Chan, A., Devonshire, E., Hughes, I., Mahony, M. J., Neville, V. and Saetherskar, T. A. (2003) *Writing a Literature Review,* (last accessed 27 February 2009), from http://www2.fhs.usyd.edu.au/arow/o/m16/writing_lit_rev.doc.

Bryman, A. and Bell, E. (2003) *Business Research Methods*, Oxford University Press, New York, New York, United States.

Busch, T. and Hoffmann, V. (2007) Emerging Carbon Constraints for Corporate Risk Management, *Ecological Economics,* 62(3), pp. 518-528.

Buysse, K. and Verbeke, A. (2003) Proactive Environmental Strategies: A Stakeholder Management Perspective, *Strategic Management Journal,* 24(5), pp. 453-470.

Carbon Planet (2008) *Regulatory Landscape,* (last accessed 2 January 2009), from http://www.carbonplanet.com/regulatory_landscape.

Carbon Trust (2006) *Carbon Footprints in the Supply Chain: The Next Step for Business,* (last accessed 21 February 2009), from http://www.carbontrust.co.uk/Publications/publicationdetail.htm?productid=CTC616&metaNoCache=1.

Carbon Trust (2007a) *Carbon Footprint Measurement Methodology Version 1.1,* (last accessed 27 February 2009), from http://www.carbontrust.co.uk/publications.

Carbon Trust (2007b) *Carbon Footprinting: An Introduction for Organisations,* (last accessed 16 February 2009), from http://www.carbontrust.co.uk/publications/publicationdetail?productid=CTV033.

Carmines, E. and Zeller, R. (1990) *Reliability and Validity Assessment*, Sage University, Newbury Park, California, United States.

Cattell, R. B. (1966) The Scree Test for the Number of Factors, *Multivariate Behavioral Research,* 1(2), pp. 245-276.

Cattell, R. B. (1978) *The Scientific Use of Factor Analysis*, Plenum, New York, New York, United States.

CDP (2002) *Carbon Disclosure Project: About Us,* (last accessed 17 January 2009), from http://www.cdproject.net/index.asp.

CDP South Africa (2007) *Carbon Disclosure Project South Africa Report JSE Top 40,* (last accessed 11 February 2009), from http://www.cdproject.net/reports.asp.

CDP South Africa (2008) *Carbon Disclosure Project South Africa Report JSE Top 100,* (last accessed 11 February 2009), from http://www.cdproject.net/reports.asp.

Clemens, B. (2001) Changing Environmental Strategies Over Time: An Empirical Study of the Steel Industry in the United States, *Journal of Environmental Management,* 62(2), pp. 221-231.

Clemens, B. (2006) Economic Incentives and Small Firms: Does it Pay to be Green?, *Journal of Business Research,* 59(4), pp. 492-500.

Corbett, C. and Kirsch, D. (1999) *ISO 14000: An Agnostic's Report from the Frontline*, John E. Anderson Graduate School of Management at UCLA, Center for International Business Education and Research (CIBER), Los Angeles, California, United States.

Cronbach, L. J. (1951) Coefficient Alpha and the Internal Structure of Tests, *Psychometrika,* 16(3), pp. 297-334.

Cropper, M. and Oates, W. (1992) Environmental Economics: A Survey, *Journal of Economic Literature,* 30(2), pp. 675-740.

Darnall, N., Henriques, I. and Sadorsky, P. (2008) Do Environmental Management Systems Improve Business Performance in an International Setting?, *Journal of International Management,* 14(4), pp. 364-376.

Davidson III, W. and Worrell, D. (2001) Regulatory Pressure and Environmental Management Infrastructure and Practices, *Business & Society,* 40(3), pp. 315-342.

DEAT (2005a) *Carbon Dioxide Emissions,* (last accessed 19 January 2009), from http://soer.deat.gov.za/indicator.aspx?m=570.

DEAT (2005b) *Greenhouse Gasses and the Greenhouse Effect,* (last accessed 19 January 2009), from http://www.environment.gov.za/climatechange2005/greenhouse_gases_and_the_greenhouse_effect.htm.

DEAT (2005c) *National Greenhouse Gas Inventory,* (last accessed 19 January 2008), from http://www.environment.gov.za/climatechange2005/national_greenhouse_gas_inventory.htm.

DEAT (2007) *About Us,* (last accessed 24 January 2009), from http://www.environment.gov.za/.

Dechant, K. and Altman, B. (1994) A Study of the Environmental Disclosure Policies for Australian Corporations, *Accounting and Business Research,* 26(3), pp. 187-199.

Delmas, M. and Toffel, M. (2004) Stakeholders and Environmental Management Practices: An Institutional Framework, *Business Strategy and the Environment,* 13(4), pp. 209-222.

Dlugolecki, A. and Loster, T. (2003) Climate Change and the Financial Services Sector: An Appreciation of the UNEPFI Study, *Geneva Papers on Risk and Insurance - Issues and Practice,* 28(3), pp. 382-393.

Dunn, O. J. (1964) Multiple Comparisons Using Rank Sums, *Technometrics,* 6(2), pp. 241-252.

Dunn, S. (2002) Down to Business on Climate Change, *Greener Management International,* 39, pp. 27-41.

EPA (2008) *What We Do,* (last accessed 15 February 2009), from http://www.epa.ie/whatwedo/.

Fabrigar, L. R., Wegener, R. C., MacCallum, R. C. and Strahan, E. J. (1999) Evaluating the Use of Exploratory Factor Analysis in Psychological Research, *Psychological Methods,* 4(3), pp. 272-299.

Feldman, S., Soyka, P. and Ameer, P. (1996) *Does Improving a Firm's Environmental Management System and Environmental Performance Result in a Higher Stock Price?*, ICF Kaiser, Fairfax, Virginia, United States.

Fogler, H. and Nutt, F. (1975) A Note on Social Responsibility and Stock Valuation, *Academy of Management Journal,* 18(1), pp. 155-160.

Forden, A., Wilson, K. and Bright, B. (2008) *Your Global Carbon Footprint,* (last accessed 27 February 2009), from http://uwstudentfpweb.uwyo.edu/B/BBRIGHT1/AECL1000/AECL%20Termpaper%20(Revised).pdf.

GHG Protocol (2009) *The Greenhouse Gas Protocol Initiative: The Foundation for Sound and Sustainable Climate Strategies,* (last accessed 15 February 2009), from http://www.ghgprotocol.org/.

Giurco, D. and Petrie, J. (2007) Strategies for Reducing the Carbon Footprint of Copper: New Technologies, More Recycling or Demand Management?, *Minerals Engineering,* 20(9), pp. 842-853.

Gonzalez-Benito, J. and Gonzalez-Benito, O. (2006) A Review of Determinant Factors of Environmental Proactivity, *Business Strategy and the Environment,* 15(2), pp. 87-102.

Gore, A. (2000) *Earth in the Balance*, Houghton Mifflin Company, Boston, Massachusetts, United States.

Gorsuch, R. L. (1983) *Factor Analysis Second Edition*, Lawrence Erlbaum Associates, Hillsdale, Michigan, Unites States.

Gray, W. and Shadbegian, R. (1993) Environmental Regulation and Manufacturing Productivity at the Plant Level, NBER, Washington D.C., United States.

Groenewegen, P. and Vergragt, P. (1991) Environmental Issues as Threats and Opportunities for Technological Innovation, *Technology Analysis and Strategic Management,* 3(1), pp. 43-55.

Grubb, M., Vrolijk, C. and Brack, D. (1999) *The Kyoto Protocol: A Guide and Assessment*, Royal Institute of International Affairs, London, United Kingdom.

Hair, J. F., Anderson, R. E., Tatham, R. L. and Black, W. C. (1995) *Multivariate Data Analysis Fourth Edition*, Prentice Hall, New Jersey, New York, United States.

Hall, R. (1999) *Organizations: Structures, Processes, & Outcomes Seventh Edition*, Prentice Hall, New Jersey, New York, United States.

Hammond, G. (2007) Time to Give Due Weight to the Carbon Footprint Issue, *Nature,* 445(18), p. 256.

Hansen, J. and Sato, M. (2004) Greenhouse Gas Growth Rates, *Proceedings of the National Academy of Sciences,* 101(46), pp. 16109-16114.

Hansen, M. W. (2003) Managing the Environment Across Borders: A Survey of Environmental Management in Transnational Corporations in Asia, *Transnational Corporations,* 12(1), pp. 27-52.

Hart, S. L. (1997) Beyond Greening: Strategies for a Sustainable World, *Harvard Business Review,* 75(1), pp. 66-77.

Hart, S. L. and Ahuja, G. (1996) Does it Pay to be Green? An Empirical Examination of the Relationship between Emission Reduction and Firm Performance, *Business Strategy and the Environment,* 5(1), pp. 30-37.

Henriques, I. and Sadorsky, P. (1996) The Determinants of an Environmentally Responsive Firm: An Empirical Approach, *Journal of Environmental Economics and Management,* 30(3), pp. 381-395.

Hintze, J. L. (2007a) *NCSS Statistical System: User's Guide II Descriptive Statistics, Means, Quality Control, and Design of Experiments,* (last accessed 14 November 2009), from http://www.ncss.com/pdf/manuals/NCSSUG2.pdf.

Hintze, J. L. (2007b) *NCSS Statistical System: User's Guide IV Multivariate Analysis, Clustering, Meta-Analysis, Forecasting / Time Series, Operations Research, Mass Appraisal,* (last accessed 19 September 2009), from http://www.ncss.com/pdf/manuals/NCSSUG4.pdf.

Houghton, J. (1994) *Global Warming, the Complete Briefing*, Cambridge University Press, Cambridge, United Kingdom.

Hunt, C. B. and Auster, E. R. (1990) Proactive Environmental Management, *Sloan Management Review,* 31(2), pp. 7-18.

Hutchinson, C. (1996) Integrating Environmental Policy with Business Strategy, *Long Range Planning,* 29(1), pp. 11-23.

IEA (1996) *Emissions of CO_2,* (last accessed 19 January 2009), from http://www.iea.org/.

IEA (2009) *About the IEA,* (last accessed 17 February 2009), from http://www.iea.org/about/index.asp.

IPCC (1988) *About IPCC,* (last accessed 17 January 2009), from http://www.ipcc.ch/about/index.htm.

IPCC (2001) *Climate Change 2001: Synthesis Report, Summary for Policy Makers,* (last accessed 27 February 2009), from http://www.ipcc.ch/ipccreports/assessments-reports.htm.

IPCC (2007) *Working Group 1 Report: The Physical Science Basis,* (last accessed 27 February 2009), from http://www.ipcc.ch/ipccreports/assessments-reports.htm.

Jeswani, H. K., Wehrmeyer, W. and Mulugetta, Y. (2008) How Warm is the Corporate Response to Climate Change? Evidence from Pakistan and the UK, *Business Strategy and the Environment,* 17(1), pp. 46-60.

Jolliffe, I. T. (1972) Discarding Variables in a Principal Component Analysis. I: Artificial Data, *Applied Statistics,* 21(2), pp. 160-173.

Jose, A. and Lee, S. (2007) Environmental Reporting of Global Corporations: A Content Analysis Based on Website Disclosures, *Journal of Business Ethics,* 72(4), pp. 307-321.

Kaiser, H. F. (1960) The Application of Electronic Computers to Factor Analysis, *Educational and Psychological Movement,* 20(1), pp. 141-151.

Kaiser, H. F. (1974) An Index of Factorial Simplicity, *Psychometrika,* 39(1), pp. 31-36.

Karmali, A. (2006) *Best Practice in Strategies for Managing Carbon. In: Tang, A. and Yeoh, R. (ed) Cut Carbon, Grow Profits*, Risk Books, London, United Kingdom.

Khanna, M. and Anton, W. (2002) Corporate Environmental Management: Regulatory and Market-Based Incentives, *Land Economics,* 78(4), pp. 539-558.

Khanna, M. and Damon, L. (1999) EPA's Voluntary 33/50 Program: Impact on Toxic Releases and Economic Performance of Firms, *Journal of Environmental Economics and Management,* 37(1), pp. 1-25.

King, A. and Lenox, M. (2001) Does it Really Pay to be Green? An Empirical Study of Firm Environmental and Financial Performance, *Journal of Industrial Ecology,* 5(1), pp. 105-116.

Kirk, D. (1995) Environmental Management in Hotels, *International Journal of Contemporary Hospitality Management,* 7(6), pp. 3-8.

Kitzes, J., Galli, A., Bagliani, M., Barrett, J., Dige, G. and Wiedmann, T. (2007) 'A Research Agenda for Improving the National Ecological Footprint Accounts', International Ecological Footprint Conference.

Klassen, R. and Whybark, D. (1999) The Impact of Environmental Technologies on Manufacturing Performance, *Academy of Management Journal,* 42(6), pp. 599-615.

Koehler, D. A. (2007) The Effectiveness of Voluntary Environmental Programs - A Policy at a Crossroads, *The Political Studies Journal,* 35(4), pp. 689-722.

Kolk, A. and Pinkse, J. (2004) Market Strategies for Climate Change, *European Management Journal,* 22(3), pp. 304-314.

Kruskal, W. and Wallis, W. (1952) Use of Ranks in One-Criterion Variance Analysis, *Journal of the American Statistical Association,* 47(260), pp. 583-621.

Kyoto Protocol (1997) *Kyoto Protocol,* (last accessed 17 January 2009), from http://unfccc.int/kyoto_protocol/items/2830.php.

Lash, J. and Wellington, F. (2007) Competitive Advantage on a Warming Planet, *Harvard Business Review,* 85(3), pp. 94-96.

Lashof, J. and Ahuja, D. (1990) Relative Contributions of Greenhouse Gas Emissions to Global Warming, *Nature,* 344(6266), pp. 529-531.

Leedy, P. D. and Ormrod, J. E. (2001) *Practical Research Planning and Design Seventh Edition*, Merril Prentice Hall, New Jersey, New York, United States.

Lenzen, M., Murray, J., Sack, F. and Wiedmann, T. (2007) Shared Producer and Consumer Responsibility - Theory and Practice, *Ecological Economics,* 61(1), pp. 27-42.

Levy, D. L. (1995) The Environmental Practices and Performances of Transnational Corporations, *Transnational Corporations,* 4(1), pp. 44-67.

Lynas, M. (2007) *Carbon Counter*, Harper Collins Publishers, Glasgow, Scotland.

Lyon, T. and Maxwell, J. (2002) *Voluntary Approaches to Environmental Regulation: A Survey. In Frazini, M. and Nicita, A. (ed) Economic Institutions and Environmental Policy*, Ashgate Publishing, London, United Kingdom.

Magretta, J. (1997) Growth Through Global Sustainability: An Interview with Monsanto's CEO, Robert B. Shapiro, *Harvard Business Review,* 75(1), pp. 78-88.

Martin, R. (1998) *ISO 14001 Guidance Manual*, University of Tennessee, Oak Ridge, Tennessee, United States.

Meyer, J. and Rowan, B. (1977) Institutionalized Organizations: Formal Structure as Myth and Ceremony, *American Journal of Sociology,* 83(2), pp. 340-363.

Min, H. and Galle, W. (2001) Green Purchasing Practices of US Firms, *International Journal of Operations and Production Management,* 21(9), pp. 1222-1238.

Mingay, S. (2008) *Green IT: A Lesson for all Developing Countries from South Africa,* (last accessed 11 January 2009), from http://www.gartner.com/resources/160900/160951/green_it_a_lesson_for_all_de_160951.pdf.

Mingay, S. (2009) *Too Many Enterprises are in Denial about Carbon Management,* (last accessed 27 February 2009), from http://www.gartner.com/resources/165200/165292/too_many_enterprises_are_in__165292.pdf.

Morgenstern, R. and Pizer, W. (2007) *Reality Check: The Nature and Performance of Voluntary Environmental Programs in the United States, Europe, and Japan*, Resources for the Future, Washington D.C., United States.

Muller, E. (2007) *Factors Influencing Greenhouse Gas Emission Reduction from South African Industry.* University of the Witwatersrand, Johannesburg, South Africa.

Murray, J. and Dey, C. (2009) The Carbon Neutral Free for All, *International Journal of Greenhouse Gas Control,* 3(2), pp. 237-248.

NASA Goddard Space Institute for Space Studies (2007) *2006 Was the Earth's Fifth Warmest Year,* (last accessed 11 January 2009), from http://www.nasa.gov/centers/goddard/news/topstory/2006/2006_warm.html

Netherwood, A. (2001) *Environmental Management Systems. In: Welford, R. (ed) Corporate Environmental Management 1: Systems and Strategies*, Earthscan Publications, London, United Kingdom.

Packard, K. and Reinhardt, F. (2001) What Every Executive Needs to Know About Global Warming, *IEEE Engineering Management Review,* 29(2), pp. 36-41.

Pfeifer, S. and Sullivan, R. (2008) Public Policy, Institutional Investors and Climate Change: A UK Case Study, *Climatic Change,* 89(3), pp. 245-262.

Porter, M. E. (1991) America's Green Strategy, *Scientific American,* 264(4), p. 168.

Porter, M. E. and Van der Linde, C. (1995) Toward a New Conception of the Environment - Competitiveness Relationship, *Journal of Economic Perspectives,* 9(4), pp. 97-118.

Post, J. E. and Altman, B. (1994) Managing the Environmental Change Process: Barriers and Opportunities, *Journal of Organizational Change Management,* 7(4), pp. 64-81.

Pratt, L. and Fintel, E. (2002) *Environmental Management as an Indicator of Business Responsibility in Central America. In Utting, P. (ed) The Greening of Business in Developing Countries: Rhetoric, Reality and Prospects*, Zed Books, London, United Kingdom.

Putt del Pina, S. and Bhatia, P. (2002) *Working 9 to 5 on Climate Change,* (last accessed 11 January 2009), from http://www.wri.org/publication/working-9-5-climate-change-office-guide.

Putt del Pina, S., Levinson, R. and Larson, J. (2006) *Hot Climate, Cool Commerce: A Service Sector Guide to Greenhouse Gas Management,* (last accessed 27 February 2009), from http://www.wri.org/publication/hot-climate-cool-commerce.

Ramus, C. A. (2002) Encouraging Innovative Environmental Actions: What Companies and Managers Must Do, *Journal of World Business,* 37(2), pp. 151-164.

Rees, W. E. (1992) Ecological Footprints and Appropriated Carrying Capacity: What Urban Economics Leaves Out, *Environment and Urbanisation,* 4(2), pp. 121-130.

Republic of South Africa (1998) *National Environmental Management Act 107 of 1998,* (last accessed 15 February 2009), from http://www.deat.gov.za//PolLeg/GenPolicy/2007May16/NEMA8of2004.doc.

Republic of South Africa (2004) *National Environment Management: Air Quality Act 39 of 2004,* (last accessed 15 February 2009), from http://www.environment.gov.za/PolLeg/Legislation/2006Jan10/NEM_Air_Quality_Management_Act_(Act39_0f_2004).pdf.

Revelle, R. and Suess, H. (1957) Carbon Dioxide Exchange between Atmosphere and Ocean and the Question of an Increase of Atmospheric CO_2 during Past Decades, *Tellus 9*, pp. 18-27.

Rockness, J., Schlachter, P. and Rockness, H. (1986) *Hazardous Waste Disposal, Corporate Disclosure, and Financial Performance in the Chemical Industry. In Neimark, M. (ed) Advances in Public Interest Accounting*, JAI Press, Greenwich, United Kingdom.

Rodhe, H. (1990) A Comparison of the Contributions of Various Gasses to the Greenhouse Effect, *Science,* 248(4960), pp. 1217-1219.

Roosevelt, T. (1907) *The Conservation of Natural Resources: Seventh Annual Message to Congress,* (last accessed 10 May 2009), from http://www.pbs.org/weta/thewest/resources/archives/eight/trconserv.htm.

Rugman, A. M. and Verbeke, A. (1998) Corporate Strategies and Environmental Regulations: An Organizing Framework, *Strategic Management Journal,* 19(4), pp. 363-375.

Russo, M. V. and Fouts, P. A. (1997) A Resource-Based Perspective on Corporate Environmental Performance and Profitability, *Academy of Management Journal,* 40(3), pp. 534-559.

Schaltegger, S. and Burrit, R. (2000) *Contemporary Environmental Accounting*, Greenleaf Publishing, Sheffield, United Kingdom.

Schaltegger, S. and Synnestvedt, T. (2002) The Link between Green and Economic Success: Environmental Management as the Crucial Trigger between Environmental and Economic Performance, *Journal of Environmental Management,* 65(4), pp. 339-346.

Schelling, T. (1992) Some Economics of Global Warming, *American Economic Review,* 82(1), pp. 1-14.

Schmalensee, R., Stoker, T. and Judson, R. (1998) World Carbon Dioxide Emissions: 1950-2050, *Review of Economics and Statistics,* 80(1), pp. 15-27.

Sebitosi, A. and Pillay, P. (2008) Renewable Energy and the Environment in South Africa: A Way Forward, *Energy Policy,* 36(9), pp. 3312-3316.

Shell (2008) *Shell Energy Scenarios to 2050,* (last accessed 01 January 2009), from http://www-static.shell.com/static/aboutshell/downloads/our_strategy/shell_global.../SES%20booklet%2025%20of%20July%202008.pdf.

Shrivastava, P. (1995) Environmental Technologies and Competitive Advantage, *Strategic Management Journal,* 16(Special Issue), pp. 183-200.

Sinha, P. and Flederbach Jr, W. (2008) *The Business Case For Carbon Management,* (last accessed 27 February 2009), from http://www.obg.com/documents/2008/3/31/Greenhouse%20Gas%20Management%20Journal.pdf.

Stanwick, P. A. and Stanwick, S. D. (2001) CEO Compensation: Does it Pay to be Green?, *Business Strategy and the Environment,* 10(3), pp. 176-182.

Tan, J. and Peng, M. (2003) Organizational Slack and Firm Performance During Economic Transitions: Two Studies from an Emerging Economy, *Strategic Management Journal,* 24(13), pp. 1249-1263.

UNFCCC (1998) *Kyoto Protocol to the United Nations Framework Convention on Climate Change,* (last accessed 07 February 2009), from http://unfccc.int/resource/docs/convkp/kpeng.pdf.

UNFCCC (unknown-a) *Essential Information: Feeling the Heat,* (last accessed 1 February 2009), from http://unfccc.int/essential_background/feeling_the_heat/items/2913.php.

UNFCCC (unknown-b) *The Greenhouse Effect and the Carbon Cycle,* (last accessed 27 February 2009), from http://unfccc.int/essential_background/feeling_the_heat/items/2903.php.

UNFCCC (unknown-c) *Kyoto Protocol,* (last accessed 2 February 2009), from http://unfccc.int/kyoto_protocol/items/2830.php.

Van der Merwe, C. (2007a) *Business Failing to Seize Opportunities in Greenhouse Gas Abatement,* (last accessed 27 December 2008), from http://www.engineeringnews.co.za/article/business-failing-to-seize-opportunities-in-greenhouse-gas-abatement-2007-10-19.

Van der Merwe, C. (2007b) *SA's Top Firms Disclose Carbon Footprint,* (last accessed 27 December 2008), from http://www.engineeringnews.co.za/article/sa-039-s-top-firms-disclose-carbon-footprint-2007-11-23.

Van der Merwe, C. (2008) *JSE's Top 100 Companies to Disclose Carbon Footprint,* (last accessed 27 December 2008), from http://www.engineeringnews.co.za/article/jse-s-top-100-companies-to-disclose-carbon-footprint-2008-08-01.

Van Schalkwyk, M. (2007) *SA: Van Schalkwyk: Launch of South African Carbon Disclosure Report,* (last accessed 17 January 2009), from http://www.polity.org.za/article.php?a_id=122098.

Vastag, G. and Melnyk, S. (2002) Certifying Environmental Management Systems by the ISO 14001 Standards, *International Journal of Production Research,* 40(18), pp. 4743-4763.

Vitousek, P. (1994) Beyond Global Warming: Ecology and Global Change, *Ecology,* 75(7), pp. 1861-1876.

Walley, N. and Whitehead, B. (1994) It's Not Easy Being Green, *Harvard Business Review,* 72(3), pp. 46-52.

Warhurst, A. and Mitchell, P. (2000) Corporate Social Responsibility and the Case of Summitville Mine, *Resources Policy,* 26(2), pp. 91-102.

Wiedmann, T. and Minx, J. (2007) *A Definition of Carbon Footprint. In: Pertsova, C. (ed) Ecological Economics Research Trends*, Nova Science Publishers, New York, New York, United States.

Winer, B. J. (1971) *Statistical Principles in Experimental Design*, McGraw-Hill, New York, New York, United States.

WRI (2004) *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard,* (last accessed 27 February 2009), from http://www.wri.org/publication/greenhouse-gas-protocol-corporate-accounting-and-reporting-standard-revised-edition.

WRI (2006) *Climate Analysis Indicators Tool,* (last accessed 08 February 2009), from http://cait.wri.org/figures.php.

WRI (2009) *About WRI,* (last accessed 15 February 2009), from http://www.wri.org/about.

WRI (unknown) *The Greenhouse Gas Protocol: Measuring to Manage: A Guide to Designing GHG Accounting and Reporting Programs,* (last accessed 27 February 2009), from http://www.ghgprotocol.org/files/measuring-to-manage.pdf.

APPENDIX A: RESEARCH INSTRUMENT

The Graduate School of Business Administration
2 St David's Place, Parktown, Johannesburg, 2193
PO Box 98, Wits, 2050
Telephone: +27 11 717 3600, Facsimile: +27 11 643 2336
Website: www.wbs.ac.za

Dear Respondent,

I am a student at the University of the Witwatersrand conducting a research report in accordance with a requirement for fulfilment of a Master of Business Administration.

You are being asked to participate in a study investigating the management of carbon footprints and Greenhouse Gas emissions in South Africa. The participation will involve a 20 minute structured telephone interview where your responses will be noted by the interviewer. All responses will remain confidential and anonymous. Kindly inform the interviewer if you would like to be sent a copy of the results for your perusal.

Your participation is voluntary, if at any time during the interview you wish to withdraw your participation, you are free to do so without prejudice.

Yours sincerely

_____

Kent Diepraam
MBA Student
Wits Business School
Cell: 083 727 9999
Email: kentdm@gmail.com

I confirm that Kent Diepraam is a *bona fide* student at Wits Business School and is conducting research under my supervision

Yours sincerely

_____

Dr Anthony Stacey
Faculty of Commerce, Law and management
Graduate School of Business Administration
University of the Witwatersrand

CARBON FOOTPRINT MANAGEMENT SYSTEMS IN SOUTH AFRICA

INTRODUCTION - CONTACT PERSON: I am ……, an independent interviewer. We are conducting a survey to discover your company's thoughts, feelings and attitudes towards managing carbon footprints and Greenhouse Gas emissions in South Africa for a MBA thesis. I would like to talk to the person who is in charge of making decisions and implementing "going green" in your company.

RESPONDENT: REPEAT INTRODUCTION. Please note that your answers will be treated as confidential. Your participation is greatly appreciated and please note that your name as well as all responses will remain confidential and anonymous. Your opinion is very important to us, and any additional comments you would like to make would be most appreciated.

RESPONDENT COMPANY : _____

COMPANY ADDRESS: _____

RESPONDENT NAME: MR/MS: _____

RESPONDENT DESIGNATION: _____

TELEPHONE WORK/ CELL: _____

EMAIL ADDRESS:

SECTION 1: DEMOGRAPHICS AND COMPANY INFORMATION – ASK ALL	
Q1.1 COMPANY SIZE How many employees are employed by your company? (**READ OUT) (A)**	**Circle One**
SME 0 - 200 Employees	1
Corporate 200+ employees	2
Q1.2 ECONOMIC SECTOR Which one of the following industries does your company fit into? (**READ OUT) (B)**	**Circle One**
Primary (for example agriculture, agribusiness, fishing, forestry and all mining and quarrying industries)	1
Secondary (for example manufacturing, construction)	2
Tertiary (for example insurance, government, tourism, banking, retail, education, and social services)	3
SECTION 2: SCREENING – ASK ALL	
FQ1. COMPANY SITUATION Please tell me which of these describes your company's situation: (**READ OUT) (C)**	**Circle One**
We currently measure our Greenhouse Gas emissions	1
We are in the process of measuring our Greenhouse Gas emissions and the information will be available soon	2
We realise climate change implications and are just getting started	3
We have no intention to measure our Greenhouse Gas emissions	4
CLOSE IF CODE 4, KEEP QUESTIONNAIRE. CODE 1-3 CONTINUE	

FQ2. COMPANY SITATION Please describe your company's situation: (**READ OUT) (D)**	**Circle One**
I am the sponsor for all decision making with regard to the Greenhouse Gas emissions strategy that my company is involved in	1
I am responsible for all decision making with regard to the Greenhouse Gas emissions strategy that my company is involved in	2
I manage the Greenhouse Gas emissions strategy that my company is involved in	3
I am not the sponsor or responsible for the decision making or manage the Greenhouse Gas emissions strategy that my company is involved in	4
GET CORRECT PERSON IF CODE 4, CODE 1-3 CONTINUE	

SECTION 3: GHG EMISSIONS STRATEGY - ASK SECTION 3 FOR ALL QUALIFYING RESPONDENTS		
QUESTION 3.1 WHY CREATE A GHG EMISSIONS STRATEGY: I am going to read out statements that represent some reasons why companies create a Greenhouse Gas Strategy. Using a 10 point scale, where 1 is 'Not at all Important' and 10 is 'Extremely Important', please rate how important the following statements were to your company's Greenhouse Gas Strategy creation. If the statement is not applicable, please tell me. **WRITE IN, IF N/A CODE AS "99. INTERVIEWER TO ROTATE STATEMENTS**		**WRITE IN (1-10)**
E	My company saw an opportunity to increase profits	
F	My company saw an opportunity to decrease costs	
G	My company believes that the government will pass environmental legislation limiting Greenhouse Gas emissions in the next few years	
H	We are a multi-national and our parent/holding company is bound by environmental legislation such as the Kyoto Protocol	
I	My company is forward thinking and likes to be involved in the forefront of innovation	
J	My company wanted better relationships with suppliers	
K	My company saw an opportunity to increase our technological processes	
L	My company wanted to create a competitive advantage	
M	My company came under pressure from the directors	
N	My company came under pressure from consumers	
O	My company came under pressure from our own employees	
P	My company came under pressure from environmental groups	
Q	My company came under pressure from the government	
R	My company views environmental issues as increasingly important	
S	We wanted to further our company through product/service development	
T	My company wanted to mitigate physical risks	
U	My company wanted to mitigate public policy risks	
V	My company wanted to mitigate competitive impacts	
W	My company wanted to mitigate any possible legal risks	
X	My company wanted to mitigate any possible reputational risks	
Y	Other Please specify	
Z	Other Please specify	

SECTION 4: ELEMENTS OF GHG EMISSIONS STRATEGY. ASK SECTION 4 FOR ALL RESPONDENTS.		
QUESTION 4.1 WHAT ELEMENTS DOES THE GHG EMISSIONS STRATEGY CONTAIN: I am going to read out statements that represent some elements of a Greenhouse Gas Strategy. Using a 10 point scale, where 1 is 'Not at all Involved' and 10 is 'Extremely Involved', please rate how involved your company's Greenhouse Gas Strategy is on these statements. If the statement is not applicable, please tell me. **WRITE IN, IF N/A CODE AS "99. INTERVIEWER TO ROTATE STATEMENTS**		**WRITE IN (1-10)**
AA	My company assesses regulatory risks	
AB	My company assesses supply chain risks	
AC	My company assesses product and technology risks	
AD	My company assesses legal risks	
AE	My company assesses reputational risks	
AF	My company assesses physical risks	
AG	My company uses a Greenhouse Gas Inventory such as the Greenhouse Gas Protocol	
AH	My company uses another Greenhouse Gas Protocol for the Greenhouse Gas Inventory	
AI	My company developed our own Greenhouse Gas Inventory	
AJ	My company has designed a system to collect and store the Greenhouse Gas emission data	
AK	My company uses the ISO 14001 for our Greenhouse Gas emissions strategy	
AL	My company conducts a review of the climate change risks	
AM	My company includes the Greenhouse Gas emission programme into the company strategy	
AN	My company conducts scenario strategy plans for our Greenhouse Gas emissions programme	
AO	My company assesses the supply and demand for carbon in our Greenhouse Gas emissions programme	
AP	Our company's Greenhouse Gas emissions programme is driven from senior management down to lower rank employees	
AQ	Our company's Greenhouse Gas emissions programme is driven from the lower rank employees up to senior management	
AR	My company includes environmental training programmes	
AS	My company has a written environmental policy	
AT	Other Please specify	
AU	Other Please specify	

SECTION 5: QUESTIONS FOR PILOT STUDY ASK SECTION 5 FOR PILOT RESPONDENTS ONLY.
5.1 For the first question, **WHY CREATE A GHG EMISSIONS STRATEGY** what did you understand was being asked from the question wording? **INTERVIEWER PLEASE READ OUT Q3.1 TO RESPONDENT. WRITE IN VERBATIM ANSWER**
5.2 Did you have any confusion regarding the instructions given for the first question?
5.3 Were any statements on this question confusing and did not make sense?
5.4 For the second question **WHAT ELEMENTS DOES THE GHG EMISSIONS STRATEGY CONTAIN**, what did you understand was being asked from the question wording? **INTERVIEWER PLEASE READ OUT Q4.1 TO RESPONDENT. WRITE IN VERBATIM ANSWER**
5.5 Did you have any confusion regarding the instructions given for the second question?
5.6 Were any statements on this question confusing and did not make sense?

ASK ALL RESPONDENTS	**YES**	**NO**
Would you like me to fax or e-mail you a copy of the confirmation letter that this is information would only be used for the purpose of a MBA thesis? (AV)	**1**	2

ASK ALL RESPONDENTS	**YES**	**NO**
Would you like to receive a copy of the results? (AW)	**1**	2

THANK AND CLOSE

APPENDIX B: CONSISTENCY MATRIX

A consistency matrix is a tool used for the alignment of your sub-problems, research proposal, scaling technique, and subsequent data analysis. It also includes main literature sources for the reader's perusal.

A consistency matrix is constructed for each sub-problem and can be viewed on the accompanying pages.

Table 19: Consistency matrix for why organisations create Carbon Footprint Management Systems

The purpose of the research is to explore why and how South African organisations are responding to climate change					
Sub-problem 1	**Research question**	**Literature review**	**Source of data**	**Type of data**	**Analysis**
Identify the reasons for implementation of Carbon Footprint Management Systems in South Africa.	One or more of these factors: • Financial performance (Section 2.5.1); • Regulatory environment (Section 2.5.2); • Parent company obligations (Section 2.5.3); • Stakeholder pressure (Section 2.5.4); • Technological and competitive advantage (Section 2.5.5); • Proactive stance (Section 2.5.6); and • Mitigating risk (Section 2.5.7) are reasons for the implementation of Carbon Footprint Management Systems in South Africa.	(Groenewegen and Vergragt 1991; Dechant and Altman 1994; Levy 1995; Shrivastava 1995; Henriques and Sadorsky 1996; Magretta 1997; Russo and Fouts 1997; Rugman and Verbeke 1998; Schaltegger and Burrit 2000; Buysse and Verbeke 2003; Dlugolecki and Loster 2003; Hansen 2003; Delmas and Toffel 2004; Kolk and Pinkse 2004; Clemens 2006; Karmali 2006; Lash and Wellington 2007; Van der Merwe 2007a; Bosetti and Buchner 2008; Darnall et al. 2008; Mingay 2008; Pfeifer and Sullivan 2008; Sinha and Flederbach Jr 2008)	**QUESTION 3.1 WHY CREATE A GHG EMISSIONS STRATEGY:** I am going to read out statements that represent some reasons why companies create a Greenhouse Gas Strategy. Using a 10 point scale, where 1 is 'Not at all Important' and 10 is 'Extremely Important', please rate how important the following statements were to your company's Greenhouse Gas Strategy creation. If the statement is not applicable, please tell me.	Verbal ordinal scale	Descriptive statistics Factor analysis Non-Parametric Kruskal-Wallis significance test

Table 20: Consistency matrix for what are the elements contained within Carbon Footprint Management Systems

The purpose of the research is to explore why and how South African organisations are responding to climate change					
Sub-problem 2	**Research question**	**Literature review**	**Source of data**	**Type of data**	**Analysis**
Describe elements of current Carbon Footprint Management Systems in South Africa.	One or more of these elements: • Assess organisational position (Section 2.6.1) • A GHG Inventory (Section 2.6.2); • Reporting mechanisms (Section 2.6.3); • Long-term strategy planning (Section 2.6.4); and • Implementation platform (Section 2.6.5) are being used in the structure of Carbon Footprint Management Systems in South African Organisations.	(Kirk 1995; Corbett and Kirsch 1999; Hall 1999; Ramus 2002; Dlugolecki and Loster 2003; Kolk and Pinkse 2004; Karmali 2006; Putt del Pina et al. 2006; Lash and Wellington 2007; Sinha and Flederbach Jr 2008; WRI unknown)	**QUESTION 4.1 WHAT ELEMENTS DOES THE GHG EMISSIONS STRATEGY CONTAIN:** I am going to read out statements that represent some elements of a Greenhouse Gas Strategy. Using a 10 point scale, where 1 is 'Not at all Involved' and 10 is 'Extremely Involved', please rate how involved your company's Greenhouse Gas Strategy is on these statements. If the statement is not applicable, please tell me**.**	Verbal Ordinal Scale	Descriptive Statistics Factor Analysis

APPENDIX C: JSE SECURITIES EXCHANGE TOP 100

Organisation	Sector
Absa Group	Banks
AECI	Chemicals
African Bank Investments	Banks
African Oxygen Ltd	Chemicals
African Rainbow Minerals	Metals and Mining
Allied Electronics Corporation (Altron)	Electronic Equipment and Instruments
Allied Technologies	Telecommunication Services
Anglo American	Metals and Mining
Anglo Platinum	Metals and Mining
AngloGold Ashanti	Metals and Mining
Apexhi Properties A,B,C	Real Estate
ArcelorMittal South Africa	Steel
Aspen Pharmacare Holdings	Pharmaceuticals
Astral Foods	Food Products
Aveng	Construction and Engineering
Avi Food products AQ not public –	Food Products
Avusa (formerly Johnnic Comms.)	Media and Photography
Barloworld	Industrial
BHP Billiton	Metals and Mining
Bidvest Group	Industrial Products and Services
Caxton Ctp Publish Print	Publishing
Compagnie Financière Richemont SA	Textiles, Apparel and Luxury Goods
Datatec	Software and Computer Services
Dimension Data Holdings	IT Consulting and Services
Discovery Holdings	Insurance
Emira Property Fund	Real Estate
Exxaro Resources	Metals and Mining
FirstRand	Banks
Foschini	Textiles, Apparel and Luxury Goods
Fountainhead Property Trust	Real Estate
Gold Fields	Metals and Mining
Gold Reef Resorts	Leisure Entertainment and Hotels
Grindrod	Trading Companies and Distributors
Group Five	Construction and Engineering
Growthpoint Properties	Real Estate

Organisation	Sector
Harmony Gold Mining Co	Metals and Mining
Highveld Steel And Vanadium	Steel
Hulamin	Steel
Illovo Sugar (Associated British Foods)	Food Products
Impala Platinum Holdings	Metals and Mining
Imperial Holdings	Trading Companies and Distributors
Investec	Diversified Financials
JD Group	Speciality Retail
JSE	Diversified Financials
Kumba Iron Ore	Metals and Mining
Lewis Group	Speciality Retail
Liberty International	Real Estate management and Development
Liberty Life Group	Insurance
Lonmin	Metals and Mining
Massmart Holdings	Multiline retail
Medi-Clinic Corp	Healthcare Providers and Services
Metorex	Metals and Mining
Metropolitan Holdings	Insurance
Mondi Limited	Paper and Forest Products
Mr Price Group	Multiline retail
MTN Group	Telecommunication Services
Murray & Roberts	Construction and Engineering
Mvelaphanda Group	Diversified Financials
Mvelaphanda Resources	Metals and Mining
Nampak	Industrial
Naspers	Media and Photography
Nedbank Group	Banks
Netcare	Healthcare Providers and Services
New Clicks Holdings	Food and Drug Retailing
Northam Platinum	Metals and Mining
Old Mutual	Diversified Financials
Pangbourne Prop	Real Estate
Peregrine Holdings	Diversified Financials
Pick n Pay Holdings	Food and Drug Retailing
Pretoria Portland Cement	Construction Materials
PSG Group	Diversified Financials
Rainbow Chicken	Food Products
Raubex Group	Construction and Engineering
Redefine Income Fund	Real Estate
Remgro	Industrial

Organisation	Sector
Reunert	Electrical Equipment
RMB Holdings	Banks
SA Corporate Real Estate Fund	Real Estate
SABMiller	Beverages and Tobacco
Sanlam	Insurance
Santam	Insurance
Sappi	Paper and Forest Products
Sasol	Integrated Oil and Gas
Sentula Mining	Metals and Mining
Shoprite Holdings	Food and Drug Retailing
Standard Bank Group	Banks
Steinhoff International Holdings	Household and Personal Products
Sun International	Leisure Entertainment and Hotels
Super Group	Trading Companies and Distributors
Telkom SA	Telecommunication Services
The Spar Group	Food and Drug Retailing
Tiger Brands	Food Products
Tongaat Hulett	Food Products
Trencor	Trading Companies and Distributors
Truworths International	Textiles, Apparel and Luxury Goods
Wesizwe Platinum	Metals and Mining
Wilson Bayly Holmes-Ovcon	Construction and Engineering
Woolworths Holdings	Food and Drug Retailing

APPENDIX D: CREATION REASONS EFA OUTPUT

Output Created		21-Sep-2009 10:34:31
Comments		
Input	Data	F:\Thesis\Data\SPSS\Data V01.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	177
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Increase_Profit TO Reputational_Risk /PRINT UNIVARIATE INITIAL ROTATION /print initial det kmo repr extraction rotation fscore univaratiate /plot eigen rotation /CRITERIA FACTORS(4) ITERATE(100) /EXTRACTION PC /CRITERIA ITERATE(100) /ROTATION VARIMAX /METHOD=CORRELATION .
Resources	Processor Time	0:00:00.969
	Elapsed Time	0:00:01.422
	Maximum Memory Required	48440 (47.305K) bytes

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Increase_Profit	7.2647	3.07634	102
Decrease_Cost	7.3333	2.86783	102
Pass_Regulation	7.5294	2.46442	102
Multi_National	6.0392	3.43517	102
Forefront_Innovation	7.8431	2.34519	102
Relationship_Suppliers	7.5686	2.51140	102
Increase_Technology	7.6863	2.59848	102
Competitive_Advantage	7.2843	2.73002	102
Pressure_Directors	5.6569	3.46837	102
Pressure_Consumers	5.3333	3.17582	102
Pressure_Employees	5.2059	3.20994	102
Pressure_EnvironGroups	5.1176	3.25575	102

	Mean	Std. Deviation	Analysis N
Pressure_Government	4.6373	3.22978	102
Environ_Important	7.8725	2.46026	102
Increase_Prod_Service	7.5784	2.49529	102
Physical_Risk	7.7647	2.48232	102
Policy_Risk	7.4706	2.65026	102
Competitive_Risk	7.1961	2.65524	102
Legal_Risk	7.6078	2.71832	102
Reputational_Risk	7.5784	2.66044	102

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.839
Bartlett's Test of Sphericity	Approx. Chi-Square	1669.462
	df	190
	Sig.	.000

Communalities

	Initial	Extraction
Increase_Profit	1.000	.738
Decrease_Cost	1.000	.749
Pass_Regulation	1.000	.595
Multi_National	1.000	.492
Forefront_Innovation	1.000	.749
Relationship_Suppliers	1.000	.726
Increase_Technology	1.000	.751
Competitive_Advantage	1.000	.649
Pressure_Directors	1.000	.798
Pressure_Consumers	1.000	.839
Pressure_Employees	1.000	.768
Pressure_EnvironGroups	1.000	.767
Pressure_Government	1.000	.760
Environ_Important	1.000	.810
Increase_Prod_Service	1.000	.668
Physical_Risk	1.000	.743
Policy_Risk	1.000	.803
Competitive_Risk	1.000	.729
Legal_Risk	1.000	.825
Reputational_Risk	1.000	.644

Extraction Method: Principal Component Analysis.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.845	44.223	44.223	8.845	44.223	44.223
2	3.411	17.053	61.275	3.411	17.053	61.275
3	1.349	6.746	68.022	1.349	6.746	68.022
4	.997	4.986	73.008	.997	4.986	73.008
5	.803	4.015	77.022			
6	.766	3.832	80.855			
7	.602	3.009	83.863			
8	.508	2.541	86.404			
9	.484	2.421	88.826			
10	.413	2.067	90.893			
11	.358	1.789	92.682			
12	.284	1.421	94.103			
13	.262	1.309	95.412			
14	.205	1.025	96.436			
15	.165	.825	97.261			
16	.154	.769	98.031			
17	.134	.668	98.699			
18	.106	.529	99.228			
19	.086	.432	99.660			
20	.068	.340	100.000			

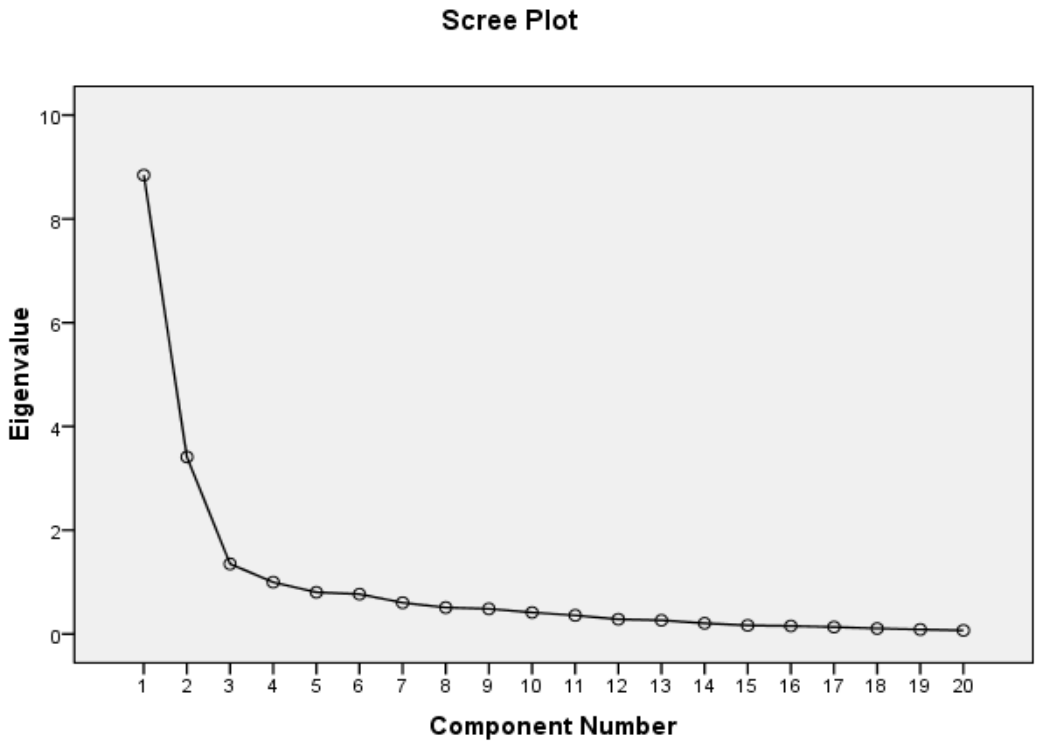
Component Matrix[a]

	Component			
	1	2	3	4
Increase_Profit	.534	-.027	.546	-.393
Decrease_Cost	.487	-.197	.680	.104
Pass_Regulation	.688	-.181	.293	.060
Multi_National	.471	.423	-.134	.269
Forefront_Innovation	.683	-.239	.219	.420
Relationship_Suppliers	.761	-.326	.059	-.193
Increase_Technology	.754	-.221	.152	-.334
Competitive_Advantage	.760	-.115	-.150	-.187
Pressure_Directors	.526	.716	-.079	-.039
Pressure_Consumers	.562	.721	-.033	-.057
Pressure_Employees	.419	.763	.039	.090
Pressure_EnvironGroups	.464	.717	.185	.063
Pressure_Government	.538	.681	.068	-.052
Environ_Important	.588	-.321	.121	.589
Increase_Prod_Service	.746	-.285	-.168	-.043
Physical_Risk	.813	-.145	-.245	.002
Policy_Risk	.850	-.127	-.250	-.039
Competitive_Risk	.790	-.223	-.210	-.106
Legal_Risk	.845	-.214	-.252	-.031
Reputational_Risk	.734	-.156	-.259	.117

Rotated Component Matrix[a]

	Component			
	1	2	3	4
Increase_Profit	.261	.177	.799	-.009
Decrease_Cost	.117	.042	.703	.489
Pass_Regulation	.458	.134	.462	.393
Multi_National	.231	.600	-.129	.248
Forefront_Innovation	.435	.105	.250	.697
Relationship_Suppliers	.727	.012	.417	.155
Increase_Technology	.671	.096	.539	.035
Competitive_Advantage	.748	.202	.213	.051
Pressure_Directors	.211	.866	.031	-.052
Pressure_Consumers	.220	.884	.088	-.044
Pressure_Employees	.029	.873	.034	.053
Pressure_EnvironGroups	.019	.850	.188	.098
Pressure_Government	.168	.839	.168	-.007
Environ_Important	.398	.002	.075	.804
Increase_Prod_Service	.775	.052	.153	.205
Physical_Risk	.805	.210	.073	.211
Policy_Risk	.839	.238	.096	.181
Competitive_Risk	.820	.122	.151	.137
Legal_Risk	.864	.159	.101	.205
Reputational_Risk	.729	.175	-.012	.286

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.



Variable	Increase_Profit	Decrease_Cost	Pass_Regulation	Multi_National	Forefront_Innovation	Relationship_Suppliers	Increase_Technology	Competitive_Advantage	Pressure_Directors	Pressure_Consumers	Pressure_Employees	Pressure_EnvironGroups	Pressure_Government	Environ_Important	Increase_Prod_Service	Physical_Risk	Policy_Risk	Competitive_Risk	Legal_Risk	Reputational_Risk
Increase_Profit	1.00																			
Decrease_Cost	**0.56**	1.00																		
Pass_Regulation	**0.38**	**0.47**	1.00																	
Multi_National	0.21	0.03	0.24	1.00																
Forefront_Innovation	**0.32**	**0.47**	**0.58**	**0.33**	1.00															
Relationship_Suppliers	**0.52**	**0.34**	**0.59**	0.22	**0.63**	1.00														
Increase_Technology	**0.53**	**0.39**	**0.59**	0.20	**0.49**	**0.70**	1.00													
Competitive_Advantage	**0.31**	**0.31**	**0.48**	0.28	**0.44**	**0.61**	**0.64**	1.00												
Pressure_Directors	0.25	0.07	0.24	**0.54**	0.15	0.22	0.20	**0.36**	1.00											
Pressure_Consumers	0.25	0.10	0.28	**0.55**	0.20	0.23	0.29	**0.35**	**0.82**	1.00										
Pressure_Employees	0.21	0.16	0.06	**0.46**	0.16	0.02	0.11	0.24	**0.72**	**0.71**	1.00									
Pressure_EnvironGroups	0.22	0.20	0.24	**0.39**	0.20	0.09	0.26	0.21	**0.62**	**0.74**	**0.74**	1.00								
Pressure_Government	0.27	0.12	**0.31**	**0.38**	0.18	0.23	0.28	**0.29**	**0.74**	**0.75**	**0.67**	**0.78**	1.00							
Environ_Important	0.18	**0.45**	**0.48**	0.20	**0.64**	**0.44**	**0.38**	**0.40**	0.07	0.07	0.04	0.11	0.14	1.00						
Increase_Prod_Service	**0.31**	**0.32**	**0.46**	0.16	**0.45**	**0.56**	**0.67**	**0.60**	0.16	0.23	0.16	0.17	0.19	**0.56**	1.00					
Physical_Risk	**0.33**	**0.34**	**0.46**	**0.36**	**0.53**	**0.63**	**0.54**	**0.59**	**0.30**	**0.33**	0.23	0.23	**0.35**	**0.43**	**0.69**	1.00				
Policy_Risk	**0.39**	**0.33**	**0.47**	**0.35**	**0.51**	**0.64**	**0.58**	**0.59**	**0.33**	**0.37**	0.26	**0.30**	**0.34**	**0.46**	**0.69**	**0.86**	1.00			
Competitive_Risk	**0.29**	0.28	**0.57**	0.23	**0.56**	**0.60**	**0.64**	**0.73**	0.23	0.28	0.21	0.19	0.26	**0.41**	**0.66**	**0.67**	**0.75**	1.00		
Legal_Risk	**0.37**	**0.33**	**0.55**	**0.31**	**0.52**	**0.71**	**0.57**	**0.67**	**0.36**	**0.35**	0.15	0.14	**0.30**	**0.51**	**0.68**	**0.74**	**0.79**	**0.71**	1.00	
Reputational_Risk	**0.31**	0.28	**0.40**	0.27	**0.46**	**0.53**	**0.48**	**0.50**	**0.33**	0.26	0.20	0.20	0.26	**0.52**	**0.56**	**0.63**	**0.71**	**0.56**	**0.80**	1.00

APPENDIX E: ELEMENTS CONTAINED EFA OUTPUT

Notes

Output Created		21-Sep-2009 10:34:49
Comments		
Input	Data	F:\Thesis\Data\SPSS\Data V01.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	177
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES Assess_RegulatoryRisk TO Written_Policy /PRINT UNIVARIATE INITIAL ROTATION /print initial det kmo repr extraction rotation fscore univaratiate /plot eigen rotation /CRITERIA FACTORS(4) ITERATE(100) /EXTRACTION PC /CRITERIA ITERATE(100) /ROTATION VARIMAX /METHOD=CORRELATION .
Resources	Processor Time	0:00:01.000
	Elapsed Time	0:00:01.422
	Maximum Memory Required	43972 (42.941K) bytes

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Assess_RegulatoryRisk	6.7188	3.27576	96
Assess_SupplyChainRisk	6.8333	3.14113	96
Assess_TechnologicalRisk	6.8750	3.01313	96
Assess_LegalRisk	6.9583	2.92689	96
Assess_ReputationalRisk	7.0521	3.06893	96
Assess_PhysicalRisk	7.0625	3.03943	96
GreenhouseProtl_Inventory	4.98958	3.367006	96
Other_Inventory	4.4896	3.34977	96
Inhouse_Inventory	6.0625	3.42994	96
Design_Store_Data	5.2292	3.50782	96
ISO_14001	4.8750	3.39116	96

	Mean	Std. Deviation	Analysis N
Review_ClimateRisk	6.0104	3.10007	96
Company_Strategy	6.0104	3.25575	96
Scenario_Planning	5.7292	3.36070	96
Supply_Demand	6.0729	3.33481	96
Drive_Senior	7.0729	3.36622	96
Drive_Junior	3.6042	3.28467	96
Training_Programmes	6.3125	3.37268	96
Written_Policy	6.5729	3.41127	96

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.880
Bartlett's Test of Sphericity	Approx. Chi-Square	1485.362
	df	171
	Sig.	.000

Communalities

	Initial	Extraction
Assess_RegulatoryRisk	1.000	.757
Assess_SupplyChainRisk	1.000	.812
Assess_TechnologicalRisk	1.000	.836
Assess_LegalRisk	1.000	.876
Assess_ReputationalRisk	1.000	.830
Assess_PhysicalRisk	1.000	.753
GreenhouseProtl_Inventory	1.000	.750
Other_Inventory	1.000	.699
Inhouse_Inventory	1.000	.633
Design_Store_Data	1.000	.680
ISO_14001	1.000	.727
Review_ClimateRisk	1.000	.746
Company_Strategy	1.000	.734
Scenario_Planning	1.000	.756
Supply_Demand	1.000	.768
Drive_Senior	1.000	.708
Drive_Junior	1.000	.504
Training_Programmes	1.000	.722
Written_Policy	1.000	.813

Extraction Method: Principal Component Analysis.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.625	50.658	50.658	9.625	50.658	50.658
2	2.359	12.415	63.073	2.359	12.415	63.073
3	1.136	5.978	69.052	1.136	5.978	69.052
4	.986	5.189	74.240	.986	5.189	74.240
5	.756	3.978	78.219			
6	.573	3.014	81.232			
7	.565	2.973	84.205			
8	.536	2.818	87.024			
9	.453	2.385	89.409			
10	.365	1.919	91.329			
11	.342	1.802	93.130			
12	.274	1.440	94.570			
13	.244	1.284	95.854			
14	.202	1.064	96.918			
15	.148	.779	97.698			
16	.143	.753	98.451			
17	.127	.671	99.122			
18	.103	.540	99.662			
19	.064	.338	100.000			

Component Matrix[a]

	Component			
	1	2	3	4
Assess_RegulatoryRisk	.775	-.365	.095	-.123
Assess_SupplyChainRisk	.826	-.315	.175	.006
Assess_TechnologicalRisk	.746	-.528	-.001	.008
Assess_LegalRisk	.774	-.512	.085	.092
Assess_ReputationalRisk	.715	-.560	.058	.047
Assess_PhysicalRisk	.680	-.530	-.076	-.062
GreenhouseProtl_Inventory	.793	.225	.245	-.105
Other_Inventory	.573	.239	.386	-.405
Inhouse_Inventory	.498	.524	.136	.303
Design_Store_Data	.676	.440	-.002	-.168
ISO_14001	.745	.288	-.074	-.288
Review_ClimateRisk	.736	.161	-.253	-.337
Company_Strategy	.822	.108	-.050	.210
Scenario_Planning	.811	.156	.105	.250
Supply_Demand	.810	.249	.020	.221
Drive_Senior	.598	.158	-.196	.536
Drive_Junior	.404	.348	.468	.024
Training_Programmes	.756	.139	-.358	-.052
Written_Policy	.607	.210	-.618	-.136

Extraction Method: Principal Component Analysis.

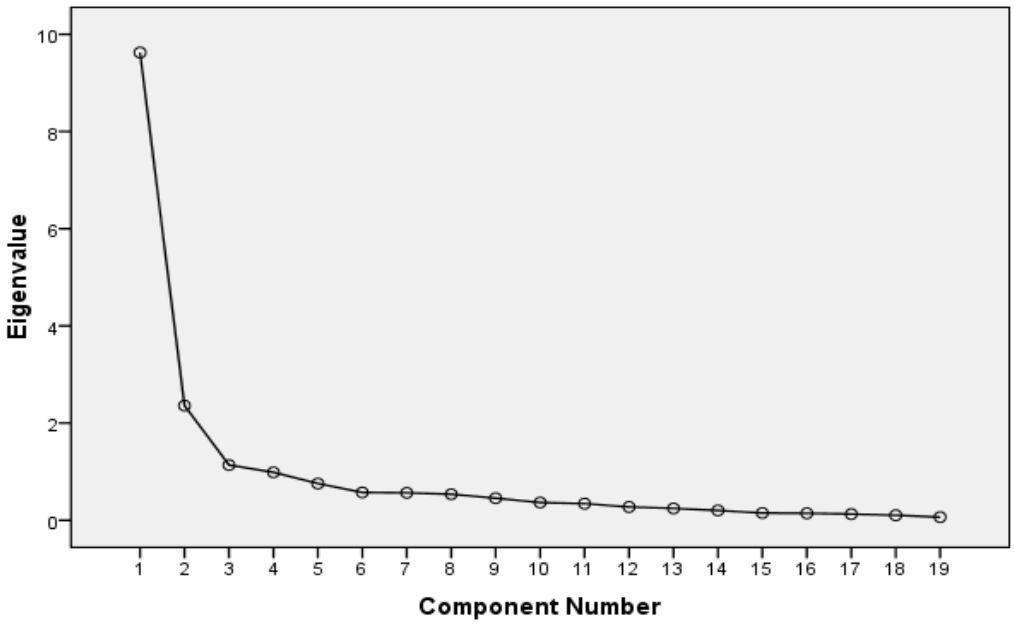
a. 4 components extracted.

Rotated Component Matrix[a]

	Component			
	1	2	3	4
Assess_RegulatoryRisk	.780	.244	.280	.102
Assess_SupplyChainRisk	.784	.171	.331	.243
Assess_TechnologicalRisk	.878	.196	.079	.142
Assess_LegalRisk	.892	.116	.126	.225
Assess_ReputationalRisk	.889	.113	.078	.146
Assess_PhysicalRisk	.829	.247	.025	.060
GreenhouseProtl_Inventory	.356	.311	.647	.329
Other_Inventory	.219	.238	.771	-.016
Inhouse_Inventory	-.069	.163	.425	.649
Design_Store_Data	.092	.522	.546	.316
ISO_14001	.244	.613	.503	.197
Review_ClimateRisk	.317	.720	.337	.116
Company_Strategy	.435	.367	.284	.574
Scenario_Planning	.408	.248	.393	.611
Supply_Demand	.327	.348	.386	.625
Drive_Senior	.241	.241	-.013	.769
Drive_Junior	.039	-.051	.641	.298
Training_Programmes	.337	.676	.156	.357
Written_Policy	.160	.847	-.024	.262

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

Scree Plot



Variable	Assess_RegulatoryRisk	Assess_SupplyChainRisk	Assess_TechnologicalRisk	Assess_LegalRisk	Assess_ReputationalRisk	Assess_PhysicalRisk	GreenhouseProtl_Inventory	Other_Inventory	Inhouse_Inventory	Design_Store_Data	ISO_14001	Review_ClimateRisk	Company_Strategy	Scenario_Planning	Supply_Demand	Drive_Senior	Drive_Junior	Training_Programmes	Written_Policy
Assess_RegulatoryRisk	1.00																		
Assess_SupplyChainRisk	**0.81**	1.00																	
Assess_TechnologicalRisk	**0.77**	**0.77**	1.00																
Assess_LegalRisk	**0.71**	**0.80**	**0.83**	1.00															
Assess_ReputationalRisk	**0.69**	**0.72**	**0.78**	**0.87**	1.00														
Assess_PhysicalRisk	**0.67**	**0.64**	**0.75**	**0.74**	**0.76**	1.00													
GreenhouseProtl_Inventory	**0.54**	**0.57**	**0.47**	**0.51**	**0.46**	**0.41**	1.00												
Other_Inventory	**0.41**	**0.46**	**0.32**	**0.32**	0.27	0.22	**0.61**	1.00											
Inhouse_Inventory	0.25	0.28	0.15	0.18	0.11	0.03	**0.56**	**0.33**	1.00										
Design_Store_Data	**0.39**	**0.40**	**0.30**	0.28	0.22	**0.33**	**0.59**	**0.45**	**0.52**	1.00									
ISO_14001	**0.54**	**0.46**	**0.41**	**0.42**	**0.34**	**0.37**	**0.68**	**0.53**	**0.40**	**0.72**	1.00								
Review_ClimateRisk	**0.56**	**0.51**	**0.42**	**0.40**	**0.43**	**0.44**	**0.56**	**0.44**	**0.30**	**0.54**	**0.63**	1.00							
Company_Strategy	**0.54**	**0.66**	**0.53**	**0.57**	**0.51**	**0.46**	**0.66**	**0.39**	**0.41**	**0.55**	**0.57**	**0.57**	1.00						
Scenario_Planning	**0.50**	**0.60**	**0.51**	**0.60**	**0.51**	**0.44**	**0.68**	**0.41**	**0.51**	**0.55**	**0.56**	**0.56**	**0.73**	1.00					
Supply_Demand	**0.50**	**0.61**	**0.43**	**0.50**	**0.41**	**0.43**	**0.67**	**0.47**	**0.49**	**0.60**	**0.55**	**0.60**	**0.78**	**0.78**	1.00				
Drive_Senior	**0.38**	**0.39**	**0.38**	**0.37**	**0.34**	**0.32**	**0.36**	0.22	**0.44**	**0.38**	**0.44**	**0.33**	**0.56**	**0.51**	**0.59**	1.00			
Drive_Junior	0.16	**0.32**	0.11	0.17	0.18	0.10	**0.36**	**0.36**	**0.31**	**0.40**	0.28	**0.30**	**0.33**	**0.40**	**0.38**	0.22	1.00		
Training_Programmes	**0.44**	**0.54**	**0.45**	**0.54**	**0.48**	**0.45**	**0.58**	**0.34**	**0.39**	**0.52**	**0.61**	**0.62**	**0.60**	**0.55**	**0.55**	**0.49**	**0.30**	1.00	
Written_Policy	**0.32**	**0.37**	**0.38**	**0.30**	**0.30**	**0.32**	**0.36**	0.28	**0.32**	**0.46**	**0.48**	**0.64**	**0.51**	**0.43**	**0.50**	**0.39**	0.13	**0.70**	1.00

APPENDIX F: KRUSKAL-WALLIS SIGNIFICANCE TEST OUTPUT

Page/Date/Time 1 2009/10/01 05:28:28 PM

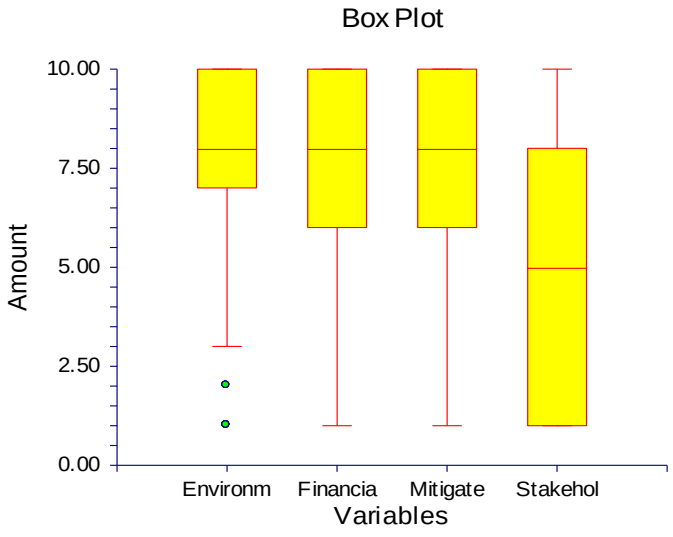
Database H:\Thesis\Data\DataFactor.S0

Response Environmental_Innovation,Financial_and_Reg,Mitigate_Risk,Stakeholder_Pressure_and_Parent

Tests of Assumptions Section

Assumption	Test Value	Prob Level	Decision (0.05)
Skewness Normality of Residuals	-12.6081	0.000000	Reject
Kurtosis Normality of Residuals	-7.3484	0.000000	Reject
Omnibus Normality of Residuals	212.9633	0.000000	Reject
Modified-Levene Equal-Variance Test	89.7410	0.000000	Reject

Box Plot Section



Hypotheses

H_0: All medians are equal.

H_a: At least two medians are different.

Test Results

Method	DF	Chi-Square (H)	Prob Level	Decision(0.05)
Not Corrected for Ties	3	325.6178	0.000000	Reject H0
Corrected for Ties	3	334.7659	0.000000	Reject H0
Number Sets of Ties	10			
Multiplicity Factor	9.493834E+08			

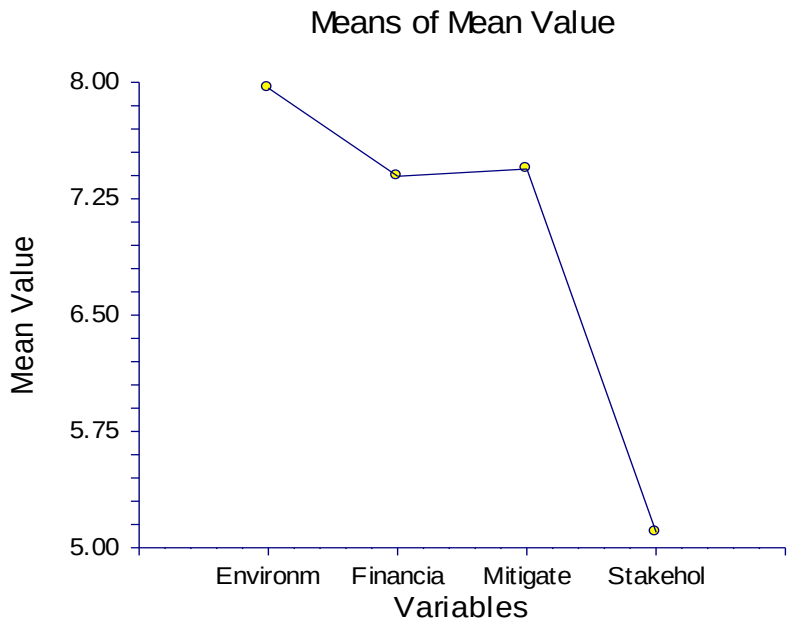
Group Detail

Group	Count	Sum of Ranks	Mean Rank	Z-Value	Median
Environmental_Innvtion	346	671298.50	1940.17	6.4354	8
Financial_and_Reg	500	900335.00	1800.67	4.3506	8
Mitigating_Risk	1505	2696154.00	1791.46	8.9462	8
SthhlderPrss_and_Prnt	912	1057428.50	1159.46	-17.8453	5

Means and Effects Section

Term	Count	Mean	Std Error	Effect
All	3263	6.834508		6.974077
A:				
Environmental_Innovation	346	7.96242	0.153998	0.988350
Financial_and_Reg	500	7.394	0.1281062	0.419923
Mitigating_Risk	1505	7.441196	0.0738392	0.467119
Stakeholder_Pressure_and_Parent	912	5.098684	9.485447E-02	-1.875393

Plots of Means Section



Kruskal-Wallis Multiple-Comparison Z-Value Test (Dunn's Test)

Variable	EnvtlInntion	FinReg	MtgtRisk	StkPress
Environmental_Innovation	0.0000	2.1470	2.6844	13.3078
Financial_and_Reg	2.1470	0.0000	0.1919	12.4019
Mitigating_Risk	2.6844	0.1919	0.0000	16.2095
Stakeholder_Pressure_and_Parent	13.3078	12.4019	16.2095	0.0000

Regular Test: Medians significantly different if z-value > 2.5758

Bonferroni Test: Medians significantly different if z-value > 3.1440